



# Decommissioning Learnings

Sharing good practice  
across industrial sectors  
2020

Cross-  
Industry  
Learning



# Contents

<b>Introduction</b>	<b>4</b>
<b>The Decommissioning Landscape</b>	<b>6</b>
<b>The story so far...</b>	<b>8</b>
<b>Technical Innovation</b>	<b>10</b>
<b>Cost &amp; Schedule</b>	<b>14</b>
<b>Innovation &amp; Regulation</b>	<b>16</b>
<b>Late Life Asset Management</b>	<b>18</b>
<b>Sharing Good Practice in Standards</b>	<b>20</b>
<b>Project Management, Commercial Models &amp; Supply Chain</b>	<b>22</b>
<b>Outcomes</b>	<b>24</b>
<b>Participating Organisations so far</b>	<b>26</b>
<b>Next Steps</b>	<b>29</b>
<b>Library</b>	<b>30</b>
<b>Case Study: Tetra Tech</b>	<b>32</b>
<b>Case Study: Game Changers</b>	<b>34</b>
<b>Contacts</b>	<b>35</b>



# Introduction

**Britain has always been a world leader in energy generation. As far back as the 1700s the nation was the birthplace of the Industrial Revolution and coal powered energy production. Later in the 20th century, Britain led the world in deploying civil nuclear power and opening the North Sea to oil and gas production. More recently, we've been a leading developer of offshore wind as a clean and renewable source of energy.**

Being at the forefront of energy production also means that we're one of the first nations faced with decommissioning legacy infrastructure and facilities.

In the nuclear sector we're decommissioning the UK's earliest nuclear sites and offshore platforms and pipelines are being removed in oil and gas, while in defence they're decommissioning nuclear-powered submarines and older wind farms are being decommissioned in the offshore renewables sector.

Though our scope may be different, our different industries have a lot in common when it comes to decommissioning.

These commonalities range from our need for technologies that let us remotely access hazardous areas and approaches to regulation to things like culture, leadership and project management. Environmental remediation brings with it many challenges, and we all stand to benefit from cross-industry sharing of expertise and learning.

It's important that our industries work together to share lessons learned, swap tools and techniques and build a cross-industry supply chain and exportable UK expertise. At the NDA, we've been working with the Oil & Gas Authority\*, the Environment Agency, the National Nuclear Laboratory (NNL), and now with Defence and Renewables, to organise a series of workshops and seminars to stimulate cross-industry learning.

This report shares some of the learnings to date and provides an opportunity for you to participate in forthcoming events.



**David Peattie,**  
CEO, NDA

\*In March 2022 the Oil and Gas Authority changed its name to the North Sea Transition Authority (NSTA) to reflect its evolving role in the energy transition.



# The Decommissioning Landscape



**High decommissioning costs exist for a number of UK industries as illustrated in the by no means exhaustive table of example liabilities below. The UK has the potential to become global leader, creating a decommissioning capability across industry sectors, and valuable exportable skills.**

<b>Industry</b>	<b>Cost (£ Billion)</b>	<b>Schedule (Years)</b>	<b>Major Scopes Items</b>
<b>UK Civil Nuclear (NDA)<sup>1</sup></b>	124 (undiscounted) 131 (discounted) 48 (within next 20 years)	~120 (to 2137)	17 sites, including Sellafield, Dounreay, Magnox, Capenhurst, Springfields plus construction of Geological Disposal Facility
<b>UK Civil Nuclear (EDFE)<sup>2</sup></b>	20 (provision)	~100	8 Nuclear Power Stations
<b>UK Defence (Nuclear Powered Submarines)<sup>3</sup></b>	7.5 (provision)	>30	20 out-of-service + 10 in-service
<b>UK Oil &amp; Gas<sup>4</sup></b>	51 (P50) 67 (P90)	<50	UK Continental Shelf
<b>UK Renewables<sup>5</sup></b>	~4-12	~50	Offshore Wind

### **Sources**

1. NDA Annual Report & Accounts 2018/19 Nuclear Provisions
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 2019 Cost Estimate Report
5. The Crown Estate – current versus future estimate for capacity yet to be built

# The story so far...

## Themes of Common Interest Workshops & Seminars Topics

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

**The ‘Beast from the East’ that smothered the British Isles with snow in February 2018 did not prevent the nuclear and oil & gas industries from convening in Aberdeen to agree a joint plan for sharing cross-industry learnings on the subject of decommissioning.**

The consensus that emerged was that these and other industries would benefit from a series of structured and ongoing engagements on areas of common interest.

The civil nuclear and oil & gas industries are natural partners to launch this learning initiative, as they both face large decommissioning bills (between them over £200 billion),

long decommissioning timescales (a hundred years or so), and are just a little of the way up their learning curves (some 10-15% into their missions). Both industries place a large burden on the UK taxpayer, are highly regulated, are in the business of containment of hazardous materials, and environmental remediation.

We are pleased to announce, in this first of a series of reports, the results of the cross-industry learnings achieved to date, and invite your participation, feedback and input for future workshops and seminars as we broaden themes, introduce new topics, and include more industries.

Workshops and roundtables to date have covered most of the topics deemed as high priority for shareable experiences and expertise. Each attended by up to 25 subject matter experts relevant to the topic, from industries including rail, water, defence, nuclear and oil & gas, these discussion-intensive workshops have write-ups suitable for wider consumption, which are summarised in this report. For topics that generated most interest, workshops will be reconvened in our future programme.





Engagements have been designed to bring together not just different industries, but also a cross-section of organisations from within each industry. A typical workshop has representatives from layers of government, regulator, authority, operator, tier 1 and 2 supply chain and SMEs, academia, consultancies, trade associations and other institutions. The discussion works best when perspectives from across the spectrum of industry players are face-to-face. Workshops and seminars have comprised relatively small, hand-picked, invited-only participation, strongly facilitated and conducted under the Chatham House Rule to encourage openness. Shareable write-ups, post workshop webinars and other forms of dissemination have ensured the wider availability of learnings to those who could not be in the room, and this report adds to this body of material.

Where possible, workshops have included a relevant site visit; nothing beats a visit to Sellafield to achieve a sense of the scale and realities of the challenge.

Gratitude is offered in particular to the Oil & Gas Authority, the Environment Agency, NNL and my colleagues in NDA for contributing to the organisation of these engagements and this report, and to TotalDECOM for support in organising cross-industry events and the launch of this publication.

The learnings shared in this report are based on the following workshops:

- Project Management, Commercial Models & Supply Chain, hosted by Sellafield Ltd at Lillyhall, Cumbria, October 2018
- Technical Innovation hosted by the Oil & Gas Technology Centre and National Decommissioning Centre, Aberdeen, February 2019
- Late Life Asset Management hosted by the University of Strathclyde, Glasgow, March 2019
- Innovation & Regulation hosted by NNL, London, May 2019
- Cost & Schedule hosted by the NDA and Oil & Gas Authority, London July 2019
- Standards hosted by the Environment Agency, Manchester, November 2019.

As the UK transitions to a lower-carbon economy to meet its net zero commitment by 2050, decommissioning of the old to make way for the new is a key part of the puzzle. The cross-industry learning initiative supports this strategy by stimulating improved industrial productivity, reskilling the workforce, and building on a unique stock of technology and skills that bring benefit across the economy and have significant potential in overseas markets.

The UK government has also challenged the nuclear sector to reduce the cost of decommissioning by 20%, and the cost of oil and gas decommissioning by 35%. Working together, we stand a better chance.

**Karl Sanderson,**  
*Head of Cross-Industry Learning,*  
**NDA**

\*In June 2021 the Oil and Gas Technology Centre was renamed to the Net Zero Technology Centre (NZTC).



# Technical Innovation





**The UK nuclear decommissioning legacy is diverse and complex. Delivering our mission needs many ‘never-done-before’ solutions, which require significant innovation and novel engineering approaches. Our strategy is to solve the challenging technical problems safely and wherever possible for less cost to the taxpayer, whilst aiming to be more effective and efficient.**

Research and Development are essential to decommissioning our sites and are delivered in partnership with our supply chain. The majority of the work is carried out by our site licence companies and subsidiaries and their suppliers to address specific challenges. NDA also commission a portfolio of strategic Research, Development and Innovation to help shape our overall strategy, deliver innovation and support skills development across multiple sites.

Collaboration with other public and private sector organisations is important to leverage investment and maximise sharing of expertise. Technology and innovation are also essential for operation and decommissioning of oil and gas facilities. Gaining and sharing expertise across our sectors and supply chains will enable us to solve our challenges safer, faster and at less cost.



## Workshop between Nuclear Decommissioning and Oil and Gas Decommissioning

There are many areas in common between the sectors from a technology and innovation perspective. A workshop was held in early 2019, hosted at the Oil & Gas Technology Centre (OGTC\*) attended by a selection of organisations requiring and delivering technology and innovation to these sectors. A webinar and report of the workshop were produced and are available by request.

As well as the technical challenges that require innovation, wider aspects for successful deployment of innovation which are common to both sectors such as cultural practices and leadership were discussed. Understanding the context of the sectors and identifying the shared challenges will be key to understanding where any potential value can be gained through collaboration.

Common areas for investigation identified were in digital and data simulation, how we work with the supply chain to encourage and deliver innovation and in specific technology development and deployment in areas such as characterisation and remote cutting (including underwater).

Since the workshop there has been continued collaboration in academic research in particular. The NDA PhD bursary scheme has invited applications this year for academic research with benefit to both sectors. We look forward to reviewing the proposals and continued collaboration. There has been continued dialogue between key organisations from the supply chain including NNL and National Decommissioning Centre.

## Progress in Innovation and Technology

Two consortia, led by Barron and Wood have recently reached the next round of an innovation competition that could help decommission highly radioactive facilities at Sellafield. The projects were among five collaborative consortia, comprising almost 30 organisations, which have spent the last two years taking their conceptual innovative ideas from the drawing board to prototype demonstrators for testing in a simulated radioactive environment. Launched in 2017, the £8.5 million Integrated Innovation in Nuclear Decommissioning competition was funded by the NDA, Innovate UK and BEIS. Solutions developed by all the projects featured the use of virtual reality, 3D imaging and autonomous navigation. They can be potentially up scaled for larger challenges as well as other hazardous environments such as oil and gas.

The two successful projects will now progress to demonstrating their solutions in one of Sellafield's radioactive facilities.

\*In June 2021 the Oil & Gas Technology Centre was renamed to the Net Zero Technology Centre (NZTC).



## Grand Challenges for Nuclear Decommissioning

There is already a diverse portfolio of work to develop technology and engineering solutions to support delivering our nuclear decommissioning mission. To demonstrate the importance of innovation we have recently set out our grand challenges for technical innovation. These are intended to provide an opportunity for collaboration across our sites and sector but also with other industries such as oil and gas which will have similar challenges. They identify areas of key importance where innovative ideas could alter the status quo by being bold, cross-cutting and disruptive in challenging our thinking. They are not about incremental efficiencies or continuous improvements which we would expect to continue in parallel.

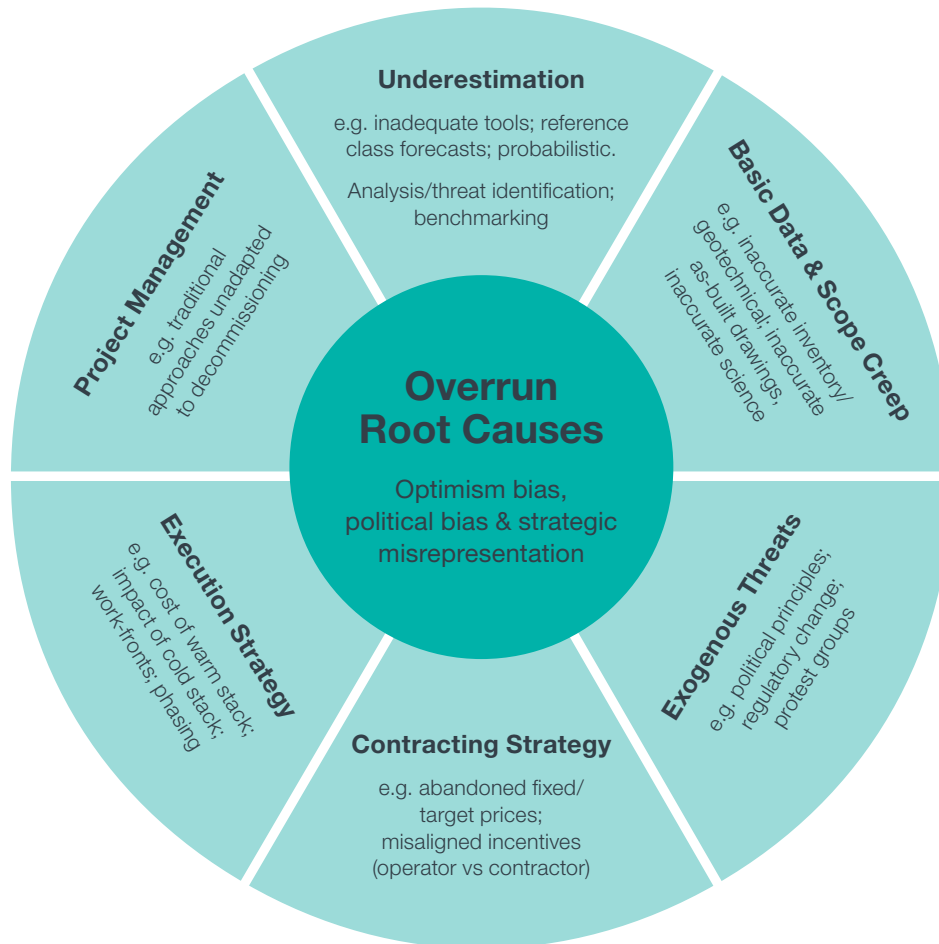
As well as identifying key overarching themes where technical innovation could deliver significant benefits we have published interim innovation aims and the grand challenges themselves see <https://www.gov.uk/government/news/nda-sets-out-its-grand-challenges>

These will provide pace to realise interim aims as well as setting the expectation for delivering differently by 2030. We expect a number of key emerging technologies will play a significant role such as advanced robotics, artificial intelligence, autonomous systems, adaptive wearables, smart sensors, advanced photonics, digital solutions and next generation connectivity solutions. Solutions may also be applicable to the oil and gas decommissioning challenges or may already be available or in development in this sector.

We look forward to collaborating on delivering these aims in the next five to ten years.

**Professor Melanie Brownridge,**  
*Technology and Innovation,*  
*Director NDA*

# Cost & Schedule



**Cost and schedule over-runs are a familiar feature of projects, and decommissioning projects are a frequent example. Project delivery within budget and schedule generally remains the exception, especially on very large projects, and the root causes of this for greenfield/new-build projects have been much studied. Less well understood are cost and schedule performance on decommissioning projects. A cross-industry workshop was convened in London in July 2019, to examine the problem.**

Participating in the workshop were 23 organisations including key government departments, authorities and institutions covering the nuclear, oil and gas and wider industry, plus operators, members of the supply chain and relevant trade associations.

The nuclear industry has been challenged by its sector deal to reduce the cost of decommissioning the UK civil nuclear estate by 20% (from nearly £150 billion). Oil and gas is similarly challenged to reduce the cost of decommissioning its UK offshore infrastructure by 35% (from £60 billion). Early indications are that oil and gas is making good progress in securing cost reductions while, in contrast, the nuclear provision is rising year on year.

The workshop offered an opportunity for the industries to share learnings. Both decommissioning programmes have significant implications for the public purse, and the sharing of lessons learned is one way of securing value for money for the taxpayer.

In the workshop, the nuclear industry shared data on over-runs which suggested that, for their projects, costs triple and timescales double on average compared to original estimates. Some projects have over-run on cost by a factor of 10 and been delivered a decade late. Supported by academic studies, and operators' own analyses, participants explored the reasons why, and what can be done.

Practitioners with data on cost and schedule performance over many decades over a wide variety of industries participated in the workshop. These suggested that when things become problematic, mega-projects do not just go slightly wrong, but fail in disproportionately costly ways.

Many nuclear decommissioning projects run to several billion pounds each, and the dimensions of failure of such projects (cost growth, schedule slippage, scope shortfalls) increases with the schedule aggressiveness. A legacy of the UK civil nuclear estate is that there is a need to swiftly mitigate nuclear risks in old facilities, making schedule aggressiveness frequently necessary.

### *“political bias is considerable – immature projects get sanctioned”*

Examination of the root causes of over-runs suggests that failure is often predictable, and rooted in matters such as inadequate definition and preparation; late changes in strategy and scope; gaps in project basic data; and the schedule aggressiveness mentioned above.

Participants also heard that data suggests that project sponsors largely control the results, whether success or failure. The graphic illustrates that optimism biases (i.e. systematic underestimation) by project teams, political bias by decision makers, and strategic misrepresentation of estimates by contractors, are significant elements of the problem, rather than pure project failure. Projects don't necessarily just go wrong; they are often poorly estimated at the outset.

Consequently, workshop participants discussed tools and techniques for identifying and removing bias, for example:

- **Benchmarking:** The Oil & Gas Authority shared its success in deploying a benchmarking database for decommissioning projects, which encouraged the sharing of lessons learned between operators. Nuclear shared their plans for building such a database.
- **Reference Class Forecasting:** NDA shared its plans for deploying a database and tool for calibrating early-stage projects.
- **Scope Aggregation and Contractor Alignment:** Various operators shared their experiences in putting together campaigns of work across which learnings, indeed entire teams, could be leveraged from project to project.

Participants also shared stories of successful outcomes including the decommissioning of the Brent Bravo and Miller offshore platforms, and the removal of plutonium contamination at the Low Level Waste Repository. The Engineering Construction Industry Training Board presented their Project Collaboration Toolkit, and Sellafield shared its hopes for the Programme & Project Partners initiative.

### *“project owners pushback on estimates that don't fit preconceived expectations”*

In breakout groups, participants considered how to improve the accuracy of cost forecasts. Some highlights of proposed solutions include:

- Use of probabilistic rather than point estimates, clarifying inclusion/exclusion of risks and uncertainties.

- Earlier stakeholder involvement in decision making, while options are still only vaguely defined, with inevitably wide ranges in estimates at such early stage of definition.
- Establishing tools to compare and contrast estimates with other projects, such as reference class forecasting and benchmarking databases.

### *“lack of capability to handle strategic misrepresentation by contractors”*

Breakout groups also considered where future savings will come from. Some highlighted suggestions were:

- Leaving more latitude for innovation from the supply chain, by avoiding over specification of solutions by operators.
- Developing 'factory solutions' rather than bespoke ones, allowing repetition across operators.
- Technological and cultural change.
- Aggregation of scope/campaigning across operators.

A webinar of the workshop output, incorporating more detail, is available on request as is the full workshop output.

Well characterised cost and schedule estimates underpin quality decision making, and this topic will be revisited in 2020.

**Karl Sanderson,**  
*Head of Cross-Industry Learning,*  
NDA

**Ian Fozdar,**  
*Decommissioning Manager UK,*  
Oil & Gas Authority

# Innovation & Regulation

**Industrial Strategy has placed considerable emphasis on innovation as a mechanism to increase productivity and deliver economic growth.**

For regulated high hazard sectors, innovation presents both an opportunity and a challenge. NNL organised a cross sector roundtable in May 2019 at the Royal Academy of Engineering that brought together leaders from government, industry, regulators and academia associated with nine high hazard sectors to explore this issue.

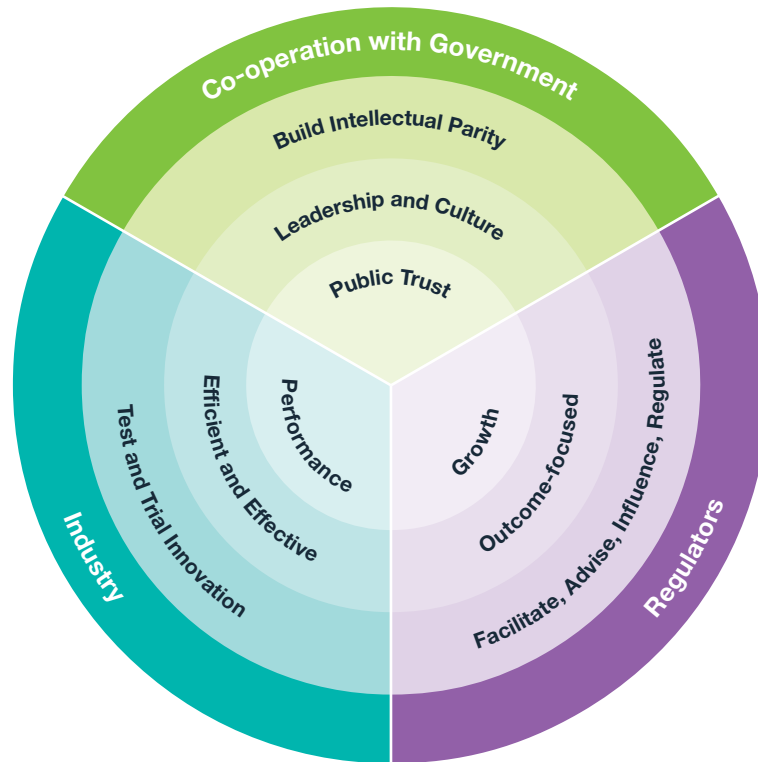
Presentations and open discussion led to a greater understanding of the different approaches to regulation and the opportunity and challenge of driving innovation to build positive economic impact.

Nine key principles were agreed that provide a blueprint for action through cooperation with government, industry, and regulators – which are summarised in the figures.

We have highlighted a number of programmes that can be used to develop and embed these principles into the regulatory system. Continued dialogue with action on innovation and regulation, encouraged by government, will help ensure that cross-sector engagement continues as an enabler of development and a catalyst of innovation to drive economic growth in a safe, secure and environmentally responsible manner.

**Anthony Banford,**  
*Chief Technologist,*  
NNL





	Co-operation with Government	Industry	Regulators
<b>WHY</b>	<p><b>1. Public Trust</b></p> <p>Earn public trust by effective engagement and action to strengthen the societal licence to operate with recognised benefits and an agreed risk picture of safety, security and environmental outcomes.</p>	<p><b>2. Performance-based</b></p> <p>Deliver sustainable growth with societal benefits employing a performance-based approach for managing safety, security and environmental outcomes with a strategic and holistic perspective on risk.</p>	<p><b>3. Regulation for growth</b></p> <p>Deliver an internationally-recognised enabling approach to regulation for growth creating opportunities for inward investment, and leading the way in reducing barriers to innovation and enabling societal benefit.</p>
<b>WHAT</b>	<p><b>4. Leadership and Culture</b></p> <p>Invest in leadership and culture that has the courage to challenge, conviction to change, openness to trust, and attitude to learn, building effective interactions between regulators and with industry.</p>	<p><b>5. Efficient and Targeted</b></p> <p>Drive an efficient and targeted approach to demonstrate safety, security and environmental outcomes with a proportionate resource-to-risk approach. Reduce gold-plating and support a flexible approach for meeting standards.</p>	<p><b>6. Outcome-focused</b></p> <p>Take a strategic and holistic approach to outcome-focused regulatory decision making that focuses on the highest consequence risks. Discourage gold-plating and published guidance becoming overly prescriptive.</p>
<b>HOW</b>	<p><b>7. Intellectual Parity</b></p> <p>Develop knowledge via foresight activities, grow experience through secondments and strengthen resilience with cross-sector engagement to build intellectual parity between regulators and industry.</p>	<p><b>8. Test &amp; Trial Innovation</b></p> <p>Establish approaches to test and trial innovation in a safe space (sandpits) and early and open engagement with regulators operating in an outcome-focused and enabling way.</p>	<p><b>9. FAIR and Enabling</b></p> <p>Use an enabling approach that Facilitates, Advises, Influences then Regulates (FAIR) industry. Drive efficiency, build common methods and terminologies across regulators, and create a single 'front door' for industry.</p>

# Late Life Asset Management

## Background

**There is a common misunderstanding that decommissioning is a relatively simple process in which facilities are razed to the ground, and that this should be cheap and quick to achieve.**

The truth for high hazard industries is that a more extended period and higher cost is required to understand the challenge, safe and environmentally conscious solutions to be identified, planned for, financed and delivered.

These extended periods add to the challenges of managing the assets and supporting infrastructure during their late life.

***Asset Management is the coordinated activity of an organisation to realise value from assets (ISO55000)***

To complicate the challenge, assets across high hazard sectors have common additional features:

- Assets were not designed with decommissioning in mind.
- Operational lifetimes extended beyond the original design.
- Function and design basis changed measurably from original intent.
- Technical challenges exist in understanding asset condition, how that condition may deteriorate, creating investment uncertainty.
- Asset value has already been sunk through their operational phase, making investment decisions to allow rapid decommissioning progress more problematic in comparison with remaining operational assets that attract a return on investment.
- Management technologies utilised are largely those inherited from up to 60 years of operations.
- Assets were managed by maintenance and engineering, focussed on keep plant and facilities operating, creating a silo culture where decisions regarding new versus existing assets were entirely separate.

The management techniques and technologies that have been/are being developed across industry and supply chain create an opportunity to reconsider how best to manage our assets, with the potential to significantly reduce the time and cost of decommissioning.

## Asset Management

Asset Management good practice focusses on the whole life management of physical assets. Lifecycle asset management is crucial to ensuring optimised investment decisions are made to manage performance and risks (both threats and opportunities) whilst ensuring the best use of financial and people resources.

## Research Workshop

A cross-industry workshop was convened at the University of Strathclyde in March 2019 to discuss the status and challenges of asset management. The workshop involved representative from authorities, regulators, operators, supply chain and academia, from across nuclear, oil & gas, rail and water sectors. The workshop reviewed inputs from this wide array of representatives, demonstrating a collaborative approach to the needed research, and offering opportunities for the industries to share learnings.

Around 60 delegates participated, representing 26 organisations. Whilst the majority were affiliated to the nuclear sector, there was significant involvement and input from non-nuclear companies, including speakers from Rail, Defence, Environment Agency, Academia, Oil and Gas, Engineering and Construction consultancy industries.

### The event focused on:

- The role of research and innovation in understanding, managing and improving asset performance.
- Identifying opportunities to work collaboratively, understanding in a more structured and detailed way the current needs, implementing and sharing the outcome of research.
- Establishing a commitment and plan to share and implement research.

A key outcome was recognition that sectors shared common challenges and would benefit from collaboration across industry with support from supply chain and academia.

In the workshop, organisations shared their experiences of the asset management journey including challenges, solutions and benefits. Trade organisations demonstrated technologies that had been developed to aid the in the management of assets, from organisational and process through to information, digital and decision making.

The event generated considerable interest in working together within and outside the nuclear sector.

### Key learnings from the workshop include:

- Adopting good practice (ISO55001) enables historic issues, UK Industrial Strategy and Nuclear Sector Deal challenges to be met.
- Resolution of common challenges would benefit from collaboration across industry with support from government, supply chain and academia.
- A more cohesive and structure approach is needed taking advantage of existing forums (NDA, with support of licensed companies, to take the lead).
- UKRI, EPSRC and other bodies to enable funding partnerships developing low to mid Technical Readiness Level (TRL) technologies for industry and commercial exploitation.
- Identify off-the-shelf solutions.
- To establish a coherent picture of the innovation and research landscape using existing programmes e.g. NIRAB and Strathclyde's research programme.
- Sharing and codifying best practice e.g. using OGTC and NDA HUB as options.
- Establish common dictionary, objectives and indicators to enable more effective collaboration.
- Collect more case studies to help strengthen cases for change and to provide 'lead and learn' opportunities.

- Several ad hoc one to one follow up arrangements were made. The Rail and Oil and Gas sectors were able to demonstrate mature arrangements and high public value from years of investment in lifecycle asset management research.

## Progress since the Workshop

Asset management innovation is now establishing itself alongside technical decommissioning innovation. The workshop benefited the NDA in particular, enabling a picture of what is required to be developed. Ongoing bilateral opportunities are being discussed with trade organisations, the Oil and Gas sector, and Universities.

**Martin Grey,**  
*Asset Management Specialist,*  
**NDA**

# Sharing Good Practice in Standards

**The NDA and its regulators have been working together to understand the status of nuclear standards. The domestic (UK) standards framework is generally fit for purpose to meet regulators' expectations and the UK government's (BEIS) aspirations for standards.**

The International Standards Organisation makes clear a link between good quality standards and better regulation, and the use of international standards in regulation is a topic of wider economic interest according to the OECD.

Recognising the benefits of standards, the strong supportive link to innovation, and reservations about the effectiveness of industry coordination, it was decided to enable cross sector sharing and learning on the subject, sponsored by the NDA and facilitated by the Environment Agency. The workshop shared stories of standards and regulation across sectors to encourage adoption of good practice.

## What are standards?

Standards are market-based tools that are used by governmental policy makers and regulators to deliver better and outcome focused regulation. The standards pyramid requires active coordination, co-creation and participation at all levels.

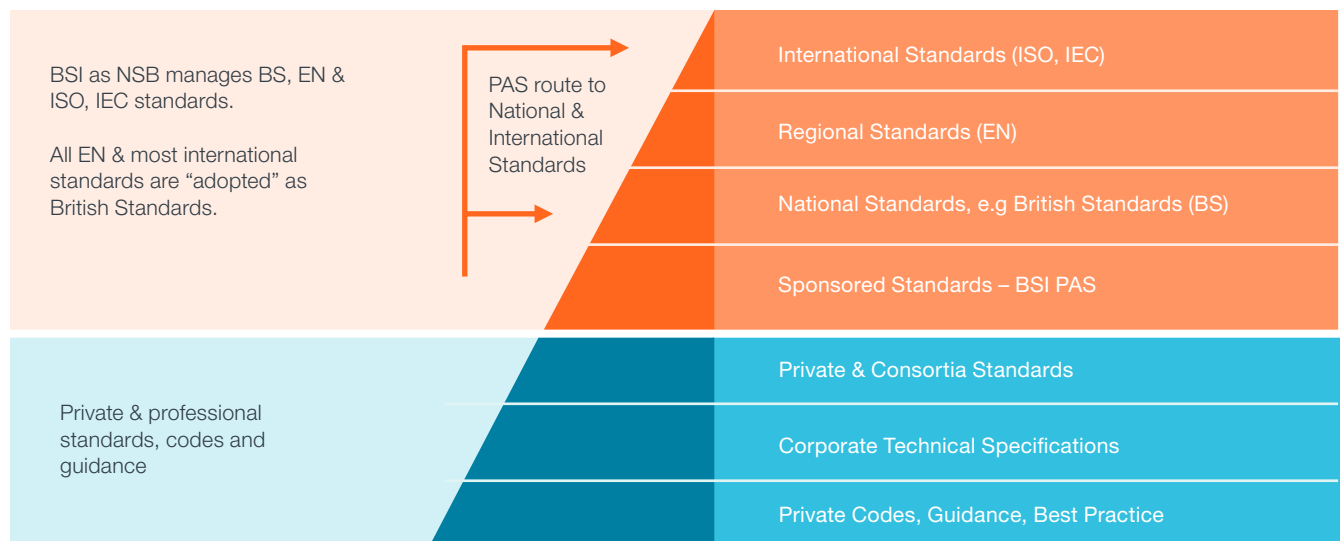
## Cross-sector Workshop

The workshop was held in November 2019 in Manchester, with the aim of facilitating engagement, and the sharing and transfer of learning across sectors. The event was attended by 30 attendees from across the nuclear industry, BSI, Environment Agency, ONR, NDA, NNL, BEIS, the Water Industry (Water UK) and Network Rail. The engagement comprised facilitated discussions focussed around presentations from experts, and breakout sessions to consider the challenges and identify priority areas for collaboration.

## Questions asked of participants included:

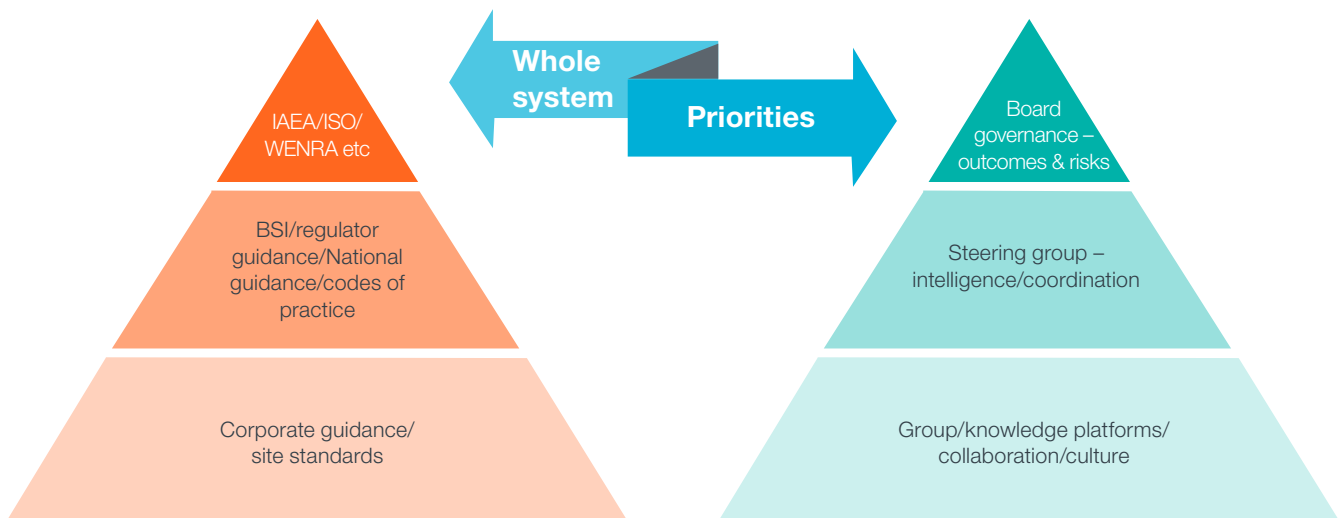
- What are the main lessons for each sector to learn in its approach to standards (international and domestic)?
- What are the common challenges each sector faces with creation and use of standards and suggested mitigations?
- How do we ensure effective and efficient two-way flow between domestic and international?
- What is the scale and urgency of the change? What level of coordination is required?
- What are the top priorities and actions?

## National, European & International Standards



95% of national standards published in the UK, year on year, are international & European

# Standards Framework



Feedback from participants identified the following topics that, if addressed, would help drive consistency and quality in the production of industry standards:

- Review and governance process
- Competence (capability and capacity)
- Provision of sufficient funding and resources
- Minimising duplication and improving consistency
- Greater co-ordination or involvement of ‘standards committees’ – potential for nuclear standards board funded by UK nuclear sector
- Value of standards better recognised within industry.

Work by the Nuclear Engineering Directors Forum (NEDF), National Nuclear Ventilation Forum, NNL and BSI was recognised as demonstrating good practices.

### Top priorities and actions were considered to be:

- Build on work carried out by the NEDF to establish a road map of industry standard groups and how they are contributing to standards

- Establish the feasibility of a ‘Nuclear Industry Standards Body’ (similar to Water UK approach)
- Improve communications on forthcoming work on standards – including sharing the NEDF roadmap on the NDA Knowledge Hub
- Produce a simple, standardised methodology for review and issue of standards
- Review the funding mechanism to continue standards works and support the co-ordination of standard producing groups
- Identify where there are more learning opportunities between industry sectors.

## Following on from the Workshop

The workshop gave some clear direction in what should be achieved to drive quality and consistency in the production of standards, although the mechanisms for doing so need tailoring. To support any approach, a number of actions are now being undertaken which include:

- Discussion and representation from key nuclear sector stakeholders and standard setting bodies.
- Regulatory alignment and a common position statement from regulators to support industry.
- Discussion with BEIS to ensure support and establish a clear link between international standards and domestic standards.

Follow on actions are planned in 2020 to develop the concept of a nuclear standards board and coordinating group to spread best practices and address the issues identified in the workshop.

**Peter Orr,**  
Nuclear Regulator,  
Decommissioning and  
Clean-up Programme Manager,  
Environment Agency

# Project Management, Commercial Models & Supply Chain

*In October 2018, NDA and The Oil & Gas Authority (OGA)\* hosted, in conjunction with Sellafield Ltd, a workshop of senior managers from the oil and gas and civil nuclear sectors.*

Project Management, Commercial Models and Supply Chain were the themes for the day, in particular, what key lessons could be shared to reduce future costs while supporting the decommissioning mission. A site visit to Sellafield's facilities helped oil and gas participants visualise some of the challenges common to both industries and demonstrate some of the issues involved in decommissioning the world's most complex nuclear site.

Predictable project delivery performance and the management of risk and uncertainty were discussed, with the associated need to build the right projects to deliver business outcomes.

Each sector shared perspectives on delivering project management capability via bespoke academies, that provide both hard technical capabilities and softer skills.

On commercial models, the difference between the NDA's Parent Body Organisation/Site Licence Company (SLC) structure, and the concept of wholly owned subsidiaries was discussed. Sellafield is now a wholly owned subsidiary, a model whose intent is to simplify the interfaces between NDA and its SLCs

to allow delivery of their mission more effectively, through greater autonomy of decision making, and avoiding the need for complex contract management and change control.

Within Sellafield, long term alliances have been created to overcome transactional relationships with the supply chain.

This provides market stability and enables investment by suppliers in local capability and capacity. Examples include Design Services Alliance (providing engineering design and safety case assessment services); Decommissioning Delivery Partners (providing high hazard retrievals and risk reduction); and Infrastructure Strategic Alliance (delivering basic infrastructure including electrical distribution systems, utilities, roads, bridges etc).

However, under these arrangements, Sellafield has tended to approach the market with a prescribed solution, limiting the ability of the supply chain to innovate. A new approach is through an alliance known as Project and Programme Partners (PPP), which was awarded in April 2019. PPP enables a partnership approach that aims to have a single integrated team from the outset.

\*In March 2022 The Oil and Gas Authority changed its name to the North Sea Transition Authority (NSTA) to reflect its evolving role in the energy transition.



A single project delivery team, a single outcome, with a single agreed target price, and a focus on delivery. PPP will deliver £7 billion in projects over 10 years.

The example of PPP at Sellafield, and the way that Magnox uses a fleet approach for rolling learnings from one Nuclear Power Plant decommissioning project to the next, illustrate ways in which scope is being aggregated within the nuclear sector to drive efficiencies.

Within the oil and gas sector, examples of aggregation of scope are more limited, partly because the decommissioning is being carried out by multiple operators within a competitive framework. However, the workshop participants heard a key insight that competition between operators on decommissioning scope does not deliver value. Operators neither want, nor need a competitive edge in decommissioning, but rather consider that cross-operator collaboration is essential in driving value and resolving the common challenges they face.

In this way, operators in the oil and gas sector can secure economies of scale across multiple units and projects, and the learnings from nuclear may point the way in which this might be achieved.

From a supply chain perspective, it is critical that the operators become intelligent customers to the supply chain, drawing in particular on SME expertise and understanding the know-how they bring. The supply chain typically operates across industries, and therefore automatically brings cross-industry learnings that might otherwise be absent, as well as bringing considerable experience in high hazard, high complexity, cost effective demolition. SMEs are typically rooted in local communities, directly engaged in training and education, addressing socio-economic issues providing jobs and direct support to local economy; all matters that the NDA and OGA are keen to support.

In this first of the series of cross-industry engagements, participants from across the range of institutions from both sectors concluded that there is more that such industries have in common, than which sets them apart.

**Graeme Rankin,**  
*Head of Transformation Integration  
and Benchmarking,  
Sellafield Ltd*

# Outcomes

## What Difference Does This Make...

**Two years ago, when the nuclear and oil & gas industries first convened to discuss cross-industry learning, there was some doubt as to whether the industries had any decommissioning needs in common. After all, half of oil & gas decommissioning cost is the plugging and abandonment of wells, and how many wells does the nuclear industry have?...None.**

Two years on, no one is in doubt any longer that, despite the differences in scope, the industries have common decommissioning challenges and opportunities. Whereas before, industry conferences catered solely to their own industry's needs, presuming their work to be 'unique', now most conferences and engagements include a cross-industry component to stimulate learning. The UK's Offshore Decommissioning Conference in 2018 kicked this off with a keynote address from nuclear, and in 2019 included offshore wind in the agenda in addition to the usual oil & gas.

TotalDECOM, which has always had a cross-industry scope, has gone from strength to strength, with a broader audience each year, and this year 2020 the need to split the event into an International Conference and a separate Supply Chain Expo incorporating NDA workshops.

The biggest achievement of the engagements to date can thus be characterised as making cross-industry conversations part of what is now considered business-as-usual, part of the day job rather than a luxury at the bottom of the to-do list.

The endorsement of the NDA and OGA in sponsoring this process has given personnel permission to think out-of-the-box.

More specifically, there are tangible economic benefits to the collaboration. From a nuclear perspective, over the years, many innovations have had their origins in other industries. Examples include dredger shapes adapted from the clam fishing industry then used in Sellafield ponds for radioactive sludge, sub-sea scanning technologies in murky environments adapted for nuclear ponds, robotic arms adapted from the car industry for use in closed cells for manipulating nuclear waste, remotely operated vehicles (land-based, underwater and aerial drones) adapted from defence, oil & gas and consumer electronics tasked for surveying hazardous environments.

Arising from the workshops specifically covered by this report, further collaboration has arisen in the joint sponsorship of academic research supporting both nuclear and oil & gas.

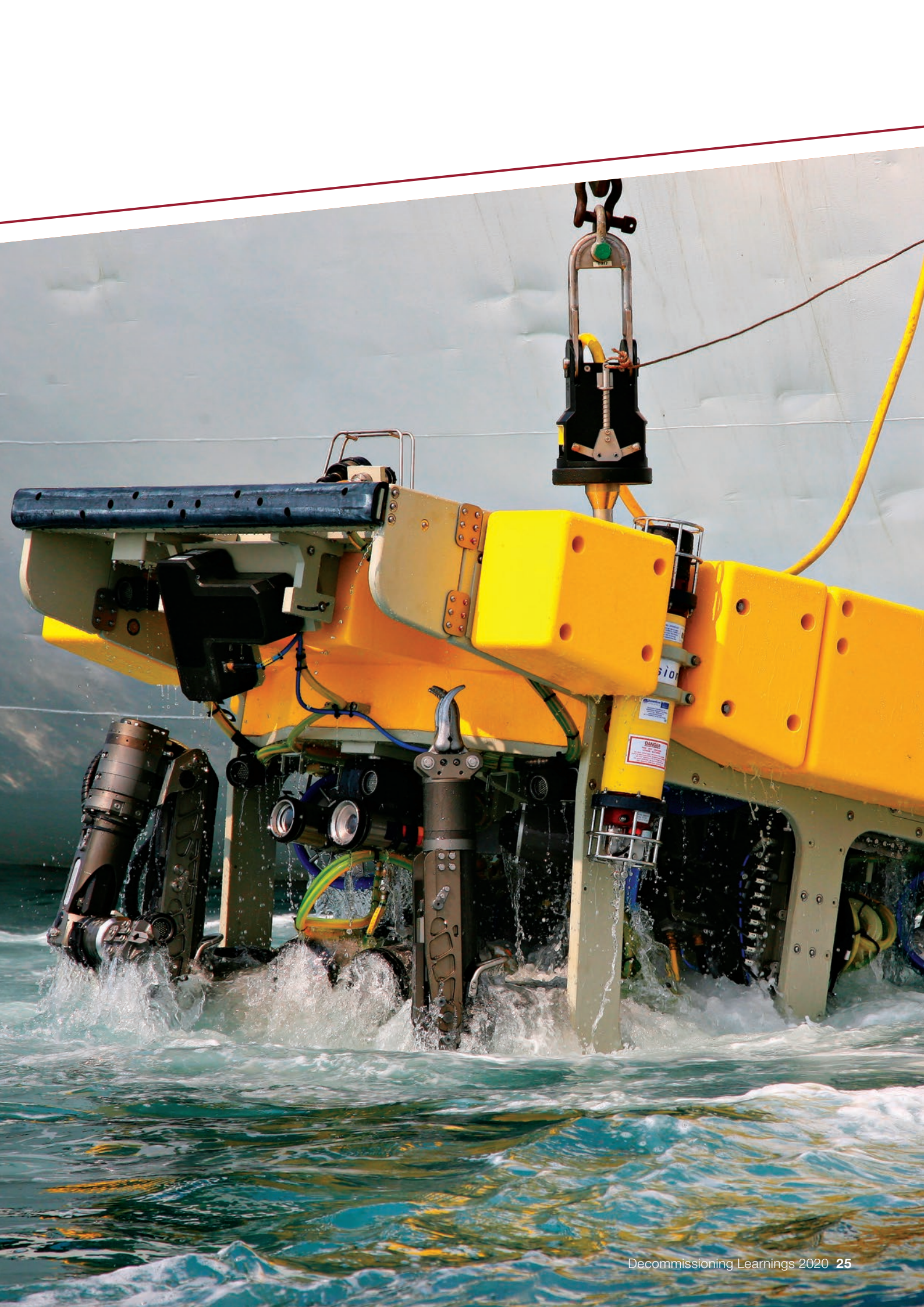
The key test of whether the learning process is working is when participants come back for more. At the close of each workshop to date, the views of participants have been solicited in whether it was useful, and heard positive feedback. The audience is clamouring for more, to delve deeper into subjects already covered, and explore new topics.

TotalDECOM shares an objective with the NDA and OGA of furthering cross-industry engagement on the subject of decommissioning and is pleased to support the initiative and endorse this report.

**George Colquhoun,**  
CEO, TotalDECOM







# Participating Organisations so far

## HM Government

Business, Energy & Industrial Strategy

Treasury

UK Government Investments

Infrastructure and Projects Authority

Defence

National Audit Office

## Trade/Event Associations

Oil & Gas UK

Decom North Sea

TotalDECOM

Energy Industries Council

Nuclear Energy Insider

Nuclear Industry Association

NOF Energy

## Regulators/ Authorities/Agencies

Nuclear Decommissioning Authority

Office for Nuclear Regulation

National Nuclear Laboratory

Oil & Gas Authority

Defence Infrastructure Organisation

Environment Agency

The Crown Estate

Atomic Weapons Establishment

UK Atomic Energy Authority

Water UK

Network Rail

UK Space Agency

Civil Aviation Authority

Defence Nuclear Safety Regulator

Health and Safety Executive

Scottish Environmental Protection Agency

Office of Rail and Road

Ofwat

Natural Resources Wales

## Supply Chain & SMEs

Wood

BakerHicks

Innserve

Jacobs

Mott MacDonald

Rolls-Royce

Thornton Tomasetti

ABB

AECOM

EY

Tetra Tech

PwC

FIS360

GDES UK

IPA Global

Turner & Townsend

IHS Markit

BAE Systems

Costain

KBR

Ebeni

GasLog

## Institutions/ Not-for-Profit

[Oil & Gas Technology Centre](#)

[National Decommissioning Centre](#)

[Engineering Construction Industry Training Board](#)

[Innovate UK](#)

[Nuclear Innovation and Research Advisory Board](#)

[Engineering and Physical Sciences Research Council](#)

[UK Research and Innovation](#)

[Nuclear Advanced Manufacturing Research Centre](#)

[British Standards Institute](#)

[Nuclear Energy Director's Forum](#)

[Nuclear Industry Council](#)

[Royal Academy of Engineering](#)

[Lloyds Register Foundation](#)

## Working Groups

[Nuclear Sector Deal](#)

[Nuclear Skills Strategy Group](#)

[National Skills Academy Nuclear](#)

[Maximising Economic Recovery \(MER\) UK](#)

[Offshore Petroleum Industry Training Organisation](#)

## Operators

[Sellafield](#)

[Magnox](#)

[Dounreay](#)

[Radioactive Waste Management\\*](#)

[Low Level Waste Repository\\*](#)

[Shell](#)

[Decom Energy \(Fairfield\)](#)

[Taqa](#)

[Repsol Sinopec](#)

[Horizon Nuclear Power](#)

[NNB Gen Co](#)

[Urenco](#)

[EDF Energy](#)

[Vattenfall](#)

[Severn Trent](#)

## Academia

[University of Aberdeen](#)

[University of Strathclyde](#)

[University of Leeds](#)

[Imperial College London](#)

[Robert Gordon University](#)

[University of Liverpool](#)

[University of York](#)

[University of Cardiff](#)

[Cranfield University](#)

## Industry/ Regional Groups

[Britain's Energy Coast Business Cluster](#)

[Cumbria Local Enterprise Partnership Opportunity North East](#)

[Scottish Enterprise](#)

[Skills Development Scotland](#)

[Satellite Applications Catapult](#)

\*Nuclear Waste Services was launched on 31st January 2022. This new organisation brings together LLW Repository Ltd, Radioactive Waste Management Ltd and the NDA's Integrated Waste Management Programme.



# Next Steps

## Moving Forward...

The most recent cross-industry engagement tackled the topic of building UK decommissioning capability, including transferable skills. A write-up will be available soon. 2020 will also see engagements on subjects as diverse as; Exportable UK Expertise; Sustainable Regional Economies; Governance & Assurance; Designing for Decommissioning; and Safety in Onshore Demolition & Dismantling.

With the UK to host COP 26, the UN Climate Change Conference, there is no better time than to convene industries on the environmental footprint of their decommissioning, which is not emission-free. We envisage a workshop on net zero during the course of 2020.

Beyond these new topics not yet covered, the intention is to revisit, on a roughly biennial basis, the important areas of common interest covered by this report, for which much enthusiasm has been expressed.

Nuclear and oil & gas are already deeply engaged, and conversations have commenced with defence, renewables, rail, water, and the space industry. In the 2021 edition of this report, we envisage announcing valuable learnings shared with these sectors, and further benefits from participation in this cross-industry initiative.

## How can I participate?

Please feel free to contact the individuals at the end of this report who are charged with overseeing much of the organisation of future workshops and can guide you to become involved.

Last but not least, remember to think cross-industry during your day job. You might be pleasantly surprised to find that your industry is not unique, that your challenges are often faced by others, and that a colleague in another industry will often be able to add enormous value to your enterprise with a key insight, freely shared.

**Karl Sanderson,**  
*Head of Cross-Industry Learning,*  
**NDA**

# Library

## OCTOBER 2018

### **Project Management, Commercial Models, Supply Chain Workshop** Lillyhall, Sellafield

A workshop of qualified managers from the oil and gas and civil nuclear sectors. The agenda was a full-day discussion on 3 of the 14 identified themes: Project Management, Commercial Models and Supply Chain.

## MARCH 2019

### **Late Life Asset Management Workshop** University of Strathclyde, Glasgow

The purpose of this workshop was to identify opportunities to work collaboratively on asset management research.

## JULY 2019

### **Cost and Schedule Workshop** London

The purpose of this workshop was to discuss cost and schedule overruns for decommissioning projects.

## FEBRUARY 2019

### **Technical Innovation Workshop** Oil & Gas Technology Centre, Aberdeen

A cross-industry engagement between nuclear decommissioning and oil & gas sectors, focussing on Technical Innovation, one of the thematic areas of common interest.

## MAY 2019

### **Innovation and Regulation Roundtable** London

The purpose of this roundtable was to discuss how Industrial Strategy has placed considerable emphasis on innovation as a mechanism to increase productivity and deliver economic growth.

## NOVEMBER 2019

### **Standards Workshop** London

Nuclear, water and rail working together with regulators to understand the status of standards (guidance).

**crossindustry@nda.gov.uk**



# Sharing the Knowhow: Tetra Tech, Incorporating WYG



## Decommissioning Camp Bastion – understanding, managing and adapting to complexity

**Decommissioning and complexity often go together. Strategic planning and communication determine success, especially when closing down Camp Bastion (BSN), the British Forces base in Afghanistan once synonymous with the fight against the Taliban.**

BSN supported 14,000+ troops and live operations across 26km<sup>2</sup> alongside NATO alliances. In an active warzone, it had to self-sufficiently support living and working conditions.

As UK troops withdrew from BSN in 2014, all infrastructure was assessed for disposal or handover to the Afghan National Army (ANA). Over 18 months, project management and technical consultancy WYG worked alongside Royal Engineers and MOD to manage BSN's live infrastructure and decommissioning. Strategic surveying, planning and engineering were at the forefront of this process.

The lessons we learned followed three key principles: Plan, Engage, Adapt.

## Plan

A great way to manage a complex project is anticipating its end state. Along with delivering infrastructure, WYG selected a team to manage withdrawal and remain among the last few civilian-supporting organisations and contractors.

These experts continually liaised with key stakeholders to prepare for operations closing down over several phases of withdrawal all interlinked with one another. The demobilisation of infrastructure managed by WYG spanned the MOD's logging, inspection, cleaning, and transportation of over 50 aircraft, 3400 vehicles, key machinery, and 50,000+ ISO containers.





## Engage

Successful decommissioning hinges on deep understanding of complex needs, requiring persistent engagement.

In developing options, works requirements, designs and governance for contracts to be let, WYG managed and reported on all construction elements planned from start to finish.

This ranged from scope of works, safe systems of works, communication with facilities providers and civilian contractors, to site inspections, and final handover.

On all our projects since, we have taken to heart just how important it is to obtain buy-in from all involved and ensure consistency in the organisations delivering the works. The key to this is bringing the right team with the appropriate experience and communication skills to manage, engineer and deliver complex work.



## Adapt

Inevitably, new constraints arise throughout complex project life cycles, making adaptability crucial.

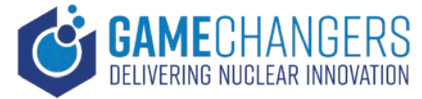
Even two months before handover, infrastructure was still being built at BSN. Everything undertaken had to support military capability, even as the Theatre Logistics Group dwindled in personnel from its peak of 800. We adapted to accommodate ever-changing operational demands whilst maintaining programme continuity and reviewing ways to foster safe progression. Examples included providing technical advice to adhere to full operational requirements and reviewing any knock-on infrastructure effects. In the face of changing priorities, we learned the importance of accounting for monetary risks and budgeted accordingly.

BSN represents an incredible achievement in infrastructure design, management, and decommissioning. Members of staff received individual Commander Commendations, with all full-time deployed staff receiving the Civilian Service Medal: Afghanistan and ISAF NATO medals for contributing to the government's work in Afghanistan.

The success of our work, including our collaboration and integration with the Special Team Royal Engineers throughout decommissioning greatly bolstered our ability to deliver full-life cycle projects from inception to design to construction. It later led the DIO to commission WYG on several other complex large-scale projects such as BATUK, the UK Naval Support Facility in Bahrain, and more.

In 2019, WYG joined the Tetra Tech group, a leading provider of consulting and engineering services, employing 20,000 in 450 locations worldwide. Later in 2020, WYG will adopt Tetra Tech's brand. In collaboration with the Tetra Tech family, this strengthened market position will expand the global know-how and experience we bring clients.

# Sharing the Knowhow: Game Changers



## Sellafield quest reveals cross sector solutions

Game Changers is an innovation programme designed to find solutions to Sellafield's nuclear decommissioning challenges. The scheme has recently achieved considerable success in identifying cross sector technology which has the potential to be developed to meet Sellafield's needs. These projects make use of expertise developed in a wide range of applications varying from plugging abandoned oil wells to detecting art fraud and producing state of the art bumpers for super sports cars.

The Game Changers programme is delivered by NNL and FIS360, specialists in supporting innovative technologies from concept to commercial production.

Working closely with Sellafield, the Game Changers team define and publicise challenges. Through far-reaching partnerships, they can then identify the very best technology and processes to accelerate and reduce the costs of decommissioning.

Successful Game Changers projects include a gamma camera developed in the academic sector, firstly for the space industry. It was subsequently used in medical applications and now further work at Loughborough University is adapting the technology to help characterise Sellafield's gloveboxes.

Glasgow-based researchers at the Fraunhofer Centre for Applied Photonics, working with Game Changers, are defining an answer

to the problem of remote hydrogen detection, which may well have important potential not only for Sellafield but also for the nuclear industry world-wide. This ground-breaking quantum technology project relies on innovative photodetectors also used in driverless vehicles and mobile phones.

Techniques used in the design of Bugatti Veyron bumpers and the armour plating of civilian aircraft used in conflict zones are being adapted to develop new nuclear waste encapsulation. Cryoroc's technology, developed in Yorkshire, has the potential to dramatically reduce the cost of storing nuclear waste.

Scientific know-how at Strathclyde University used to detect moisture in cakes and art fraud is being applied

at Sellafield to look for early signs of corrosion in nuclear waste containers.

Rawwater Engineering Company's Molten Metal Manipulation technology used to plug abandoned wells is being adapted for potential use in sealing cracks. Following successful development through the Game Changers programme, Rawwater is also now working with the Ministry of Defence to produce a front-line emergency repair backpack. In addition, they have secured a contract working with a major Japanese nuclear energy provider.

As Game Changers looks forward to its fourth year working with Sellafield, new challenges will be defined, and the focus is expected to remain on identifying the very best of scientific development across all sectors.



# Contacts

**Karl Sanderson,**  
Head of Cross-Industry Learning,  
Nuclear Decommissioning Authority  
karl.sanderson@nda.gov.uk

**Heather Barton,**  
Cross-Industry Learning Manager,  
Nuclear Decommissioning Authority  
heather.barton@nda.gov.uk

**Pauline Innes,**  
Head of Offshore Decommissioning,  
Oil & Gas Authority  
pauline.innes@nstauthority.co.uk

**Dr. Frank Allison,**  
Managing Director,  
FIS360  
frank@fis360.com

**Peter Orr,**  
Nuclear Regulator and Decommissioning  
Programme Manager,  
Environment Agency  
peter.orr@environment-agency.gov.uk

**Anthony Banford,**  
Chief Technologist,  
National Nuclear Laboratory  
anthony.w.banford@uknnl.com

**Prof Melanie Brownridge,**  
Technology and Innovation Director,  
Nuclear Decommissioning Authority  
melanie.brownridge@nda.gov.uk

**Simon Sjenitzer,**  
Director,  
Tetra Tech  
simon.sjenitzer@tetrattech.com

**George Colquhoun,**  
CEO,  
TotalDECOM  
george@totaldecom.com

**Contact us:**

***crossindustry@nda.gov.uk***



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