Nuclear Decommissioning Authority

Strategy

Effective from March 2021

Cleaning up the UK's earliest nuclear sites, caring for people and the environment

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Strategy presented to Parliament pursuant to Schedule 2 of the Energy Act 2004.

Strategy presented to Scottish Parliament pursuant to Schedule 2 of the Energy Act 2004.

March 2021

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Contents

Key

Glossary terms appear in *italics*

(SOxx) refer to the Strategic Outcomes as reported in the Mission Progress Report

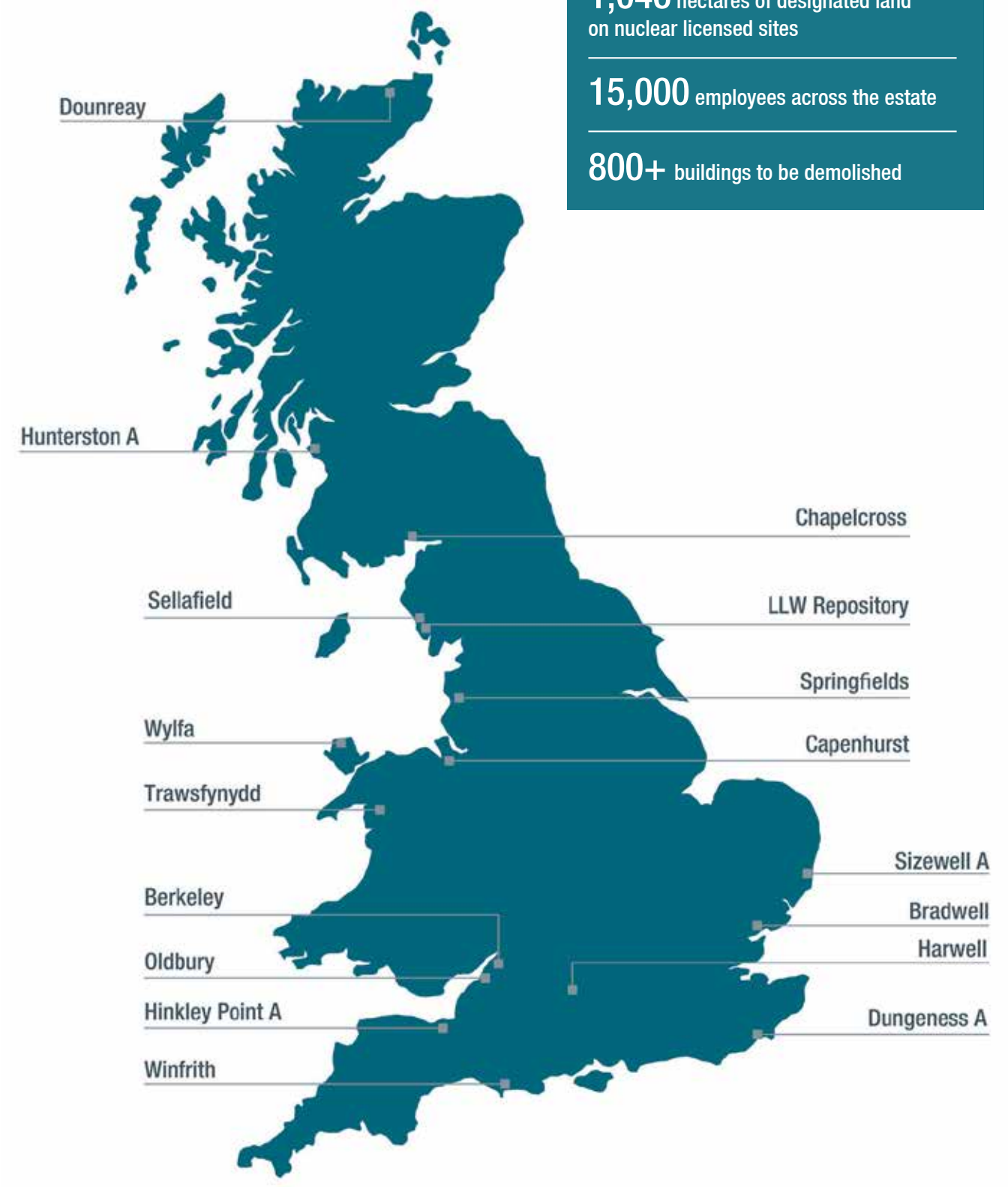
Our Estate

17 nuclear sites across the UK

1,046 hectares of designated land on nuclear licensed sites

15,000 employees across the estate

800+ buildings to be demolished



Preface

In 2005, the Nuclear Decommissioning Authority (NDA) was established as a Non-Departmental Public Body under the Energy Act (2004) (ref 1).

Our purpose is to clean up the UK's earliest nuclear sites safely, securely and cost effectively. Doing this with care for our people, communities and the environment is at the heart of our work. Our strategy is founded on our commitment to overcoming the challenges of nuclear clean-up and decommissioning, leaving our sites safe and ready for their next use.

We work with UK government and the devolved administrations to ensure their policies are reflected in our strategy and implemented at our sites. Our sponsoring department is the Department for Business and Industrial Strategy (BEIS), with additional obligations to Scottish ministers for matters affecting Scotland.

Our clean-up mission covers 17 sites, 14 in England and Wales as designated by the Secretary of State for BEIS and 3 in Scotland also designated jointly by the Scottish ministers. We have a range of supplementary functions including supply chain development, research and development, skills, socio-economic support for local communities, and stakeholder engagement. We are also responsible for implementing both geological disposal and the UK nuclear industry's Solid Low Level Waste Strategy *(ref 2)* and we perform certain advisory functions for the Secretary of State.

The Energy Act (2004) *(ref 1)* requires us to review and publish our Strategy every 5 years but we continually develop our strategy to reflect our latest understanding enabling us to make progress in the most appropriate way. This Strategy, our fourth iteration, continues that evolution and improvement and since the publication of our last Strategy in 2016 *(ref 3)*, we have advanced our thinking in some important areas including site decommissioning and remediation and integrated waste management. In this Strategy, we present the challenges, our proposed direction over the next strategy period and the actions we are planning to progress our mission.

Implementation of this Strategy is dependent upon continual assessment of affordability and value for money as well as business case approvals at the time of implementation. Delivery of the Strategy will benefit from a simpler NDA group operating model, founded on alignment and collaboration, and focus on value for money. We recognise that, in the short to medium-term, the COVID-19 pandemic will put significant pressure on public sector finances which may impact on our future funding settlements and consequentially mean we need to review our strategic and delivery priorities.

Social responsibility is important to us and is fundamental to our strategy. We can only succeed by working collaboratively with our site communities, regulators and other stakeholders including UK government and the devolved administrations. We seek to involve our stakeholders in open dialogue and recognise their views as an important part of our strategic considerations.

How we communicate our strategy and report progress

ENGAGE WITH OUR STAKEHOLDERS

NDA Strategy

Last Published: March 2021
12 week public consultation
Describes how we will deliver our mission, ensuring that the UK's nuclear legacy sites are decommissioned and cleaned up safely, securely, cost-effectively and in ways that protect people and the environment.

Energy Act requirement. Covers 100+ years.

Published every 5 years.

NDA Business Plan

Last Published: April 2020
8 week public consultation
Describes key activities across the group over the next 3 years that align to our strategic outcomes and details the funding available for the next year.

Energy Act requirement. Covers 3 years.

Published every year.

REPORT PROGRESS

Mission Progress Report

Last Published: July 2019
Provides our stakeholders with a clear and concise story of NDA mission progress since 2005, that demonstrates delivery of our strategic themes and outcomes as explained in our Strategy.

Covers 100+ years.

Published every 5 years.

NDA Mid-Year Performance Report

Last Published: February 2021
Provides a progress update against Business Plan activities and incorporates the NDA group targets.

Published every year.

NDA Annual Report and Accounts

Last Published: July 2020
Describes achievements and spending. Reports against Business Plan activities and contains an overall progress update against our mission.

Energy Act requirement. Covers 1 year.

Published every year.

1.0 Introduction

Our mission is to deliver safe, secure, sustainable and publicly acceptable solutions to the challenge of nuclear clean-up and waste management.

1.1 Background

The UK nuclear industry has evolved since the Second World War, responding to UK government policy requirements related to civil nuclear energy and defence. This has resulted in a legacy of sites and facilities as well as a number of operational nuclear power and fuel cycle plants.

The Energy Act (2004) *(ref 1)* created the NDA to take responsibility for decommissioning the legacy sites that make up our estate, which contain many unique and difficult nuclear decommissioning challenges. The risks and hazards the NDA manages are amongst the most challenging anywhere in the world and internationally there are few programmes of the same scale and complexity. Our previous Strategies *(ref 3,4,5)* presented a clear understanding of what is required to deliver our mission. Our current plans indicate that the mission will take over 100 years to complete and it is estimated to cost in excess of £120 billion to deliver.

The aim of our mission is simple: to complete the clean-up of our legacy sites and release them for beneficial reuse. However, due to its nature and scale, the delivery of our mission remains subject to significant uncertainties and complexities. These are associated with the condition of the assets and nature of the decommissioning programmes, and projects that have no national or international precedent. Furthermore, over such long timescales we are exposed to changes in social attitudes, science, regulation and supply chain capabilities, amongst others, that we cannot predict.

In delivering our mission, our priority is to uphold safety and adherence to environmental standards, while reducing costs and accelerating progress wherever possible underpinned by the principles of quality management and *continuous improvement*. Most of our funding comes from the UK government *(see **Funding**)* and we therefore have a duty to the taxpayer to pursue value for money. Our responsibilities also extend to our people, local communities and stakeholders. These responsibilities are supported by the Public Services (Social Value) Act 2012 *(ref 6)* and the Cabinet Office Procurement Policy Note PPN 06/20 *(ref 7)* which require us to evaluate positive social, economic and environmental impacts i.e. achieving social value through our procurement activities.

In our previous Strategies *(ref 3,4,5)* we signalled significant changes to our strategic approach and some of these changes have already transformed delivery across the group and some will do so in the future. Specifically, in our 2016 Strategy *(ref 3)*, we:

- reiterated our relentless focus on reducing risk and hazard across the NDA estate. In particular, this meant demonstrating progress on the decommissioning of Legacy Ponds and Silos (LP&S) at Sellafield, defueling our Magnox stations following the end of electricity generation and consolidating plutonium from Dounreay to Sellafield
- committed to finish reprocessing in the Thermal Oxide Reprocessing Plant (THORP) in November 2018 and aimed to complete Magnox reprocessing as soon as practicable, expected to be around the end of 2020. This meant the end of plutonium and Highly Active Liquor (HAL) production, enabling the Sellafield mission to predominantly focus on risk and hazard reduction, decommissioning and remediation
- maintained a strong focus on appropriate storage and management of nuclear materials, spent fuel and waste, to avoid future legacies and continuing to receive spent fuel from the EDF Energy (EDF) fleet of Advanced Gas-Cooled Reactors (AGRs) for their operating life
- identified a number of strategic opportunities each of which, if fully developed and implemented, would accelerate and facilitate more effective delivery of our mission such as:

- adoption of site specific decommissioning strategies at Magnox sites which would result in a rolling programme of activity across the fleet
- changes to regulations for sites in the final stages of decommissioning (enabling optimisation of interim/end states)
- the development of a risk-informed rather than classification-based approach to integrated waste management (including flexible and effective lifecycle management, introduction of alternative treatment technologies, near-surface disposal for some decommissioning waste and making better use of the disposal capabilities we already have)

• further developed a number of critical enabler strategies which would modify the manner in which our mission is delivered, for example in our people and socio-economic strategies.

At the time our previous Strategy *(ref 3)* was being developed it was apparent that mission delivery could be improved by evolving our operating model. A decision was taken to make Sellafield Limited a wholly-owned subsidiary of the NDA with effect from 2016, rather than operate the site under a *Parent Body Organisation (PBO)* arrangement, which was the favoured method of introducing private sector expertise to the *Site Licence Companies (SLCs)* at the time the NDA was formed. The decision was reached after detailed consideration and engagement with the UK government on the most appropriate model for the management and operation of the site given the uncertainties and complexities of the work required. However, private sector expertise is still required to support delivery of the Sellafield activities and, in the revised model, Sellafield Limited engages with the private sector at a strategic level to achieve more effective delivery. Our award of the Magnox PBO contract was subject to a legal challenge and in 2019 we concluded that Magnox Limited should also be managed as a subsidiary. We have also made a decision to make Dounreay Site Restoration Limited (DSRL) and Low Level Waste Repository Limited (LLWR Limited) wholly-owned subsidiaries of the NDA and this process will conclude in 2021. These changes will mark the completion of the NDA's transition from the PBO model to a group approach (see ***Information on the NDA Group***). 2021 has also seen us bring together our extensive transport and logistics expertise into a single transport division, known as Nuclear Transport Solutions (NTS). We will continue to explore how we can best combine our waste management activity to optimise the skills and expertise we have across the NDA group. Any further changes will be subject to engagement with stakeholders and the necessary approval processes.

We strongly believe that the subsidiary model and the closer alignment of the NDA and its group businesses will create a stable and effective implementation framework. This will be achieved through the One NDA way of working which is firmly based on maximising the opportunities that come from working more effectively and efficiently as a group of businesses who can learn from each other and wider industry, while striving for *continuous improvement* in everything that we do.

The benefits we are focussed on achieving from the subsidiary model and the One NDA way of working are:

- increased value for money and social value for the taxpayer
- enhanced performance and delivery of outcomes
- strong organisational health
- improved stakeholder confidence and trust
- improved culture for our people.

While the One NDA way of working is building an effective and efficient implementation framework for the delivery of our mission, we continue to act as a strategic authority. We will ensure that government policies are reflected in our strategy and implemented across the group, clearly specifying our requirements to the businesses.

To demonstrate the progress we have made we have developed an approach to mission reporting. This tracks our progress in mission delivery since the NDA's inception and is summarised in the recently published Mission Progress Report *(ref 8)*. This will be published every 5 years at a minimum alongside each Strategy. This document is currently being further developed to incorporate financial and risk information and other performance metrics.

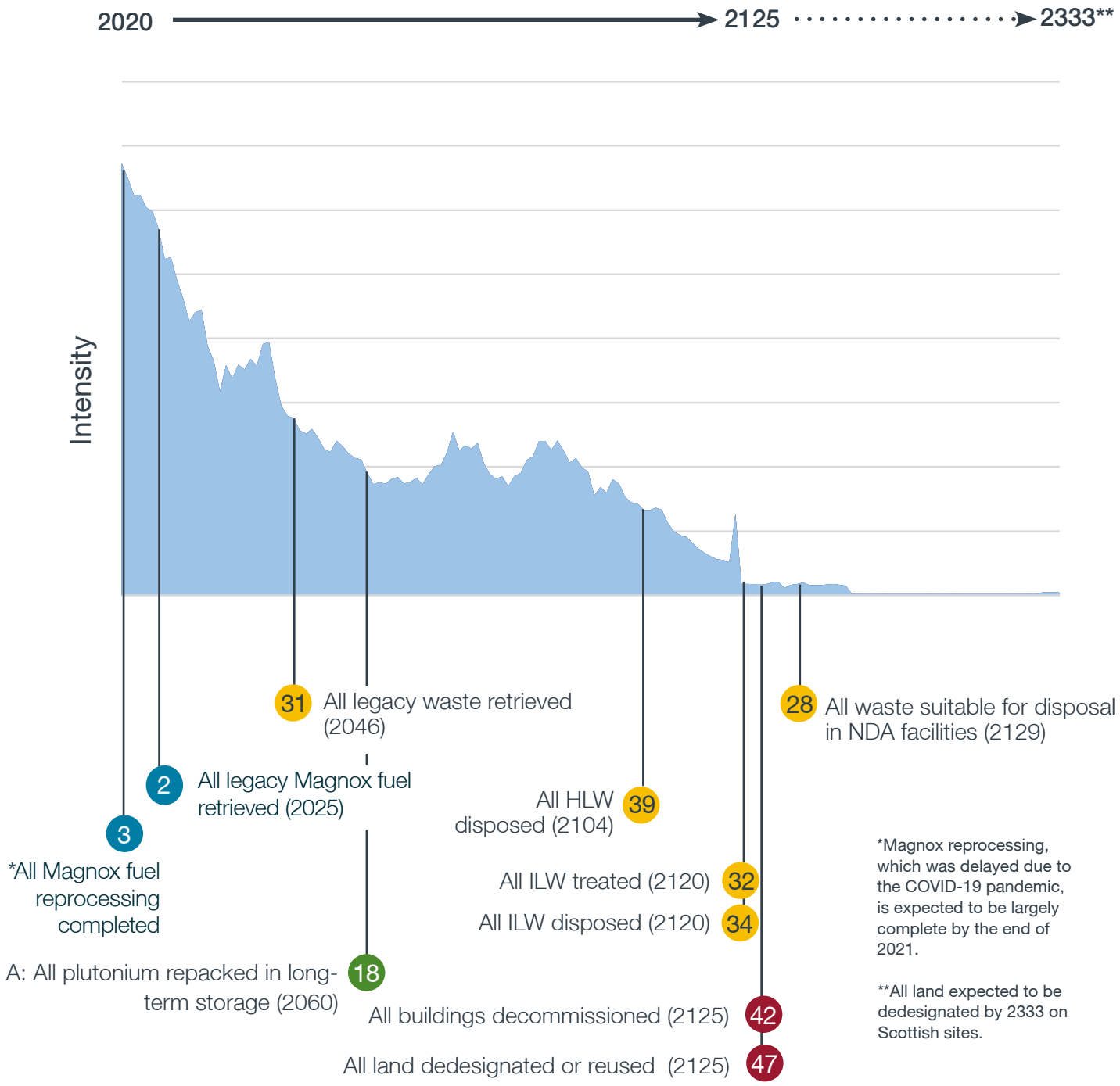
Mission progress since our previous Strategy *(ref 3)* includes:

- retrievals from legacy ponds at Sellafield commenced in the period and are ongoing, and it is anticipated that the first retrievals from the legacy silos will commence in 2020-21
- THORP reprocessing was concluded in November 2018
- Magnox reactors were fully defueled in November 2019

- prior to the impact of the COVID-19 pandemic, Magnox reprocessing remained on a trajectory to conclude reprocessing around the end of 2020. This will see the end of civil plutonium and HAL production
- plutonium consolidation from Dounreay to Sellafield was completed in December 2019
- continued diversion of waste from the LLWR for treatment through effective application of the *Waste Hierarchy* and harnessing the supply chain
- publication of the Radioactive Waste Strategy *(ref 9)* in 2019 with the commitment to seek integrated solutions for the benefit of the nuclear industry, the development of a number of technical opportunities to support ultimate delivery covering thermal processes and near-surface disposal, although much work is still to be to done to realise the benefits
- the advent of the One NDA way of working which supports the ambition to maximise synergies and collaboration across the NDA group.

With our new Mission Progress Reporting *(ref 8)* we believe that it will be easier for our stakeholders to visualise progress against our strategic outcomes *(see table 1)*.

Roadmap for mission delivery - the NDA group



*Magnox reprocessing, which was delayed due to the COVID-19 pandemic, is expected to be largely complete by the end of 2021.

**All land expected to be dedesignated by 2333 on Scottish sites.

	BUSINESS DELIVERY OF STRATEGIC OUTCOMES	Sellafield	Magnox	Dounreay	LLWR	RWM	NTS	Capenhurst	Springfields
SPENT MAGNOX FUEL	**1 All Magnox sites defueled**	✓	✓				✓		
	2 All legacy Magnox fuel retrieved	✓							
	3 All Magnox fuel reprocessing completed	✓							
	4 All remaining Magnox fuel in interim storage	✓							
	5 All remaining Magnox fuel disposed	✓				✓			
SPENT OXIDE FUEL	6 All EDFE oxide fuel received	✓					✓		
	7 All legacy oxide fuel retrieved	✓							
	8 All oxide fuel reprocessing completed	✓							
	9 All remaining oxide fuel in interim storage	✓							
	10 All remaining oxide fuel disposed	✓				✓			
SPENT EXOTIC FUEL	11 All exotic fuel defueled	✓		✓					
	12 All exotic fuel consolidated	✓		✓			✓		
	13 All exotic fuel reprocessing completed	✓							
	14 All remaining exotic fuel in interim storage	✓							
	15 All remaining exotic fuel disposed	✓				✓			
PLUTONIUM	16 All plutonium produced	✓							
	17 All plutonium consolidated	✓		✓			✓		
	18 A: All plutonium repacked in long-term storage	✓							
	B: All cans not suitable for extended storage repackaged								
	19 All plutonium in interim storage	✓							
	20 All plutonium reused or disposed	✓				✓			
URANICS	21 All uranium produced	✓							
	22 All uranium consolidated	✓	✓	✓			✓	✓	✓
	23 All uranium treated							✓	✓
	24 All uranium in interim storage	✓						✓	
	25 All uranium reused or disposed	✓				✓		✓	

	BUSINESS DELIVERY OF STRATEGIC OUTCOMES	Sellafield	Magnox	Dounreay	LLWR	RWM	NTS	Capenhurst	Springfields
LOW LEVEL WASTE	26 All LLW produced	✓	✓	✓	✓			✓	✓
	27 All LLW treated - to enable diversion or reuse	✓	✓	✓	✓		✓	✓	✓
	28 All waste suitable for disposal in NDA facilities	✓	✓	✓	✓		✓	✓	✓
	29 All waste suitable for permitted landfill disposed	✓	✓	✓	✓		✓	✓	✓
INTERMEDIATE LEVEL WASTE	30 All ILW produced	✓	✓	✓	✓			✓	✓
	31 All legacy waste retrieved	✓			✓				
	32 All ILW treated	✓	✓	✓				✓	✓
	33 All ILW in interim storage	✓	✓	✓				✓	✓
	34 All ILW disposed	✓			✓	✓	✓		
HIGH LEVEL WASTE	35 All HLW produced	✓							
	36 All HLW treated	✓					✓		
	37 All HLW waste in interim storage	✓					✓		
	38 All overseas HLW exported	✓					✓		
	39 All HLW disposed	✓				✓			
OPERATIONAL AND PLANNED	40 All planned new buildings operational	✓	✓	✓	✓	✓		✓	
	41 All buildings primary function completed	✓	✓	✓	✓	✓		✓	✓
DECOMMISSIONING AND DEMOLITION	42 All buildings decommissioned	✓	✓	✓	✓	✓		✓	✓
	43 All buildings demolished or reused	✓	✓	✓	✓	✓		✓	✓
SITES	44 All land delicensed or relicensed		✓	✓	✓				
	45 All land in End State - all planned physical work complete	✓	✓	✓	✓			✓	✓
	46 All land demonstrated as suitable for reuse	✓	✓	✓	✓			✓	✓
	47 All land dedesignated or reused	✓	✓	✓	✓			✓	✓

Table 1 - Mission Progress Reporting Strategic Outcomes

✓ Denotes outcome complete

✓ Applicable to each SLC/company

1.2 Current Context

Changes to the operating environment in which the NDA exists, and related threats and opportunities, will impact our future strategy.

The world continues to face the unprecedented difficulties caused by the COVID-19 pandemic, with serious health, social and economic consequences for people and businesses. The long-term consequences of the pandemic are far from clear. It is our current view that the overarching strategy remains coherent and robust and that strategic developments underway and those proposed remain relevant. However, they will be continuously assessed by us and our businesses as the situation evolves. The impact of the COVID-19 pandemic may be considerable, introducing uncertainty into the timing and duration of the spending review process so that any exercise undertaken will be set in a radically different fiscal environment and is likely to compound an already challenging situation. While refocussing our operational stance we have identified areas in which we can improve the way we work, simplifying processes and driving a digital agenda to deliver our strategic objectives.

Since our previous Strategy *(ref 3)*, we have successfully maximised net revenues from the remaining reprocessing contracts and other income, such as the sale of NDA-owned land. However, our income has reduced and additional scope delivery, including mitigating the impact of risks such as cyber security and exiting the European Union, have meant that we have requested additional funds to maintain the pace of mission delivery. The increased spending review settlements received reinforce the importance of our mission.

With the possible funding impacts of the COVID-19 pandemic and the reduction in projected revenues, there are significant future challenges to funding if the pace at which the NDA delivers its mission is to be maintained or increased. We have very limited potential to significantly increase net revenues, and thus reduce the required public funding. Unlike a public limited company (PLC) we cannot freely invest in facilities or capability which could ultimately deliver a return on investment. We will work with government to explore opportunities as part of spending review considerations.

At the time of writing this Strategy, a BEIS departmental review of the NDA is underway. It was a recommendation of previous National Audit Office reports that such a review should be undertaken. The review is taking a fundamental look at the NDA's form and functions, governance arrangements, operational effectiveness and efficiency. The fieldwork for the review has included extensive desk-based research, a site visit to Sellafield and a large number of interviews with personnel across the NDA group and government, and with external stakeholders including trades unions, suppliers, site stakeholder groups and local authority representatives. The report from the review is expected to be published in due course. It is anticipated that any relevant outcomes from the review will feed into our future strategy.

When the NDA was formed in 2005, nuclear energy was not seen as a part of the UK's future energy mix. The UK government's nuclear new build agenda is now considered a key part of achieving a low carbon economy, as detailed in the Energy White Paper: Powering our Net Zero Future (2020) *(ref 10)*. Although this only indirectly affects the NDA's mission it does impact the overall policy environment and, for example, the capabilities and focus areas for our supply chain and development of skills. We have seen other significant changes in both the nuclear and broader industrial/business context culminating most recently in the launch of the UK government's Clean Growth Strategy *(ref 11)*, 25 Year Plan to Improve the Environment *(ref 12)*, Industrial Strategy *(ref 13)*, Export Strategy *(ref 14)* and the subsequent development of 10 sector deals and a number of local industrial strategies. The Nuclear Sector Deal *(ref 15)* between the private sector and the UK government, is based on a vision up to 2030, but it has the potential to be the foundation for much longer-term progress and activity, setting out an ambition for the nuclear sector to deliver a 30% reduction in the cost of new build projects, savings of 20% in the cost of decommissioning compared with current estimates, achieve 40% female participation in nuclear and win up to £2 billion of domestic and international contracts. We actively support and promote the goals of the deal and collaborate with the private sector on this important work in order to maintain the health of the UK's civil nuclear sector.

We are represented on each of the 5 industry working groups, providing them with appropriate subject matter expertise and information.

The NDA implements UK government and the devolved administrations' policies through its strategies. In implementing these policies, we continue to work closely with UK government and the devolved administrations to identify opportunities to improve and optimise the policy framework. Optimisation of the policy framework would facilitate improved delivery of our mission, support and align with our strategy development activities and could provide the NDA with further strategy and delivery flexibility. UK government and the devolved administrations are considering an update of the policy framework on nuclear decommissioning and radioactive substances management. Proposals for consultation will be discussed and agreed later in 2021.

Since the NDA was formed, global awareness of *sustainability* and specifically *decarbonisation*, clean growth and social value have become ever more important. This has contributed to the development of the United Nations Sustainability Development Goals (UN SDGs) *(ref 16)* and declaration of climate emergencies by UK, Welsh and Scottish Parliaments with legislation to reduce the *emissions of greenhouse gases to net zero* across the entire UK by 2050.

To achieve *sustainability* requires a balance of social, environmental and economic factors. These 3 pillars are key components of the *NDA's Value Framework (ref 17)* which is a list of factors, developed with stakeholders, that we value in relation to our mission, consider during decision making and incorporate in our strategy.

The emergence of social value i.e. maximising the positive social, economic and environmental impacts achieved as a result of procurement, employment and investment activity, has begun to transform the way businesses in the UK and globally operate. This presents us with new opportunities for optimisation and how we do business in order to meet the intent of the Energy Act (2004) *(ref 1)* to support socio-economic development in the communities where we operate.

We are well placed to respond to this increased interest in *sustainability* as our mission is *de facto* one of delivering sustainable outcomes. Although these outcomes were implicit in our previous 3 Strategies *(ref 3,4,5)*, we have now decided to seek out further opportunities to deliver our mission in a more sustainable way. For example, whilst the ongoing delivery of the mission will itself significantly reduce our carbon footprint, we are currently exploring means by which to accelerate the *decarbonisation* of both our own operations and those of our supply chain.

We currently believe that the main *sustainability* challenges for the NDA are:

- decommissioning and remediating our nuclear sites in the most effective, efficient and sustainable way
- eliminating waste and reducing the consumption of natural resources by design through the reuse, repair, repurposing and recycling of assets
- decarbonising the estate, and supporting the UK commitments to reduce *greenhouse gas emissions to net zero* in England and Wales by 2050 and in Scotland by 2045
- embedding behaviours which promote *sustainability* within our own workforce and throughout our supply chain
- maintaining a suitable decommissioning and waste management capability which is both enduring and adaptable to change
- maximising the socio-economic benefits derived from the mission, thereby encouraging diverse and resilient economies and thriving, inclusive communities
- listening to and working with our stakeholders, to gain their trust and support for the next beneficial use of released land
- enhancing biodiversity and environmental net gain.

We recognise that the debates about *sustainability* and specifically climate change and social value are ongoing. We will continue to review our approach to ensure that it reflects good practice on *sustainability* that delivers present and long-term value as well as the expectations of our stakeholders, and complements the approaches of our regulators as outlined in their respective strategies and plans, for example, the Environment Agency's 5 Year Action Plan *(ref 18)*, the Scottish Environment Protection Agency's Regulatory Strategy *(ref 19)*, Nuclear Power & Decommissioning Sector Plan *(ref 20)* and local development plans.

We recognise that changes in context may result in changes to our strategy and to maintain the support, confidence and trust of our stakeholders we continue to engage with them, especially at local authority and community level. We do this to deliver better solutions and to understand stakeholder concerns and aspirations. To improve our engagement we continue to modify and target our interactions based on feedback and levels of interest in topics and issues raised.

As well as public engagement we also need to work effectively with our businesses, government and regulatory colleagues since many of our strategic opportunities rely on changes to operational practices, government policy or the regulatory and legislative framework. We have developed strongly inclusive, collaborative and mutually respectful engagement approaches which, by establishing a shared and aligned vision, allow us to consider differing perspectives and facilitate change.

We are committed to learning from our experiences and *continuous improvement* by recognising feedback and recommendations.

Maintaining the support, confidence and trust of our stakeholders is vital

1.3 Funding

As a Non-Departmental Public Body, the NDA's annual spending limits are set by UK Parliament, combining government grant with income from our commercial activities *(see fig 1)*. Government's recognition of the vital importance of the NDA mission in dealing with the UK's nuclear legacy is reflected in continued investment and support for safe and secure nuclear operations and a broad range of decommissioning activities across the group. UK government investment has increased as commercial revenue has declined following the end of large-scale electricity generation and the completion of THORP reprocessing contracts at Sellafield.

There are significant risks to some current operations because they rely on fragile and ageing assets. Failure of these assets could result in increased variability in both income and cost.

A projection of expected income and expenditure for delivering our mission is shown in Appendix B. To secure sufficient funding for the NDA mission we will seek to reduce decommissioning costs in line with the ambition for the Nuclear Sector Deal *(ref 15).* We will also continue to explore all available options to optimise revenue from existing assets and continue to discuss with BEIS what opportunities for revenue generation, based on NDA assets and capabilities, could emerge from changes in policy.

The *Lifetime Plans (LTPs)* of our SLCs are updated as our understanding of the decommissioning programmes and costs improve and the uncertainty ranges associated with them are better understood. The dates indicated for milestones in this Strategy and the associated Mission Progress Reporting *(see **Background**)* are potentially subject to change as our plans and priorities are reviewed further and optimised. We show our progress in dealing with the legacy in our evolving Mission Progress Reporting *(ref 8)*.

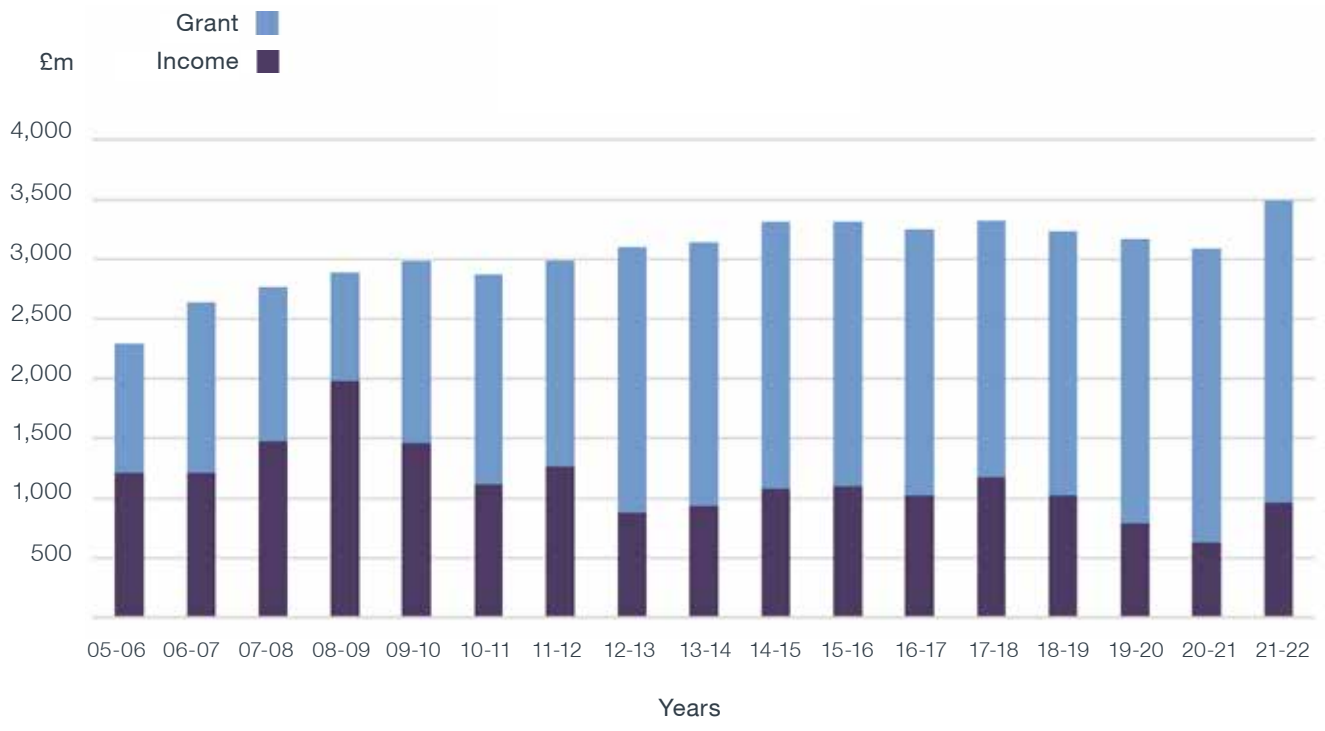


Figure 1 - Combined grant and income since 2005

2.0 Our Approach to Strategy

This Strategy describes our high level approach to delivering our mission. We work on strategic issues all the time and our strategic positions evolve as a result. Our Strategy is a snapshot of the status of strategic topics at the time of publication.

Early decommissioning plans inevitably focused on site by site solutions and were reflected in our first Strategy *(ref 4)*. As our strategies have evolved, more generic approaches have been introduced to improve the delivery of our mission and secure best value for money.

Each of our 17 sites is currently operated under a site licence. Our *Site Licence Companies (SLCs)* are responsible for day to day operations and the delivery of site programmes. To secure the implementation of strategy through site programmes, our strategic requirements are translated into action through specifications detailing the strategic outcomes required for the sites which are then used by the SLCs to develop their plans. Specifications are managed under change control processes and reviewed periodically. Sites use the Programme and Project Management lifecycle to develop their plans which are then embedded in their *Lifetime Plans (LTPs)*. The NDA subsequently monitors and measures the SLCs' delivery performance against the agreed plans.

2.1 Strategic Themes and Topics

In our previous Strategies *(ref 3,4,5)* we identified 5 strategic themes under which we grouped all activities that support the delivery of our mission *(see fig 2)*. This approach has allowed us to bring a clear focus to our mission and better understand the relationships between its different components; it has served us well and our strategy and our planning and reporting processes continue to be based on this approach.

Site Decommissioning and Remediation defines our approach to decommissioning redundant facilities and managing land quality in order that each site can be released for beneficial reuse.

Spent Fuel Management defines our approach to managing the diverse range of spent nuclear fuels for which we are responsible.

Nuclear Materials defines our approach to dealing with the inventory of uranium and plutonium currently stored on some of our sites.

Integrated Waste Management considers how we manage all forms of waste arising from operating and decommissioning our sites, including waste retrieved from legacy facilities.

Critical Enablers support the overall delivery of our mission and, in some cases, reflect the supplementary duties assigned to the NDA by the Energy Act (2004) *(ref 1)*.

There is a great deal of interdependence between the themes and hence limited discretion to stop activities under a particular theme without impacts on other themes. These impacts are not limited to our estate only (e.g. our spent fuel management strategy can affect electricity generation).

Our 5 strategic themes are further divided into individual topic strategies. Our Strategy is structured to reflect these topic strategies, summarising the strategic position under the following headings:

- **Objective** – What is the objective of the strategy?
- **Our Strategy** – What is our current strategy, and any associated risks and opportunities?
- **Strategy Development** – What strategy development do we plan to undertake in the future?
- **Delivery** – What have we delivered so far and how do we plan to implement our strategy?

To help in identifying interactions between topic strategies and strategic themes colour coding is used to indicate the strategic themes and the related strategic outcomes are reported in accordance with numbering given in the Mission Progress Report *(ref 8) (see table 1)*. Organising our work in this way provides clarity and a consistent basis for communicating with our stakeholders.

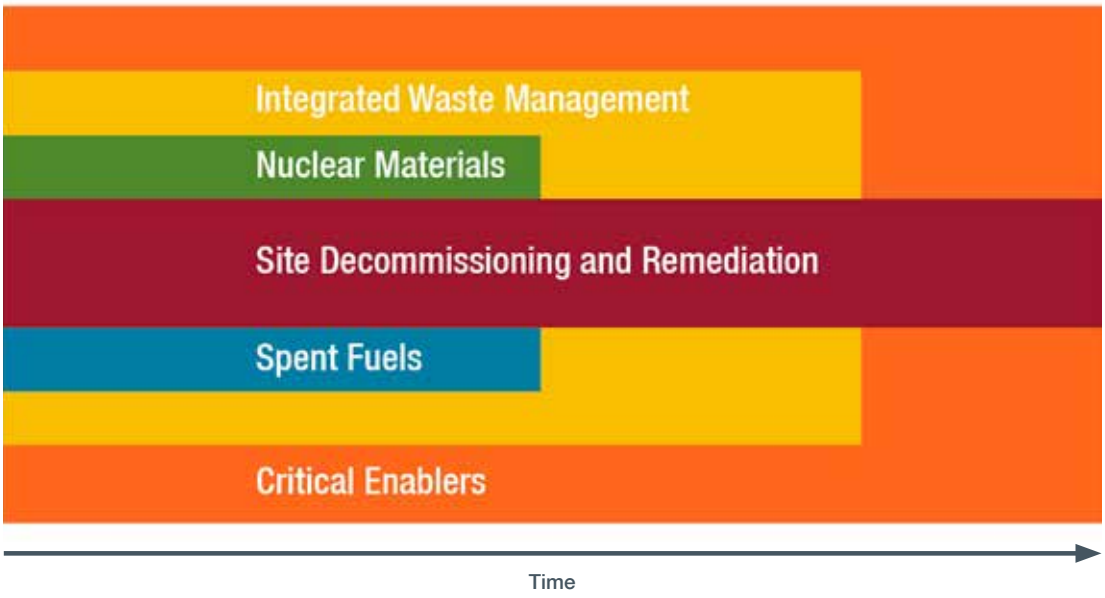


Figure 2 - Illustration of the 5 strategic themes with an indication of how they interact. Site Decommissioning and Remediation is the driving theme supported by Integrated Waste Management; the need to manage Spent Fuels and Nuclear Materials is an early part of Site Decommissioning and Remediation; the entire mission is underpinned by the Critical Enablers.

2.2 Strategy Management

To manage the many interactions between the different parts of our strategy we have a *Strategy Management System (SMS) (ref 21)*. This simple, gated decision-making process enables us to:

- develop strategy in a controlled fashion through distinct stages, allowing us to engage effectively with government, devolved administrations, nuclear regulators, SLCs and other stakeholders on its development and possible changes in strategic direction
- ensure the strategy is robust and coherent at all times, recognising the numerous interdependencies
- effectively respond to internal and external events that impact our strategy
- ensure compliance with the regulatory framework
- transparently underpin the decisions we make on preferred strategic options.

Our SMS approach is aligned to Her Majesty's Treasury (HM Treasury) guidance, using a business case approach to build up the underpinning rationale for a strategic decision. It allows us to demonstrate to our stakeholders that we are spending the funds allocated to us on the right things and in the right way. This means doing more than simply meeting regulatory obligations. The decisions we make must deliver value for money in its broadest sense; the best overall solution for this and future generations. Consequently, shortly after the NDA's creation, we worked with stakeholders to agree those things that we value in relation to our mission. These factors were gathered together as the *NDA Value Framework (ref 17) (see fig 3).*

The *NDA Value Framework* is not a decision-making process; it is a list of factors that we consider during decision making. In selecting a preferred strategy, we consider the performance of each option in relation to factors in the *Value Framework*. No attempt is made to pre-empt the weighting of different factors because the weighting will be specific to the decision in question, indeed it may be that only a subset of factors is relevant.

The *NDA Value Framework* can be used whenever there is a need for a holistic, evidence-based evaluation of alternative options. In practice, the *Value Framework* is particularly useful for strategic decisions when setting the direction of travel and deciding what to do (rather than how to do it). By using the *NDA Value Framework* in these early stages, we have greater confidence that everything stakeholders value about our mission will pervade decisions right through to implementation and delivery. It also provides essential context and evidence for regulatory assessments in these later stages.

Importantly, the *NDA Value Framework (ref 17)* also captures the 3 pillars of *sustainability* and social value: the economy, society and environment. Our use of the *Value Framework* ensures that *sustainability* is considered in our strategy.

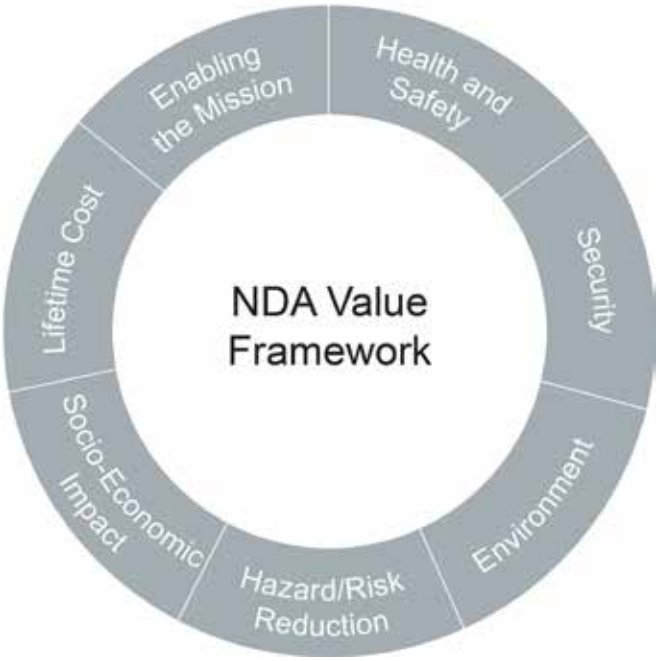


Figure 3 - NDA Value Framework

Definition of Hazard: *Hazard is the potential for harm arising from an intrinsic property or ability of something to cause detriment.*

Definition of Risk: *Risk is the chance that someone, or something that is valued, will be adversely affected by the hazard.*

To assess the impacts of our strategy at a national level an overarching Integrated Impact Assessment (IIA) has been carried out for this Strategy. The environmental, health and socio-economic impacts of our driving strategic themes outlined in the IIA report are summarised in Appendix A.

2.3 Lessons from Strategy (2016)

Since the publication of our previous Strategy *(ref 3)*, we have re-examined the way we approach strategy development for Critical Enablers. We identified limitations of the SMS process in developing our Critical Enabler strategies, especially where they directly support the mission strategies. With the advent of the One NDA way of working a number of the Critical Enabler strategies have been updated and some new strategic objectives have been identified.

We identified that in addition to engaging with our stakeholders there is a clear need to engage more regularly with our SLCs and subsidiaries during strategy development. We have now established the necessary fora to engage with strategy functions across the NDA group to ensure seamless interaction between strategy development, implementation and delivery.

We continue to avoid including tactical and operational information in our strategy and instead focus on our high level approach. We recognise that this tactical and operational information is of significant interest to our stakeholders, and we have developed the Mission Progress Report *(ref 8)* to better explain our progress under the strategic themes. We now place greater emphasis on linking our strategic outcomes with tactical and operational information presented in the Mission Progress Report, our Business Plan and Annual Report and Accounts. We ask that our Strategy is read alongside the Mission Progress Report, which outlines progress against strategic outcomes *(see table 1)*, the annual Business Plan, which sets out our objectives and plans for the following 3-year period and the Annual Report and Accounts, which reports our performance against these activities.

Tactical and operational information can now be seen in our Mission Progress Report

3.0 Our Evolving Strategy

The Energy Act (2004) (ref 1) established the NDA to ensure focus on the UK nuclear legacy and existing commercial contracts. This was achieved by working together with governments on policy and legislative changes and by introducing the strategic themes and topics.

Our strategic objectives and outcomes were developed transparently with the help of our stakeholders. Progress in the delivery of strategic outcomes, development of strategic opportunities, and changes in government policy mean that we are now well placed to better integrate our strategies for ***Site Decommissioning and Remediation, Spent Fuels, Nuclear Materials*** and ***Integrated Waste Management*** *(see fig 4).*

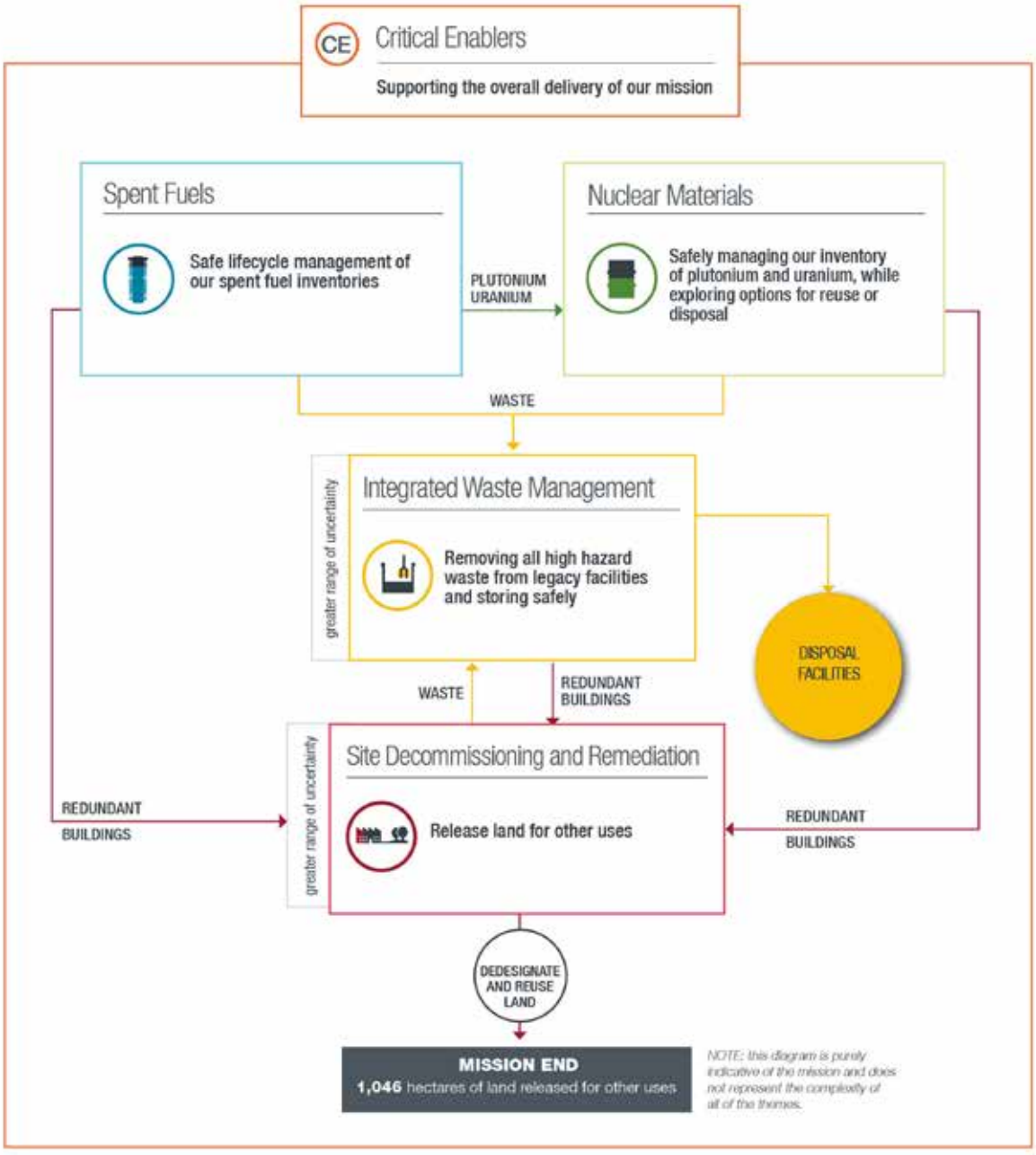


Figure 4 - Integration of our strategies

Our focus during this Strategy period will be to develop a better understanding of the interactions between the ***Site Decommissioning and Remediation*** and ***Integrated Waste Management*** themes. Our aspiration is that at least one of our sites will be fully decommissioned and released for beneficial reuse by 2040. To achieve this we will use *'lead and learn'* approaches wherever possible and maintain decommissioning progress across our sites and facilities, ensuring that site interim and end states take advantage of the risk-informed approach to waste management and disposal. In addition to policy and strategy development we will explore options around how best to set up the NDA group waste businesses and how they interact with waste consigners and the supply chain.

We now also have a much clearer understanding of the spent fuels and nuclear materials we are dealing with, their interim storage regimes pending disposal, and their potential ultimate disposal to a *Geological Disposal Facility (GDF)*. The Magnox sites have already achieved significant risk and hazard reduction through defueling and consolidation at Sellafield. We have consolidated all plutonium at Sellafield, thus reducing the risk and hazards at Dounreay. While we develop our future *disposition* strategy we will ensure consolidated spent fuel and nuclear materials are safely and securely stored.

We will also build on the early progress demonstrated on the high hazard programmes at Sellafield and pursue fit for purpose approaches to retrievals, packaging and storage pending disposal, reducing risks in the near term and understanding the residual hazards.

While we continue to ensure the combined outcomes of recent developments in strategy are realised *(see fig 4),* we continue to review our strategy, supporting interventions at our sites where the outcomes can be optimised. In doing so, we will work closely with stakeholders and the supply chain, involving them in decision making where appropriate.

With the renewed emphasis on group-wide approaches *(see* ***Background****)* we have increased our focus on ***Critical Enabler*** strategies.

We recognise that innovation is critical to improvements in cost, schedule and quality. We aim to pursue the benefits of commercially available technologies and innovations in other sectors and the risks and rewards associated with developing novel technologies. We are aware that some technological solutions may challenge historic practices or the current regulatory framework, but could reduce our risk profile or reduce environmental impacts while providing greater value for money. To ensure such opportunities are not missed, we will continue to work closely with regulators to maintain an environment in which innovation is encouraged and thrives.

The NDA cannot deliver its mission without its people and to be successful we need to be able to attract and retain talented and committed individuals. We are committed to raising awareness of equality, diversity, inclusivity, health and wellbeing across the group. We will invest in skills development through apprenticeships and opportunities for lifelong learning and development. We recognise changes in employment patterns and will strive to ensure that our approach reflects these changes and allows our people to develop their careers and maintain work life balance according to their personal circumstances.

We know that we cannot deliver our mission without the capabilities and skills of our supply chain and are aware of the significant constraints in planning and delivery of large-scale infrastructure projects. This will be a challenge for us and our suppliers, but it is also an opportunity for us improve how we maintain our new and aging assets, and how we develop the UK supply chain as a global leader in the nuclear decommissioning market as envisaged by the Industrial Strategy *(ref 13)*. We are in a unique position to support this vision and will endeavour to use our position in the development of the UK supply chain for the benefit of our mission and the UK as a whole.

Our priority is to ensure safety and compliance with environmental standards. We also recognise the part we play in sustainable development and have included this as a new topic strategy.

Through our socio-economic and supply chain strategies we would like to see more opportunities awarded to our local communities, which in turn will support the development of sustainable and resilient communities that enable the delivery of the NDA mission.

While the NDA is the custodian of sensitive materials and information that needs to be protected, we recognise the need to increase our focus on optimising the return from reuse of NDA information and knowledge assets. In order to do this we will develop a vision for the group, bringing together several critical activities in order to set a goal to transform the way the group works. This will define how we get the right information, knowledge and know-how to the right people when they need it, enhancing operational performance and enabling improved and effective decision making, while ensuring materials are protected in a way that reflects the very latest intelligence about the nature of threats.

Like all businesses, we are exposed to potential interruptions to our operations from security threats and cyber attacks. The number of threats and attacks has increased significantly since our previous Strategy *(ref 3)*, and we have responded by increasing the resources deployed to defend the NDA group against them. We have included new topic strategies for Security and Resilience and Cyber Security. We also play our part in broader government cyber security initiatives to ensure we benefit from, and contribute to, the highest possible level of security and resilience.

Our transport infrastructure, systems, processes and skilled workforce have evolved over a significant period of time to meet the requirements of the nuclear industry. As the NDA mission changes, we will organise our transport capability so that it will be able to respond to changing transport requirements and minimise the carbon footprint of all our transport activities.

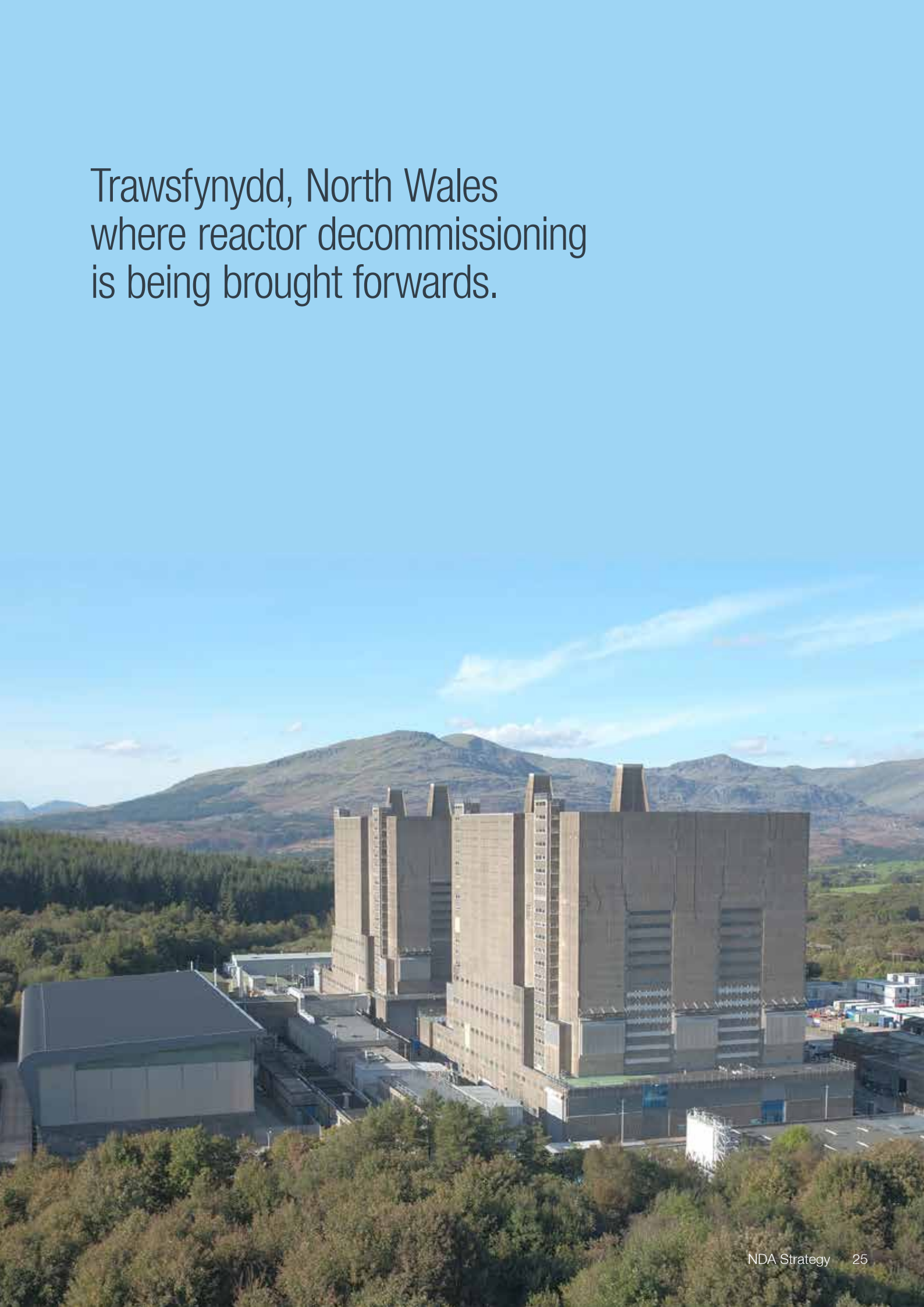
Finally, where the UK government wishes us to do so, we will leverage our competencies and capabilities for the benefit of the taxpayer. We are now working closely with UK government on options relating to the future management of Advanced Gas-Cooled Reactors (AGRs) at the end of electricity generation, and waste and decommissioning activities associated with the Ministry of Defence (MOD) owned liabilities. Where the NDA is best placed to take on the management of new liabilities without adversely impacting the core mission, and the UK government asks us to do so, we will aim to deliver greater value to the taxpayer through a coordinated approach to the management of public sector nuclear liabilities.

With the publication of the UK Industrial Strategy *(ref 13)* and Export Strategy *(ref 14),* there has been a significant and consistent government focus on enhancing the reputation of the UK on the international stage. The NDA has been asked to play a prominent role in demonstrating the breadth and scale of the UK decommissioning programme and the UK supply chain, which delivers much of our mission, in securing overseas business. However, we should be clear that any assistance or support provided by the NDA, or its subsidiaries, do not detract from our mission to deliver safe, sustainable and publicly acceptable solutions to the challenge of nuclear clean-up and waste management, and generate value to the taxpayer.

To deliver our strategic outcomes sooner, safely and securely will require continued funding from government at a time when the global economy is under pressure and our revenues are reducing. We need to continue to show that we are delivering our mission more cost effectively than ever before and our group development activities will support this *(see **Background**)*.

Overall, whilst progress has been gradual, we have transformed our approach and put ourselves in a strong position for the next stage of strategy development and delivery.

Trawsfynydd, North Wales where reactor decommissioning is being brought forwards.



4.0 Site Decommissioning and Remediation

Objective: *To decommission and remediate our designated sites, and release them for other uses.*

STRATEGIC OUTCOMES -
steps to achieving our mission

OPERATIONAL AND PLANNED

40 All planned new buildings operational

41 All buildings primary function completed

DECOMMISSIONING AND DEMOLITION

42 All buildings decommissioned

43 All buildings demolished or reused

SITES

44 All land delicensed or relicensed

45 All land in End State - all planned physical work complete

46 All land demonstrated as suitable for reuse

47 All land dedesignated or reused

Site decommissioning and remediation is our primary focus and all other strategic themes support or enable its delivery.

We can only complete our decommissioning and remediation mission if we secure effective solutions for managing spent fuels, nuclear materials and waste *(see **Spent Fuels, Nuclear Materials** and **Integrated Waste Management**)*. Decommissioning involves decontaminating, dismantling *(SO42)* and demolishing *(SO43)* facilities that have reached the end of their useful lives. Remediation *(SO46)* breaks the pathway between the contamination source and people and the environment.

The decommissioning and remediation of our sites presents a number of major challenges:

- facilities more than 60 years old that were neither designed nor operated with decommissioning in mind
- deteriorating infrastructure
- ground and groundwater contamination resulting from a variety of past uses, including non-nuclear activities.

The NDA's role in decommissioning and remediation is to work with stakeholders to define what should be achieved at our sites. This means that we are responsible for defining both the target and timing (priority and pace) of decommissioning and remediation, allowing the *Site Licence Companies* (SLCs) to determine how best to deliver this outcome in a manner consistent with regulatory requirements.

Our Strategy

Our preferred approach to decommissioning *(SO42&43)* and remediation *(SO46)* is characterised by a number of key principles and concepts. These principles and concepts are fundamental to the 4 topic strategies that make up the Site Decommissioning and Remediation theme, namely Decommissioning, Land Quality Management, Site Interim and End States and Land Use *(see fig 5)*.

At the heart of the Site Decommissioning and Remediation theme are the principles of optimisation and proportionality, which allow us to make best use of resources in delivering our mission. Identifying the preferred approach to decommissioning and remediation requires that the benefits and detriments of different options are balanced in an attempt to deliver the greatest net benefit. The optimisation process takes into account stakeholder views on a range of relevant factors as set out in the *NDA Value Framework (ref 17)*, and is intended to enable transparent identification of sustainable solutions. Above all other factors, we value actions that safely reduce risk to people and the environment both now and in the future. However, our actions must be proportionate to the risk.

In the early stages of decommissioning a nuclear installation, any remaining spent fuel and *Higher Activity Waste (HAW)* are removed and stored securely. Once nuclear hazards no longer exist at the installation, radiological hazards typically fall by over 99%. As decommissioning progresses, the nature of the hazard becomes more conventional, broadly similar to that at non-nuclear industrial sites undergoing remediation for radioactive contamination. Our strategy is to ensure that approaches to decommissioning and remediation reflect the changing nature of hazards that exist throughout the lifetime of a nuclear installation *(see fig 6)* and ensure actions are proportionate to the level of risk associated with these hazards. Much of our recent strategy development work has focussed on making the case for a regulatory framework that is flexible enough to enable proportionate, risk-informed solutions *(see **Case Study: Optimising Site End States**)*.

The principles of proportionality and optimisation are critical for determining the priority, pace and target of decommissioning and remediation for each facility or site. Our approach to prioritisation is influenced strongly by the level of risk to people and the environment *(see fig 7)*.

Where risks are *intolerable* we will take urgent action to reduce them until they are at least tolerable. In such cases, we may make a conscious decision to accept appropriate near-term increases in risk in order to achieve enduring risk reduction.

As far as possible, we want the end of each journey to result in the beneficial reuse of our sites *(SO47).* Rather than waiting for the next use to be identified through market interest, our strategy is to work with stakeholders to identify credible uses for our land that could benefit society either when our mission is complete or on an interim basis prior to achieving the *site end state.* This includes researching opportunities for reusing the land we own on behalf of government to support other government priorities such as national infrastructure projects.

For both the target and timing of decommissioning and remediation, the optimum solution will be case-specific. To support optimisation, the NDA provides strategic direction and guidance on decision making, which SLCs can deploy throughout ongoing reviews and revisions of *Lifetime Plans (LTPs)*. We also maintain an overview of decommissioning and remediation projects to ensure helpful precedents are set, and to encourage a *'lead and learn'* culture across the NDA group.

The principles of optimisation and proportionality are at the heart of the UK government's proposal to amend the legislative framework that applies to nuclear sites *(ref 22)*, which we have supported for a number of years and continue to support. The proposed amendments would enable the Office for Nuclear Regulation (ONR) to relinquish regulation of a site once it is content that all nuclear safety and security concerns have been resolved. This has 2 key benefits, which are explored further in the topic strategies that make up the **Site Decommissioning and Remediation** theme. Firstly, the amendments would allow a more proportionate approach to regulation. Secondly, the proposed amendment would give site operators greater flexibility to optimise end states on a site by site basis, in consultation with local stakeholders.

The environment agencies' expectations for optimisation are described in their Guidance on Requirements for Release from Radioactive Substances Regulation (GRR) *(ref 23)*. This guidance brings together in a transparent way the various radioactive waste management options permissible under environmental legislation, and explains how a site may eventually be released from associated regulatory control.

Cutting up the last delay monitoring tank at the Bradwell ponds

We will work with our SLCs and the regulators to manage this balance safely and ensure we are taking a lifecycle view of risk to people and the environment.

Even when risks are tolerable, risk reduction remains a key driver for decommissioning and remediation. Our SLCs will monitor existing risk levels and act proportionately to ensure that the net level of risk does not increase in the long term.

Where the risk to people and the environment is less significant, as is the case for the majority of facilities within the NDA estate, the driver for further work is mission completion and prioritisation takes greater account of other factors in the *NDA Value Framework (ref 17).* This recognises that whilst risks might be tolerable or *broadly acceptable*, there are other advantages to progressing with hazard and risk reduction that influence prioritisation. For example, all decommissioning and remediation projects have potential to minimise the burden of asset management; maintain and develop skills for future decommissioning and remediation projects; strengthen the supply chain; test emerging technologies; release land for reuse by the SLC or society; and demonstrate progress that instils confidence in the nuclear industry. Furthermore, allocating unlimited resources to reduce an *intolerable risk* may not yield commensurate benefits, for example because tasks must follow a set sequence rather than being completed in parallel. With this in mind, our strategy is to progress decommissioning on as broad a front as resources allow.

The pace of decommissioning and remediation is a function of its priority and achievability, where achievability is influenced by aspects such as availability of resources (skilled people, funding, etc), waste management infrastructure and appropriate technology. *(see **Integrated Waste Management, Research, Development and Innovation**, and **People**).*

Experience has shown that the target for decommissioning and remediation is best communicated by describing the end state and a number of *interim states* for each site. Together they describe the journey from the state of the site today through to the agreed end state.

Our strategy for *site end states (see **Site Interim and End States**)* relies heavily on the principles of optimisation and proportionality; our strategy is to employ risk-informed remediation objectives for our sites that balance the benefits and detriments of site decommissioning and remediation. Applying these principles will ensure that materials, waste and contamination are managed in a way that is safe, but the optimised solution may not necessarily lead to them being removed from the site.

In cases where the *site end state* will not be achieved for many decades, our strategy is to define an end state assumption that enables progress but without committing to an end state that might ultimately prove to be unsuitable or undesirable. We will also make appropriate use of *interim states* to focus delivery on near-term goals. *Interim states* typically mark a stepped reduction in risk or hazard on the way to the *site end state.*

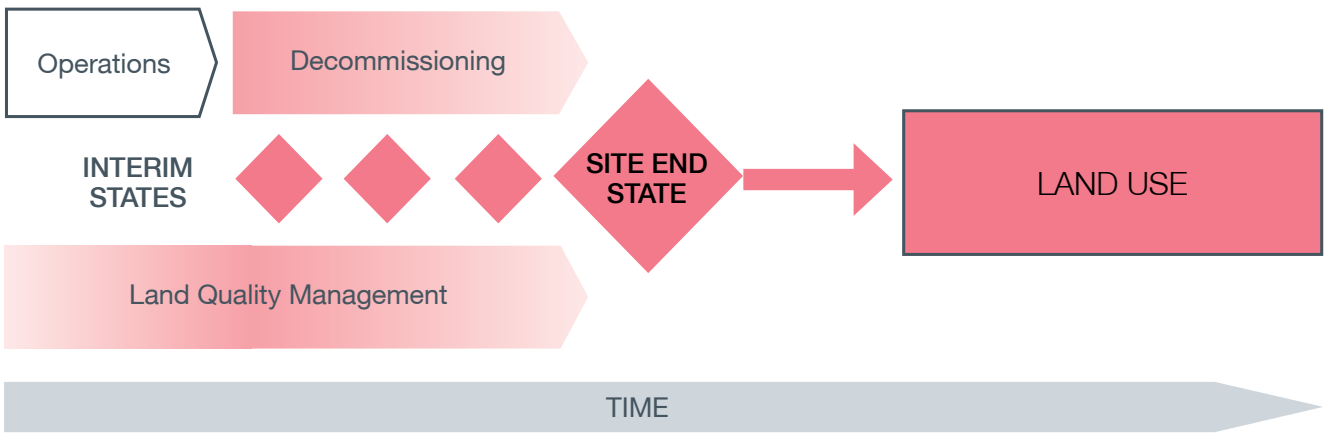


Figure 5 - Site Decommissioning and Remediation timeline

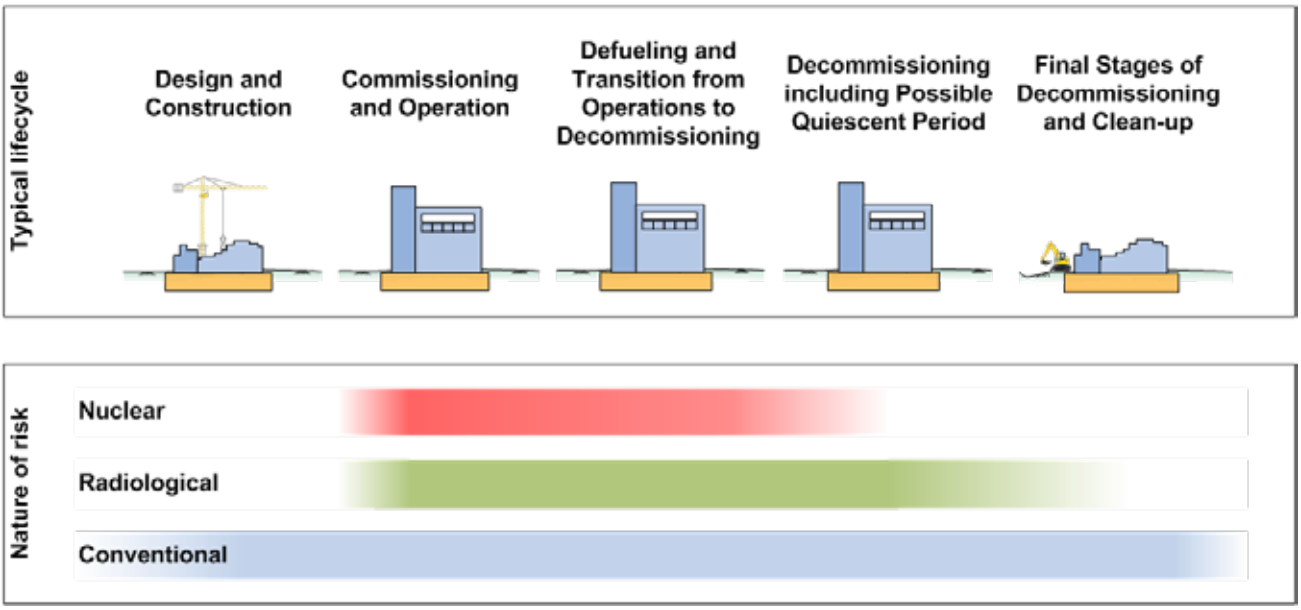


Figure 6 - Changing nature of risk throughout the lifetime of a nuclear installation

Figure 7 - Summary of our approach to prioritisation of risk

Case Study: Ponds and Silos at Sellafield

The Legacy Ponds and Silos (LP&S) at Sellafield represent some of the most complex and difficult decommissioning challenges in the world, and they remain the highest risk in the NDA estate. They date back to the very start of the nuclear industry and were constructed at a time when priorities were very different to those of today. As a result, decommissioning the LP&S at Sellafield is a complex task which remains a top priority for the NDA.

In our previous Strategy *(ref 3)* we said that the retrieval of high hazard materials from the Sellafield LP&S was an area of specific focus, with the objective of urgently reducing the *intolerable risk* that they pose.

Since then, significant progress has been made in retrieving waste from the LP&S, with some major milestones being achieved. In 2018, we started the removal of empty nuclear fuel skips from the First Generation Magnox Storage Pond (FGMSP). Sellafield Limited worked with the supply chain to manufacture suitable storage containers, which was an essential enabler to starting this work, and also drew on lessons from skip operations elsewhere in the NDA group. More than 50 skips have now been cleaned and removed, which has created enough space to enable the removal of sludge, fuel and debris from the pond floor. Sludge retrievals have also started in the highest priority area in the facility, which contains the most significant inventory. Across the Ponds and Silos projects we have now:

- removed significant quantities of bulk fuel and over 300 tonnes of solid *Intermediate Level Waste (ILW)* from the Pile Fuel Storage Pond (PFSP) *(SO2&7)*. One of the pond operating bays has now been fully cleared of sludge, equipment and operational waste *(SO31)*. This bay is now being prepared to be isolated from the rest of the pond so that it can be drained of water. This will provide essential learning for the development of the strategy for the removal of water from the entire pond
- removed more than 100 cubic metres of sludge from the FGMSP *(SO31)*, to the extent that areas of the pond floor are now visible for the first time in over 50 years. Over 100 tonnes of fuel has also been removed from the pond *(SO7)*
- the first of the 400 tonne silo emptying plants has now been installed in the Magnox Swarf Storage Silo (MSSS). It is now in the final phases of commissioning before retrieval operations begin, which represents a momentous step forward in the delivery of the NDA's mission *(SO31)*
- new access has been created for the retrieval of waste from the Pile Fuel Cladding Silo (PFCS) and the equipment has been installed, ready for retrieval *(SO31)* to begin shortly.

Using remotely operated vehicles to help in the cleaning up of legacy ponds and silos

4.1 Decommissioning

***Objective:** To deliver site end states as soon as reasonably practicable with a progressive reduction of risk and hazard.*

When facilities on nuclear sites reach the end of their useful life they cease operations and if they cannot be used for other purposes they are decommissioned *(SO42)*. The NDA estate includes reactors, chemical plants, research facilities, waste management facilities, fuel fabrication and reprocessing plants, all of which present different decommissioning challenges. Decommissioning is a staged process initially involving removal of operational material and waste (sometimes known as *Post Operational Clean Out (POCO)*) followed by more extensive decontamination *(SO42)* and full or partial dismantling *(SO43)* of facilities, with the ultimate objective of reaching an agreed end state.

Most of our facilities were neither built nor operated with decommissioning in mind. Furthermore, there are cases where POCO has been delayed, which further complicates decommissioning. This situation reflects decisions made in a different time with different priorities and societal expectations, and characterises some of our most complex facilities, for example the LP&S at Sellafield, which were used to prepare fuel for reprocessing and store waste respectively. Significant progress has been made in recent years in overcoming some of the challenges presented by these facilities, thereby reducing the risk that they represent *(see* ***Case Study: Ponds and Silos at Sellafield****)*.

Our Strategy

Existing facilities will be operated and maintained with decommissioning and waste minimisation in mind, and new facilities will be designed for decommissioning, thereby learning from mistakes of the past.

Once operations have ceased, our preference is to decommission *(SO42)* our sites as quickly as we can. The benefits of this strategy are many and varied. For example, as well as reducing risks that facilities present to people and the environment, this strategy also allows us to develop skills and approaches that are essential for maintaining decommissioning capability, proving new technologies, strengthening the supply chain and progressing our mission. However, in some cases there are clear benefits to be had from slowing or deferring work; we might choose to slow or defer decommissioning, for example, to take benefit from *radioactive decay*, to adopt a *'lead and learn'* approach, or to realise an opportunity for reusing a facility. In addition, there are a number of constraints that might divert us from our preferred approach and prompt us to slow or defer decommissioning. Notable constraints include access restrictions, a lack of waste management infrastructure, and limited resources including supply chain capacity. In practice, the preferred decommissioning strategy will be case-specific taking account of lifecycle risks to people and the environment and other relevant factors in the *NDA Value Framework (ref 17).*

In all cases, the preferred priority and pace of decommissioning must be a conscious decision. The decision will be informed by stakeholder views and will be subject to review and revision as and when new information comes to light, for example learning from experience or responding to the availability of new technologies. Any decision to slow or defer decommissioning must be underpinned by an appraisal of the consequences of deferral including a robust evaluation of resources required to maintain the facility in a safe condition. In cases of *deferred decommissioning*, it is particularly important to determine an appropriate *interim state* that avoids making decommissioning more complex in the future. The role of *interim states* is described further in the **Site Interim and End States** topic strategy.

In our previous Strategy *(ref 3)*, we committed to reviewing the optimum timing of Magnox reactor decommissioning *(SO42)*.

This study has clearly demonstrated that the optimum timing of decommissioning is case-specific, reflecting the nature and context of the facility or site in question. Consequently we have concluded that a 'blanket strategy' of *deferred decommissioning* across the Magnox fleet is not appropriate; our preference is to adopt site-specific strategies for each Magnox site. This position has been informed by our experience of deferring decommissioning at Bradwell ***(see Case Study: Timing of the Magnox Reactor Decommissioning Strategy)***.

In addition to the NDA's decision on the preferred decommissioning strategy, the pace of decommissioning *(SO42)* is also a consequence of approaches adopted by our businesses to deliver that strategy. Our strategy is to ensure our businesses adopt a risk-informed approach, so that the way they work is proportionate to the risk they are managing. This is actively supported by regulators.

The approach to decommissioning is also influenced strongly by our ***Integrated Waste Management*** theme *(SO26-39)* and the *Waste Hierarchy*. Our businesses will determine the optimum approach to decommissioning informed by a sound understanding of the waste that will be generated and how that waste might be minimised and managed. Our strategy is to adopt waste-informed decommissioning, mapping how waste will be managed before creating it. We will also continue to improve predictions of waste arising from decommissioning to inform the development of waste management infrastructure and thereby enable decommissioning to progress.

Strategy Development

We will play our part in understanding and, where possible, reducing the influence of constraints on decommissioning. For example, it may be appropriate to explore alternative waste management infrastructure where the pace of decommissioning would otherwise be dependent on the development of a *Geological Disposal Facility (GDF) (SO34&39)*.

As part of the development of the NDA prioritisation process and the *NDA Value Framework (ref 17)*, a consistent means of expressing the level of concern presented by a facility was created: the Safety and Environmental Detriment (SED) score (this is separate to the safety cases produced by operators to demonstrate high standards of nuclear safety). It takes account of the inventory within a facility (radioactive and chemical) and the ability of the facility to contain that inventory (asset design and condition). SED has been used to help discriminate between those facilities presenting *intolerable*, tolerable and *broadly acceptable* risks to people and the environment. As our mission progresses and risks reduce, the shortcomings of SED scores as a differentiator between low risks are becoming increasingly apparent and are now rarely used in prioritisation and progress reporting. We are therefore committed to reviewing the use of SED scores and determining if and how they might be improved.

We will also seek to develop indicators for other factors in the *NDA Value Framework (ref 17)* as an input to decision making and progress reporting. We want to lead by example in this area and will continue to push for and contribute to international good practice on measuring the impact of decommissioning on society, which is an important aspect of *sustainability* alongside environmental and economic aspects. We will also continue to contribute to international guidance on estimating the cost of decommissioning and remediation.

We will continue to support the UK government's proposal to amend the legislative framework that applies to nuclear sites *(ref 22)* and enable more streamlined regulation during the final stages of decommissioning and clean-up. The proposed amendment would enable ONR to relinquish regulation of a site once it is content that all nuclear safety and security concerns have been resolved. At this point residual hazards are broadly similar to those at non-nuclear industrial sites such that health and safety on the site can be regulated by the Health and Safety Executive (HSE) and will continue to be regulated by the relevant environment agency and local authority. This arrangement represents a more proportionate approach to regulation and will allow us to remove a site's nuclear label, which can influence the way in which a site is perceived and managed. It would also ensure that a site is regulated by the most appropriate regulators at each stage of the decommissioning process, and allow regulators to concentrate their specialist skills on sites that require their expertise.

We will work with our SLCs to review existing decommissioning strategies as and when new information comes to light.

Delivery

The NDA has revised the strategic specification for Magnox reactor decommissioning to reflect the change to site-specific decommissioning strategies *(SO42)*. In response, Magnox Limited will determine the strategy that best suits each site and develop a *business case* for revising LTPs accordingly ***(see Case Study: Timing of the Magnox Reactor Decommissioning Strategy).*** This will necessarily include revisions to enabling strategies, for example to develop skills, manage waste and strengthen the supply chain *(see **Integrated Waste Management**, **People**, and **Supply Chain**).*

The revised strategy will involve decommissioning being brought forward at some sites, which creates opportunities to develop new technologies and innovative approaches such as neutralisation of asbestos, recovery of mild steel and the retrieval and storage of reactor graphite, all of which could be of commercial interest to the UK supply chain and supports the Nuclear Sector Deal *(ref 15)*.

The *NDA Value Framework (ref 17)* describes in more detail the influence of relevant factors on our decision-making process. SLCs will use this guidance to inform periodic reviews of the decommissioning plans in the light of emerging opportunities and constraints.

To improve the efficiency of strategy delivery, the Decommissioning Working Group, comprising decommissioning experts from the NDA group and beyond actively share experience and learning. These experts also explore common research requirements (acting as a working group of the Nuclear Waste and Decommissioning Research Forum (NWDRF)) *(see **Research, Development and Innovation**)*, examine potential shared solutions, discuss requirements for skills development and, where appropriate, arrange training workshops. As an example, a cross-industry working group has been formed to overcome constraints affecting decommissioning of facilities contaminated with alpha radiation, which is complex and specialised work. The group has identified potential to increase decommissioning efficiency by improving the availability of skills, safety case development and the deployment of new technologies. This will be an important focus area for the foreseeable future.

Decommissioning work at Dungeness A

Case Study: Timing of the Magnox Reactor Decommissioning Strategy

The previous strategy for decommissioning Magnox reactor sites was developed over 30 years ago and involved deferring reactor decommissioning at all sites for approximately 85 years from reactor shutdown *(SO42)*. In 2016, we committed to reviewing this strategy with Magnox Limited to take account of new experience and developments in the decommissioning landscape *(ref 3)*.

Bradwell had previously been named as a lead site when the strategy was blanket deferral, and much of this new experience has come from placing Bradwell into an *interim state* suitable for long-term deferral. As well as developing innovative approaches to decommissioning (e.g. developing techniques to retrieve, condition and package *ILW*), the experience at Bradwell has improved our understanding of the costs and risks associated with preparing sites for deferral. It has also demonstrated that some sites are unsuitable for longer periods of deferral. The work completed by Magnox Limited at Bradwell has helped to demonstrate that interim storage of waste in a dedicated facility is neither as complex nor as expensive as previously thought, albeit dependent on site-specific factors including the views of local stakeholders.

The review of the Magnox reactor decommissioning strategy *(SO42)* is now complete. We have concluded that whilst the *deferred decommissioning* strategy continues to have benefits in some cases, it is not appropriate as a blanket strategy for all reactors in the Magnox fleet because of their different design, location, age and physical condition. Consequently, the NDA has endorsed a site-specific approach to Magnox reactor decommissioning which will involve a mix of decommissioning strategies. For some sites this will result in their decommissioning being brought forward whilst for others a deferral strategy with varying deferral periods will be the chosen approach. Magnox Limited will now prepare a *business case* (or cases), informed by local and national stakeholder views, for implementing this strategic change.

Bradwell in an interim state suitable for long-term deferral

We have worked with both local and national stakeholders to identify factors from the *NDA Value Framework (ref 17)* that will discriminate between strategies for each site. This engagement has included discussion at the NDA Stakeholder Summit and various Site Stakeholder Group meetings, as well as strategy development groups involving government, regulators and local authorities. In November 2018, a large joint stakeholder event expressed the Value Framework factors as discriminatory questions *(see table 2)*.

Magnox Limited has begun the process of selecting the optimum decommissioning strategy *(SO42&43)* for each of the Magnox reactors and, based on a review using the factors listed below and in the *NDA Value Framework (ref 17)*, Trawsfynydd has been chosen as a lead site for Magnox reactor decommissioning. This is primarily because the external structure has degraded extensively since it was shut down in 1991 such that substantial amounts of work would be required to make it safe for a long period of deferral; work that would then need to be undone to complete reactor dismantling. Furthermore, the site is located in Snowdonia National Park and in an area with a relatively weak local economy that is strongly dependent on work at the site.

The intention is that together the site-specific strategies will result in a rolling programme of activity as the Magnox fleet is decommissioned. This will maximise the opportunity for sharing any lessons learned, developing and implementing new technologies and strengthening wider capability. As a whole, the programme will collectively be geared towards reducing risk, reducing lifetime costs and growing skills and knowledge to deliver benefits both nationally and to local communities.

While we expect the new site-specific decommissioning strategies to be defined over the next 12 to 18 months, they will be continually reviewed and optimised using the learning obtained from the sites being decommissioned *(SO42&43)*. It is expected that the strategy for decommissioning Calder Hall (a former Magnox reactor on the Sellafield site) will also incorporate learning from the lead Magnox site, Trawsfynydd. The development of site-specific strategies at the Magnox reactor sites does not affect programmes at Harwell and Winfrith. Continued focus on safety and risk reduction will remain the overriding priorities across all the sites.

NDA Value Framework Factor	Discriminatory Question
Health and safety Risk and hazard reduction	For each credible decommissioning strategy, what work (level of effort) is required to manage risks to people (workers and public)?
Environment	For each credible decommissioning strategy, what work (level of effort) is required to protect the environment? For each credible decommissioning strategy, what is the volume and nature of waste arising?
Socio-economic impact	To what extent does the community and local supply chain depend upon work at the site? What opportunities (value and likelihood) exist for alternative use of land at the site? How great is the visual impact of reactors?
Enabling the mission	What is the potential for reactor decommissioning to generate learning of relevance to other reactors? To what extent will reactor decommissioning allow the trial of new technologies or other strategic opportunities?
Lifetime cost	What work is required to prepare the reactors for deferral, and how much of this could be avoided by progressing with reactor dismantling? What opportunities exist for aligning decommissioning on neighbouring sites and what are the associated benefits?
Achievability (resources and logistics)	What capacity exists for interim storage of waste? Will interim storage of waste be problematic? How easy would it be to maintain or acquire a suitably qualified workforce after a period of deferral?

Table 2 - NDA Value Framework factors and their discriminatory questions

4.2 Land Quality Management

Objective: *To ensure that land quality is managed in a timely manner to protect people and the environment.*

Land quality management involves managing risks to people and the environment (including natural resources) from radioactive and non-radioactive contamination in ground and groundwater. In line with regulatory expectations and industry good practice guidance, the key activities for land quality management are to:

- prevent leaks, spills and the spread of contamination
- develop, maintain and continuously improve a land quality management strategy and plan in consultation with stakeholders, taking into consideration both radioactive and non-radioactive contamination
- identify and characterise contamination as soon as practicable
- evaluate management and remedial options and prioritise activities to deliver sustainable remediation targets
- keep good records and manage knowledge appropriately.

Each of our sites has land contamination. It is essential that we understand the nature and extent of the contamination through effective characterisation to inform the preferred site interim or end state and ensure that the approach to achieving those states is proportionate to risk, now and in the future *(SO46).*

The UK has a comprehensive regulatory framework to prevent and manage contamination in ground and groundwater. Aligned with this framework, protection of people and the environment (including natural resources) is our primary and enduring consideration in deciding how to manage land contamination. The extent to which people and the environment are at risk depends on the properties of the contaminant, how much contamination is present, and how people and the environment could come into contact with the contamination.

Remediation breaks the pathway between the contamination source and people and the environment. Some remediation actions such as large-scale excavation can have significant negative effects on ecosystems as well as posing other environmental and safety risks. Ensuring an appropriate balance between the benefits and detriments of remediation *(SO46)* is core to this strategy as well as the site interim and end states strategy.

The remediation of land has the potential to generate large volumes of material. The demolition of redundant buildings will also generate large volumes of concrete and brick rubble. The majority of the waste arising is either not contaminated or lightly contaminated. This waste represents a significant liability to the NDA but could also be a valuable resource in site restoration. It is a major challenge to decide how best to manage this waste, and denotes an important interface with our ***Integrated Waste Management*** theme *(SO26-39)*.

Our Strategy

Our strategy for land quality management *(SO46)* is to employ early, risk-informed decision making to ensure our actions are proportionate to the level of risk. Aligned with our decommissioning strategy *(SO42&43)*, our preference is to remediate our sites to deliver sustainable end states as soon as reasonably practicable. This means taking account of lifecycle risks to people and the environment and other relevant factors such as potential for reuse of sites and their natural resources for the benefit of society, locally or nationally. The impact and relevance of such factors will be case-specific. In some cases, prompt action will be required to prevent contamination spreading and reduce the volumes of land requiring remediation. In other cases it may be necessary or preferable to defer remediation, for example where low levels of contamination exist beneath buildings that are still to be demolished. Any decision on the timing of remediation should be a conscious decision.

We recognise that decommissioning and land remediation activities cannot be considered in

isolation as they are linked. If decommissioning activities are not carefully implemented they could lead to contamination.

In line with the *Waste Hierarchy*, our strategy is to explore options for minimising the amount of material being excavated and disposed of as waste where it aligns with a sustainable end state. This could include using *in situ* remediation techniques (e.g. *Monitored Natural Attenuation*) to remediate the land. When waste is generated from remediation (or demolition), our strategy is to explore opportunities for its beneficial reuse on or off site. For example, the waste could be a valuable resource for restoration work (e.g. landscaping, void filling or flood defences). This approach has the additional advantage of minimising the use of new materials and reduces environmental impacts associated with the work (e.g. reducing emissions associated with transport movements and protecting natural resources). Reuse of waste must represent a net benefit and allow the *site end state* to be achieved. Legislation requires that beneficial reuse of radioactive waste is classed as waste disposal (termed 'disposal for a purpose' in the GRR) and therefore may require planning permission and will be subject to regulatory control *(see **Integrated Waste Management**)*.

We are committed to reporting land quality at each of our sites and showing how risks posed by land contamination are being managed. Such records must be maintained for as long as an environmental permit remains in force, and should be archived for use by others, for example in the NDA's Archive *(see **NDA Archives Limited**)*. This is particularly important where residual contamination is being remediated *in situ* for a period, or waste has been disposed of on site. Our records will be available to future users and owners of the site and must meet the needs of regulators and the land development industry.

Strategy Development

We continue to work with local authorities, nuclear regulators and our SLCs to facilitate the beneficial reuse of wastes generated from demolition activities and land remediation. For example, we are undertaking research to determine the potential impact of reusing decommissioning rubble *(see **Research, Development and Innovation**)*. We are also working with regulators to understand, test and, where appropriate, develop proportionate regulatory approaches that enable handling and stockpiling of materials and waste suitable for reuse where it represents the most sustainable solution.

We will work with our SLCs to improve estimates of waste and material arising from land quality management and balance these against the estimate of material required for restoration work. If it is evident that waste or material from one site could be a valuable resource on another site for environmental, social and / or economic reasons, we will explore the associated practical and legal implications of this and the social acceptance of associated decisions.

Delivery

The current understanding of each site's land quality and environmental setting will be reported by SLCs in land quality records. SLCs will continue to deliver the strategy through plans and procedures that minimise contamination and evaluate options for existing contamination. SLCs will continue to appraise options for sustainable remediation to deliver interim and end states on a case-specific basis, ensuring action is timely and proportionate to risk.

To ensure consistency in strategy delivery *(SO46)* we convene regular meetings of land quality management experts from the nuclear industry at the Nuclear Industry Group for Land Quality (NIGLQ) to share lessons learned and maintain awareness of emerging good practice. The group examines potential shared solutions, discusses requirements for skills development and, where appropriate, arranges training workshops. The group also provides an opportunity for regulators to engage with the wider nuclear industry and thereby allow industry experience to inform development of emerging regulatory guidance.

NIGLQ explores common research and development requirements (supporting the NWDRF). Current areas of research include: innovative measurement methods for radionuclides; understanding the long-term performance of remediation solutions and disposals; and, developing methods to quantify *sustainability* in land and groundwater remediation *(see **Research, Development and Innovation**)*.

4.3 Site Interim and End States

Objective: *To define credible objectives for the decommissioning and remediation of each site (or part of a site).*

The NDA owns significant quantities of land, of which around one quarter is designated, i.e. land that has been assigned to us by the UK government for decommissioning and remediation *(SO47)*. As part of our responsibilities to government we are required to propose the end state for designated land at each of our sites. The *site end state* describes the condition to which the site (land, structures and infrastructure) will be taken at the end of the decommissioning process.

For many of our sites, the *site end state* is not scheduled to be achieved for many decades. For these sites it is difficult to define the *site end state* in detail without ruling out credible options prematurely. To support the development of plans and maintain clarity of the decommissioning journey, *interim states* are used to describe natural milestones and decision points on the way to the *site end state*.

Site interim and end states together define objectives for ongoing management of structures, infrastructure and land quality as well as having implications for the management of spent fuels, nuclear materials and waste arising from operations, decommissioning and remediation.

In our previous Strategy *(ref 3)*, we committed to working with the regulators (safety regulators, environment agencies and planning authorities) to explore options for more proportionate regulatory control of sites as they progress towards their end state. This has led to a proposal from UK government to amend the legislative framework that applies to nuclear sites *(ref 22)* and enable more streamlined regulation during the final stages of decommissioning and clean-up. The proposed amendment would enable site operators to optimise end states on a site by site basis, in consultation with local stakeholders and under regulation by the relevant environment agency *(see **Case Study: Optimising Site End States**)*.

Our Strategy

Our strategy is to employ risk-informed remediation objectives for our sites that balance the benefits and detriments of site decommissioning *(SO42&43)* and remediation *(SO46)*. The optimum end state (the end state that delivers the greatest net benefit) will be site-specific. This recognises that, in some cases, removing all traces of a site's industrial use does more harm than good. It is our strategic preference to work with government, regulators and local communities to ensure that remediation of our sites is safe, sustainable and publicly acceptable, and enables their beneficial reuse as early as possible using controls to protect people and the environment from residual hazards where necessary. Consequently, experience has shown that as well as describing the physical state of the site, the end state description should include an indication of the future use(s) that the site will be able to accommodate over time and any controls that might be required until the site is suitable for unrestricted use *(SO47).*

Identifying the optimum end state involves working with stakeholders to compare the performance of different options against factors in the *NDA Value Framework (ref 17)*. The evaluation of options must be holistic, considering impacts on and off the site both now and in the future. For example, it is necessary to look beyond the site in question and consider also the impact on people and the environment at the disposal facility receiving waste from the site.

In cases where the *site end state* will not be achieved for many decades, it is unlikely that a site operator will have all the information required to evaluate options, for example option evaluation would require predictions of future regulatory requirements and would presuppose what society may desire for a site at the time it will be remediated.

Fixing a *site end state* now would risk pursuing an unsuitable or undesirable end state, and could rule out options currently not envisaged.

However, without a vision of the final destination, it is difficult to set objectives for the ongoing decommissioning and remediation journey, and there is a risk of inadvertently foreclosing options for an end state. Consequently, our preference is to define an assumption for the end state at each site and retain alternative options as a contingency. As decommissioning and remediation progress and new information comes to light the end state assumption will be reviewed and contingency options removed. This iterative cycle will continue until such time as we have the information required to finalise the *site end state (see fig 8).*

A clear articulation of the next *interim state* is as important as a vision for the final destination. This mirrors the internationally recognised approach of decommissioning in stages. An *interim state* is typically a stable state that marks a stepped reduction in risk or hazard, and may be associated with a reduction in regulatory controls. An *interim state* can be followed by continued or *deferred decommissioning*, i.e. a decision may be taken to work towards the next *interim state* or to pause. However, particular care must be taken in defining *interim states* appropriate for *deferred decommissioning* to avoid making decommissioning more complex when it restarts in the future *(see Decommissioning)*.

Given that an *interim state* is typically a stable state, it is important that the route to the next *interim state* is clear before starting to work towards it. Furthermore, in all but exceptional circumstances, facilities should not move away from a stable *interim state* until it is clear how waste arising will be managed.

Interim states are a good communication tool to align expectations, increase motivation and secure commitment to decommissioning plans for internal and external stakeholders. They allow SLCs to plan more effectively and can also be used as contract milestones.

We do not anticipate the preservation of our facilities for the benefit of national industrial heritage. However, the preservation of facilities for this purpose will be subject to case-specific assessment in line with planning policy. Whilst we do not intend to preserve physical evidence of the nuclear industry, one of the objectives of the NDA's Archive is to preserve its history.

Strategy Development

We will continue to work with the UK government in support of its policy to amend the legislative framework that applies to nuclear sites *(ref 22)* and enable a more sustainable approach to waste management and land remediation. We will develop guidance on choreographing engagement with regulators and local communities from the point at which ONR relinquishes regulation of a site through to identifying and delivering the preferred *site end state*. This will build on guidance being developed for planning authorities on determining planning applications for *in situ* disposal of waste and reusing waste for a purpose *(SO46)*. We will develop a narrative on the role of waste management in sustainable remediation including a description of ways in which the optimisation of end states delivers against government policy on *sustainability* and *net zero greenhouse gas emissions*, especially in cases where the optimised solution involves reusing waste for the benefit of people and the environment *(see **Sustainability**)*.

We will work with key stakeholders to agree the information that should be recorded by our SLCs about interim and end states to ensure that assets are used appropriately and safely now and in the future. Records will play an important role in ensuring the control of risks to people and the environment from residual hazards. We will continue working with the International Atomic Energy Agency (IAEA) and draw on good practice from other sectors to develop our understanding of physical and administrative controls required to protect people and the environment from residual contamination and how these are maintained after the end state has been achieved.

We will work with local authorities to ensure that *site end states* and statements on the next planned use of sites are consistent with local waste and development plans.

Delivery

The NDA has prepared guidance for SLCs on the iterative approach to optimising end states and the role of *interim states.* The guidance reflects learning from experience of developing interim and end states for facilities and sites across the NDA estate.

Site end states are currently being reviewed for all of our sites. With the exception of Winfrith, end states will not be achieved for many decades and so the focus is on developing credible options for the *site end state* from which an end state assumption can be selected ***(see Case Study: Optimising Site End States)***. This will enable progress and inform development of *interim states* as nearer-term objectives.

Site interim and end states have the potential to affect the local community and local authority development plans, for example in terms of employment and skills retention *(see **People**)*. This emphasises the need for ongoing stakeholder engagement *(see **Public and Stakeholder Engagement**)*.

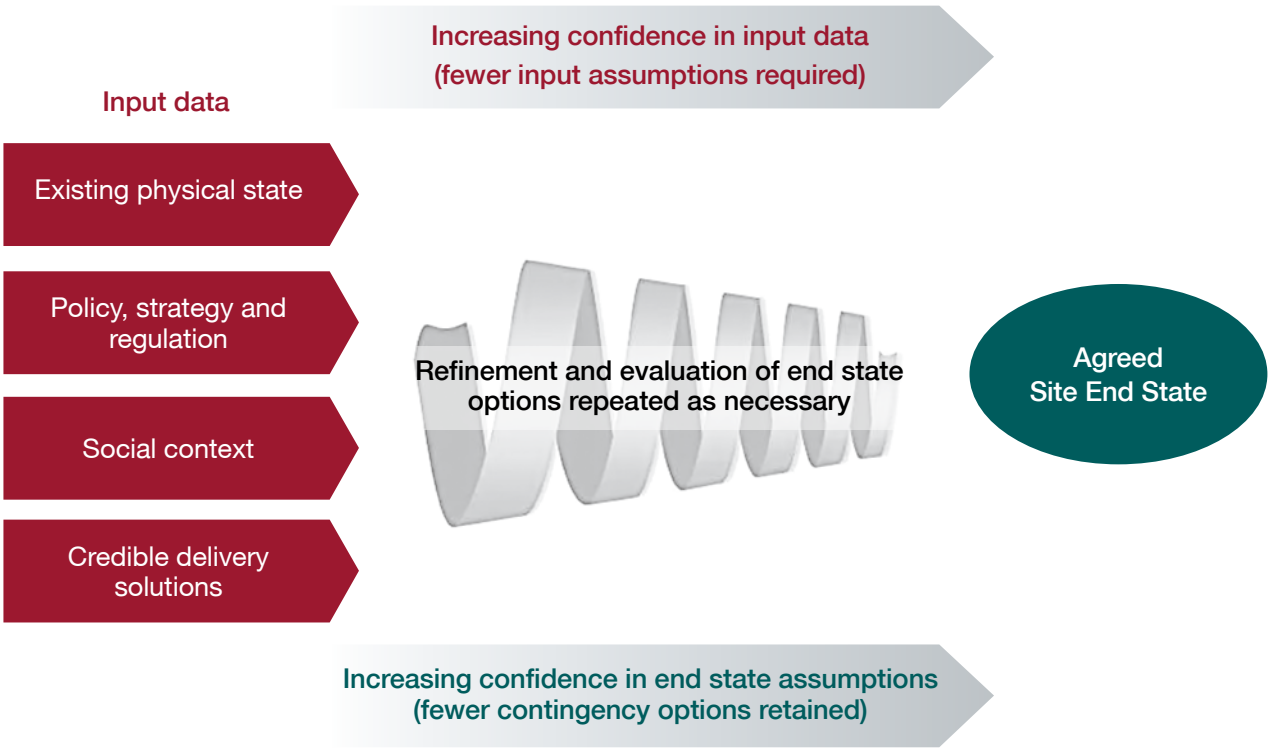


Figure 8 - Iterative and adaptive approach to defining a site end state

Case Study: Optimising Site End States

A key benefit of the UK government's proposal to amend the legislative framework for nuclear sites *(ref 22)* is that operators will have greater flexibility to optimise *site end states (SO46)*. The new framework will allow operators to balance the overall safety and environmental risks associated with remediation and consider a broader range of options in pursuit of the optimised solution. Pressure on parliamentary time has delayed the necessary amendments to primary legislation. The NDA has continued to work with regulators (safety regulators, environment agencies and local authorities) and the UK government to identify secondary legislation and guidance that will be required to realise the full extent of benefits that the change is expected to deliver. This has included supporting the environment agencies with development of their GRR *(ref 23)*. In particular, the GRR, issued in 2018, incorporates learning from trial applications of previous drafts at 3 NDA sites: Winfrith in Dorset; Trawsfynydd in north Wales; and Dounreay in Caithness, Scotland.

Magnox Limited and Dounreay Site Restoration Limited (DSRL) are optimising the *site end state* for the 3 *'lead and learn'* sites because decisions about remediation are imminent. With the exception of Winfrith, it is not expected that the *site end state* will be achieved for many years. Therefore the focus is on defining an end state assumption in enough detail to inform the next *interim state*.

The existing end state assumptions were established in 2006 following the formation of the NDA. The recent reviews of end states at the 3 *'lead and learn'* sites have all highlighted the importance of considering structures below ground (e.g. foundations and basements). All 3 sites have extensive subsurface structures. Excavating these structures would reduce contamination on site and allow immediate unrestricted use of the land, but transporting the waste to be disposed of below ground elsewhere would result in a number of impacts on people and the environment. The reviews note risks to workers, the public and the environment associated with excavating substructures, transporting waste and importing fresh material to fill voids.

In September 2017, following a period of public consultation, Magnox Limited revised the *site end state* assumption for the Winfrith site to include leaving structures below ground at the 2 closed reactors (Steam Generating Heavy Water Reactor (SGHWR) and DRAGON), along with some ground contamination. The revision was informed by modelling that predicts land will be suitable for its next planned use (publicly accessible heathland) without removing the subsurface contamination. Likewise, in March 2019, Magnox Limited revised the *site end state* assumption for Trawsfynydd to include leaving in place some of the lightly contaminated subsurface structures (e.g. subsurface portion of reactor bioshields and pond structures) and using concrete from demolition of above ground structures as infill for unwanted sub-surface voids. Assessments predict that as a consequence of *radioactive decay* and the natural degradation of contaminants, the associated land would be suitable for unrestricted use shortly after the existing ILW store has been demolished. Both of these end state assumptions remain subject to further optimisation, evaluation by regulators and wider stakeholder engagement. Learning from this exercise will feed into work by Magnox Limited to develop *site end state* assumptions for their remaining sites.

The Dounreay site is more complex. Consequently, DSRL has chosen to look at individual components of the site that together contribute to the *site end state*. These components include installations, current and future disposals, areas of land contamination, sub-surface structures and other discrete site conditions. Work will initially focus on the key components whose individual end states will have the greatest impact on the overall *site end state*.

DSRL has reached the stage of updating the credible options for the *site end state* assumption at Dounreay. These options are informing technical studies which, with the input of key stakeholders, will be used to identify an underpinned and optimised *site end state* assumption over the next 2 years. This assumption will be subject to an ongoing programme of optimisation.

Building on the work undertaken at the *'lead and learn'* sites, Sellafield Limited and Low Level Waste Repository Limited (LLWR Limited) have begun to review and optimise the *site end state* assumptions for their sites. For the LLWR site, the end state assumption for the disposal area is largely defined by the *Environmental Safety Case*. Work has now commenced on considering the options for the remainder of the site to form a balanced, coherent solution for the whole site. *Site end state* options are currently being developed and evaluated taking into account future disposal site operational requirements. These options will be discussed with stakeholders prior to adoption.

Sellafield Limited has initiated a programme of work to review the current *site end state* assumption, which makes reference to an inner and outer zone. Work is underway to identify credible options for the end state and then initiate assessment of these options. Sellafield Limited will work with stakeholders to ensure that the work is informed by the views of the community around the site. The first proposed steps are to improve on the end state assumption by:

1. No longer considering the site in terms of inner and outer spatial zones, but instead by identifying optimised and sustainable options for components at a smaller scale than the site as a whole

2. Building up the picture of the *site end state* over time, one component at a time and balancing these in the context of the entire site to ensure that the most sustainable *site end state* assumption is realised

3. Undertaking an in depth analysis of the component of lightly radioactively contaminated soils and subsurface structures to find the right initial end state assumption based on the benefits and drawbacks of each option. It is important to determine an end state assumption for this component because it affects remediation decisions being made now.

An artist's impression of Dounreay's site end state

4.4 Land Use

Objective: *To optimise the reuse of NDA sites.*

Our land use strategy explores how our land can be used either when our mission is complete *(SO47)* or on an interim basis prior to achieving the *site end state* (an interim use). Examples of land use vary from industrial and commercial use through to recreational use and nature conservation. Understanding the value and credibility of different land uses plays an important part in defining sustainable site interim and end states. For example, it is important to understand whether the detriment of achieving a specific end state can be justified by the benefit a land use provides.

Although it is helpful to assume a next land use when defining the *site end state*, we only have responsibility for the latter. The next land use will be defined by the next owner *(SO47)* in accordance with the planning regimes and taking account of stakeholder views as appropriate. However, to enable decommissioning and remediation to progress and offer greatest value for money, it is necessary to understand which land use(s) would be credible for our sites. We can therefore make decisions about which structures and infrastructure should be removed and what is the most appropriate way to manage residual contamination or waste disposed of on site.

Many things can affect how a site could be used, including the location of the site and its distance from towns and transport links. Other factors to consider include the physical characteristics of the site, commercial interest, environmental designations and local planning policy. Evaluating these factors is important when identifying credible next uses, especially for sites where the next owner, and consequently the next use, is unknown.

The 'value' a user can get from land can be measured in many ways. Typically, it is measured by the value of a divestment or the generation of income from a new use. However, there is recognition of the wider socio-economic and environmental benefits that land can provide, for example land could be used for carbon offsetting or green energy. Understanding the value of land can also lead to identifying opportunities for interim use(s) that could provide income for our mission as well as socio-economic benefit for the local community.

Examples of where reuse has already happened include the reuse of the former Berkeley Technology Centre by South Gloucestershire Council; the reuse of Stroud College as a renewable energy, engineering and nuclear centre; release of land at Harwell for use by the Harwell Science and Innovation Campus; and the release of land at Winfrith to support the growth of local business and provide security to the decommissioning supply chain.

Our Strategy

Land is a national asset which supports society's ability to grow and prosper *(SO47)*. It is a finite resource and we must use it wisely. Our strategy is to identify credible uses for our land that could benefit society either when our mission is complete or on an interim basis prior to achieving the *site end state*.

We commit to encouraging the reuse of *brownfield land* over the development of *greenfield land*. This is in line with government policy and the principles of sustainable development.

Rather than waiting for the next use to be identified through market interest, we will be proactive about researching and raising awareness of reuse opportunities for all our sites, including opportunities for reusing our land to support other government priorities such as national infrastructure projects. This ensures we can promote the reuse of our land and property in a timely manner and focus our decommissioning and remediation activities to support its reuse.

Securing a valuable future use for our sites will help us to maintain the pace of decommissioning and remediation when the level of risk to people and the environment is no longer a strong driver for progress. Where the benefits of reuse are significant, we may be able to justify quicker decommissioning and remediation, and ultimately release land earlier than originally scheduled.

Understanding how a site can be used is one of the factors that will inform the physical state of the site and the extent to which controls can be used. These controls need not stop the land from being reused but control the risk presented by any residual contamination that may remain. This approach is widely used in the reuse of former industrial land in other sectors.

Strategy Development

We will continue to explore factors that influence land use and the value that land can deliver. This includes articulating the social and environmental benefits of land in addition to commercial metrics.

We will work with UK government and the devolved administrations who are the ultimate owners of our land to understand how it could be used to support other priority projects, particularly for sites where the land may not currently have a high commercial value. We will engage with local government to better understand what they need from land in their area.

Working with key stakeholders and international counterparts (e.g. IAEA), we will develop our understanding of the appropriate controls that should be in place to ensure our sites can be reused where residual contamination is being managed. We will also ensure a full appreciation of ways in which any residual liabilities will be managed if and when the NDA no longer owns the land.

We will ensure our guidance to SLCs on defining *site end states* contains the most up to date information on managing the link between the use and state of land. This guidance and the growing experience of the NDA group will inform the optimisation of site interim and end states by our SLCs.

Delivery

The NDA and SLCs will gather information to increase our understanding of credible next use options and hence credible site interim and end states. We will identify the socio-economic and environmental benefits as well as the commercial value of our land. This will be consistent with national and international good practice for determining the value of a given land use.

To ensure consistency in strategy delivery we have established a Strategic Land Management Working Group (SLMWG) comprising members from across the NDA group and wider government where appropriate. As well as ensuring that our SLCs have the land and property they need to complete their mission, the SLMWG proactively considers opportunities for land reuse. Where our land is surplus to requirement (on an interim or permanent basis) the SLMWG will determine how to divest or lease it, thereby linking our strategy with operational and commercial functions. This board will continue to promote opportunities for the reuse of our land to stimulate progress in decommissioning and the release of land.

In addition to designated land the NDA has, for historical reasons, a number of smaller parcels of land of limited strategic value, either in terms of enabling decommissioning or providing value to others. The NDA will pursue a programme of commercial disposals or other ways of putting this land back into societal use.

5.0 Spent Fuels

Objective: *To ensure safe, secure and cost-effective lifecycle management of our spent fuels.*

STRATEGIC OUTCOMES -
steps to achieving our mission

SPENT MAGNOX FUEL

1. All sites defueled
2. All legacy fuel retrieved
3. All Magnox fuel reprocessing completed
4. All remaining Magnox fuel in interim storage
5. All remaining Magnox fuel disposed

SPENT OXIDE FUEL

6. All EDFE oxide fuel received
7. All legacy fuel retrieved
8. All oxide fuel reprocessing completed
9. All remaining oxide fuel in interim storage
10. All remaining oxide fuel disposed

SPENT EXOTIC FUEL

11. All exotic fuel defueled
12. All exotic fuel consolidated*
13. All exotic fuel reprocessing completed
14. All remaining exotic fuel in interim storage
15. All remaining exotic fuel disposed

*irradiated fuel only

The NDA inventory of spent fuels consists of large quantities of oxide fuels, along with smaller quantities of Magnox fuel and non-standard and diverse fuel types which we refer to as ‘exotic fuels’.

The oxide and Magnox spent fuels have arisen from commercial power production reactors. The spent oxide fuel that the NDA manages is predominantly Advanced Gas-Cooled Reactor (AGR) spent fuel which comes to Sellafield from EDF Energy (EDF). The exotic fuels tend to have come from prototype, experimental or research reactors as part of the development of the nuclear power industry in the UK during the latter half of the 20th century.

Managing our spent fuels effectively is essential to enable us to decommission and remediate our sites and release them for other uses.

In making strategic decisions we consider the lifecycle of spent fuels, their products, wastes and discharges and all of the existing or potential facilities that are required to manage them. We engage with government, regulators and stakeholders on the strategic options before finalising our strategic decisions and implementing them.

One approach to the management of spent fuels is to reprocess, separating the spent fuel into its component parts of uranium and plutonium, various waste streams and authorised discharges. An alternative approach is to interim store the spent fuels, potentially for several decades, until they can be classified as waste, conditioned and disposed of in a *Geological Disposal Facility (GDF).*

The interim storage of spent fuels over long periods of time, in line with international good practice, does not preclude reprocessing them at some point in the future if it becomes economic to do so.

Fuel Handling Plant - Sellafield

Our Strategy

In this section we explain the principles and approach we use to manage our spent fuels.

Our strategy for managing our spent fuels that remain at the end of reprocessing focusses on 3 distinct phases: consolidation, safe and secure interim storage and *disposition*.

The strategy for each of our fuel types is explained in more detail in the subsequent topic strategies.

Consolidation

Our strategy is to consolidate all our spent fuels at Sellafield. We will also apply this strategy to fuels we manage on behalf of other organisations such as the Ministry of Defence (MOD).

Removing spent fuel from reactor sites and consolidating it at Sellafield significantly reduces the radioactivity and hazard at those sites and enables their decommissioning and remediation. Managing all of our spent fuels at Sellafield allows us to make best use of the extensive and unique facilities, capabilities and expertise at this site.

Safe and secure interim storage

Our strategy is that spent fuels received at Sellafield are placed into safe and secure interim storage in line with regulatory requirements.

Reprocessing at the Thermal Oxide Reprocessing Plant (THORP) finished in 2018 *(SO8).* Magnox reprocessing, which was delayed due to the COVID-19 pandemic, is expected to be largely complete by the end of 2021. Any remaining spent fuels will need to be safely and securely interim stored for several decades. These timescales are longer than the storage time of spent fuels which have been stored in the UK prior to reprocessing, and this introduces uncertainties which will need to be managed.

Spent fuels are typically interim stored under water in ponds or in dry conditions in specially designed storage casks or vaults. These 2 approaches are commonly referred to as wet and dry storage respectively.

Our spent fuels have a diverse range of characteristics in terms of the physical form of the fuel and the material in which it is clad and arranged into a fuel assembly. A consequence of this is that, based on our knowledge and experience of managing these fuels over long periods of time, some fuels are more suited to wet storage while others are more suited to dry storage.

Based on the long experience of managing AGR spent fuels at Sellafield, interim storage under water is currently the best available technology for interim storage of these fuel types. We also have other oxide fuels which can be stored under the same arrangements as AGR fuels.

For some of our fuels, wet storage is a suitable approach only for a limited amount of time. For these fuels, there are different types of dry storage technology available. In this context, dry storage options cover a range of potential technologies: from approaches which vacuum dry fuels and seal them in a canister or tube under an inert gas, to approaches which store fuels under air in a vault or specially designed container.

Over many decades, Sellafield Limited has gained considerable operational experience and technical knowledge in the storage of spent fuels. We will continue to undertake research into both wet and dry storage technologies to underpin the interim storage of our spent fuels *(see **Research, Development and Innovation**)*.

To ensure access to international good practice and technology development relevant to our spent fuels programmes we will continue to build and maintain meaningful and targeted collaboration with international organisations with technical expertise in spent fuel management *(see **International Relations**)*.

Disposition

In our previous Strategy *(ref 3)* we made a commitment to reprocess the contracted amount of spent oxide fuel at THORP. This milestone was reached in 2018 and reprocessing operations at THORP have finished. The remaining oxide fuel inventory, including future arisings of AGR spent fuel, is being interim stored at Sellafield safely and securely.

Operations at the Magnox reprocessing plant were suspended for several months due to the COVID-19 pandemic, which has delayed the completion of reprocessing.

Reprocessing of spent Magnox fuel restarted in October 2020 under COVID-19 secure working arrangements and, if performance is sustained, is expected to be largely complete by the end of 2021. Around this time the plant is expected to start the transition to *Post Operational Clean Out* (POCO), which is the first phase of decommissioning.

Our strategy for the spent fuels which have not been reprocessed is to place them in an interim store pending a future decision on whether to classify them as waste for disposal in a GDF.

For planning purposes, we assume that the remaining spent fuels will be disposed of in a GDF. We are working with Radioactive Waste Management Limited (RWM) on options for disposal of our spent fuel inventories.

We will invest in the facilities and infrastructure required to safely and securely provide interim storage for our spent fuels *(see **Asset Management**)* until a decision is made to classify spent fuels as waste, a GDF becomes available, and spent fuels can be transported there for disposal *(see **Transport and Logistics**)*.

To successfully manage and dispose of our spent fuels in a GDF, we must ensure that we continue to maintain records and a knowledge base about our fuels *(see **Information Governance** and **Case Study: Higher Active Waste Package Records**)*. In some cases, this includes obtaining additional information required for interim storage and disposal as well as knowledge transfer between operators within the NDA group and also from EDF.

In line with UK government expectations, the NDA group will continue to supply advice and information to third parties involved in the UK's nuclear new build programme and developers of advanced nuclear technologies.

THORP

5.1 Spent Oxide Fuel

Objective: *To ensure safe, secure and cost-effective lifecycle management of spent oxide fuels.*

AGR spent fuels are the largest part of our oxide fuel inventory. These fuels come from the 7 EDF-owned AGR nuclear power stations in England and Scotland. We are contractually committed to receive and manage all of the AGR spent fuel arising from EDF's powers stations *(see **Non-NDA Liabilities**)*. The management of AGR spent fuel is a major source of commercial income for the NDA.

In 2012, we confirmed our strategy to reprocess the contracted amount of spent fuel in THORP as the most viable and cost-effective option. These contracts for reprocessing were with EDF for AGR spent fuel and with overseas customers for Light Water Reactor (LWR) fuel.

In November 2018, we achieved this objective and reprocessing operations at THORP ceased *(SO8)*.

In delivering this strategy we created sufficient space to receive and manage all the AGR fuel from EDF power stations *(SO9)*, which avoids having to build additional and expensive storage capacity for AGR fuel. Even with significant lifetime extensions to EDF's AGR fleet, our strategy for the receipt and management of AGR fuel remains robust.

Most of the AGR spent fuel that will be stored at Sellafield will be owned by the NDA but some of the fuel will be owned by EDF. This split in ownership reflects the changes to the UK nuclear industry that occurred in the mid-2000s when British Energy, the company that then owned the AGR power stations, was restructured.

In 2014, following public consultation *(ref 24)*, the UK government agreed that for some small quantities of overseas origin fuels, where it would not be possible or economic to reprocess them before we ceased commercial operations in THORP, these fuels could be subject to 'virtual reprocessing'. This means that the overseas origin fuels are retained in the UK, the NDA takes the title to them, and that products and wastes are allocated to customers as if reprocessing had been carried out, and, where appropriate, returned to customers in line with contractual commitments.

Where a suitable *business case* could be made we took this approach to retain these fuels in the UK and enact virtual reprocessing. This ensured that the UK did not become a net importer of nuclear waste. As a result, all spent fuel that is now committed to interim storage is UK owned and we are not managing overseas-owned fuels.

Since our previous Strategy *(ref 3)*, we have continued to work with RWM on improving our understanding of how our oxide spent fuels can be disposed of in a GDF in the event that we classify them as waste *(SO10)*.

Our Strategy

Our spent oxide fuel strategy covers spent AGR fuel and small amounts of other oxide fuels that can be managed alongside spent AGR fuel. We currently hold about 2,000 tonnes of spent AGR fuel at Sellafield and by the time defueling of the AGR power stations finishes, within the next 15 years, this is expected to increase to about 5,000 to 6,000 tonnes.

Our strategy is to consolidate all spent AGR fuel from the EDF AGR stations in a single pond in the THORP facility at the Sellafield site, and interim store all oxide fuels *(SO9)* pending a future decision on whether to classify the fuel as waste for disposal in a GDF *(SO10)*.

Strategy Development

We will store spent oxide fuels at Sellafield for several decades *(SO9)* before the high heat generating part of a GDF *(SO10)* is ready to receive them and all fuel has been transported to it.

Sellafield Limited has continued to develop its approach for the interim wet storage of AGR and other oxide spent fuels *(SO9)* to the point of packaging for disposal *(SO10)* *(see **Radioactive Waste**)*. This approach is based on the considerable operational experience and technical knowledge base which Sellafield Limited has accumulated over several decades of managing spent oxide fuel.

The long timescales for interim storage mean that a number of our **Critical Enabler** strategies are particularly relevant to this strategy.

We will need a clear focus on asset management capability to ensure that our spent fuel storage facilities and supporting infrastructure, such as transport assets, continue to operate as required until the spent fuel programme is complete *(see **Asset Management** and **Transport and Logistics**)*.

Interim storage and disposal of our spent fuels is an intergenerational programme requiring skills, capabilities, information and knowledge to be maintained over several decades *(see **People** and **Information Governance**)*. To this end, we are working with Sellafield Limited, RWM and EDF to identify and share the necessary records and information to support the storage and disposal of AGR spent fuel.

We will continue to monitor performance and plant conditions and develop options, including contingency options, to manage risks and uncertainties. We will undertake research and development to underpin the interim storage and disposal of spent fuels. This work will further our understanding of the behaviour of spent fuel in interim wet storage, and the alternative approach of dry storage *(SO9)* *(see **Research, Development and Innovation**)*, and also help to maintain skills and capabilities.

Delivery

EDF has publicly declared its intention to operate its AGR power stations for as long as this is safe and economic. Based on EDF's published plans, it is expected that by the early 2030s all the AGR power stations will have ceased generating electricity.

Following permanent shutdown, all of the remaining spent fuel at the AGR power stations will be defueled from the reactors and consolidated to Sellafield. During this defueling phase there will be an increased demand to move the spent fuel from the power stations to Sellafield. It is important that we maintain fuel transport assets and infrastructure to support our strategy for oxide fuels *(see **Transport and Logistics**)*.

To be able to meet these demands, in 2016, the AGR Operating Programme (AGROP) was launched to develop an integrated, collaborative delivery programme covering the activities of all delivery partners: EDF and the NDA and its subsidiaries (including Sellafield Limited and Direct Rail Services Limited (DRS)). These organisations share a common mission to ensure the safe, secure and cost-effective defueling of the AGR power stations.

For planning purposes, we assume that all spent oxide fuels at Sellafield will be disposed of in a GDF. According to the current plan, the GDF would be able to receive spent fuel in 2075 *(SO10)*.

This means that we are preparing to store spent oxide fuel at Sellafield site for several decades *(SO9)*. To ensure its safe storage, spent fuel is stored under water in carefully managed conditions to prevent or minimise corrosion. This approach also ensures that, if a future decision is taken to dispose of spent oxide fuel in a GDF *(SO10)*, it can be readily recovered, dried and packaged for disposal.

5.2 Spent Magnox Fuel

Objective: *To ensure safe, secure and cost-effective lifecycle management of spent Magnox fuels.*

The Magnox reactors were the first generation of commercial nuclear power stations to operate in the UK. The NDA has the responsibility to defuel *(SO1)* and decommission *(SO42&43)* all of these reactors.

All 26 reactors have been shut down and the last of the Magnox reactors has now been defueled *(SO1)* and the fuel consolidated at Sellafield. The consolidation of spent fuel at Sellafield for reprocessing results in a significant reduction in radioactivity and hazard at the reactor sites. The successful completion of defueling at Wylfa power station in September 2019 marked a very significant milestone in the NDA mission.

Spent fuel reprocessing at Sellafield started in 1952 and the Magnox reprocessing plant started operations in 1964. By early 2020, nearly 99% of Magnox fuel destined for reprocessing *(SO3)* had been reprocessed and there was only around 600 tonnes of fuel remaining. Operations at the Magnox reprocessing plant were suspended for several months due to the COVID-19 pandemic, which has delayed the completion of reprocessing.

Reprocessing of spent Magnox fuel restarted in October 2020 under COVID-19 secure working arrangements and, if performance is sustained, is expected to be largely complete by the end of 2021. Around this time the plant is expected to start the transition to POCO, which is the first phase of decommissioning. The end date for reprocessing is dependent on both the performance of reprocessing and the availability of the alternative approach of dry storage, which is discussed in more detail opposite.

Our Strategy

Our strategy for spent Magnox fuels covers Magnox fuel from commercial power stations and a range of metal fuels from the legacy ponds, First Generation Magnox Storage Pond (FGMSP) and Pile Fuel Storage Pond (PFSP) *(SO2).*

The last of the spent Magnox fuel received from the commercial power stations has been consolidated in the Fuel Handling Plant (FHP) at Sellafield. Our current strategy is to reprocess as much of the spent Magnox fuel as is practicable, in line with the Magnox Operating Programme (MOP), and to complete reprocessing as soon as is practicable *(SO3)*. After a period of pond storage, any remaining fuel is expected to be transferred into dry storage *(SO4)* pending a future decision on whether to condition and dispose of it in a GDF *(SO5).*

Some degraded metal fuels remain in or have been recovered from legacy ponds. As much of this material is heavily degraded it is not suitable for reprocessing in our existing facilities. The strategy for this fuel is to transfer the material into dry storage. To reduce the risk of managing these fuels some of it has been transferred to the more modern pond, FHP, where it will be stored until it can be transferred into dry storage *(SO4)*. We expect that, following a period of dry storage for several decades, the fuels recovered from the legacy ponds will be conditioned and disposed of as waste in a GDF *(SO5).*

Strategy Development

The spent fuel from Magnox reactors is composed of a uranium metal rod (or bar) encased in a can made of an alloy of magnesium called Magnox, which gives the fuel its name. Both the Magnox cladding and the uranium metal rod are susceptible to corrosion in water and, for this reason, Magnox fuel can only be stored in a pond for a limited amount of time under carefully controlled conditions.

The reprocessing of spent Magnox fuel reduces the long-term risk of managing spent Magnox fuel at Sellafield *(SO3)*. However, reprocessing does produce more plutonium and Highly Active Liquid waste (HAL) which requires further management *(SO35-39)*.

It is important to reprocess *(SO3)* as much spent Magnox fuel as practicable but also to make sure a contingency option is available. Otherwise, in the event of a problem with the reprocessing plant throughput, reprocessing may need to be extended for prolonged time periods at considerable cost to the NDA, as well as diverting resources from hazard reduction activities at Sellafield.

Finishing Magnox reprocessing is a complex issue. In this final phase a decision will need to be made on when to stop reprocessing, taking into account the amount of fuel that is left, our confidence in the alternative option of dry storage, the cost of continuing reprocessing, production of separated plutonium, and the condition and availability of the reprocessing plant.

We will continue to work with Sellafield Limited, regulators and stakeholders to complete the Magnox reprocessing programme in line with the MOP *(SO3)* and implement an alternative option to manage any fuel that has not been reprocessed *(SO4&5)*.

Delivery

In 2012, recognising the operational and throughput uncertainties associated with Magnox reprocessing, primarily due to the age of the plant involved, we estimated that reprocessing should complete by 2020 *(SO3)*.

In 2016, we highlighted that due to the age of the facilities this could lead to a gradual loss of performance or sudden, acute failure. To address this risk, we have worked with Sellafield Limited on options so that any remaining fuel can be safely and cost-effectively managed.

Sellafield Limited has developed a new container for the storage of highly degraded Magnox fuels which have been or will be recovered from the legacy ponds and are not suitable for reprocessing. These storage containers, called self-shielded boxes, provide containment and shielding for the Magnox fuel. Sellafield Limited has built a new waste and spent fuel store, the Interim Storage Facility (ISF), which could potentially hold the self-shielded boxes containing spent fuel *(SO4)*.

Over the coming years, and subject to regulatory approvals, the fuels retrieved from the legacy ponds will be transferred into self-shielded boxes which will then be stored in the new ISF. Following a period of interim storage, the fuels in the ISF are expected to be conditioned and disposed of in a GDF *(SO5)*.

Based on work recently completed by Sellafield Limited, we now have sufficient confidence that the approach developed for highly degraded fuels from the legacy ponds could potentially be used to manage any remaining spent Magnox fuel at completion of the MOP.

The Interim Storage Facility (ISF) at Sellafield

5.3 Spent Exotic Fuel

Objective: *To ensure safe, secure and cost-effective lifecycle management of spent exotic fuels.*

We manage a small inventory of non-standard fuels, commonly referred to as 'exotic fuels'. These fuels include metallic, oxide and carbide materials. They are a legacy we inherited from earlier nuclear industry activities such as the development of research, experimental and prototype fuels and reactors.

Examples of exotic fuel types include fuels arising from the Dounreay Fast Reactor (DFR), the Dounreay Prototype Fast Reactor (PFR), the Windscale AGR reactor and the Steam Generating Heavy Water Reactor (SGHWR) at Winfrith.

Some, but not all, of these fuels share common characteristics with oxide and Magnox fuels and can be managed in the same facilities. One example is DFR material which is similar to Magnox fuel and suitable for reprocessing or dry storage. However, some of the exotic fuels present their own particular management challenges due to their diverse and sometimes unique properties. In some cases, specifically tailored solutions for their long-term management and *disposition* will be required.

We are also contracted to receive and store *irradiated fuels* from MOD arising from the development and operation of the UK Defence Nuclear Programme *(see* ***Non-NDA Liabilities****)*.

Since our previous Strategy *(ref 3)*, some exotic fuels have been reprocessed *(SO13)*. For some fuels it is not economic or possible to reprocess them within existing facilities and decisions were taken to store (SO14) them until a GDF becomes available *(SO15)*.

The DRAGON fuel currently held at Harwell is one of the exotic fuels for which reprocessing was not a possible option and the fuel has been classified as waste in the UK National Inventory. We have decided that this fuel will be encapsulated using existing waste processing facilities at Sellafield to simplify our approach to storage pending disposal *(SO32&33)*. We have started to transfer this fuel to Sellafield where it will be stored until a GDF is available *(SO34)*.

Our Strategy

Our strategy is to consolidate all our exotic fuels at Sellafield *(SO12)* and store them safely and securely either alongside oxide or Magnox fuels, or develop bespoke solutions for some fuels pending a decision whether to classify them as waste for disposal in a GDF *(SO15)*.

This strategy of consolidation optimises the use of facilities, skills and capabilities at Sellafield and provides better value to the UK taxpayer as it allows us to accelerate decommissioning and remediation of the Dounreay and Harwell sites making it more cost effective in the long term.

Strategy Development

The individual nature of exotic fuels means that the approach for managing each fuel type is made on a case by case basis. For each option we are working to better understand the issues associated with their storage, treatment and in some cases disposal. Specifically tailored solutions for long-term management and *disposition* could be required. We will continue to work with Sellafield Limited and RWM to underpin long-term management and the potential disposal options for exotic fuels *(see* ***Research, Development and Innovation****)*.

On behalf of MOD we currently receive *irradiated fuels* and store them on an interim basis at Sellafield. These fuels are owned by MOD. The decisions and strategy for their long-term management and *disposition*, beyond interim storage, rests with MOD. We will continue to work closely with MOD to support it in developing options for the long-term *disposition* of these fuels.

Delivery

We are continuing to consolidate the exotic fuels from Dounreay and Harwell to Sellafield for long-term management. This includes, for example, the fuels from the DFR, the PFR and the DRAGON fuel.

Some of our exotic fuels are compatible with storage arrangements for oxide and Magnox fuels and are being, or will be, stored alongside them. For some small amounts of exotic fuels at Dounreay, which will be transferred to Sellafield *(SO12)*, it is likely that new dry storage capabilities will be required on this site *(SO14)* *(see **Asset Management**)*.

The strategy for DFR fuel is to consolidate it to Sellafield and reprocess as much of this fuel as practicable before the Magnox reprocessing plant ceases operations *(SO13)*. Any remaining DFR fuel will be placed into dry storage at Sellafield pending a decision to treat, package and dispose of it in a GDF *(SO15)*. By early 2021, over half of this material had been shipped to Sellafield and reprocessed.

Inside the Dounreay Fast Reactor sphere

The Vision: Nuclear Safeguards

Safeguards

Nuclear safeguards are measures to verify that civil nuclear materials and activities are only used for their intended peaceful purposes. They include the requirement to keep accurate accounts of quantities and the location of nuclear materials.

As safeguards arrangements change due to decommissioning progress and the UK exiting the European Union (EU) and the European Atomic Energy Community (Euratom), the NDA is sharpening its focus on this important area.

International Atomic Energy Agency

The International Atomic Energy Agency (IAEA) is an independent science and technology-based intergovernmental organisation within the United Nations family. Part of the IAEA's role is to conduct independent verification to ensure that states comply with their non-proliferation agreements, including nuclear safeguards.

The UK is a signatory to the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) *(ref 25)* and has concluded a voluntary offer safeguards agreement and Additional Protocol (AP) agreement with the IAEA. This means that all civil nuclear material at UK nuclear facilities is eligible for IAEA safeguards inspection, and that reports on civil nuclear material, facilities and other civil nuclear fuel cycle-related activities must be submitted to the IAEA.

Euratom

Since 1973, the Euratom safeguards inspectorate, operating under the direction of the European Commission (EC), has been the *de facto* safeguards regulator for the UK. Operators were required to submit detailed reports to the EC on holdings and movements of nuclear materials and the nuclear facilities concerned. This information was subject to independent assessment and inspection by the Euratom safeguards inspectorate to confirm it was correct and accurate before being reported to the IAEA. The Office for Nuclear Regulation (ONR) has become the UK's domestic regulator for nuclear safeguards now that Euratom arrangements no longer apply to the UK (from the end of the transition period).

ONR

Legislation was introduced in preparation for the UK's departure from the EU and Euratom. The Nuclear Safeguards Act (2018) *(ref 26)* makes provision for a new domestic safeguards regime which replaced that provided by the UK's membership of Euratom. ONR will, on behalf of the UK, ensure implementation of the State System for Accountancy and Control (SSAC) in order that the UK meets its international safeguards obligations in respect of facilitating IAEA activities and reporting on safeguards, and other obligated reports. ONR, as the UK domestic regulator for safeguards, will seek evidence that operators are accounting for and controlling qualifying nuclear material and, where appropriate, enforce compliance through nuclear safeguards regulations.

Why should the NDA be involved in safeguards?

The NDA owns large quantities of spent fuel and nuclear material, including a significant inventory of non-military separated plutonium arising from reprocessing operations. Although this is managed on our behalf by the *Site Licence Companies* (SLCs), we have a responsibility to ensure that safeguards obligations, both domestic and international, are met along with safety and security.

Through One NDA we will make the best use of resources, skills, knowledge and capabilities across the group to act in the interests of the safeguards mission.

The detailed inventory information held by safeguards teams across the NDA is essential in knowing what material we have and where it is stored. These are also important lifetime records to inform future strategy and potential disposal to a *Geological Disposal Facility (GDF)*.

The Vision: Nuclear Safeguards contd

Future Developments
ONR, in its role as the UK's domestic nuclear safeguards regulator, will undertake inspections and assessments at our sites that manage nuclear materials. This will offer assurance that appropriate material accountancy and control arrangements are in place and that sites comply with the Nuclear Safeguards Regulations 2019 *(ref 27)*.

Safeguards experts from across the NDA group have been supporting ONR and the Department for Business, Energy and Industrial Strategy (BEIS) in the development of the new regulatory regime. Our sites are reporting nuclear material movements to the new UK Safeguards Information Management and Reporting System (SIMRS) operated by ONR. This system will equip the UK to compile operator declarations of nuclear material movements and inventory holdings within the UK and, now that the transition period is complete, provide the reports on nuclear material to meet UK obligations under safeguards agreements with the IAEA.

Safeguards activities at our sites are also changing as decommissioning progresses:

- all Magnox reactors are now defueled, ending the need to account for bulk quantities of spent fuel at these sites
- reprocessing will end, simplifying some accounting arrangements at Sellafield, although future repackaging and *disposition* of plutonium will increase workload
- consolidation of nuclear material from Dounreay and Harwell to Sellafield.

The NDA is increasing its oversight in this important area to support our sites in meeting the new legislation as our clean-up and decommissioning mission progresses while ensuring cost-effective delivery. We will also be actively engaged during the development of approaches to safeguards related to *geological disposal.*

Magnox reactors, such as this one at Wylfa, are now all defueled, ending the need to account for bulk quantities of spent fuel at the site

6.0 Nuclear Materials

Objective: *To ensure safe, secure and cost-effective lifecycle management of our nuclear materials.*

STRATEGIC OUTCOMES -
steps to achieving our mission

PLUTONIUM

16 All plutonium produced

17 All plutonium consolidated

18 A: All plutonium repacked in long-term storage
B: All cans not suitable for extended storage repackaged

19 All plutonium in interim storage

20 All plutonium reused or disposed

URANIUM

21 All uranium produced

22 All uranium consolidated

23 All uranium treated

24 All uranium in interim storage

25 All uranium reused or disposed

Our Nuclear Materials theme is made up of the Plutonium and Uranium topic strategies.

The NDA manages large quantities of civil uranium and plutonium arising from nuclear fuel cycle activities such as enrichment, fuel fabrication and reprocessing. The nuclear materials which we hold are diverse in nature and properties.

Implementing a solution for the management of all of our nuclear materials is essential to enable us to decommission our sites and deliver our mission.

Our strategy is to safely and securely store our nuclear materials *(SO19&24)* in line with regulatory requirements while we develop and implement effective lifecycle solutions for their management in accordance with applicable UK government policy *(ref 28)* and international good practice *(SO20&25)*.

Some of our nuclear materials have the potential to be reused in nuclear fuel for generating electricity while others are likely to be unsuitable for reuse and ultimately will need to be treated as waste for disposal.

The majority of these nuclear materials are UK owned. However, some of those managed by the NDA are owned by overseas utilities *(see **Non-NDA Liabilities**)*. These materials are managed in line with contractual commitments and customer requirements and are stored safely and securely. Overseas-owned nuclear materials held by the NDA are ultimately the responsibility of their owners.

All of our plutonium is stored at the Sellafield site. Plutonium is highly radioactive and fissile requiring specialised skills and facilities to handle it. Stringent safety and security arrangements are required to store plutonium. The priority for the UK government is to put the inventory *beyond reach* which will reduce the burden of long-term security risks and proliferation sensitivities for future generations to manage. The NDA is actively working on developing credible options to meet this requirement.

Our uranium is in a variety of chemical forms. Uranium is both radioactive and chemically hazardous and so requires appropriate management arrangements. Some of the forms, such as uranium hexafluoride tails (Hex), present additional hazards requiring further management measures to ensure their safe storage and to minimise their potential to damage the environment. Once our uranium has been treated *(SO23)* to reduce the associated detriments to levels acceptable for interim storage *(SO24)*, it is held in safe and secure storage facilities pending the development of *disposition* options *(SO25)*.

Uranium has the potential to be reused as nuclear fuel to generate electricity *(SO25)*. The value of our uranium is determined by the economics of nuclear fuel production and the quality of the uranium. Much of our uranium may have no future use and so will need to be managed as waste. Recognising this, our uranium is included in the UK Radioactive Waste Inventory *(ref 29)*.

Disposal of unusable uranium will be in line with national policies *(SO25)* *(see **Radioactive Waste**)*.

Our uranium is located at a number of our sites. Where there is a benefit and it is economic to do so we will continue to consolidate our uranium at sites which we consider are best suited to its management.

6.1 Plutonium

Objective: *To ensure the safe and secure management of separated plutonium held by the NDA and to work with the UK government to develop a long-term solution.*

One of the most complex challenges facing the NDA in dealing with the UK's nuclear legacy is managing the inventory of separated civil plutonium held in the UK, both ongoing safe and secure storage and its final *disposition*.

Separated plutonium has arisen from large-scale reprocessing of spent fuel from both UK Magnox and Advanced Gas-Cooled Reactor (AGR) power stations. It has also arisen from overseas energy utilities under historical commercial agreements.

Civil plutonium production from spent fuel reprocessing will finish when the Magnox reprocessing plant completes its mission. This will end nearly 70 years of plutonium production at Sellafield *(SO16)*.

At the end of reprocessing there will be around 140 tonnes of separated civil plutonium stored safely and securely in the UK.

In 2019, we completed the consolidation of plutonium held at Dounreay to Sellafield, enabling progress towards the decommissioning and remediation of the Dounreay site *(SO17)*. As a consequence, all of the UK's civil separated plutonium is held at Sellafield except for tiny amounts used by some organisations and companies for research and commercial purposes. Some of the materials moved from Dounreay present unique management challenges due to their form and storage configuration *(SO18&19)* which will require increased focus in the coming years.

The safe and secure management of civil separated plutonium is a UK government priority. Continued, indefinite, long-term storage leaves a burden of security risks and proliferation sensitivities for future generations to manage.

The UK government, working with the NDA, aims to identify a long-term solution that will put the UK's civil plutonium *beyond reach (SO20)*. Implementing a long-term solution for plutonium is essential for dealing with the UK's nuclear legacy.

Our Strategy

The NDA's strategy for plutonium has 3 components: consolidation of material at Sellafield *(SO17)*, which is now complete; ensuring long-term safe and secure storage can be delivered at Sellafield and working with the UK government to determine the right approach for putting this nuclear material *beyond reach*. This strategy is supported by a campaign of repackaging and treatment of packages *(SO18)*, to ensure the material can continue to be stored safely and securely in accordance with regulatory requirements *(SO19)*. Due to the size of the plutonium inventory and the complexity of developing and implementing the options, any long-term management solution will take many decades to fully implement.

Civil plutonium can only be used for peaceful purposes. It is managed strictly in accordance with the UK's voluntary International Safeguards agreements with the International Atomic Energy Agency (IAEA). As a result of the UK's exit from the European Union and consequential withdrawal from the treaty establishing the European Atomic Energy Community (Euratom Treaty) in January 2021, the Office for Nuclear Regulation (ONR) took over responsibility for ensuring UK compliance with these agreements *(see **NDA Vision: Nuclear Safeguards**)*.

In 2011, the government decided that overseas-owned plutonium stored in the UK under contractual arrangements, which remains the responsibility of the owners, could be managed alongside UK plutonium or transferred to UK ownership subject to commercial terms that are acceptable to the UK government *(SO20)*. Our strategy for overseas-owned plutonium is to continue to work with our customers to reach commercial settlements in accordance with national policies *(see **Non-NDA Liabilities**)*. In the long term, we believe this will reduce uncertainties and simplify the implementation of a strategy to deal with all of the plutonium held by the NDA in the UK.

Strategy Development

Developing a long-term solution for plutonium

The NDA is working with the UK government to identify and implement a *disposition* solution that puts the UK's plutonium *beyond reach (SO20)*. This is where the material is placed in a form which reduces the enduring security risks and burden during storage, and is aligned with its ultimate disposal in a *Geological Disposal Facility (GDF)*.

Some of the plutonium is suitable for reuse as Mixed Oxide Fuel (MOX) in nuclear reactors, followed by storage as spent fuel pending disposal in a GDF. However, some plutonium will not be suitable for reuse due to its physical or chemical properties. It will need to be immobilised and treated as waste, followed by storage pending disposal in a GDF. Both approaches are considered to meet the requirement to reduce the security burden of storing these materials and places them *beyond reach*.

To date the NDA, in partnership with Department for Business, Energy and Industrial Strategy (BEIS), has undertaken work to investigate the feasibility of both plutonium reuse and immobilisation options in the UK *(SO20)*. We will continue to work with technology suppliers, developers, regulators and the UK government to establish how both reuse and immobilisation options could be implemented *(see **Research, Development and Innovation**)*.

This work is focussed on demonstrating and developing each of the technical options under consideration, including the potential for them to be constructed and licensed in the UK. Implementation scenarios continue to be developed with the associated cost and schedule estimates for the facilities and processes needed to deliver each approach informed by technology development work. Options for reuse of plutonium as MOX in light water reactors (LWRs) can be shown to be the most mature from a technical and licensing perspective. Part of the focus in future will be on developing immobilisation options to improve confidence in their potential for successful deployment and improve understanding of the issues associated with *geological disposal*. The NDA is investigating a range of immobilisation options, some of which may be better suited to subsets of the inventory, particularly those groups less suitable for reuse in reactors and where it may be possible to make progress in the short term.

This development work also supports the UK's ability to retain a skilled workforce necessary to manage plutonium and the capability to implement a long-term *disposition* solution. Further focus may be required in future to maintain the full range of skills necessary to enable effective plutonium management *(see **People**)*. To support the maintenance and development of relevant skills for plutonium handling, the NDA is sponsoring an initiative, the Alpha Resilience and Capability (ARC), in partnership with Sellafield Limited and other organisations managing alpha-related challenges in the UK.

Putting the UK's civil plutonium *beyond reach* is a long-term solution. However, the implementation of such a programme will be complex to manage with significant technical, economic and socio-economic challenges and uncertainties and will take several decades to complete.

The UK government has been clear that this nationally important decision can only be taken when it can be underpinned with sufficient evidence and should not be made in isolation. This is due to potential interactions with national security and important infrastructure investments including nuclear new build and *geological disposal*.

The NDA continues to work with the UK government to meet the conditions necessary to make this decision. Further updates will be provided in line with UK government expectations.

Delivery

Underpinning long-term interim safe and secure storage

Due to the radioactive and fissile nature of the material, plutonium handling and storage requires specialised facilities and effective management arrangements.

There are a number of plutonium stores on the Sellafield site. Our aim is to gradually transfer all plutonium into the most modern facilities such as the Sellafield Product and Residue Store (SPRS) and its extensions over the next few decades *(SO19)*.

To ensure that the plutonium packages can be safely stored in SPRS, they will be repackaged and, where appropriate, some plutonium will be treated to stabilise it for long-term storage *(SO18)*.

A major new facility to repackage materials is required to support this strategy. Known as SRP (SPRS Retreatment Plant), this facility will repackage, and, where appropriate, re-treat all of the plutonium packages. It is expected to start operating within the next several years *(SO18)*.

The NDA considers some of the older plutonium packages and facilities used in early production to be amongst the highest hazards on the Sellafield site. A major programme of asset care has and continues to be undertaken at these facilities to support safe operation until they can be taken out of service and decommissioned. Some older packages are to be repacked in existing plants to ensure their safe management in the short to medium term. This will be followed by repacking all these materials again through SRP so that they can be safely stored for the long term in SPRS *(SO18)*. SRP and the interim repacking programme are examples of the active interventions we believe will be required to safely manage the storage of these materials in the medium to longer term.

Delivery of the strategy is supported by a technical programme that aims to improve understanding of the underpinning science for storing these materials over extended timescales while looking to apply modern technologies such as robotics in an intelligent way to improve the safety and effectiveness of operations. The NDA and its estate collaborate on these developments with a range of organisations in industry, academia and worldwide operators who face similar challenges.

The Sellafield Product and Residue Store (SPRS) when it was under construction

6.2 Uranium

Objective: *To continue safe and secure storage of our uranium inventory, to support its reuse where cost effective and to ensure its final disposition.*

The uranium we manage has been produced from nuclear fuel cycle operations such as *enrichment*, fuel fabrication and reprocessing since the 1950s *(SO21)*. The inventory is stored safely and securely *(SO24)*.

We own most of the uranium on our sites; the remaining material is owned by our customers including the Ministry of Defence (MOD), EDF Energy (EDF) and overseas utilities *(see **Non-NDA Liabilities**)*. We manage customers' materials in accordance with the terms of contracts we have with them.

The NDA-owned inventory comprises approximately 54,000 tonnes of uranium, over 95% of which is at Capenhurst with the remainder at Dounreay, Sellafield, Springfields and Harwell. The inventory comprises the following:

- Magnox Depleted Uranium (MDU), a product of spent Magnox fuel reprocessing
- THORP Product Uranium (TPU) in the form of Uranium Trioxide (UO_3), a product of spent oxide fuel reprocessing
- Hex, a by-product of uranium enrichment
- High Enriched Uranium (HEU) from research reactor fuel development and production
- Low enriched, natural and depleted uranium in a variety of forms recovered from fuel fabrication processes.

The following developments have occurred since the publication of our previous Strategy *(ref 3)*:

- Magnox reprocessing is expected to be largely complete by the end of 2021 and the Thermal Oxide Reprocessing Plant (THORP) reprocessing plant has closed. Accordingly, stocks of reprocessed uranium will soon stop increasing *(SO20)*
- we have continued the development of an approach to reduce the hazard and potential to damage the environment of our Hex cylinders through repackaging and deconversion in Urenco facilities at Capenhurst *(SO23)*
- in support of an international medical isotope production programme with Europe-wide societal benefits, we have exported approximately 700kg of HEU from Dounreay to the USA where it will be reused as Low Enriched Uranium (LEU) nuclear fuel *(SO25)*
- we have worked with Radioactive Waste Management Limited (RWM) to determine that bulk quantities of uranium held in England could, in principle, be disposed of in a GDF in the event that these materials, if not reused, were to be declared waste *(SO25)* *(see **Integrated Waste Management**)*
- we have instigated a programme to identify *disposition* routes for materials which contain low levels of uranium, where recovery of the materials for reuse is uneconomic *(SO32-34)*.

Our Strategy

What is covered under this strategy?

Recognising that our uranium has the potential to be reused as nuclear fuel to generate electricity or in other applications, but that it may not be possible to reuse the entire inventory, the strategy options are:

- continued safe and secure storage pending either *(SO24)*:
  - sale for reuse where practicable *(SO25)*
  - conditioning to an appropriate form for disposal *(SO25)*.

As the economics of nuclear fuel production are driven by market prices for the mining and processing of fresh uranium, the sale value of our inventory can change markedly over time. Uses of uranium outside the nuclear fuel cycle, such as in gamma radiation shielding, are currently small scale. Consequently, and given the diversity of our inventory, there is no single preferred management option for the whole inventory at any one time.

Strategy Development

We will continue to work with the UK government and businesses operating in the nuclear fuel cycle to identify and realise cost-effective opportunities for reuse. We will also continue to underpin the interim storage arrangements of our uranium, and disposal options for uranium that cannot be reused.

Delivery

Consolidation and Storage - The majority of our inventory is at Capenhurst and other uranium, apart from TPU, will be co-located there *(SO22)*. Wherever possible, we make best use of existing facilities provided they are fit for purpose. TPU is stored in a purpose-built facility at Sellafield and the majority of the inventory is owned by our customers. Our TPU will therefore continue to be stored in the same store.

Treatment - Most of our uranium is in an oxide form which is suitable for interim storage; however, our Hex is not because it is chemically reactive.

Most of our Hex is stored at Capenhurst with some at Springfields where it is managed safely by Urenco Nuclear Stewardship (UNS) and Springfields Fuels Limited (SFL) respectively. Many of our Hex storage cylinders are several decades old and are showing signs of local external corrosion. We are continuing with our strategy to transfer our Hex into modern cylinders and then deconvert it into a form of uranium oxide, which is much less hazardous and more suitable for long-term management *(SO23)*. In the meantime we will continue to work with UNS and SFL to support the safe management of Hex until it can be deconverted.

We have a small quantity of uranium contained in residues of low uranium concentration. These do not pose any significant hazard but are not suitable for interim storage. We are evaluating these residues to identify viable, cost-effective and environmentally responsible routes to either recover the uranium for interim storage at Capenhurst or condition the material for disposal as waste.

Disposition - In order to benefit society and the environment, our preferred *disposition* route is sale for reuse in the nuclear fuel cycle or other applications. However, some of our inventory may not be economic to reuse and so will not have a sale value. Uranium that cannot be reused will need to be disposed of as waste *(SO25)*.

Hex awaiting final disposition at Capenhurst

Case Study: Export of High Enriched Uranium in Support of Medical Isotope Production

When the NDA took over the UK's nuclear liabilities, it inherited around 700kg of High Enriched Uranium (HEU) at Dounreay which had to be removed to enable progress towards decommissioning and remediation of the site. We had plans to transport the HEU to Sellafield for safe and secure interim storage pending the development of a *disposition* route.

In 2014, we began to evaluate an alternative plan to send the material to the USA for *down-blending* and reuse as fuel in civil nuclear reactors in exchange for the supply of a different form of the material to Europe for use as research reactor fuel and in the production of medical isotopes. This would remove the HEU from Dounreay and also provide ultimate *disposition* of the material while realising cost benefits compared with the original plan *(SO25)*.

The programme supported the Memorandum of Understanding (MOU) signed in 2014 between the US Department of Energy / National Nuclear Security Administration (US DOE/NNSA) and the Euratom Supply Agency (ESA) *(ref 30)*. This MOU recognised the need to provide limited supplies of HEU from the USA for medical isotope production and research reactor fuel until facilities in Europe converted to using Low Enriched Uranium (LEU). In turn, the European Atomic Energy Community (Euratom) identified excess, unirradiated HEU that could be *down-blended* to LEU for use as nuclear fuel.

At the 2016 Nuclear Security Summit, the Prime Minister announced the UK's intention to transfer the HEU from Dounreay to the USA. The UK's Statement *(ref 31)* noted: "The transfer will consolidate and achieve a net reduction in global HEU holdings, whilst providing real societal benefits."

Our HEU included a broad range of materials and more than 1,250 individual items that varied greatly in form and enrichment, reflecting the extensive fuel cycle operations that Dounreay had performed over the course of 4 decades including research reactor fuel fabrication and reprocessing.

The transfer campaign was complex, with an array of technical, logistical, safety and security considerations. Approximately a dozen organisations from the USA and the UK worked together in its planning and execution, requiring many hundreds of hours of work by all the organisations involved to ensure the secure movements of the material:

- US DOE/NNSA's Office of Material Management and Minimisation (M3), the Y-12 National Security Complex (Y-12), Dounreay Site Restoration Limited (DSRL) and the NDA led the effort
- DSRL modified an existing glovebox and installed a new uranium processing line to treat and package the materials for transport
- transport packages of both US and French origin were used. ONR, US DOE and US Department of Transportation approved and validated the licences of both types of package and their payloads and ONR approved the transport security arrangements for each shipment

Modified glovebox line for uranium processing

- the UK Civil Nuclear Constabulary, Police Scotland and MOD Police provided policing and maintained security for the land transports
- the US Air Force provided air transport to the USA using C-17 aircraft
- amendments to the UK's Nuclear Industries Security Regulations were made to widen the powers of ONR to regulate transport of fissile material by air. These amendments required approval by the UK Parliament
- Highlands and Islands Airports Limited (HIAL) refurbished the runway at Wick John O'Groats airport as well as other airport infrastructure; this will support future airport usage
- the Defense Threat Reduction Agency (DTRA) of the US Department of Defense contributed to the logistics effort. DTRA's Cooperative Threat Reduction (CTR): Global Nuclear Security Program (GNS) provided funding for the air transportation as well as dedicated equipment used to prepare the cargo for air transport. DTRA personnel were also involved in preparation and loading activities at the point of departure.

The USA and UK organisations held detailed planning meetings in the UK in advance of each shipment. Lessons learned from the previous shipments were reviewed and adjustments made to the preparatory activities, logistics, and operational timeline. Over the course of the project, the stakeholders also conducted 2 tabletop exercises to discuss contingencies and refine planning assumptions.

A total of 6 shipments to the USA were completed safely and securely between 2016 and 2018 *(ref 32,33).*

The successful completion of the project represents an important milestone in the programme to decommission and clean up the Dounreay Site. The work contributed to mutually beneficial strategic outcomes for multiple organisations internationally.

Loading the aircraft at Wick John O'Groats airport

7.0 Integrated Waste Management

Objective: *To ensure that wastes are managed in a manner that protects people and the environment, now and in the future, and in ways that comply with government policies and provide value for money.*

STRATEGIC OUTCOMES -
steps to achieving our mission

LOW LEVEL WASTE

26 All LLW produced

27 All LLW treated - to enable diversion or reuse

28 All waste suitable for disposal in NDA facilities

29 All waste suitable for permitted landfill disposed

INTERMEDIATE LEVEL WASTE

30 All ILW produced

31 All legacy waste retrieved

32 All ILW treated

33 All ILW in interim storage

34 All ILW disposed - final disposal operational

HIGH LEVEL WASTE

35 All HLW produced

36 All HLW treated

37 All HLW in interim storage

38 All overseas HLW exported

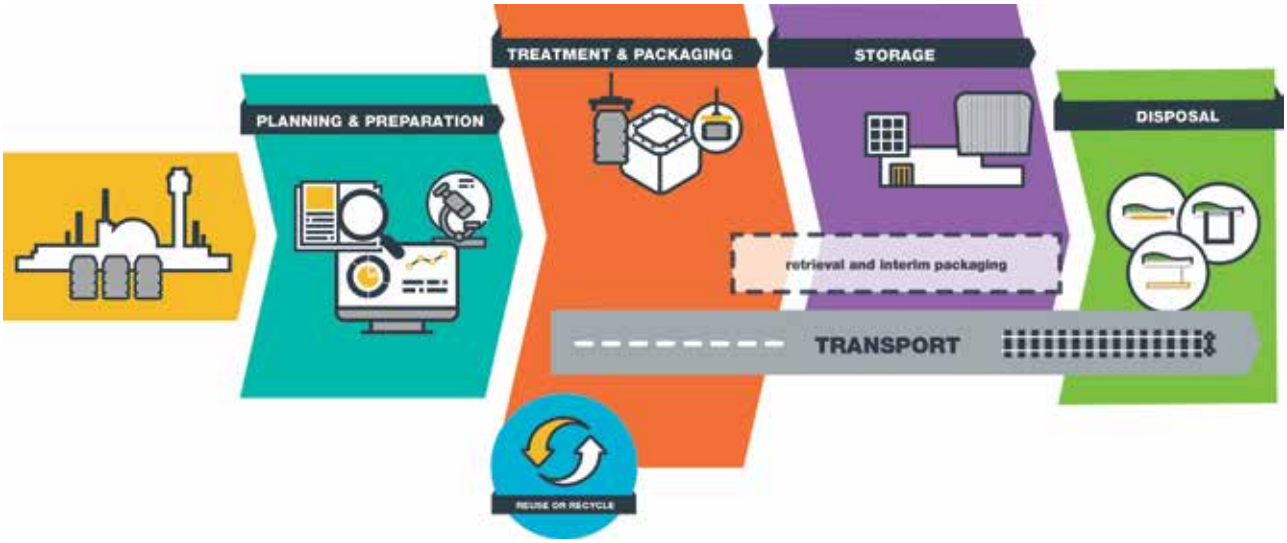
39 All HLW disposed - final disposal operational

Nuclear site operations and successful site decommissioning and remediation depend on the availability of robust, sustainable waste management infrastructure. Effective waste management is an essential requirement for the delivery of our mission and is a significant part of our programme.

The wastes we have to manage are diverse in terms of radiological, chemical and physical properties and this leads to a broad range of risks we have to manage today and for decades to come. We will continue to seek opportunities for waste optimisation and deliver robust, cost-effective and sustainable infrastructure. Using this risk-informed approach, we are developing and implementing an integrated waste management system that provides a range of treatment, storage and disposal capabilities. This will ensure we make the right choices in order to deliver the right lifecycle solutions for all of our waste.

The lifecycle of waste management involves a series of steps: waste generation, treatment, packaging, storage, transport *(see **Transport and Logistics**)* and disposal *(see fig 9)*. When managing waste during these steps, opportunities to minimise, re-use and recycle should be considered; the *Waste Hierarchy* should be applied. This strategic theme covers the full spectrum of waste types the NDA group will continue to manage over many decades. The theme is broken down into the following topic areas; solid radioactive wastes, gaseous and liquid discharges and non-radioactive wastes.

Figure 9 - The Waste Management Lifecycle *(SO26-39)*



Waste management on our sites is changing as our mission moves away from operations to decommissioning, site remediation *(see **Site Decommissioning and Remediation**)* and safe and secure management of those wastes that require interim storage. This means we will generate larger volumes of lower activity radioactive and non-radioactive wastes, with an associated increase in opportunities for waste minimisation, reuse and recycling. We expect our *Site Licence Companies* (SLCs) to apply the *Waste Hierarchy* and we challenge them to ensure they derive as much value as practicable from the waste management system and appropriately manage the environmental impacts. However, we need to ensure that retrievals of legacy wastes *(SO31)* are managed promptly and effectively pending the availability of disposal routes.

We continue to support the UK government and devolved administrations in the development of their radioactive waste management policies and provide essential waste management services for the UK as a whole. Radioactive Waste Management Limited (RWM) is a wholly-owned subsidiary of the NDA, established as a delivery body to work with the producers of radioactive waste, to develop waste management solutions and deliver *geological disposal* for *Higher Activity Waste (HAW)* in England and Wales *(ref 34)* *(SO34&39)*. We are also responsible for the implementation of the UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry *(ref 2)*, which is being delivered by Low Level Waste Repository Limited (LLWR Limited) with support from SLCs and the wider nuclear industry *(SO28)*.

Scottish policy for the management of HAW is long-term management in near-surface facilities *(ref 35)*. The Scottish government policy addresses disposal solutions, long-term storage and baseline improvement initiatives such as waste processing and storage consolidation opportunities. The policy also committed the Scottish Government to developing a supplementary Implementation Strategy, which was published in 2016 *(ref 36)*. We will continue to support Scottish Government where we plan to investigate earlier opportunities for the implementation of near-surface disposal solutions and determine the long-term management approach for the more difficult wastes, mostly stored at the Dounreay site *(SO34)*.

UK government and the devolved administrations are considering updating some radioactive waste management policies to support the NDA's vision to explore a comprehensive and consistent risk-informed approach to the management of all solid radioactive waste. This risk-informed approach would build on the 2007 UK Low Level Waste (LLW) Policy *(ref 37)* and subsequent changes being delivered through the UK LLW Strategies and National LLW Programme. Updating the policies could allow us to implement new management options for some of our HAW inventory while ensuring that waste minimisation activities are being pursued throughout the lifecycle. It would also allow for the introduction of a wider range of disposal facilities than those already in place or planned for. Greater flexibility in disposal options could lead to earlier and more cost-effective decommissioning of nuclear facilities.

In our Radioactive Waste Strategy, published in September 2019 *(ref 9)*, we made a commitment to create an Integrated Waste Management (IWM) programme. Building on group-wide NDA initiatives such as Integrated Project Teams (IPTs) and the success of the national LLW programme, this integrated programme will drive changes in waste management behaviour and culture, to allow waste producers to flexibly and effectively manage their waste as well as to develop proportionate waste management solutions. The IWM programme will incorporate a system approach and comprise a broad spectrum of activities that bring value to the NDA group and wider industry. Adopting an integrated approach across the waste management life cycle allows us to readily identify the capabilities required to deliver it.

The scope of the programme will evolve over time as it matures and we use it to drive the priorities of the time, for example:

- management of waste according to the level of risk it poses
- waste and transport container solutions
- enhancing the treatment capability for radioactive waste.

In delivering the IWM programme, we will continue to ensure that effective waste plans are being safely implemented across our estate, recognising the need to manage risks and pursue opportunities site-wide, estate-wide or, if appropriate, across the UK.

As part of our approach we will embrace innovation by promoting and supporting new initiatives where they add real value to our waste management activities. We invest in research and development to address the challenges of waste management and continue to track and benchmark international developments and collaborate with other countries to share good practice *(see **Research, Development and Innovation** and **International Relations**)*. The NDA represents the UK at senior waste management forums at the International Atomic Energy Agency (IAEA) and Organisation for Economic Co-operation and Development – Nuclear Energy Agency (OECD-NEA), where we continue to provide active and welcomed support (see ***International Relations***).

Our Strategy

Our strategy is to make more use of a risk-informed approach, rather than rely on the simple classification-based system for waste management and to seek solutions that help to optimise the lifecycle of both radioactive and non-radioactive wastes. This risk-informed approach enables wider application of the *Waste Hierarchy* and allows us to make optimum use of our treatment, storage and disposal infrastructure.

We also use the following IWM principles to inform the development and implementation of all our waste strategies within the NDA IWM theme:

- **support key risk and hazard reduction initiatives** by enabling a flexible approach to long-term waste management. For some wastes it may be necessary to adopt a multi-stage process to achieve a final disposal product, which could include the separate management of bulk retrievals and residual material to support hazard reduction programmes
- **consider the entire waste management lifecycle**, including how waste management is needed to support other NDA strategic or wider UK initiatives such as large-scale decommissioning programmes
- **apply the *Waste Hierarchy*** *(see fig 10)*, which is a permit requirement and should be used as a framework for waste management decision making. This enables an effective balance of priorities including value for money, affordability, technical maturity and the protection of health, safety, security and the environment

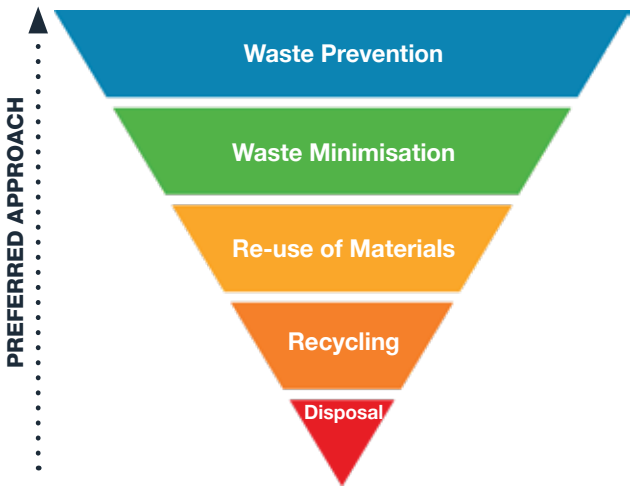


Figure 10 - The Waste Hierarchy

- **promote timely characterisation and segregation of waste**, which delivers effective waste management
- **provide leadership giving greater integration across the estate and the supply chain**, in particular by seeking appropriate opportunities to share treatment and interim storage assets, capabilities and learning
- **support and promote the use of robust decision making processes** to identify the most advantageous options for waste management
- **enable the availability of sustainable, robust infrastructure** for continued operations, hazard reduction and decommissioning.

The *Waste Hierarchy* continues to be an important cornerstone of our strategy. This means that for existing and any new facilities it is a requirement to minimise future waste arisings. It recognises that while disposal is the least preferred option, without disposal capability our mission would be impossible to complete. Waste management relies on extensive current and future infrastructure (see ***Asset Management***) and many new facilities are required to support retrieval, treatment, packaging, storage, transport and disposal *(SO26-39)*.

Management of non-radioactive waste is increasingly important, as decommissioning and site remediation progresses (see ***Site Decommissioning and Remediation***). Large volumes of non-radioactive wastes will be produced and sites will need to consider how best to deal with these materials especially where reuse opportunities can be secured, e.g. site profiling, backfilling of voids.

Our waste management programmes need to be *sustainable (see **Sustainability**)* and socially acceptable *(see **Socio-Economics**)*, as our operations continue for decades and the lifecycle impacts need to be assessed from a number of perspectives, including:

- minimising demand for natural resources
- sustainable energy use and energy efficiency
- low carbon material selection, minimising CO_2 production
- innovative design concepts from within and beyond the nuclear industry
- sharing capability with other waste owners and maximising the value of our assets and
- making best use of existing capability; only building new facilities where necessary.

7.1 Radioactive Waste

Objective: *To manage radioactive waste and dispose of it where possible, or place it in safe, secure and suitable storage, ensuring that we implement the policies of UK government and the devolved administrations.*

Radioactive waste is classified into 3 categories: *High Level Waste (HLW), Intermediate Level Waste (ILW)* and *Low Level Waste (LLW)* including the sub-category of *Very Low Level Waste (VLLW)*, depending on its radioactivity and whether or not it generates heat. *Higher Activity Waste (HAW)* comprises HLW, ILW and a relatively small volume of LLW that is unsuitable for disposal at the Low Level Waste Repository (LLWR) or the LLW disposal facility at Dounreay.

The NDA published its Radioactive Waste Strategy in September 2019 *(ref 9)* following a public consultation. This single radioactive waste strategy replaces the previous NDA strategy for HAW and is consistent with the UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry *(ref 2)*, providing a consolidated position and greater clarity of our overall approach. Our strategy advocates an approach where radioactive wastes are managed according to their properties (radiological, physical, chemical) rather than simply the radioactive waste category they fall into. This promotes opportunities to use risk-informed decision making, taking into consideration risk in its broadest sense, and embed the IWM principles, such as the application of the *Waste Hierarchy* and sharing treatment and storage assets. To support the lifecycle approach, the strategy articulates our key positions, areas for further development and strategic preferences, focussing on:

- planning and preparation
- treatment and packaging *(SO27, 32&36)*
- storage *(SO33,27)*
- disposal *(SO28,29,34&39).*

The key objectives of the Radioactive Waste Strategy *(ref 9)* are to:

- drive application of the *Waste Hierarchy* where it is practicable and appropriate to do so, recognising that hazard and risk reduction and nuclear safety priorities may limit its application in certain circumstances
- provide a robust and sustainable infrastructure, essential to the safe and effective delivery of the NDA mission by making best use of existing waste management assets and developing new fit for purpose waste management routes as required
- drive/facilitate changes in waste management behaviours and culture to ensure waste producers consider all stages of the *Waste Hierarchy*
- ensure waste management infrastructure is flexible to facilitate prompt decommissioning and remediation of facilities and sites, where appropriate
- enable risk-informed waste management with greater emphasis placed on the nature of the waste rather than classification, to aid in identifying the most appropriate management route
- enable a lifecycle approach to the management of radioactive wastes which will help identify the most appropriate waste management route, determined by the risk posed by the waste
- make radioactive waste ultimately disposable in a manner that protects people and the environment
- consider materials that may become waste in the future and understand the implications of such scenarios on both the existing waste infrastructure and the requirements, timing and need for new infrastructure.

The successful implementation of radioactive waste management strategies requires effective delivery by the SLCs with support from RWM, LLWR Limited and the wider supply chain.

Planning and Preparation

Planning and preparation is the first stage in the waste management lifecycle and is an ongoing, iterative process for each of the subsequent stages. The key activities that take place within this stage include waste characterisation, defining and managing the inventory, developing appropriate safety cases and waste management planning.

Effective planning and preparation provide a foundation for the continuing application of the IWM principles throughout the lifecycle. At this early lifecycle stage, opportunities are identified to enable the preferred approach to waste management in terms of application of the *Waste Hierarchy* and the requirement to use the best available techniques.

We expect our SLCs to identify and implement opportunities for managing wastes as soon as reasonably practicable. When making waste management decisions, our SLCs should use the *NDA Value Framework (ref 17)* to support the selection of a preferred option and to engage effectively with stakeholders, including regulators and local planning authorities. Identifying common waste management challenges and opportunities across the NDA group may allow efficiencies to be realised and, potentially, the sharing of infrastructure and expertise. Furthermore, an accurate and comprehensive waste inventory provides the information needed to ensure that waste management infrastructure can accommodate future waste arisings and support the NDA mission.

Developing a detailed understanding of the inventory we need to manage is a key part of planning and preparation and is essential to enable effective and efficient treatment, packaging, storage and disposal. In support of this, the NDA manages the production of the UK Radioactive Waste Inventory (UKRWI) *(ref 29)* on behalf of the UK government. Updated every 3 years, the inventory provides the best available information on all categories of radioactive wastes and materials to:

- inform policy, strategy evaluation and development
- aid radioactive waste and material management planning
- support stakeholder engagement
- enable the UK to meet international reporting obligations.

It is necessary that data used to compile the inventory is credible, collected in a consistent and efficient manner and presented appropriately to meet stakeholder needs. We will continue to work with government, regulators and the nuclear industry through our National Inventory Forum (NIF) to identify and implement areas for improvement. Delivery of improvements will be done collaboratively through an 'Inventory Improvement Programme', where we will assess the data that we collect and report through the inventory, as well as the current method for delivery.

Characterisation and understanding the inventory play an important role in the management of waste generated by site decommissioning and remediation *(see **Site Decommissioning and Remediation**)* and forms the basis of:

- planning
- identification of the extent and nature of significant radioactive and non-radioactive contaminants
- assessment of potential risks
- implementation of waste-informed decommissioning
- safety, radiological protection and protection of the environment
- cost estimation
- supporting decisions to release buildings and sites.

In recognition of the importance of characterisation, and based on feedback from our SLCs and regulators, we have developed guidance that details the principles, processes and practices that should be followed when characterising solid radioactive wastes. It is important to note that characterisation is not restricted to radiological aspects of the waste. An understanding of non-radioactive characteristics, such as chemotoxic and physical properties, is also essential to support waste management decision making.

To simplify our overall waste management approach we will require each of our sites to deliver an Integrated Waste Implementation Plan. This will replace the previous site Integrated Waste Strategy (IWS), setting out SLCs' approaches to managing the full range of waste they generate and will provide a clear link from NDA strategy to site implementation. In the near term we will work with the regulators and industry to develop a specification for the implementation plan, which will complement regulatory requirements such as a site-wide *environmental safety case* and waste management plan.

Until appropriate disposal facilities are available to accept HAW, we must package and store waste in a manner which is safe and secure *(SO33&37)* and will ultimately result in those waste packages being disposable. We have a disposability assessment process that enables us to progress the decommissioning mission while managing the risk to operations now and for future disposals. We will continue to evaluate our approach to the management of risk across the entire waste lifecycle to ensure the balance of risk is proportionate.

Treatment and Packaging

Treatment

The purpose of waste treatment is to process waste into a form to allow for its onward management including disposal, where routes are readily available, or for interim storage pending the development of suitable disposal routes. The *Waste Hierarchy* prioritises approaches to waste management based on their impact on the environment in terms of climate change, air quality, water quality and resource depletion. The application of the *Waste Hierarchy*, as a component of the *NDA Value Framework (ref 17),* also helps us to optimise the use of our limited disposal routes and capacity.

Typically, treatment can involve a number of steps and a range of technologies, including:

- sorting and segregation: where types of waste or material are separated or are kept separate, on the basis of radiological, chemical and/or physical properties, to facilitate waste handling and/or processing and to initiate the practical application of the *Waste Hierarchy*
- size reduction: a treatment method that decreases the physical size of an item, e.g. by cutting or crushing to make subsequent packaging or treatment easier
- decontamination: the removal or reduction of radioactive contamination by a physical or chemical process to achieve reclassification of the waste, to meet specific waste management facility acceptance limits or to reduce dose uptake for subsequent operations
- thermal/chemical/physical processes: to change the waste characteristics to facilitate subsequent management steps, such as recycling or disposal
- conditioning/immobilisation: changes the form of the waste so the resulting product can be safely handled, transported, stored and disposed of
- packaging: the process of loading waste into a container suitable for handling, storage (potentially long term), transport and disposal *(see **Case Study: Packaging**).*

The effective treatment and packaging of radioactive waste allows us to achieve our strategic preference to reduce overall waste volumes and maximise long term package performance. We require a toolkit of waste treatment options to allow optimisation and the efficient use of our management routes. In particular, we are driving the future implementation of thermal treatment technologies to support this strategic preference. LLWR Limited provides a range of existing services to help waste producers manage their waste throughout the lifecycle.

Recognising that encapsulation is still a significant part of our programme, our work is also focused on coordinating efforts across the NDA group, maintaining appropriate capability and developing alternative encapsulants that could offer operational or long-term performance benefits.

We will continue to drive technology development to help deliver a range of suitable treatment routes that enable the effective management of the variety of wastes in our inventory. We are leading industry groups to coordinate waste treatment opportunities for thermal treatment technologies, encapsulation techniques and the management of problematic radioactive wastes.

We have obligations to make the NDA's waste management infrastructure available to the wider nuclear industry where appropriate, e.g. access to LLW management services, HAW disposability advice and providing a route for HAW sealed sources where the use of our infrastructure would be the optimum route. We have also provided a waste treatment service for other UK producers of radioactive waste and will continue to investigate opportunities in this area where it can be demonstrated that this is the best option and is of overall value to the taxpayer.

Packaging

The packaging stage involves the use of waste containers that are designed to provide containment through subsequent phases of the waste management lifecycle. Containers need to meet the relevant requirements of the receiving facility and any transport that may be necessary.

Our SLCs are currently responsible for the selection of waste containers (existing or new) and consider on a case by case basis a number of factors including, but not limited to, the required design life, handling, storage, gas generation, and packaging and inspection requirements.

A wide range of containers are available for packaging radioactive waste. These include single use containers that enable radioactive waste to be packaged and treated for long-term storage and/or disposal, through to containers that are designed for multiple uses, e.g. on-site transfer, transport, storage and disposal.

Packaging also includes containerisation, which is the process of initially packaging waste following retrieval, for short-term storage pending pre-treatment or pending transfer for treatment and/or disposal. Containerisation can offer benefits in terms of acceleration of decommissioning programmes and the potential to simplify treatment and storage by not foreclosing future options.

The packaging of HLW is a well-established process with an advanced programme (SO36). The vitrified product is contained within a thin walled canister developed for long-term storage. These canisters have not been designed specifically for disposal and are assumed to require additional packaging before being considered suitable for disposal in a future *Geological Disposal Facility (GDF)* *(SO39)*.

We are now undertaking a strategic review of the current SLC approach to the selection of waste containers. This will support the development of more robust and fully underpinned strategies for the design, manufacture and use of waste containers across the waste management lifecycle. We will work with our SLCs, subsidiary organisations, regulators and the wider industry to develop an approach that provides confidence that decisions taken and adopted in relation to waste containers recognise the wider benefits to the NDA group to deliver cost and schedule savings without compromising safety or environmental protection.

Storage

Storage is defined as the holding of radioactive waste or material in a facility that provides for its containment with the intention of retrieval. LLW in the UK is generally disposed of as soon as practicable, since treatment and disposal routes are available. At times it may be necessary to buffer store some volumes of LLW to support treatment and/or disposal.

Where waste cannot be treated or disposed of immediately, storage facilities are required across the estate until a route becomes available. This could include an appropriate period of time for *radioactive decay* which may result in a change in waste classification. Storage facilities are a vital component of our waste management infrastructure and must be provided and maintained until suitable disposal facilities are available *(see **Asset Management**)*. The majority of our stores are for the storage of HAW and we have robust storage arrangements, coupled with a disposability assessment process, to provide confidence that packages will be disposable at the end of the storage period *(SO32&37).*

As well as the long-term storage of wastes on the site of origin, consolidation of packaged wastes from several sites to a single location may also achieve wider strategic benefits associated with release of land for other use *(see **Site Decommissioning and Remediation**)*, reduction in hazard and security levels and optimal use of infrastructure. Several examples are being implemented within the NDA estate, for example Magnox storage consolidation options and the transfer of certain wastes from Harwell to Sellafield for treatment and/or storage. Where wastes may be consolidated between sites, appropriate stakeholder engagement will be required.

It may be necessary or desirable not to foreclose options and to store containerised raw waste in modern interim storage facilities to enable decommissioning or to progress hazard reduction. Such facilities will need to comply with regulatory requirements. The waste packages may require an additional treatment step prior to final disposal and this could place different demands on the storage system.

We have reviewed and updated our storage guidance *(ref 38)* which describes the key elements of a robust approach to interim storage for HAW. A number of stores have already been constructed across the NDA estate and plans are in place for the future construction of stores.

Making the best use of existing assets and investigating store consolidation opportunities, where available, has the potential to provide cost and/or schedule benefits. In line with UK government and devolved administration policies and Committee on Radioactive Waste Management (CoRWM) recommendations, we will ensure that our strategy allows for safe and secure storage for a period of at least 100 years.

We are developing a research and development plan *(see **Research, Development and Innovation**)* with our SLCs and subsidiaries to ensure that we maintain a robust and fit for purpose storage infrastructure that appropriately supports our decommissioning and waste management mission. This is primarily done through the work of the Stores Operations Forum and application of the NDA's industry guidance on an integrated approach to the interim storage of HAW packages *(ref 38)* that this group continues to develop and promote.

Storage consolidation opportunities have been delivered and we will continue to actively consider where there is potential benefit for further work in this area. We continue to promote information sharing and knowledge transfer to support deployment of the interim storage facility (ISF) concept across SLCs.

Storage at Trawsfynydd

Disposal

Disposal is the final stage of the waste management lifecycle and is the emplacement of waste into an appropriate facility with no intention to retrieve it.

When applying the *Waste Hierarchy*, disposal is the least preferred option, and should only be pursued when all other options have been exhausted. However, we recognise that disposal of some waste will be necessary. We advocate a risk-informed approach to disposal *(ref 9)*.

We acknowledge that the timely availability of fit for purpose, sustainable disposal capability and capacity is essential as it enables us to deliver our mission. We need a broad range of disposal capability to manage the variety of radioactive wastes; this includes *in situ* management *(SO46)*, licensed landfills *(SO29)*, near-surface disposal and *geological disposal (SO28, 34&39)*.

The NDA group benefits from the availability of existing national disposal facilities, namely permitted landfills managed by the supply chain in accordance with the Waste Framework Directive *(ref 39)* and UK Resources and Waste Strategy *(ref 40)*, and the LLWR. However, we recognise that further capability and capacity will be essential to complete our mission. This broad capability is described in ***The Vision: The Disposal Capability Needed to Complete the Mission***.

In the 2016 UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry (*ref 2*), it was recognised that some HAW, particularly wastes containing short-lived isotopes or those wastes lying at the LLW-ILW boundary, may be more appropriately managed within the LLWR. We need to ensure our overall disposal system is optimised in line with UK and NDA strategic objectives and therefore the NDA is now actively exploring the opportunity to dispose of some ILW in the LLWR. We will work with LLWR Limited, local stakeholders, regulators, governments and waste producers to ensure a suitable way forward is supported by our key stakeholders. This first step is part of a wider near-surface disposal programme.

The Radioactive Waste Strategy *(ref 9)* discussed an initial technical study that was carried out to investigate strategic options for the near-surface disposal of some of the HAW inventory that does not require the isolation and containment provided by a GDF. Our strategic preference is to develop near-surface disposal capability which could provide an opportunity for a timely disposal solution to enable site decommissioning and, in particular, risk and hazard reduction programmes and will directly support Scottish Government's HAW policy *(ref 35)* and implementation strategy *(ref 36)*. There are 2 main near-surface disposal concepts that can be implemented:

- a surface vault facility
- a vault at some tens of metres depth, accessed from the surface, e.g. disposal silos.

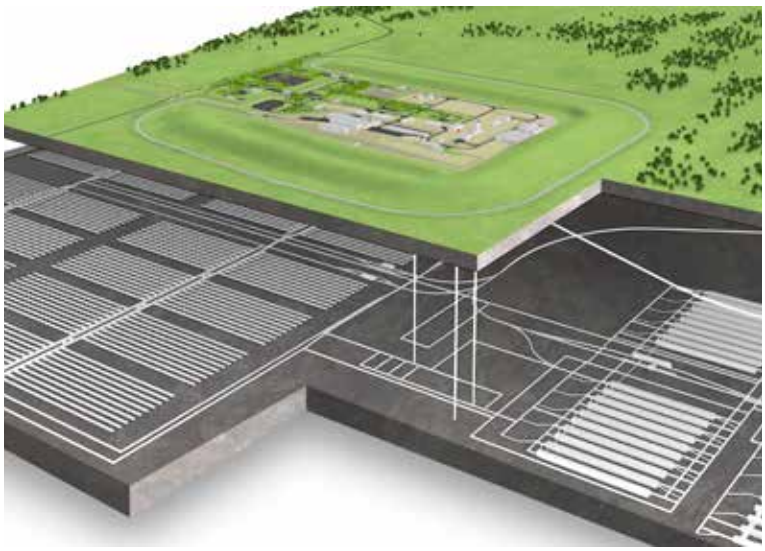
We will continue to investigate the technical feasibility of the 2 main near-surface disposal concepts that could provide capability for the UK *(ref 41).*

In December 2018, the UK government published 'Implementing geological disposal – working with communities: updated framework for the long term management of higher activity radioactive waste' *(ref 42)*. The policy document reaffirmed the UK government's policy for *geological disposal* of HAW and its commitment to working in partnership with communities that are willing to participate in the siting process. We will continue to provide effective support for the UK government's Implementing Geological Disposal Programme. RWM is the organisation responsible for the programme that delivers a GDF and it will continue to develop as an effective delivery organisation for *geological disposal.* The siting process for the GDF is in its early stages and ongoing. RWM continues to engage with people across the country to raise awareness and answer questions as we move to more formal engagement, when communities are ready to do so. To date, two formal working groups, one in Copeland *(ref 43)* and one in Allerdale, have been established *(ref 44)*.

On-site disposal is currently undertaken by some of our SLCs *(SO28)*. Sellafield Limited has an onsite facility capable of accepting some lower activity LLW and Dounreay Site Restoration Limited (DSRL) has constructed a LLW disposal facility adjacent to the site that currently accepts LLW from Dounreay and the neighbouring Ministry of Defence (MOD) Vulcan Naval Reactor Test Establishment.

The environment agencies have issued joint regulatory guidance *(ref 23)* for releasing nuclear licensed sites from radioactive substances regulation when all activities involving the generation and disposal of radioactive wastes have ceased. This guidance describes the range of options for radioactive waste management including on-site *in situ* disposal and disposal for a purpose ***(SO46)***. As described in our Site Decommissioning and Remediation theme *(see* ***Site Decommissioning and Remediation****),* we will develop on-site disposal capability where it is optimal to do so.

While we will investigate alternative approaches to disposal, where appropriate, we will actively work with our SLCs and the wider nuclear industry to establish new solutions for their wastes which minimises the need for disposal.



An artist's illustration of a Geological Disposal Facility (GDF)

VLLW disposal at a permitted landfill site

Case Study: Thermal Treatment

Significant progress has been made since our previous Strategy *(ref 3)* and we have been working closely with Sellafield Limited and the wider industry, investigating and promoting the use of thermal treatment technologies, delivering research and development to better understand the scale of potential benefits *(SO32)* *(see **Research, Development and Innovation**)*.

Thermal treatment technologies apply high temperatures to waste to destroy reactive components, reduce overall volumes and produce a stable waste form. The Thermal Treatment Integrated Project Team has carried out work to understand waste applicability, technology capability and economic aspects. We have undertaken demonstration trials using surrogate radioactive wastes to evaluate the technology and its ability to treat a range of wastes. Our trials programme has successfully processed inactive and active waste simulant under *nuclear site licence* conditions on the Sellafield site. This work is the first of its kind in the UK and has confirmed that significant volume reduction and waste passivation can be achieved for ILW streams.
We continue to work with Sellafield Limited to address cultural and technical challenges, and together we have developed a clear route to implementation of these technologies. We are providing leadership and investment to support Sellafield Limited in the implementation of a programme leading to development of future facilities for the treatment of UK wastes.

Case Study: Packaging

A range of waste containers are available to waste producers for the packaging of radioactive waste. This includes unshielded waste containers used in remote packaging activities that are stored in shielded stores. In recent years, waste producers have designed and utilised shielded waste containers to enable handling using conventional techniques to place packages into lightly shielded stores. This enables waste producers to optimise site funding, balancing container and operations costs with infrastructure costs attributed to stores.

Waste producers have historically designed and utilised waste containers to support specific programmes of work such as wastes generated from reprocessing activities at Sellafield and Dounreay, through to the packaging of operational waste from reactor sites. Prior to the formation of the NDA, there was little coordination in this area. Different designs were developed for container types, e.g. 500 litre drums and 3m^3 boxes. In recent years industry has increased the use of shielded containers, continuing the trend of more SLC-specific designs.

The NDA continues to work with waste producers to ensure that they are developing robust plans and to coordinate the development of fully underpinned strategies for the design, manufacture and use of all waste containers that take account of the whole waste management lifecycle. This ensures that decisions taken and adopted by waste producers in relation to waste containers recognise the wider benefits to the group of cost and schedule savings, without compromising safety.

The Vision: The Disposal Capability Needed to Complete the Mission

Application of the *Waste Hierarchy* to reduce the volume of waste being produced and divert waste through reuse and recycling minimises the amount of waste we have to dispose of. However, disposal of some waste produced from our mission is inevitable. To enable the disposal of all of the waste types generated there has to be a range of appropriate disposal capability and capacity in place. The range of capabilities is not a matter of operational convenience since each of the capabilities provides a degree of isolation and containment required to safely and cost-effectively manage the different types of waste. Our vision is to have a range of disposal options available to the waste producer, who can then select the most appropriate route in order to follow a risk-informed approach and ensure that waste packages are compliant for transport and waste acceptance. Optimising the use of our available disposal capability will ensure successful completion of our mission.

As the harmful properties of the waste increase, so do the safety functional requirements, driving associated engineering and cost. We need all of these disposal capabilities, not just one.

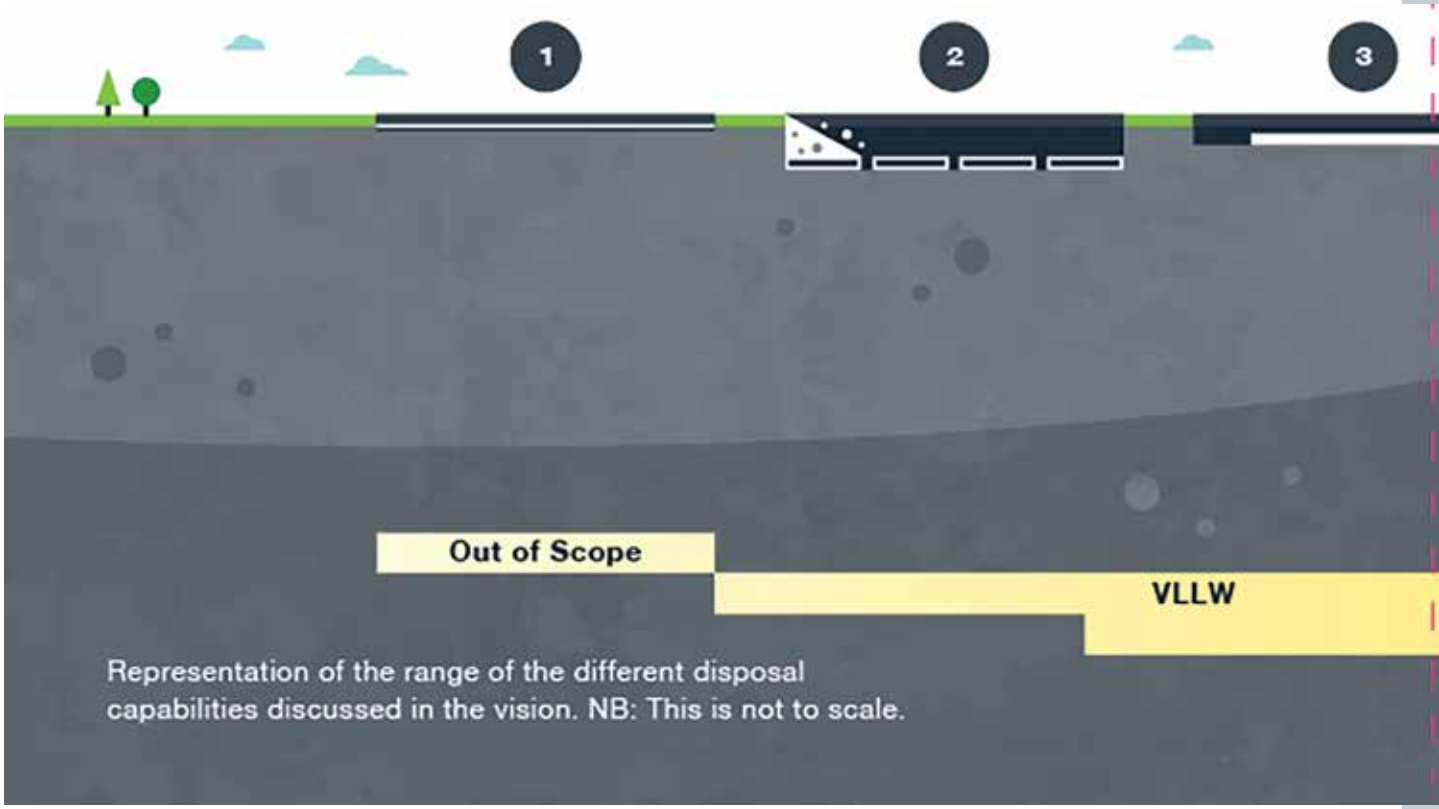
Non-Radioactive Waste Disposal 1

A small amount of the non-radioactive waste (including hazardous waste) produced throughout the estate will require disposal. Our SLCs engage with the supply chain and non-radioactive waste management organisations to dispose of these wastes.

***In Situ* Disposal / Disposal for a Purpose** 2

The disposal of radioactive waste must be optimised. All options need to be considered, including on-site disposal either *in situ* or for a purpose e.g. filling voids. Such disposals are regulated in accordance with the environment agencies' guidance on releasing sites from radioactive substances regulation *(ref 23)*. Any on-site disposals must be shown to be safe and provide the best outcome for the environment as a whole.

The types of waste that might be suitable for on-site disposal could have relatively low levels of radioactivity that require limited containment and isolation to ensure safe disposal. In addition, these wastes will generally comprise materials (such as concrete) that would normally remain on a site or be used for a purpose if they were non-radioactive wastes.



Representation of the range of the different disposal capabilities discussed in the vision. NB: This is not to scale.

Permitted Landfill 3

Permitted landfill is the disposal destination for some mixed municipal solid waste from households, commercial and industrial waste. Some landfill sites have been granted permits to dispose of Very Low Level Waste (VLLW) and some LLW along with non-radioactive waste. The types of waste that will be disposed of in such facilities contain very low levels of radioactivity that require limited isolation and containment to ensure safe disposal.

Near-Surface Disposal Facility

(i) At-Surface Disposal Facilities 4(i)

At-surface disposal facilities typically consist of a series of engineered concrete vaults, which may be covered. Waste packages, which have demonstrated that they meet the waste acceptance criteria for the facility, are emplaced in the vaults. The NDA operates 2 at-surface disposal facilities: the national LLW facility in West Cumbria and a facility in Caithness. The latter is only permitted to accept waste from the Dounreay site and the neighbouring MOD Vulcan Naval Test Reactor site. These facilities are currently in use for the disposal of LLW. The types of waste that will be disposed of in these types of facilities require a degree of engineering to provide isolation and containment.

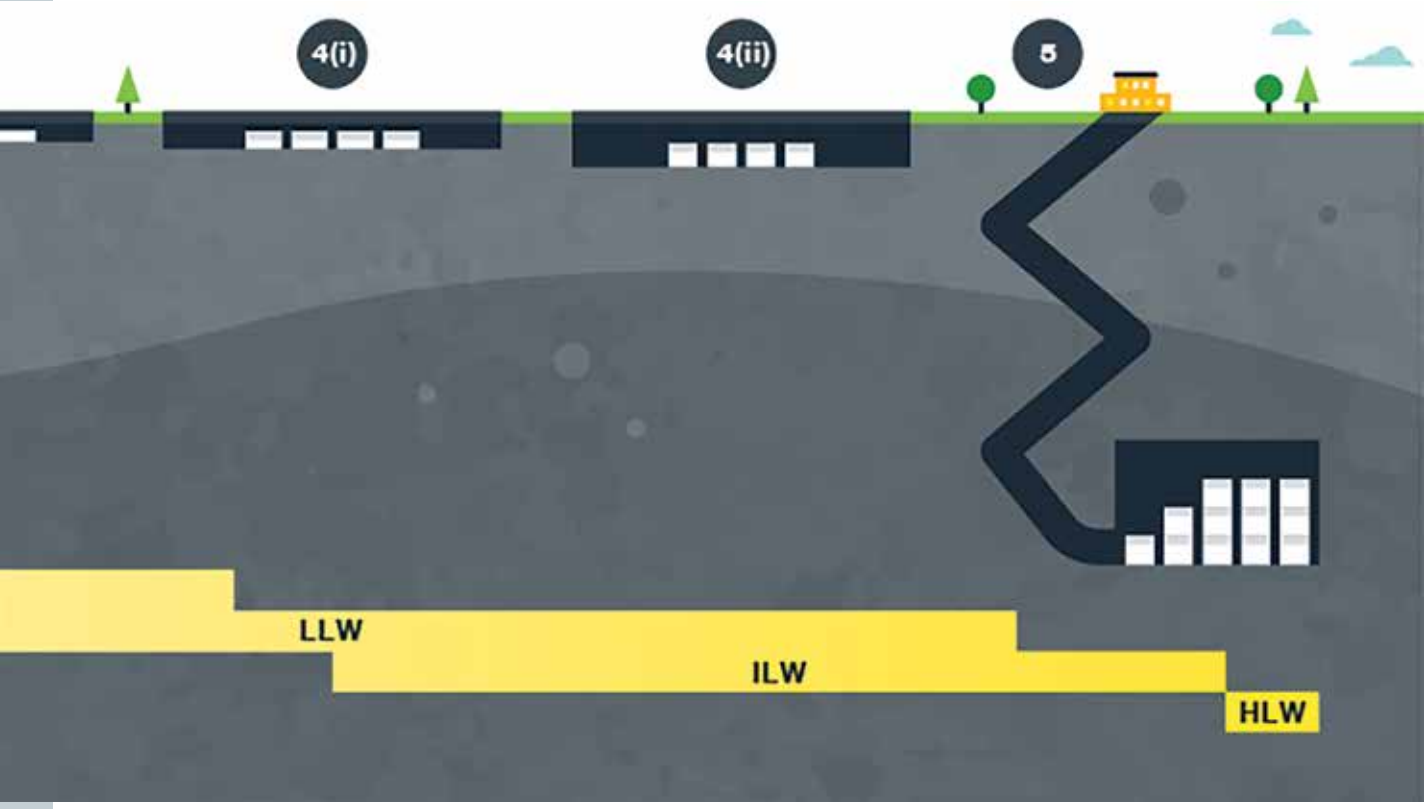
(ii) Disposal to depths of tens of metres 4(ii)

This type of near-surface disposal facility is typically positioned tens of metres below the surface and can be constructed as a series of rectangular vaults or as one or more conjoined silos. The types of waste that could be disposed of in this type of facility require a greater degree of containment and isolation from the surface environment.

Near-surface management is the current policy for disposal of HAW in Scotland. This could include the disposal of HAW in near-surface disposal facilities *(see Disposal)*.

Geological Disposal Facility 5

A GDF is a highly engineered facility capable of isolating radioactive waste with multiple protective barriers, deep underground, to ensure that no harmful quantities of radioactivity ever reach the surface environment. Some wastes will always require the containment and isolation provided by *geological disposal*. The UK and Welsh Government policy for implementing a GDF is based on working in partnership with local communities, following a community volunteering process. The Scottish Government is not participating in this project. A suitable site will only be taken forward if the local community supports it. This allows for communities to play an active role in determining their own long-term socio-economic development and prosperity. The types of waste that will be disposed of in this facility require significant containment and isolation over many thousands of years.



7.2 Liquid and Gaseous Discharges

Objective: *To reduce the environmental impact of radioactive liquid and gaseous discharges in accordance with the UK Strategy for Radioactive Discharges.*

Liquid and gaseous discharges are generated by SLCs during operations and decommissioning. They must be managed alongside other radioactive and non-radioactive wastes on a nuclear site.

The UK Strategy for Radioactive Discharges *(ref 45)* updates government policy and describes how the UK will continue to implement agreements reached at the 1998 Ministerial Meeting of the *Oslo and Paris Conventions (OSPAR)* Commission *(ref 46)* to protect the marine environment of the North-East Atlantic and subsequent OSPAR meetings on radioactive substances, particularly the Radioactive Substances Strategy (RSS) *(ref 47)*. In June 2018, the government published its review of the 2009 UK Strategy for Radioactive Discharges. The 2018 review *(ref 48)* of the 2009 UK Strategy for Radioactive Discharges (UKSRD09) stated 'this review demonstrates the clear evidence of progress being made by the UK in meeting the outcomes (not to be misinterpreted as targets) of the UKSRDS09 and contributing towards the objectives of the OSPAR Radioactive Substances Strategy'.

We have a significant role in the implementation of UKSRDS09 and consequently do not believe that a separate strategy for the NDA estate is either required or would add value.

Our Strategy

Before the COVID-19 pandemic impacted upon operations, spent fuel reprocessing was expected to be completed around the end of 2020 (see ***Spent Magnox Fuel***). Reprocessing of spent Magnox fuel restarted in October 2020 under COVID-19 secure working arrangements and, if performance is sustained, is expected to be largely complete by the end of 2021. The completion of reprocessing will be a significant step towards the reduction of radioactive discharges in the UK.

We require our SLCs to implement the UK Strategy for Radioactive Discharges *(ref 48)* and comply with relevant UK legal requirements. These are driven by the following general principles:

- unnecessary introduction of radioactivity into the environment is undesirable
- sustainable development
- use of *Best Available Technique (BAT)* in England and Wales and *Best Practicable Means (BPM)* in Scotland
- the 'precautionary principle' which allows for decisions to be made in situations where there is evidence of potential harm in the absence of complete scientific proof
- the 'polluter pays' principle where those responsible for producing the waste bear the costs of prevention, control and reduction measures

- the preferred use of ‘concentrate and contain’ in the management of radioactive waste over ‘dilute and disperse’ in cases where there would be a definite benefit in reducing environmental pollution
- application of the *Waste Hierarchy* and BAT to minimise the activity of aqueous and gaseous radioactive waste disposed of by discharge to the environment
- recognition of the requirement for flexibility to ensure that hazard and risk reduction activities are not compromised.

If there is any significant change in our predicted arisings we will need to engage with government and other stakeholders early to determine the appropriate way forward.

We recently co-developed and published an aqueous waste management good practice guide. We will continue to work with the nuclear sector to develop and maintain industry good practice guidance for the management of liquid and gaseous discharges.

We have renewed focus on delivering our overall mission sustainably and our SLCs are exploring ways in which this can be supported through more sustainable management of liquid and gaseous discharges. We will continue to work across the NDA group and with regulators to develop more sustainable ways of managing liquid and gaseous discharges.

Strategy Development

The NDA will assist the UK government throughout 2021/22 in understanding OSPAR-related commitments. The OSPAR Radioactive Substances Strategy 2020-2030 is currently in production. Our current understanding is that production of the UK’s 8th BAT report to the OSPAR commission will commence in 2023/24.

Delivery

Liquid and gaseous discharges must be managed alongside other radioactive and non-radioactive wastes on a nuclear site. Waste management decisions remain the responsibility of the SLCs, in accordance with the regulatory framework. This requires robust decision making based on a wide range of criteria, informed by UK policy and strategy.

Dounreay site

7.3 Non-Radioactive Waste

Objective: *To reduce waste generation and optimise management practices for non-radioactive wastes at NDA sites.*

NDA sites currently generate non-radioactive wastes including demolition rubble, packaging, paper and food waste. As we make progress with our site decommissioning and remediation *(see **Site Decommissioning and Remediation**)*, the volumes of non-radioactive wastes generated will significantly increase and we will need to have in place effective and expeditious ways of managing these wastes. Some wastes will be hazardous and their properties will need to be carefully considered in terms of handling, processing and, where necessary, disposal e.g. asbestos.

This strategy covers wastes from a nuclear site that have not come into contact with radioactive contamination, and wastes that have radioactivity levels which are so low that they are not in scope of radioactive substances regulation but fall under non-radioactive waste legislation. The UK has a well-established regulatory regime for the management of non-radioactive wastes that we will comply with when managing these wastes.

Our Strategy

Waste management strategies have been developed at national, regional and local level by the UK government, the devolved administrations and planning authorities. We expect our sites, and their chosen supply chain partners, to implement these strategies and lead the way in effective waste management where there are established practices and principles that support the delivery of these strategies:

- use the *Waste Hierarchy* for the management of non-radioactive waste, including hazardous waste
- use suitable decision-making criteria, e.g. BAT or BPM to ensure effective application of the *Waste Hierarchy*
- apply a rigorous approach to waste characterisation and segregation
- identify and use appropriate waste management routes
- take account of the proximity principle which aims to manage wastes in the nearest appropriate facilities.

We require our SLCs to follow these principles and industry practices to ensure full regulatory compliance. In addition, we now expect our SLCs to adopt affordable and fit for purpose design, build and operations that support sustainability goals in all of our new facilities. The NDA group should consider incentivising desirable waste management activities, e.g. a *circular economy* and the target to 'eliminate avoidable waste by 2050' *(ref 40).*

Strategy Development

The NDA's aim is, wherever possible, to eliminate further arisings of radioactive waste and minimise the volumes of non-radioactive wastes. To ensure the NDA is a leading authority, we will seek further learning and input from other sectors to inform our waste management plans. To complete our mission, the SLCs will need to build many new facilities and due consideration of the design, build and facility operations will need to take account of material use and management principles that embrace the *Waste Hierarchy* and sustainability goals that also present value for money.

Delivery

We will undertake a strategic review of the way non-radioactive wastes are currently managed, the robustness of our plans for the future and our ability to deliver the aspirations of relevant strategic initiatives, e.g. UK Resources and Waste Strategy *(ref 40).* We will seek ways to further optimise our approach, taking account of good practice across the group and also within other relevant sectors. We will continue to work with SLCs, regulators and stakeholders, including local authorities, to ensure appropriate management of non-radioactive wastes. We will make an assessment of current and future plans and implement new solutions where it is appropriate to do so. This should include reuse of waste material generated within the estate for future purposes on our sites, e.g. excavated material for void filling instead of importing new, clean material.

Excavated spoil being loaded

Waste awaiting processing

Waste loaded for transfer offsite

All images from the Harwell LETP Land Remediation Project

8.0 Critical Enablers

Objective: *Delivery of our mission is only possible through a stable and effective operating environment.*

The strategic themes presented earlier *(see **Site Decommissioning and Remediation**, **Spent Fuels**, **Nuclear Materials** and **Integrated Waste Management**)* are about ensuring that we make the right strategic decisions to best deliver our mission – we call this 'doing the right thing'.

We recognise, however, that we can only be successful if we have the right strategies that enable the delivery of our mission. We call these strategies the Critical Enablers. The Energy Act (2004) *(ref 1)* also recognised this and placed a responsibility on the NDA to develop skills *(see **People**)*, carry out research and development *(see **Research, Development and Innovation**)*, engage with our stakeholders *(see **Public and Stakeholder Engagement**)*, develop the supply chain *(see **Supply Chain**)* and operate with due regard to the socio-economic circumstances *(see **Socio-Economics**)* within our local communities to establish the conditions for successful mission delivery.

In our previous Strategies *(ref 3,4,5)* we identified that we would need to define our strategic approach in a number of areas to ensure that once the 'right thing' has been identified it can be delivered effectively and efficiently, building on shared experiences, learning and synergies and delivering economies of scale and consistency where possible. The Critical Enabler topic strategies will continue to evolve as our operating environment inevitably changes and our mission progresses.

Our previous Strategy *(ref 3)* included a topic strategy for Health, Safety, Security, Safeguards, Environment and Quality (HSSSEQ) with a strategic objective to reduce the inherent risks and hazards of the nuclear legacy by proportionate application of contemporary standards and improving environment, health, safety and security performance across the NDA estate. Due to changes in context we have decided to disaggregate HSSSEQ. Health, safety and environment are covered under one topic strategy with the addition of wellbeing and new topic strategies are proposed for Sustainability, Security and Resilience and Cyber Security. With the UK's exit from the European Union, safeguards arrangements are changing and we recognise that a new strategic direction for safeguards is required. The topic strategy for Safeguards will be developed as we gain a better understanding of the future regulatory framework and operational requirements *(see **The Vision: Nuclear Safeguards**)*. The principles of quality management and *continuous improvement* underpin everything we do, and we will ensure we continue to improve our performance in this area and explore and embed good practice as appropriate to improve delivery of our mission. Quality, which used to form part of the HSSSEQ topic strategy, is now embedded in the One NDA way of working to ensure effective and efficient delivery of the mission.

Our Strategy

Our Critical Enabler topic strategies are woven into the other strategic themes for ***Site Decommissioning and Remediation***, ***Spent Fuels***, ***Nuclear Materials*** and ***Integrated Waste Management*** to support their delivery *(see fig 11)*. The future pace of Critical Enabler development continues to be driven by the needs of the mission.

Our Critical Enabler topic strategies differ in both maturity and urgency of need. A number of the Critical Enabler topic strategies have been updated and new strategic objectives have been identified. For some topics, group-wide shared outcomes have been identified and are being pursued through One NDA to ensure effective and efficient delivery.

There is urgency to progress some of our Critical Enabler topic strategies to respond to the change in emphasis on *sustainability* and how this might fundamentally affect delivery of our mission. While our *Site Licence Companies (SLCs)* and subsidiaries are developing their own sustainability strategies, the NDA has a role in promoting approaches to cross-cutting government policies such as *net zero greenhouse gas emissions* and specific priorities such as the role of *Small and Medium Enterprises (SMEs)* in government supply chains and socio-economic aspects of our group activities. This work is ongoing and we are becoming more proactive in delivering these important shared outcomes.

While the Critical Enabler topic strategies are driven by the needs of ***Site Decommissioning and Remediation***, ***Spent Fuels***, ***Nuclear Materials*** and ***Integrated Waste Management***, from time to time they need to be considered in more detail. For instance, transport has been identified as critical for our mission. The existing transport infrastructure, systems, processes and skilled workforce have been in place for a significant period and continue to deliver on the needs of the driving themes. While the need for timely and efficient transport has not gone away, transport needs are changing. We have decided to take this as an opportunity to reorganise our transport capability so that it will be able to best respond to our short, medium and long-term needs.

In other areas, the development of Critical Enabler topic strategies is driven by requirements placed on us by others, such as the Public Accounts Committee (PAC) requirement for a new socio-economic and local impact strategy *(see **Socio-Economics**)*.

The development of our Critical Enabler strategies is an ongoing process and we will continue to adapt the topic strategies and our strategic approaches to meet the needs of the mission and our stakeholders.

Figure 11 - The components of our strategy

8.1 Health, Safety, Environment and Wellbeing

***Objective:** To improve health, safety, environment and wellbeing across the NDA group.*

The Energy Act (2004) *(ref 1)* requires the NDA to put in place measures for the protection of the environment and safety of people, secure the adoption of what we consider to be good practice and give encouragement and support to activities that benefit the social or economic life of communities living near our sites. The Health, Safety, Environment and Wellbeing (HSEW) strategy has been developed collaboratively across the NDA group to support these obligations. Delivery of the strategy will differ across the businesses.

To improve health, safety, environment and wellbeing performance across the NDA group we have chosen to discharge our obligations by monitoring, audit and review at SLC and subsidiary level. This approach, which continues to be an essential part of our governance arrangements, has allowed us to manage operational risks and maintain our role as an intelligent customer for safety, health and environmental performance.

All employers have a general duty to look after the welfare of employees under the Health and Safety at Work Act (1974) *(ref 49)* and to assess and manage risk to their staff under Management of Health and Safety at Work Regulations (1999) *(ref 50)*. This includes assessing and minimising the risk of stress-related illness. In the UK, the extent of poor mental health at work and the effect this was having on the workforce and economy prompted the UK government to commission the Stevenson / Farmer review of mental health and employers. In 2017, the findings of this review were published in the Thriving at Work report *(ref 51)*. A number of recommendations, including mental health standards, were identified and government called for these to be implemented by public bodies.

Our Strategy

Day to day operations across the NDA group remain in the control of the *nuclear site licence* holders, environmental permit holders and our subsidiaries. The NDA will always ensure that nothing it does compromises the ability of its SLCs to meet their regulatory obligations. To achieve improved health, safety, environment and wellbeing performance our strategy is to set expectations of excellent standards of performance, *continuous improvement*, good practice and learning from industry.

Reducing the inherent risks and hazards of the nuclear legacy remains the purpose of the NDA. To achieve this, our strategy is to apply proportionate approaches through the application of appropriate standards and good practice to ensure SLCs can demonstrate regulatory compliance with principles such as *As Low As Reasonably Practicable (ALARP), Best Practicable Means (BPM)* and *Best Available Techniques (BAT).*

We aim to be recognised as a leading environmental remediation organisation. Our environment strategy is developing and we are working towards a low carbon future and improved environmental outcomes to ensure that our mission outcomes are delivered in an environmentally sustainable manner (see ***Sustainability***).

Our strategy for health and wellbeing is to provide a supportive working environment across the NDA group by actively promoting and working with our employees and trade unions *(see **People**)* to develop and implement policies and standards with employee health and wellbeing at the forefront.

To protect mental health and wellbeing, we will implement the recommendations of the Thriving at Work report *(ref 51)*. In addition, the group needs to have an awareness of and the tools to address and prevent mental ill health caused by work and ensure that all our people have the knowledge and confidence to be able to look after their mental health and that of others.

Strategy Development

We will review existing standards and develop good practice guidance for safety with emphasis on risk areas such as asbestos, demolition and contractor controls collaborating across the NDA group and beyond. We will support our SLCs to adopt relevant good practice guidance to deliver our mission. In doing so, we will consult with our stakeholders and benchmark our delivery against nuclear operators and other industries worldwide *(see **International Relations**).*

We will improve our understanding of what the mission will mean for the environment and have plans in place to protect and enhance it, reducing our impact as far as is reasonably possible. We will develop a culture which recognises both short and long-term environmental protection and improvement in decision making.

We will implement all 10 of the Thriving at Work *(ref 51)* standards to improve and protect the mental health and wellbeing of people across the NDA group.

Delivery

In delivering our HSEW strategy, we have adopted a systematic and integrated approach to the management of our business and are committed to working in accordance with OHAS 45001: Occupational Health and Safety *(ref 52),* ISO 9001: Quality Management Systems *(ref 53),* ISO 14001: Environmental Management Systems *(ref 54).* We are also committed to continuously improve performance and to develop our integrated management system processes and activities.

We have reviewed health, safety and environmental improvement programmes developed across the group and identified opportunities for shared programmes, common themes and the potential to use industry good practice. We have translated this into a 3-year health, safety and wellbeing improvement programme *(see table 3)* and will be developing a detailed plan for the delivery of our environment strategy.

To deliver the mental health and wellbeing strategy, we will implement the standards of the Thriving at Work review *(ref 51).* We will champion mental health and wellbeing, and encourage all businesses to deliver on their mental health and wellbeing improvement programmes. The One NDA Mental Health Delivery Group (MHDG) brings consistency in approach to mental health and wellbeing and enables shared learning across the NDA group. We will ensure that mental health and wellbeing is explicitly recognised in policy across the NDA group and that improvement programmes are delivered. We are building a community within the NDA group to establish and develop mental health and wellbeing networks, through leadership events, to share examples of mental health and wellbeing excellence/good practice. We will raise awareness through participation in national awareness events such as Mental Health Awareness Week and World Mental Health Day. We are embedding mental health and wellbeing into NDA group HSEW reporting.

Shared Programmes	Shared Themes	Development of reporting
Safety culture of a high reliability organisation	Improving leadership and talent growth	Subject matter expert-led HSEW assurance
Policy and standards for the control of risks to the safety of people affected by our work	Radiological protection	Benchmarking
Reduced environmental permit non-compliances by 2021	Improvements to asbestos management	Reporting HSEW performance
Implementation of the 10 recommendations of the Thriving at Work report (the Stevenson/Farmer review of mental health in the workplace)	Safety representative engagement	

Table 3 - HSEW focus areas

Decommissioning work being carried out at the Dounreay Materials Test Reactor

Case Study: Mental Health and Wellbeing

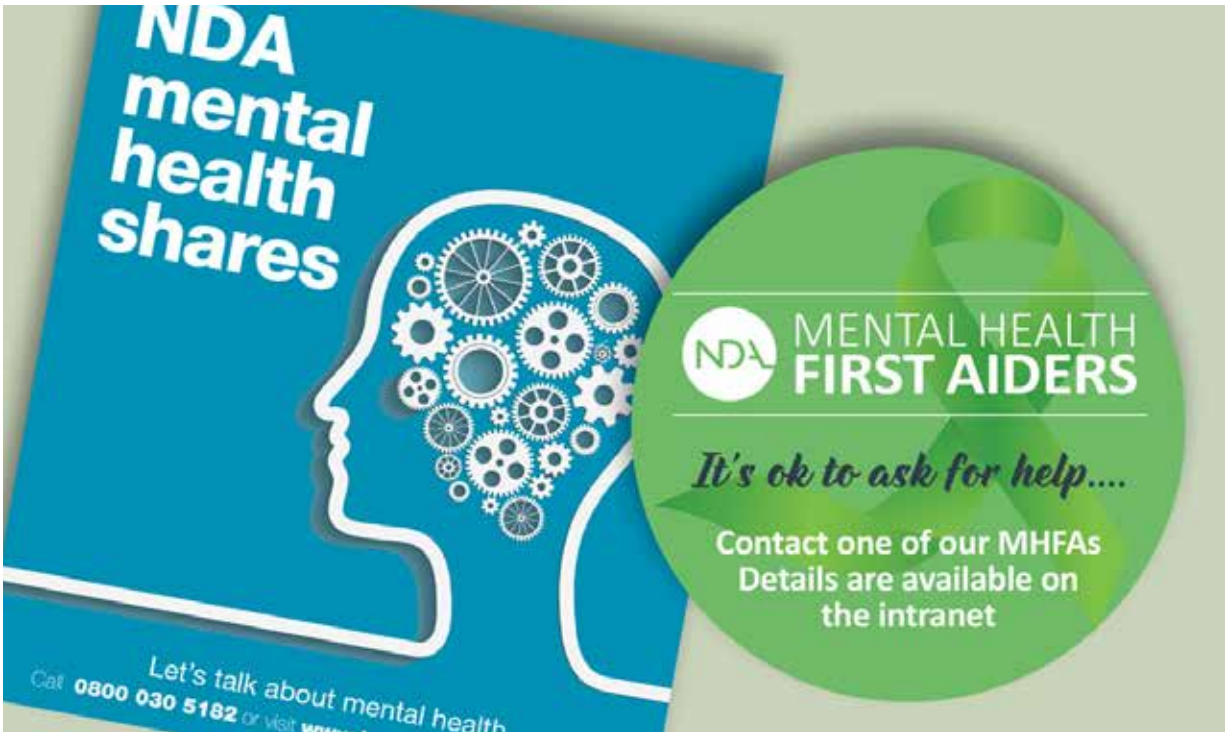
The health and safety of our people and communities is at the heart of everything we do, with mental wellbeing regarded as being as important as physical safety. A group-wide project was launched last year to help everyone feel more able to talk openly about mental health in the workplace and ensure that our people understand how to access help if they need it.

In 2019, the importance of mental health and wellbeing was firmly placed at the top of the NDA group employee agenda and given special project status and group-wide focus. With the ambition of embedding a strong mental health culture, a delivery group was formed to set strategic direction and share good practice and resources.

The project group has since committed to standardising our Employee Assistance Programme, collaborated on national awareness campaigns and developed a consistent way to measure success in this area. Each business has also committed to meet the standards set out in the Thriving at Work report *(ref 51)* and progress is reported at quarterly performance reviews.

Strong leadership is a key factor in ensuring that mental health is embedded in our culture and executive leadership is represented in each of our businesses. Mental health first aiders have been put in place by most businesses in the group, with 14 trained individuals in the NDA. Their role is to signpost people to support and encourage them to speak up about mental health and seek help if they need it. We have also enlisted the guidance and support of charities like Mind and Samaritans, with people across the group fundraising to support their important work.

Early signs are showing that the focus on mental health is starting to pay off. A recent survey carried out across the NDA group showed a 30% increase in people who responded and agreed that mental health is openly discussed in the workplace, compared to 2 years ago. The survey also showed that 91% of respondents know how to access support if they need it. Marking the success of the project so far was a major highlight of our first ever NDA group Safety and Wellbeing Awards in 2019.



Some of our mental health campaigns and initiatives

8.2 Sustainability

Objective: *To ensure that our mission outcomes and the journey to deliver them are sustainable.*

Our mission is to complete the clean-up of our legacy sites and release them for beneficial reuse. In doing this, we will deliver sustainable outcomes for the nuclear sector by maintaining the capability to decommission and remediate redundant nuclear assets, addressing our existing nuclear sites and providing for long-term material storage and disposal safely and cost effectively so as to maintain the trust and support of the public.

We are committed to the UN Sustainable Development Goals (UN SDGs) *(ref 16)* which are the blueprint to achieve a better and more sustainable future for all.

The 17 United Nations Sustainable Development Goals (UN SDGs) *(ref 16)* demonstrate the breadth of sustainability and address the global challenges we face including those related to poverty, inequality, climate change, environmental degradation, peace and justice, all of which resonate with the role of the NDA. In 2015, the UK government committed to the delivery of the UN SDGs by embedding them in the planned activity of each government department.

Our current approach to *sustainability* is based on the Brundtland definition of meeting the needs of the present without compromising the ability of future generations to meet their own needs *(ref 55)*. We will continue to refine our approach as our strategy develops but we anticipate that UN SDGs and SDG 13 on climate action will play a fundamental role in promoting improved outcomes through the delivery of our mission.

The 17 United Nations Sustainable Development Goals

Our Strategy

Our mission supports the needs of present and future generations by ensuring nuclear risks are managed safely and that land and assets are made available for their beneficial reuse. These sustainable outcomes are currently reflected in the specific considerations of our topic strategies *(see **Site Decommissioning and Remediation**, **Integrated Waste Management**, **HSEW, Security and Resilience, Research, Development and Innovation, Asset Management, Supply Chain and Socio-Economics**).*

Our ambition is not only to seek sustainable outcomes from our mission, but also to deliver our mission sustainably by integrating our strategies and seeking improved outcomes to minimise the impact on the ability of future generations to meet their own needs.

Strategy Development

Our sustainability strategy is developing and its emphasis will change over time as our mission progresses. In the short term, we are making specific efforts to measure our carbon footprint consistently across the NDA group and determine the impact of mission delivery on that footprint to identify additional opportunities for decarbonisation. In the medium to long term, ongoing collaboration on our technical grand challenges *(see **Research, Development and Innovation**)* will generate further opportunities to improve the sustainability of our mission delivery.

We will develop a sustainability strategy that will reflect the sustainable outcomes of our mission and aim to integrate our other strategies to tackle sustainability challenges *(see **Current Context**)*.

We will work together across the NDA group and with our stakeholders *(see **Public and Stakeholder Engagement**)* to identify ambitious goals and seek opportunities to reduce the timescales of the mission without compromising nuclear safety. We will set out our priorities and when they will be achieved in a sustainability plan. We will work with the Nuclear Industry Liaison Group to promote best practice in *sustainability* across the sector and continue to work with our supply partners to embed sustainability principles in our procurements *(see **Supply Chain**)*.

Decarbonisation of our mission is one of our sustainability challenges. We will develop and deliver a carbon reduction strategy in order to support the UK's commitments on carbon net zero and we will also work across the NDA group to develop climate change adaptation plans *(see **Security and Resilience**)*. We are currently analysing how our carbon footprint will change as our mission progresses and setting science-based targets to help us achieve net zero by 2050 (or sooner). We will develop a roadmap that will outline the practical measures we can take including working more efficiently, decarbonising where we can (e.g. construction methods and asset care), identifying interim opportunities for the use of our land for low carbon power generation and biodiversity projects, reducing our travel and influencing behaviour for the best environmental outcome. As we progress, we will collaborate with local authorities and take due account of their plans. We will be working with our supply chain to promote carbon reduction. Where necessary, we will support research to enable low carbon alternatives to materials such as concrete *(see **Research, Development and Innovation**)*.

We also recognise that if we are unable to avoid producing greenhouse gas emissions, due to the unique challenges of our decommissioning mission, we may need to 'offset' emissions. Where we need to do so, we will prioritise offsetting through the removal of carbon from the atmosphere, for example by planting trees or restoring peatland or supporting carbon capture.

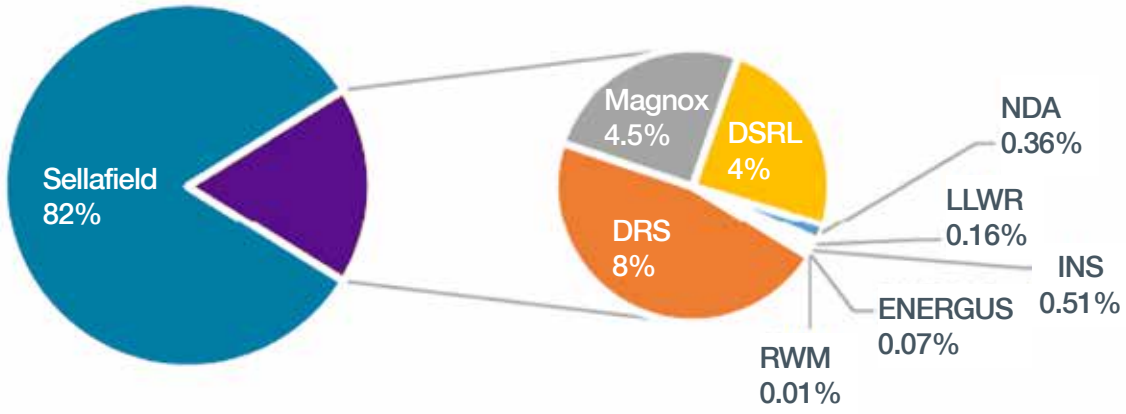
Carbon Net Zero

Carbon net zero is a key project for the NDA. We have used the Greenhouse Gas Protocol to map the NDA group carbon footprint for a baseline year of 2019/20 and this equates to 1,046,950 tonnes of CO_2e.

Scope 1 (direct emissions) and Scope 2 (indirect emissions from the purchase of electricity) account for 33% for our CO_2e emissions as detailed below (340,296 tonnes). As is to be expected, Sellafield is the biggest contributor to our group emissions, largely due to its Combined Heat and Power Plant and steam generating boiler park. Scope 3 emissions (other indirect emissions, such as from commuting, business travel, purchase of goods and services) account for the remaining 67% CO_2e (706,652 tonnes). Our construction activities dominate these emissions and reinforce the importance of low carbon construction to the delivery of our carbon reduction ambitions.

As decommissioning progresses across the estate, the NDA group carbon footprint and source of emissions will change.

% emissions by business unit



Delivery

We will deliver our sustainability strategy through leadership, engagement, collaboration and group-wide processes, for example by using the *NDA Value Framework (ref 17)* for decision making. We will use indicators and metrics to measure our performance and ensure that *sustainability* is integrated in our processes in a consistent and transparent manner.

We will continue to work across the NDA group to deliver our carbon net zero targets.

We will play our part in delivering UK government and the devolved administrations' policies and strategies such as implementation of the UN SDGs *(ref 16)*, the 25 Year Plan to Improve the Environment (*ref 12)*, the Clean Growth Strategy *(ref 11)*, the wellbeing of future generations commitments in Wales *(ref 56)* and the nuclear sector plans in Scotland *(ref 20)*, as we commit to protect and enhance the environment and biodiversity.

We will periodically report on our progress *(ref 57)* and engage on our sustainability journey with relevant stakeholders as appropriate (see ***Public and Stakeholder Engagement***).

8.3 Security and Resilience

Objective: *To provide proportionate security and resilience solutions throughout the decommissioning lifecycle.*

Security is a fundamental element of all civil nuclear operations. We are committed to protecting nuclear facilities, information, materials in use, storage in transit and transport to meet all legal and treaty requirements for example, Nuclear Industries Security Regulations 2003 *(ref 58)* and the International Atomic Energy Agency (IAEA) Convention on the Physical Protection of Nuclear Material *(ref 59)*.

Our security approach is based on a UK government reviewed threat and risk assessment for civil nuclear sites. The NDA group has undergone a series of security enhancement programmes to further improve the protection of our nuclear assets, significantly increasing security capabilities. In addition, the regulatory landscape for security has shifted from prescriptive security requirements to outcome-focussed regulation; this change encourages a risk-based approach to asset protection evidenced by the development of a strong security case.

The move to outcome-fcoussed regulation presents the NDA group with an opportunity to regularly review security requirements throughout the decommissioning process. This will create a dynamic approach to the provision of high quality but proportionate security arrangements that considers the current risks associated with each site or transport carrier.

We recognise the many threats that face the NDA and its supply chain, from cyber attacks, data breaches and Information Technology (IT) system failures to extreme weather conditions, global pandemics and terrorism. Business resilience is the ability of an organisation to quickly adapt to disruptions while maintaining continuous business operations and safeguarding people, assets and reputation. The NDA enables a group-wide focus on resilience to provide a coordinated approach where appropriate, such as for multi-site incidents.

Our Strategy

Our current Security and Resilience (SAR) strategy meets national regulations, with due regard to international agreements and good practice guidance.

Our strategy brings the NDA businesses together, taking a group-wide approach to SAR in order to improve collaborative working and, where appropriate, implement a shared approach to security arrangements.

Our aim is to ensure that the NDA group will become a leading UK SAR organisation where learning is captured, shared and utilised to continuously improve our SAR arrangements.

Strategy Development

Whilst our previous security enhancement programmes provide a stable baseline, our future SAR needs mean that we will consider new approaches that utilise the latest technologies to supplement, support and potentially replace existing SAR solutions. Over the next 5 years, we will seek to establish and deliver innovative security solutions that provide a more pragmatic and flexible approach to maintaining and supporting secure sites and a secure working environment. The strategy will concentrate on 4 key areas:

1. **Delivering proportionate risk-based SAR solutions to support the NDA mission.**

We will challenge the status quo, regularly reviewing our SAR arrangements to ensure our risk assumptions are accurate. Through the development of strong security cases we will adopt a dynamic approach to SAR delivery in order to protect our assets.

We will explore innovative SAR solutions for the NDA group and, where appropriate, use new technologies to supplement, support and enhance SAR capabilities and potentially replace existing security solutions in line with significant risk reductions during the decommissioning process (e.g. where sites no longer hold hazardous materials).

We will simplify and standardise SAR processes and procedures across the NDA group.

We will provide secure gateways that support the NDA mission through the development of solutions that enable safe and secure working practices.

We will provide clarity of SAR requirements needed to support working practices, placing greater emphasis on individual responsibility.

2. Improving SAR culture in the NDA group.

We will continue to develop and encourage improvements in the NDA group SAR culture (e.g. supporting group initiatives and shared learning).

We will encourage the development and delivery of proportionate SAR solutions (e.g. a higher paid, better trained security guarding service provides value for money, which in turn improves retention and reduces recruitment costs).

3. Providing assurance that the NDA group's SAR measures are fit for purpose.

We will set clear boundaries within the NDA group to define working relationships and expectations *(see **People**)*.

We will hold the NDA group SAR functions to account through regular engagement and site visits as part of an assurance programme. Observation, participation and comparative analysis of SAR activities will allow informed challenge through which we will encourage shared learning and *continuous improvement* across the group.

We will encourage wider stakeholder engagement that supports and includes the NDA group SAR community (e.g. at government fora).

We will continue to improve and further develop SAR accountabilities.

4. Support national resilience response and recovery capabilities.

We will support government departments to improve national response and recovery capabilities and contribute to local and regional resilience fora.

Delivery

Since our previous Strategy *(ref 3)*, we have made significant investment across the group, upgrading our security to take account of the dynamic security landscape. To deliver on the objectives of the SAR strategy we will need to ensure effective engagement with NDA internal functions; the NDA group SAR community; and external stakeholders such as the Office for Nuclear Regulation (ONR), Department for Business, Energy and Industrial Strategy (BEIS) and local resilience forums.

The delivery plan includes a SAR assurance programme that regularly engages with the NDA group SAR community (e.g. attending site exercises and holding regular progress meetings with SAR teams). In addition, an NDA group supply chain audit service will provide assurance that our supply chain partners have sufficient protective measures in place to protect the NDA's assets. This initiative greatly reduces security risks in the supply chain, while marking a step change in our approach to SAR through shared service capability.

The NDA SAR team will further support the NDA group SAR community through representation at a variety of government fora in addition to chairing internal fora where required. Our current approach is to set NDA group expectations and standards, add value by providing a group-wide overview and to deliver assurance and improvements in all SAR activities.

8.4 Cyber Security

Objective: *Proactively deter, detect, defend against, recover from and be resilient to both current and evolving cyber threats.*

The government assesses cyber attacks on the UK as a major threat to national security. Nation states and organised cyber criminals continue to target UK citizens and industry. The UK government's National Cyber Security Centre (NCSC) has publicly highlighted the unique threat to the UK energy sector, with more specific advisories concerning civil nuclear.

The Civil Nuclear Cyber Security Strategy (CNCSS) *(ref 60),* published by BEIS in 2017, set out a path over 5 years to keep the sector ahead of the rapidly evolving threats.

The ultimate cyber security risk to the NDA group is that it will suffer a radiological release as a result of a sophisticated attack. This risk is closely followed by the threat to sensitive nuclear information which duty holders are legally required to protect under the Nuclear Industries Security Regulations 2003 *(ref 58)*. However, the lesser operational and business impacts of disrupted service, and the theft of personal or financial data also have the potential to seriously erode confidence in the nuclear sector.

Our cyber security strategy is well established, but requires further integration with organisational and operational planning across the whole NDA group. The nature of the threat continues to change and is so prevalent that we have established a group-wide programme (Cyber Security Resilience Programme (CSRP)) to ensure that we become an increasingly harder target for those who seek to do harm to our businesses or our sites. We will ensure that we can collectively protect ourselves, detect cyber incidents early and have mature response and recovery plans to minimise disruption to our core mission of nuclear clean-up and environmental restoration.

Our Strategy

Our strategy is to develop a more secure and resilient estate with a collective defence through the sharing of knowledge, skills and costs. We will continue to grow the NDA group's capabilities, and aim to positively shape the defence of critical national infrastructure across the UK nuclear industry and the wider energy sector.

The NDA's cyber security strategy is aligned with government strategy being delivered by the National Cyber Security Centre *(ref 61) (see fig 12),* and requirements set by ONR. Our CSRP Target Operating Model is closely aligned with the internationally recognised National Institute of Standards and Technology (NIST) framework.

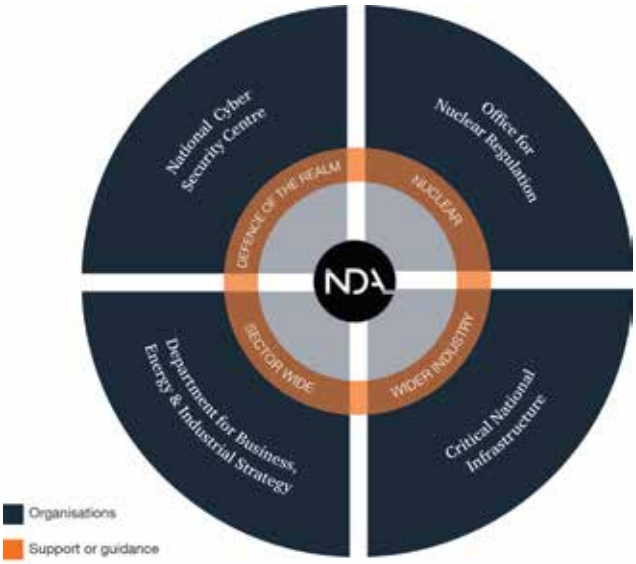


Figure 12 - Alignment with other bodies delivering the government's strategy

Strategy Development

Our strategy is mature and is being implemented though the CSRP. Our strategy needs to be responsive and we review progress on an annual basis. Review has confirmed that we remain aligned to the national strategy *(ref 61)*.

Delivery

Our strategy is enabled by providing a modern, cost-effective and secure technical infrastructure to ensure the ability to protect against a cyber attack (cyber security) and detect, respond and recover from the effects of a cyber attack (cyber resilience). These 2 areas are implemented through group-wide projects and services provided by the CSRP. The strategic implementation plan delivered by the CSRP is structured under 3 main themes:

Leadership and Governance

The CSRP supports the group to develop leadership and governance in cyber security so that the entire estate is enabled with group-wide policies and strategies and consistent management processes and procedures.

People

The CSRP offers training to staff in the following categories *(see fig 13)*:

In all cases, staff are trained in a consistent way to recognised standards and are tested and exercised in the skills they need to play their part in cyber security.

Technical

The CSRP delivers standardised software and hardware security systems across the estate. The programme looks to implement common technical solutions to common problems leveraging the buying power of the group while delivering operational effectiveness.

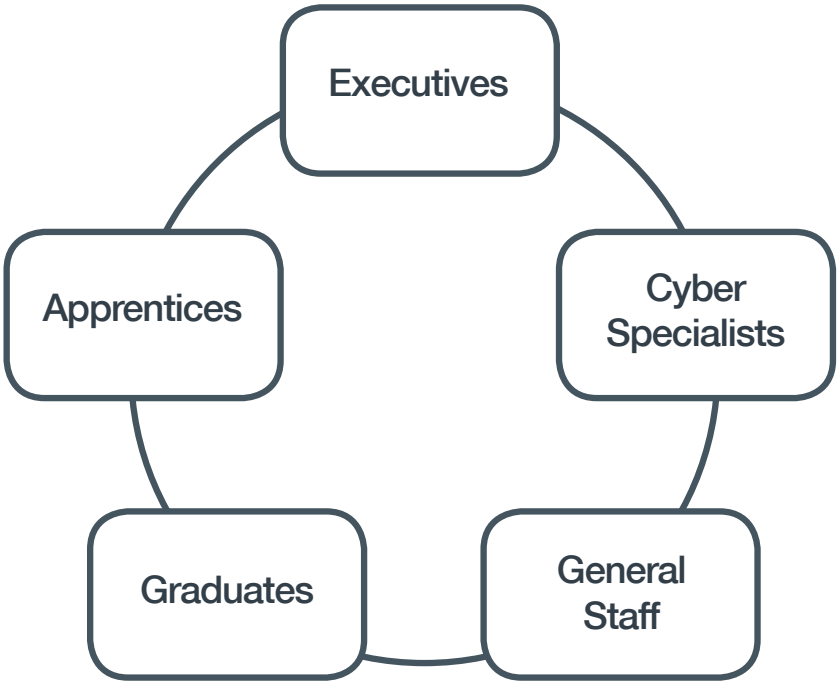


Figure 13 - CSRP staff training categories

Case Study: Exercise Purple Lumi

Purple Lumi was a 5-day exercise run in February 2020 in which managerial and technical staff practised their defence skills in a simulated cyber attack. The exercise offered a good example of how the CSRP, working alongside others in the sector, can learn from each other and practise collective defence skills. The exercise was set up to deliver the following benefits:

Operational

Purple Lumi raised the operational resilience of the NDA group by simulating a series of cyber attacks which required different parts of the sector to work together, sharing information to defeat the aggressor. This allowed participants to experience how an adversary would look to identify and exploit any cyber defence by targeting the weakest links in a digitally interconnected sector. The participants were able to test their detection and response capabilities while gaining a better awareness of how others in the sector would defend against an aggressor should the situation actually happen.

Efficiency

Any realistic scenario must reflect the inter-connectedness of systems, which is difficult for an individual business to achieve. Purple Lumi drew in staff from across the civil nuclear sector (fuel fabrication, fuel storage and electricity generation) to practise their responses to an incident.

The exercise tested staff on a cyber range (a virtual facility and environment which can replicate IT and industrial control systems in operation on a nuclear facility). These systems cannot be taken offline for testing because they are required for the continued safe operation of nuclear facilities, but were replicated in the NDA's training facility based at Energus in West Cumbria and then digitally linked to the North Atlantic Treaty Organisation (NATO) cyber range in Tallinn, Estonia. Running a range which could deliver a similar simulated environment for any single business would be uneconomical. However, for the NDA group (8 businesses and 17 sites) and the wider civil nuclear sector it is possible to justify the investment since working at group level is more cost effective.

Opportunities

Purple Lumi brought key staff together from across the sector to share their experiences, build relationships and create further opportunities to strengthen collective resilience.

Regulatory

The exercise involved regulatory authorities and the NCSC who were able to contribute and better understand their response to the management of a cyber incident within the sector.

Inside the cyber lab

8.5 Research, Development and Innovation

Objective: *To transform the safe, cost-effective delivery of our mission through research, development and innovation.*

Since the formation of the NDA we have undertaken research and development activities. Research, Development and Innovation (RD&I) is key to breaking down barriers, embracing collaboration and harnessing creativity, thereby enabling fundamental, transformational change in the delivery of our mission. Together with the sharing of good practice both nationally and internationally, the intelligent application of RD&I can improve safety, security and *sustainability* through reduction of cost, acceleration of delivery timescales, and minimise environmental impact.

As a direct result of RD&I activities across the NDA group, significant progress has been made in the development and deployment of technology, particularly in addressing high hazard areas at Sellafield. At the time of writing we are now planning and progressing decommissioning on an unprecedented scale across all our sites, and often encountering diverse and unique challenges. To address these requires continuous advancement, innovative thinking and the provision of implementable solutions. In recognition of this step change, we have updated our scope for RD&I and will focus on the further development of our culture to enable innovation to flourish.

The majority of RD&I is undertaken by our NDA group businesses and their supply chain. The NDA also directly maintains and sponsors a complementary strategic RD&I programme. Together, the combined RD&I portfolio is wide-ranging in scope and scale, often involving new and bespoke approaches and technologies.

This methodology, along with working collaboratively with other sectors, has facilitated significant advances in technical areas such as remotely operated decommissioning technologies, unmanned autonomous vehicles (UAVs), and nuclear material immobilisation. These advances have added to the knowledge base of the NDA group and contributed significantly to improved performance and accelerated delivery.

We will build on our existing collaborative approach to RD&I and continue to take a lead in creating and coordinating stronger, more diverse networks across our businesses and foster more cross-industry collaboration. We will also develop group-wide approaches to providing technical assurance and improving the uptake of innovative approaches across the group. When combined, these will contribute to culture change over the lifecycle of RD&I and enhance our capability to identify medium to long-term opportunities within the UK and internationally *(see **International Relations**)*, while ensuring appropriate RD&I is being delivered.

Our Strategy

Our strategy is established and effective but our objective has evolved, and will continue to evolve, in response to the priorities and challenges across the NDA group and the need for social acceptability of the NDA mission.

In most instances RD&I, as an integral part of their legal responsiblities and plans, is undertaken successfully by our SLCs and subsidiaries with delivery support from the supply chain. Using an integrated and transparent approach, RD&I identified by the licensee is prioritised and coordinated in order to underpin decision making and support implementation.

In addition, the NDA will continue to deliver a strategic RD&I programme which focusses on targeted, group-wide needs and maximises opportunities which inform strategy development, encourage early innovation and maintain key skills on behalf of the group where appropriate *(see **People**)*.

The output from the RD&I strategy helps to shape the direction of the driving theme strategies *(see **Site Decommissioning and Remediation**, **Spent Fuels**, **Nuclear Materials** and **Integrated Waste Management**)* plus other Critical Enabler strategies *(see **People, Supply Chain and International Relations**)*. It also generates know-how, information and data which help to underpin approaches to implementation.

Virtual and augmented reality and digital capture technologies to improve planning, training and aid decision making

Through the development of One NDA we will continue to work closely with other organisations, including regulators (ONR, the Environment Agency, the Scottish Environment Protection Agency (SEPA) and Natural Resources Wales), funding bodies, academia and the supply chain to share good practice, communicate learning and progress, and encourage investment in RD&I. We will identify synergies and engage with nuclear and non-nuclear sectors such as energy, defence, oil and gas, digital, food, medical, construction, automotive and space. We also recognise that our RD&I portfolio supports the competitiveness of UK organisations abroad in support of the Nuclear Sector Deal *(ref 15)*.

Strategy Development

Looking to the future, we will build on the success already achieved across the NDA group and continue to contribute to the delivery of targets set out in the Industrial Strategy *(ref 13)* and the Nuclear Sector Deal *(ref 15)*.

To promote effective development and delivery of the RD&I strategy and objective we will undertake the following activities:

- observe (e.g. ensure we maintain a good understanding of the current cross-sector landscape and emerging issues in relation to our needs)
- influence (e.g. through established and new engagement and communication methods)
- collaborate (e.g. co-fund, provide technical supervision or access to facilities)
- lead and commission (e.g. fund).

Our RD&I activities will focus on ensuring value for money. We will look to ensure the scope of the NDA group portfolio includes areas beyond traditional Science, Technology, Engineering and Mathematics (STEM) subjects such as project and contract management, security, *sustainability*, human factors, socio-economics, workforce mobility and social science, all of which will contribute to the successful delivery of our mission.

A key focus of our previous strategy was on promoting and delivering collaborative ways of working. Across the NDA group we have successfully demonstrated an ability to collaborate across organisations and with other UK R&D partners to fund RD&I relevant to our mission. In some instances, cross-cutting collaboration has enabled us to cultivate the right environment for innovation to succeed and we will seek to do more. In particular:

- we will continue to work with other nuclear and non-nuclear organisations to encourage and leverage cross-sector investment in RD&I and foster technology transfer between sectors and internationally

- we will collaborate, and promote collaboration as a mechanism to secure funding and leverage investment in order to achieve maximum value for money from RD&I activities. This includes research councils and academia, other government organisations such as Innovate UK and MOD, National Laboratories (e.g. National Nuclear Laboratory (NNL), National Physical Laboratory (NPL), Culham Centre for Fusion Energy (CCFE) and the wider supply chain
- we will promote and encourage the adoption of technology and innovation across the NDA group
- we will ensure our portfolio supports short, medium and long-term opportunities for RD&I to effect transformational change, including proactive horizon scanning in line with medium to long-term opportunities
- we will enable innovation to flourish through commercial mechanisms and development of a culture which encourages, recognises and rewards ideas that support transformational change
- we will support the development of subject matter experts who will become leaders in our businesses
- we will work collaboratively across the NDA group to embed good practice in technology and innovation management, technical assurance, radioactive waste inventory improvements and materials and samples management
- we will ensure that knowledge and benefits gained from across our RD&I portfolio are shared across the NDA group alongside opportunities to learn from others' experience.

Delivery

Our approach to delivery of this strategy is flexible and has been revised to realise the benefits from working collaboratively across the group. We continuously review the scope of the RD&I strategy and the requirements of the NDA group and adapt accordingly to deliver the programme.

We have well-established governance and advisory routes for RD&I including the independently chaired NDA Research Board (NDARB), NDA Group Innovation Council and the Nuclear Waste and Decommissioning Research Forum (NWDRF). The latter is a key community for identifying common needs, risks and opportunities, sharing good practice and working collaboratively on RD&I within and beyond the NDA group. NDA group employees are key members of, and contributors to, various cross-industry and international organisations which ensure opportunities for collaboration and reduce the potential for duplication.

Using robotics, autonomous systems and wearable technology to move humans away from harm

Case Study: Innovation

The NDA recognises the benefit of nurturing a culture that promotes creativity and understands the significant part innovation will play in delivering the NDA mission. Accordingly, it has invested in multi-year innovation programmes that will embed new approaches across the group.

Integrated Innovation in Nuclear Decommissioning

In early 2017, the Integrated Innovation in Nuclear Decommissioning (IIND) competition was launched. With £8.5 million of funding provided by the NDA, Innovate UK and BEIS it sought to foster collaborative innovation within the supply chain. Sellafield Limited provided end user input to help define the challenge, be part of the competition assessment process and offer further demonstration opportunities within radioactive environments. The competition was aimed at bringing radically different approaches to decommissioning. Collaborative project teams were encouraged to develop and demonstrate innovative solutions for end-to-end decommissioning of reprocessing cells that were used for decades to manage spent nuclear fuel. The challenge was to access areas within facilities that have been sealed for a number of years, establish the nature of their contents, accurately measure radioactivity levels, deploy robotic equipment to cut up large items (including large vessels and pipework), segregate the waste and retrieve it for safe storage. The objective was to develop a decommissioning toolkit of scalable, transferable and integrated solutions which would drive safer, faster and cheaper decommissioning.

The first stage of the competition identified 15 submissions with potential. Five were subsequently shortlisted, comprising almost 30 organisations including large corporations, academic institutions and small businesses, some of which were new to the nuclear sector. Each shortlisted demonstration project received up to £1.5 million and teams spent 2 years taking conceptual ideas from the drawing board to reality by building prototype demonstrators for testing in a simulated radioactive environment.

In 2019, following inactive demonstrations, 2 of the 5 were selected with a view to demonstrating their solutions in one of Sellafield's radioactive facilities. The winning projects were highly innovative, integrating a range of technologies and capabilities that have the potential to enable a step change for nuclear decommissioning. As well as robots, all the solutions featured virtual reality, 3-dimensional imaging and autonomous navigation. Potentially, they can be scaled up for larger challenges and transferred to different facilities at Sellafield, as well as other nuclear sites and non-nuclear hazardous environments.

Remote deployment of characterisation technologies taking good practice from other sectors such as defence

The Vision: Encouraging Innovation

A vital part of the NDA's mission is encouraging innovation in nuclear decommissioning to help address the wide-ranging, often unique and complex challenges across all our sites and businesses. We recognise and understand the common barriers we face across the group, and how adoption of different approaches will help unlock some of the constraints that continue to limit our ability to be innovative. To encourage the development of a culture in which innovation can thrive we have published a series of 'Grand Challenges for Technical Innovation' that are intended to be bold, cross-cutting ambitions which set a direction of travel and act as a driver for change.

These challenge themes are intentionally broad in nature and are applicable to the NDA group, across different market sectors and also have wider societal benefit. There will be areas where the nuclear sector excels and would naturally want to take a lead in driving innovation (such as radioactive waste and radiation-related safety). For other topics, such as infrastructure management, construction and digital, as well as engaging with the nuclear sector, we will actively seek to collaborate and partner, leveraging investment and developments by working alongside other sectors.

Areas for improving productivity, efficiency, effectiveness and *sustainability* across the NDA group have been identified as follows:

1. **Reducing our waste** - finding new ways to optimise the *Waste Hierarchy (see Integrated Waste Management)* by increasing recycling, reducing generation of secondary wastes and increasing the reuse of materials in order to significantly reduce volumes sent for disposal
2. **Intelligent infrastructure** – using autonomous technology to manage assets and buildings proactively and efficiently
3. **Moving humans away from harm** – reducing the need for people to enter hazardous environments using autonomous systems, robotics and wearable technology
4. **Digital delivery** - adopting digital approaches for capturing and using data to improve planning, training and aid decision making.

In taking these forward we want to encourage and use a 'best athlete' approach to innovation, ensuring we adopt good ideas and practices, irrespective of their origin. It is anticipated that by presenting our intended direction of travel and describing our aspirations and expectations we will encourage innovation and increase the pace of transformation across the group.

Challenge Theme	Aims by 2025	2030 aspirations
Reducing our waste and reshaping the waste hierarchy	70% of all initial characterisation will be undertaken in situ Results available within 24 hours	50% of decommissioning and clean-up waste recycled 70% reduction in 'secondary wastes'
Intelligent infrastructure	All external monitoring of buildings should be carried out remotely	All new buildings to be self-monitoring and energy neutral 50% lifetime cost reduction
Moving humans away from harm	Remote decommissioning of gloveboxes	50% reduction in decommissioning activities carried out by humans in hazardous environments
Digital delivery	Accurate and up-to-date 3-D virtual models for all key NDA sites	All data captured at source Used to drive decisions, planning and training

Encouraging innovation: a tabular summary of the grand challenges for technical innovation

8.6 People

Objective: *Enable and drive the delivery of our mission through our people by attracting, retaining and developing a high performing, highly skilled, talented and motivated workforce and creating a culture in which they can thrive.*

The world of work is changing on a global scale. Future generations of our workforce will be motivated in very different ways to those of today. Employee expectations are changing markedly around flexible working, agile and digital working, environmental challenges, *sustainability* and mental health. Diversity and inclusivity are driving internal workplace culture and wider societal considerations. These changes at the broadest level present both opportunities and challenges to meaningfully engage our workforce of both today and the future.

Our previous People topic strategy was written at a time when projections suggested increasing demand for skills for new build nuclear projects and an associated increase in the workforce within the decommissioning sector. This increase in workforce demand has not yet materialised and the national demand profile is less predictable than in previous strategies.

This strategy and its key threads/focus areas have been developed together with a range of partners and stakeholders. We are mindful of the need to collaborate meaningfully across the group and the wider nuclear industry while ensuring that the responsibility for full compliance with regulatory requirements remains with our individual group businesses. Safety and security for both nuclear and environmental standards is paramount and ensuring that there is adequate focus in our people strategy on these areas is ongoing. There is much we can do collectively to benefit our people, our communities and to achieve positive outcomes and outputs for the group. We will maximise opportunities created through the continued development and implementation of One NDA and in delivering our contribution to the targets and objectives of the UK government's policy position including the Nuclear Sector Deal *(ref 15)*.

Our Strategy

This strategy has been designed to build on the progress made in our previous strategies. It has taken into consideration many different factors: the complexity of skills requirements; the unique geographies of some of our locations; a diverse range of stakeholders who have a legitimate interest in the progress of our mission; our relationships with regulators, UK government and the devolved administrations; the funding model and the necessity to deliver value from a taxpayer's perspective. Our people are a significant strategic enabler to deliver our mission. We strive to create great places to work so that we can retain our people, maintain our skills base and recruit into our businesses.

Our People topic strategy has 3 main focus areas:

- ensure we have the right people, in the right roles at the right time to deliver the mission
- create the culture in which our people can thrive
- work in partnership with our recognised trade unions and the broader stakeholder community

We will continue to contribute to the socio-economic *sustainability* of the communities in which we operate while balancing the efficiency and effectiveness of our human resources.

Strategy Development

We will continue to work with our stakeholders and across the group and the wider nuclear sector to ensure that we understand what the skills demand will be in the future and how the NDA can effectively play its role to address people challenges such as national skills shortages, supply chain capacity and attraction into the sector. We will continue our work with the Nuclear Skills Strategy Group (NSSG) to provide strategic leadership in the people and skills landscape and will align our strategy to the themes within the NSSG roadmap. We also have a strategic role in the delivery of the objectives and outcomes within the Nuclear Sector Deal *(ref 15).*

The strategy will support ongoing changes within the NDA group including greater levels of group-wide collaboration, 'make versus buy' decisions, group development, Local Social and Economic Impact Strategy 2020 Update *(ref 62)* and supporting the delivery of the Nuclear Sector Deal *(ref 15)*, government policy changes and opportunities for the NDA group to do more within the UK and globally.

Delivery

Ensure we have the right people, in the right roles at the right time to deliver the mission

One NDA enables us to collaborate more meaningfully across the entire people landscape, developing group-wide focus on succession and talent, sharing approaches to skills gaps and training and, where appropriate, to co-create and procure solutions to the challenges and opportunities ahead.

Understanding current and future people capability and capacity is paramount to the success of our mission. We will refine our approach to strategic workforce planning and ensure that our data and supporting analytics are rigorous and robust. This will enable us to understand the critical specialist skills (e.g. cyber security and specific nuclear skills) we require across the NDA group, aligning this to national demands and trends and ensure we have effective knowledge management arrangements in place to support the retention of critical skills. Access to skills which support our legislative duties in security, safety and environmental considerations is paramount and we will work across the group and with our supply chain to ensure that the pipeline of skills is maintained and ongoing investment is sustained.

As we strive to innovate in our delivery programmes we need to be responsive to the changing implications for our workforce of new technologies, robotics and increasing digitisation. We are committed to reducing exposure to risk and improving safety performance through technological advancements which will impact on the roles required for the future. To achieve this:

- our businesses will develop and maintain a strategic workforce plan that allows us to mitigate workforce risk
- identify recruitment and development programmes for specific skills to support functional strategies and priorities (supply chain, procurement, stakeholder relations etc)
- supporting mobility and the sharing of resources will be actively championed in order to develop careers and deploy skills effectively, including talent and succession planning on a group-wide basis
- be clear about what great leadership looks like within the NDA group and ensure that the One NDA leadership standard is clearly understood and embedded in people processes and ways of working
- develop a One NDA Leadership Academy to future proof our leadership capability to deliver the mission
- contribute to the people objectives and priorities of the UK government and the Nuclear Sector Deal *(ref 15)*
- develop collaborative (group-wide) recruitment methodologies where appropriate
- develop a talent acquisition approach for the short, medium and long term which recognises the challenge in attracting skilled individuals to remote geographical locations and addresses the perception of the industry
- embed our ongoing commitment to apprentices and graduates in line with government targets and priorities
- ensure that specific niche and nuclear skills are maintained and invested in throughout the NDA group and our supply chain (including cyber security, intelligent customer capability, environmental science, radiation protection etc)
- collaborate to develop the optimum group-wide organisational architecture which delivers the mission in the most safe, secure and efficient way, avoiding unnecessary duplication of effort
- develop group-wide attraction and school engagement strategies to excite the next generation and their influencers on the career opportunities within decommissioning and support and encourage the uptake of key study areas to meet our demand for wide-ranging future skills requirements.

We will create the culture in which our people can thrive

All of our people, regardless of position or who they are, should be able to work in an environment where they are respected, included and able to perform at their best. Our strategic focus on equality, diversity and inclusion will be enduring. We recognise that high levels of employee engagement and satisfaction are not only ethically correct but also drive significant business value and support an effective nuclear and environmental safety and security culture.

We will ensure that our businesses recognise the responsibilities of each Board and Executive to align purpose, values and culture to support the effective delivery of the mission.

We will strive to ensure that all elements of the employee lifecycle such as attraction and recruitment, induction into the NDA group, effective leadership, role clarity, professional and personal development and managing through change are focussed on ensuring that the NDA group is a great place to work for individuals and teams.

Wherever possible, we will encourage flexible working practices that enable the delivery of the mission while reflecting wider societal norms, the expectation of work life balance and *sustainability* and support the vision of One NDA to create great places to work. We will enable and support people to achieve high levels of personal and team performance in order to support successful delivery of the mission. To achieve this:

- every business will develop a best in class employee value proposition in order to attract, recruit and retain a highly skilled, dynamic workforce
- our people will be clear on the roles they play and the rewards available for fulfilling these roles from both a financial and non-financial perspective
- we will develop a cultural blueprint, values and code of conduct that become the framework for how we operate and who we are, embedding the principles of One NDA
- we will regularly survey our workforce to assess progress against these cultural expectations in order to continually make improvements
- we will continue to drive a group-wide focus on respect and inclusion at work
- we will continue to drive a group-wide focus on diversity through our attraction, recruitment and development approaches
- we will ensure that we are compliant with all employment legislation as a minimum and we will proactively develop a progressive position on societal trends/shifts as and when they occur.

We work in partnership with our recognised trade unions and the broader stakeholder community

We recognise and value the important role that our trade union partners continue to have across the NDA group. We intend to develop our approach to working in partnership with our recognised trade unions (Prospect, Unite, General Municipal & Boilermakers (GMB), Associated Society of Locomotive Steam Enginemen and Firemen (ASLEF), Transport Salaried Staff Association (TSSA)) to shape and consider future organisational changes that enable the safe delivery of our mission. We will be open and clear in our communications around any workforce implications. We will share information as early as possible on the strategic direction of the NDA. We will seek to find areas of common interest where genuine partnership working can lead to better outcomes for our people.

We also recognise the importance of our stakeholders, including our supply chain, local communities, local authorities, regulators and UK governments. We will continue to develop meaningful relationships which support shared goals and objectives through ongoing engagement and collaboration. To achieve this:

- our businesses will review and refresh arrangements and agreements with the trade unions on an ongoing basis to ensure that business change can be managed in a constructive and balanced way
- we will build capability and capacity through technical and behavioural training on the importance of partnership working for line managers, leadership teams, human resources community and trade union representatives.

Our Leadership Standard

Case Study: Nucleargraduates

Our commitment to attracting, retaining and developing a highly skilled, talented and motivated workforce and creating a culture in which they can thrive is a fundamental foundation of our Nucleargraduates programme, which is a unique 2-year graduate development programme. Established by the NDA in 2008, the programme has been managed by our subsidiary Energus since 2010 and is now commercially operated and sponsored by a range of organisations inclu-ding: the NDA, Sellafield Limited, Magnox Limited, International Nuclear Services Limited (INS), Rolls-Royce, ONR, and the Environment Agency. To date, the programme has recruited over 400 graduates, has gained an outstanding reputation and plays a key role in attracting diverse, critical skills and talent into the nuclear sector.

Nucleargraduates recruits into key skills areas such as engineering, science and in recent years has expanded to recruit to a broader range of specialisms including: human resources, commercial, project management, communications, strategy and risk. The programme has developed excellent relationships with universities across England, Scotland, Wales and Northern Ireland and continues to attract high calibre graduates from across a diverse range of backgrounds and specialisms.

The programme includes 3 industry placements in which graduates are encouraged to gain a broad range of experience within the nuclear sector and to challenge themselves both professionally and personally; it expands their knowledge and enables them to develop their professional networks.

Case Study: Nucleargraduates

Placements also deliver great business benefit to the sponsoring organisations by enhancing the industry exposure of the graduates and enabling them to bring a wider perspective back to their sponsors.

The International Footprint is a nuclear focussed international visit arranged by the graduates themselves, themed on the technical, community and political aspects of the nuclear industry outside the UK. Graduates have visited Ukraine, Canada, Romania, Finland and Sweden in recent years developing their networks, contacts and understanding of the perception of nuclear internationally.

The programme is accredited by a number of professional institutes, bodies and societies and endorsed by the Nuclear Institute and National Skills Academy for Nuclear (NSAN). The programme has received various awards including Science Graduate of the Year 2017 at the National Nuclear Skills Awards, the 2017 Princess Royal Training Award, and the Institute of Chemical Engineering Learning & Development award in 2018 and, in 2019, the Investors in People award for Learning & Development.

The programme focuses not only on the professional development of participating individuals but also on their own personal development. All graduates are STEM ambassadors and participate in various STEM activities over the 2 years, helping to influence the next generation of young people and encouraging them to think about the nuclear industry as a career.

In 2019, we undertook a full review of the Nucleargraduates programme approach and content in order to ensure that it continues to be attractive to the brightest and best graduates and maintain this key pipeline of talent for both the NDA group and the wider UK nuclear sector.

The programme is aligned to the priorities of the Nuclear Sector Deal *(ref 15)* and contributes to a number of targets within the sector deal, notably the 40% female employed by the sector. In 2019, 46% of the Nucleargraduate intake was female and we continue to strive to achieve greater levels of diversity and inclusion.

The nucleargraduates at Chernobyl in March 2019

8.7 Asset Management

Objective: *To secure safe, reliable, available, maintainable and sustainable asset performance and optimise the through-life cost of assets.*

The Energy Act (2004) *(ref 1)* requires the NDA to secure safe, environmentally considerate and cost-effective good practice asset management across the NDA group. Securing sustainable good practice asset management enables the objective to be achieved by mitigating the risk of asset failures affecting mission delivery, ensuring compliance with regulation, improving asset reliability, delivering value for money performance, implementing group and industry learning and making best use of UK assets.

The NDA group has assets in all stages of the asset management lifecycle. Some of our assets are not yet in use, whilst asset management has allowed some of our operational assets to safely exceed their original operational lifetimes. Serviceable and operable assets enable ***Spent Fuel***, ***Nuclear Materials***, ***Integrated Waste Management*** and ***Site Decommissioning and Remediation*** mission delivery to quality, time and cost.

To ensure our assets achieve the objective, we need a continually improving asset management approach informed by good practice that focusses on value for money mission delivery. Experience has demonstrated that we need to continue to improve the NDA group capability and develop integrated through-life asset management plans for all of the assets to enable optimised delivery of our mission.

Our Strategy

The NDA group will continue to apply the guidance and principles of ISO 55001: Asset Management *(ref 63)* to ensure our objective is achieved, and to enable transitioning towards our ambition of becoming world leaders in nuclear decommissioning enabled by good practice asset management.

We will improve our understanding of performance at all levels in order to gain a clear line of sight from mission delivery to operations, identifying and resolving gaps. This meets the regulatory desire for embedding good practice asset management not only in our own asset base but supporting advances across the nuclear industry.

We recognise that people and the supply chain are key to the successful delivery of asset management. We will work across the NDA group *(see **People** and **Supply Chain**)* to ensure that roles are clear, individuals are well trained in asset management principles and *continuous improvement* techniques and that the supply chain aligns with our policies and principles.

Strategy Development

Our strategy continues to address the enduring risk that poor asset performance adversely impacts our mission. However, there are many challenges to asset management performance. To improve mission delivery we will need to accelerate asset management performance guided by ISO 55001. As reliability improves, risk also reduces and we can reduce the cost of maintenance while maintaining or even accelerating throughput in mission delivery and retire assets earlier, thereby reducing overall asset lifetime costs.

We will further develop our strategy for new and existing assets and look to obtain through-life asset management plans that fully integrate new assets into current operations. We will focus on throughput, reliability, availability and maintainability of our assets both in design and operations and track through-life performance using key performance indicators.

We will continue to cooperate across the NDA group, wider industry and the supply chain to seek and develop good practice for asset use and monitoring of performance.

To ensure availability of skills, asset management and *continuous improvement* will be included in the syllabuses of the One NDA Leadership Academy being developed *(see **People**)*.

Delivery

We will secure and maintain value for money, good practice asset management, capability and asset performance across the group by working with regulators, SLCs, subsidiaries and asset management professionals.

Improved asset capability and knowledge presents opportunities for us to push the boundaries beyond immediate asset issues and lead at a strategic level.

We are taking a stepwise approach to setting expectations for our SLCs to achieve higher levels of maturity against ISO55001: Asset Management principles and embedding good practice across the NDA group, including the supply chain. In doing so, we will drive *continuous improvement* in asset management and other functions across the group. Targets will be set for asset performance taking into consideration a range of mission related factors such as *sustainability*. Performance will be monitored and systematically improved through external benchmarking and routine performance reviews, quantifying and visualising the gaps between targets and actual performance and informing group-wide learning.

To clarify responsibilities, we are proposing that a responsible officer is appointed to be accountable for SLC asset management performance.

We will ensure that our suppliers comply with our asset management strategy and plans. We will continue to collaborate across the NDA group, wider industry sectors and supply chain to seek and develop good practice and make best use of UK assets.

We will continue to consult our key stakeholders on the development of our asset management strategy and development plans.

Case Study: Quality and Continuous Improvement - First Generation Magnox Storage Pond (FGMSP)

The use of *continuous improvement* has long been associated with manufacturing organisations such as car producers. This approach is fairly new to the NDA group businesses and one of the main reasons for not adopting it before now has been a lack of recognition that a manufacturing approach would be beneficial. What is helping gain traction is the realisation that each of our businesses needs to be able to deliver products, as do manufacturing companies, whether that is quantities of waste for interim storage or demolition of facilities and clean-up of land. There are significant benefits from applying these techniques.

A collaborative approach to *continuous improvement* is being implemented across the NDA group. This has identified various levels of continuous improvement implementation, maturity and many different standards.

In order to effectively manage implementation, experience from other sectors has helped define the priority improvement areas:

- ensuring that strategic objectives are cascaded at all levels in increasing detail throughout our businesses
- associated performance targets are clearly defined and applied on a daily, weekly and monthly basis
- a strategy is embedded to align capability in order to address gaps identified between actual performance and targets
- establish an expectation to expose and close performance gaps at all levels, in all departments.

Sellafield Limited has realigned itself to the approach described above, created a strategy, adopted a One NDA *continuous improvement* model, implemented a roadmap and created and started to deliver accredited industry good practice training to embed its strategy into the organisation. In addition, a baseline assessment tool to understand the maturity of continuous improvement across the organisation is now in use.

A good practice approach within the First Generation Magnox Storage Pond (FGMSP) shows how *continuous improvement* can improve performance. The mission delivery outcome to retrieve all *Intermediate Level Waste (ILW)* from FGMSP by the required end date *(SO31)* has been cascaded through all levels of the team focussed on FGMSP using a range of appropriate measures and targets.

What this means in FGMSP is that the objective of removing all the sludge and pond contents has been converted to a reduction in the metre cubed (m^3) of contents per year to meet the currently planned completion date. Figure 14 shows the required annual sludge removal and the cumulative lifetime cost of doing so, which is used to track performance. The information on how much sludge has been removed can also be used to show the impact that more or less than planned sludge removal has on the estimated cost. In this example, each year the project is extended an additional sum of approximately £60 million would be needed showing how important it is to prevent timescales extending into the future.

In cascading the decommissioning objective, the annual target is broken down into a weekly plan within which daily throughput (beat rate i.e. two sludge batches a day) is identified and incorporated in a Master Production Schedule. Linking the annual target number of sludge removed to achieve the m^3 retrieval targets allows individuals to clearly understand how they contribute to mission delivery and become involved in solving any problems to achieve the throughput and then record any changes to the way they work in operations, maintenance, engineering, commercial or people issues within their Quality Management System (QMS).

Visualisation and reviewing performance against targets not just for quantities of material but for safety, quality, cost and skills availability on a weekly basis allows gaps in performance to be exposed immediately and then closed by embedding improved capability in the workforce to problem solve systematically. Any learning can then be recorded and used in a continuously improving QMS.

This approach is now accepted as good practice at all levels within FGMSP.

Adopting this approach has contributed to 2019/20 delivery where all sludge targeted for removal was achieved against its most stretching target, increasing confidence that all of the sludge will be removed by 2026.

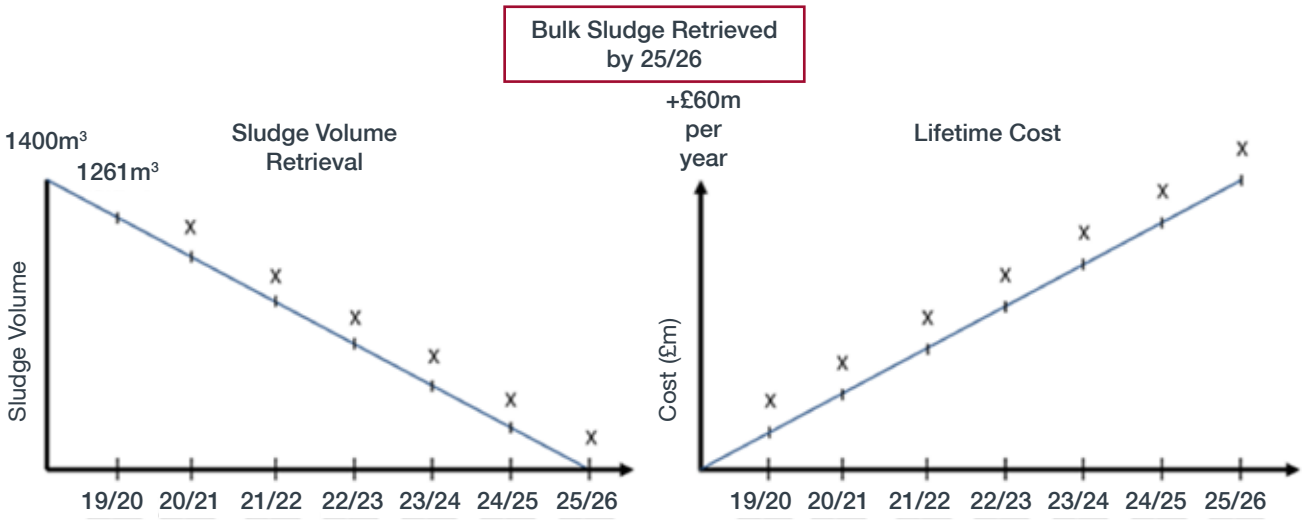


Figure 14 - On target sludge retrieval fixes lifetime cost

8.8 Supply Chain

Objective: *To build commercial capability which maintains a resilient, sustainable, diverse, ethical and innovative supply chain that optimises value for money for the UK taxpayer when sourcing goods and services.*

Since our previous Strategy *(ref 3),* the wider UK industrial market remains fragile, particularly within construction and facilities management. There has also been consolidation of key suppliers and increased competition for resources from major infrastructure projects. In the UK public sector there has been an increasing focus on people and skills *(see* ***People****)* with a drive for improved, common commercial standards and greater transparency.

In order to provide visibility and certainty for the supply chain, and to encourage new market entrants, each NDA business will continue to publish a list of current and future tender opportunities, the total value of which is approximately £1.8 billion per annum and is likely to remain stable over this strategy period. This aligns with good practice recommended by government. We recognise and support the value that *Small and Medium Enterprises (SMEs)* provide and acknowledge that this is a key priority within the government's procurement policy for generating UK growth and supporting sustainable local economies *(see* ***Socio-Economics****)*. Since the inception of the UK government's agenda to increase the proportion of spend with SMEs we have delivered Action Plans *(ref 64)* to support this strategic initiative and ensure we achieve our target of a third of NDA group-wide procurement spend with SMEs.

With the advent of One NDA, we are now uniquely placed to identify synergies across the group and will continue to perform collaborative procurement activities. Collaboration has also broadened into a number of other areas, for example the implementation of a standard tool across the group for monitoring and assessing supply chain risks.

Our Strategy

Our strategy consists of 4 main elements:

Business alignment – we will collaborate across the NDA group, working closely with project teams and engineers to develop and manage category strategies. This will enable a better understanding of future business needs and the supply market to enable us to drive economies of scale and deliver best value, recognising that value comes in many forms. This will also include a make versus buy analysis where appropriate.

Market engagement – we will engage early and proactively with the broader supply market to understand their drivers and ensure that we attract and utilise a diverse and sustainable supply base that can support us in achieving the targets set out in the Nuclear Sector Deal *(ref 15)* and other government targets.

Sustainable procurement and supporting the move to *net zero greenhouse gas emissions* – we will ensure that our procurements are designed to support and drive *sustainability*, including social value and the impact on the environment *(see* ***Sustainability*** *and* ***Socio-Economics****)*.

Supplier relationship management – we will work with existing suppliers, for mutual benefit, using their specialist expertise (including nuclear) to ensure resilience and best value in our supply chain, applying good practice from within the NDA group and throughout industry.

Strategy Development

Category Management is a strategic process for sourcing goods and services that aligns business goals and requirements with supply market capability. This involves the segmentation of spend into discrete groups of similar or related products/services (known as categories), which enables commercial teams to focus on specific areas of spend and identify opportunities for consolidation and efficiency.

We will develop and manage category strategies at NDA group level that are informed by appropriate market insight and good practice, with procurement specialists across the group working together to ensure that strategies are understood and aligned. We will ensure that category strategies are aligned with business objectives through constant engagement, including commercial representation at key strategy-setting and governance forums.

We will take a coordinated approach to supplier relationship management across the NDA group in order to maximise leverage and share commercial good practice and ensure that appropriate learning and knowledge is transferred. We will continue to focus on the role of SMEs throughout the NDA group, working together to agree a coordinated approach to developing and implementing the SME Action Plan *(ref 64)*.

We will develop the procurement strategy to support broader ethical procurement issues such as *sustainability*, prompt payment, modern slavery, fraud prevention and our obligations to consider the impact of our activities on local communities *(see **Socio-Economics**)*.

Delivery

We will build and maintain a highly competent commercial team who will work together in an open and collaborative manner in order to build trust and confidence among the NDA group, our supply chain and our stakeholders. We will use project teams and communities of good practice, drawn from commercial functions across the group, to develop and deliver a common set of strategic objectives and key projects.

Through the implementation of our strategy we will broaden the routes to market available to the NDA group and broaden our supply base. A more diverse and sustainable range of suppliers with nuclear experience will provide greater resilience and access to innovative solutions (including the potential use of innovation partnerships in support of research, development and innovation) for safe, secure and cost-effective decommissioning.

We will continue to invest in better specifications and ensure early engagement, leveraging the NDA's commercial expertise to achieve better value and outcomes.

Businesses taking advantage of the networking opportunities at one of our previous supply chain events

Case Study: Supply Chain Small and Medium Enterprise Engagement

Liaise, Innovate, Network & Collaborate (LINC)

This initiative was set up by Dounreay Site Restoration Limited (DSRL) to encourage SMEs to collaborate with each other at a local and national level to deliver innovative solutions that support the Dounreay decommissioning programme. The scheme is intended to ensure greater opportunities by removing barriers which may be perceived when engaging with larger companies (risk of staff/expertise poaching, intellectual property etc).

SMEs have been invited to self-register on the DSRL website, providing information about their company, areas of expertise and contact details. Work packages are identified, focussing on the various challenges faced across the site and details are sent directly to all the companies who have registered. Since its launch, over 230 SME companies have registered, 7 opportunities have been offered, 4 contracts have been awarded, all won by SMEs, and 3 are still to be announced.

A winning company has since progressed to work with one of DSRL's main subcontractors and has now completed a large on-site cladding job.

The initiative has subsequently been adopted and further developed by Sellafield Limited to meet its own local requirements. 465 suppliers (including 366 SMEs) have registered and 45 contracts have been awarded with a cumulative value of £1.85 million.

Business and Technical Solutions Marketplace

Low Level Waste Repository Limited (LLWR Limited) introduced a simplified electronic purchasing system, known as the Business Services Marketplace, to particularly help local businesses and SMEs to pursue opportunities that may have previously been unavailable or too difficult to access due to the time and scale of framework opportunities *(see Socio-Economics)*.

150 suppliers registered for the Business Services Marketplace and contracts with a cumulative value of £17.5 million were awarded under the scheme.

The system was updated and relaunched as the Business and Technical Solutions Marketplace in January 2020 to deliver professional services in 13 categories across all business areas. Since the relaunch, 76 suppliers have registered for the new scheme, including 45 SMEs (60%). 11 contracts have been awarded (4 to SMEs) and there are another 4 current opportunities.

8.9 Information Governance

Objective: *To effectively manage and reuse NDA knowledge and information assets in a compliant and secure manner, while seeking to transform the way we work, and continuing to invest only in that which adds value.*

The NDA owns most of the information produced and managed by the NDA group. This strategy aims to support all businesses within the group to comply with statutory and regulatory requirements and realise the value of these assets to enable delivery of the NDA mission. The first step has been achieved by embedding group-wide policies, procedures and guidance together with key centralised infrastructure consisting of an archive facility (Nucleus), a secure collaboration platform (the Hub) and a secure private cloud (Ecosystem).

The current phase of associated programme activities addresses legacy data, records and knowledge which date back to the 1940s by identifying, preserving and adding value through a sift and lift process that will ensure improved searchability and sharing both within and outside the NDA group. The next phase, currently in development, will address methods of working, how we share learning and ideas and make both legacy and current information and knowledge assets available across the civil nuclear sector and enable access to other stakeholders.

This strategy addresses 2 key NDA risks: the loss of information and knowledge due to an ageing workforce, and obsolescence of data within ageing IT systems. Both these risks have already been realised due to the changing NDA mission from operations to decommissioning, particularly at Sellafield and Magnox, and remain a high priority.

The principal benefits of this strategy support the driving themes *(see* ***Site Decommissioning and Remediation****,* ***Integrated Waste Management****,* ***Spent Fuels*** *and* ***Nuclear Materials****)* and are to ensure that we can identify and trust core waste package records without which final disposal of waste will not be possible; the long-term preservation and accessibility of land quality and other records to ensure land assets are maintained and used appropriately and safely by current and future users thus enabling *nuclear site licence*/environmental permits to be surrendered; and that we explore the potential to generate external income.

In future, records will almost always be in digital format. It is key that appropriate governance and guidance is provided to enable such data to be searchable, preserved and migrated.
In addition, it is vital to ensure that this data is trusted so that it can be used with confidence.

This strategy, together with the delivery of associated projects, programmes and services will reduce risk and overall costs and increase the ability and opportunity to share and improve information assurance and reporting. It will encourage wider openness and transparency, ensure effective collaboration and communication and thus enable the group to operate more efficiently and safely.

Sift and lift is a project within the Information Governance programme:

Sift refers specifically to the need to identify, preserve and add value to the NDA's information and knowledge assets. We identify relevant records (physical or digital), destroying records and information that are no longer required, sorting through the records and preserving them (including restoration if necessary) in accordance with NDA policy. We add value by incorporating appropriate metadata, and if possible associated knowledge and know-how, to allow accessibility and effective reuse in the future.

Lift is defined as either physical transport or digital transfer and addition to the NDA archive facility, Nucleus.

Our Strategy

Our current information governance strategy complies with statutory legislation, regulatory requirements and good practice guidance. It brings the NDA businesses together by taking a group-wide approach and promotes the efficient management and reuse of NDA assets. In line with the One NDA way of working, we will achieve this by establishing and sharing business processes, collaborative procurement opportunities, procedures and policies across the group and by adopting common standardised technologies and solutions where it is practical to do so.

Our Information Governance strategy consists of:

- Information Management to ensure compliance with relevant legislation, promote wider openness and transparency and reduce risk and baseline costs while adding value to the business
- Knowledge Management to improve business efficiency by sharing information and encouraging learning and collaboration; capturing and transferring that knowledge which is necessary to the decommissioning mission
- Information Risk Management to improve information assurance and reporting by building confidence in our ability to manage information risk effectively. Making sound business-led judgements, getting the balance right between a restrictive 'need to know' and collaborative 'need to share'
- Intellectual Property Management to protect information, knowledge and corporate know-how.

Our aim is to ensure that the NDA group becomes widely respected for the management of knowledge and information assets.

Strategy Development

We now need to focus on achieving optimum return from the reuse of NDA information and knowledge assets. To better achieve this we will develop a digital vision for the group with clearly articulated benefits and aspirations, bringing together several critical activities that will set a goal to transform the way the group works. The focus will be on getting the right information to the right people when they need it, enhancing operational performance and enabling improved and effective decision making.

To ensure we can continue to better monitor progress of our mission, we will work towards providing accessible and reliable information in support of Mission Progress Reporting *(ref 8).*

We will continue to provide leadership and effective governance of information access arrangements and information rights management while developing a common approach to information risk management across the group.

Delivery

Since our previous Strategy *(ref 3)*, significant progress has been made on our information governance programme in terms of legislative compliance, records management and storage and sharing of information, knowledge and good practice. However, there is more work to do. Over the next 5 years we will focus on a number of key areas:

Enhancement of group-wide services

We will re-compete the commercial operations contract for our long-term records storage management facility at Nucleus and continue to develop the group-wide service it provides by introducing a publicly available archive management system that will catalogue record collections. Having achieved *Place of Deposit* status, Nucleus will manage and advise the NDA group on appropriate storage, retrieval and migration of all media forms, and provide a focal point for all civil nuclear records. We will also explore the commercial potential of this service.

We will simplify and standardise our approach to information governance and assurance by improving the provision of common tools and methodologies in order to collaborate more effectively online. We will encourage the sharing of learning, experience, knowledge and know-how through our information governance fora to ensure that our people know where to access information, balancing the 'need to share' with the 'need to know'.

We have launched and are continuing to develop an NDA-owned secure collaboration platform (the Hub) for use by all stakeholders in the civil nuclear sector, including the supply chain and academia. The infrastructure needed to host this service is also now being developed to deliver a secure cloud environment capable of hosting other suitable information and communications technology (ICT) services and applications for and on behalf of the group.

Continual improvement in information and knowledge management

We will work across the group to develop their information and knowledge management improvement plans/roadmaps. We will ensure that there is good practice standardisation, that opportunities to collaborate on relevant activities and services are explored and, where possible, incentivised.

We will improve efficiency and effectiveness of our information assets by defining the requirements for and deliver a standardised group-wide records management system that interfaces with other record repositories and facilitates proactive sharing of relevant information with all stakeholders.

We will develop a common taxonomy, an electronic document and records management systems roadmap and a shared approach to digital migration and preservation.

We will support group-wide knowledge management maturity assessments and seek to benchmark performance in this area with industry and international good practice as appropriate.

Legacy data

We will complete the sift and lift of legacy records and collections across the NDA group with a consistent focus on identifying, preserving and adding value. Working with a wide range of stakeholders, we will provide a framework to support the collation of and access to existing nuclear heritage and cultural records and support a structured approach to the management of all future records.

Leadership, Governance and Assurance

In line with the One NDA way of working, we will consider the value of developing a group-wide data governance target operating model. This common operating plan will aim to ensure that data remains secure, is always available, relevant, usable and can be trusted.

Case Study: Higher Activity Waste Package Records

The NDA group holds and continues to produce a significant amount of information and data relating to all radioactive wastes. Plans for the processing and packaging of such wastes are systematically agreed with LLWR Limited and Radioactive Waste Management Limited (RWM), including expectations for the structuring of associated information and data as records. Similar expectations arise for the systematic management of information and knowledge about nuclear material that has been transferred between sites.

Ensuring that we have appropriate, accessible records is essential for safe interim storage, future completion, transport and ultimate *disposition* of waste packages. Suitable records are also essential for the future management of spent fuel and nuclear materials, including overseas return and, where appropriate, disposal. The lack of necessary, accurate and accessible information would impact on the safety case of a *Geological Disposal Facility (GDF)*, its operability and associated costs, as well as potentially precluding other possible approaches to managing wastes.

We have worked with RWM, LLWR Limited and waste producers, together with regulators (ONR / SEPA / the Environment Agency / Natural Resources Wales), to establish and implement common standards for waste package records. We are delivering a programme to identify, collate, structure and ultimately digitise information to preserve records for existing waste packages, and to apply learning to the production of records for continuing and future packaging operations.

The absence of appropriate waste package records represents a significant risk to our ability to deliver future waste management solutions, with impacts potentially including a need for repackaging and / or unnecessary design and safety compromises in disposal, as well as impacts on stakeholder confidence in the civil nuclear industry. The cost savings associated with not having to address such impacts could be tens or hundreds of millions of pounds, based on costs associated with repackaging of wastes.

8.10 Socio-Economics

Objective: *To support the maintenance of sustainable local economies for communities living near NDA sites and, where possible, contribute to regional economic growth.*

The main socio-economic impact of the NDA's work comes from local wages and supply chain expenditure. Economic studies we have commissioned show that our work supports around 40-50,000 jobs at or near our sites. In West Cumbria (Copeland and Allerdale district councils) around half of all jobs are either at Sellafield, part of its supply chain or dependent on the salaries of Sellafield and supply chain workers. Similarly, around 10% of the jobs in Caithness are dependent on Dounreay and around 5% of the jobs in North West Wales (Anglesey and Gwynedd) depend on Magnox. The impact around other Magnox sites is more localised, albeit Hunterston, Chapelcross and Dungeness have high levels of economic deprivation, making Magnox an important regional employer.

The *NDA Value Framework (ref 17)* takes local economic conditions into account as we make strategic decisions, for example on the pace of decommissioning. As we continue to deliver our mission there will be further economic opportunities on our sites, but also economic threats as work reduces. We have a responsibility to our local communities which is set out in the Energy Act (2004) *(ref 1)* legislation. To understand this responsibility, we are committed to assessing the impact of our activities on the local communities around our sites. The NDA group has budgets for socio-economic projects with economic, social and environmental goals. Recent large projects supported by the NDA group include: building a new school campus in Whitehaven, business start-up funding at Dungeness, a range of support for local museums, tidal energy projects in North West Wales and support for the harbours in Caithness.

The needs of our communities vary enormously from site to site and therefore require tailored approaches:

- West Cumbria – we actively encourage investment in West Cumbria and support local people and businesses to make the most of the economic opportunities available from our mission
- Caithness and North West Wales – we encourage diversification of the economy away from nuclear decommissioning
- other Magnox sites – we support growth strategies managed by local authorities and other public sector bodies responsible for local economic development.

To benchmark our socio-economic impact we conduct regular studies to identify good practice in economic development around the world. Our latest study investigated economic regeneration programmes in the UK (associated with the closure of coal mines and army bases) and other countries (including closures of nuclear power stations in France, Sweden and Spain) and found that failures in socio-economic strategies were often due to unrealistically optimistic assumptions, difficulties in artificially creating alternative sources of employment and poor transport links. Our analysis suggests that a tailored approach is appropriate and that the NDA should be realistic about the impact it can have on its own and work with partners wherever possible.

Despite all these constraints, the fact remains that supporting socio-economic projects is an important task and these projects are highly valued by our local stakeholders. Grants enable us to pay for work which goes beyond decommissioning, aimed at regeneration and diversification of local communities to create economic opportunities and ensuring that the economic benefits of our mission filter down (e.g. business parks near our sites). This is potentially an important and flexible tool to support the government's regional growth and "levelling up" agenda. To ensure the process of grant giving is transparent, the NDA has recently undertaken a comprehensive overhaul of its administration of the funds and associated processes.

Our Strategy

We recently revised our approach to socio-economics in our new Local Social and Economic Impact Strategy Update 2020 *(ref 62).* We recognise the need to continually improve processes and increase our impact. To meet expectations placed on us by the Energy Act (2004) *(ref 1)* and the Public Services (Social Value Act) (2012) *(ref 6)* we will work with local and regional economic development agencies in order to support the maintenance of sustainable communities leading up to and after site closures.

In supporting our local communities, our primary strategy is to ensure that decisions that direct the delivery of our decommissioning mission support local sustainable and inclusive economic growth and greater social value wherever possible. To ensure our local communities can attract future economic activity, we prioritise support and fund projects which are consistent with our responsibilities to the UK taxpayer. We work in partnership with others to increase the impact of our funding.

We recognise that our local communities have varied needs requiring tailored approaches and, where necessary, we will also fund projects which diversify local economies.

Strategy Development

We have an opportunity to consolidate progress and provide clarity on how the NDA will engage with local communities and councils. Our socio-economics strategy provides further opportunities to look at more transformational areas if there is a shared appetite to do so:

- alignment and supporting of the NDA's work on *sustainability* and reducing carbon emissions. For example, most of the NDA's sites are near to large off-shore wind farms and there are many opportunities to support their development
- we will do more to establish good practice in skills development and the creation of business parks and infrastructure building
- working collaboratively to further develop the local dimensions of the supply chain strategy *(see **Supply Chain**)*
- we will seek to integrate with wider UK government regional policy, including plans for new capital expenditure
- further integration with the UK government's energy policy *(ref 10)*. The NDA's land is a valuable asset for other nuclear projects or low-carbon energy production (either on site or nearby).

Delivery

Priorities for Sellafield

In West Cumbria, there is already a cluster of economic activity around Sellafield. Economic theory suggests that encouraging more local inward investment and high levels of local participation should create a virtuous circle of competition and innovation which generates economic growth.

In developing our thinking, we have been in close contact with local authorities. The new strategy aligns with the Cumbria Local Enterprise Partnerships's Local Industrial Strategy *(ref 65)* as well as draft economic vision documents produced by the district councils of Copeland and Allerdale. We will continue to closely align with Local Enterprise Partnerships and local authorities.

Priorities for Dounreay

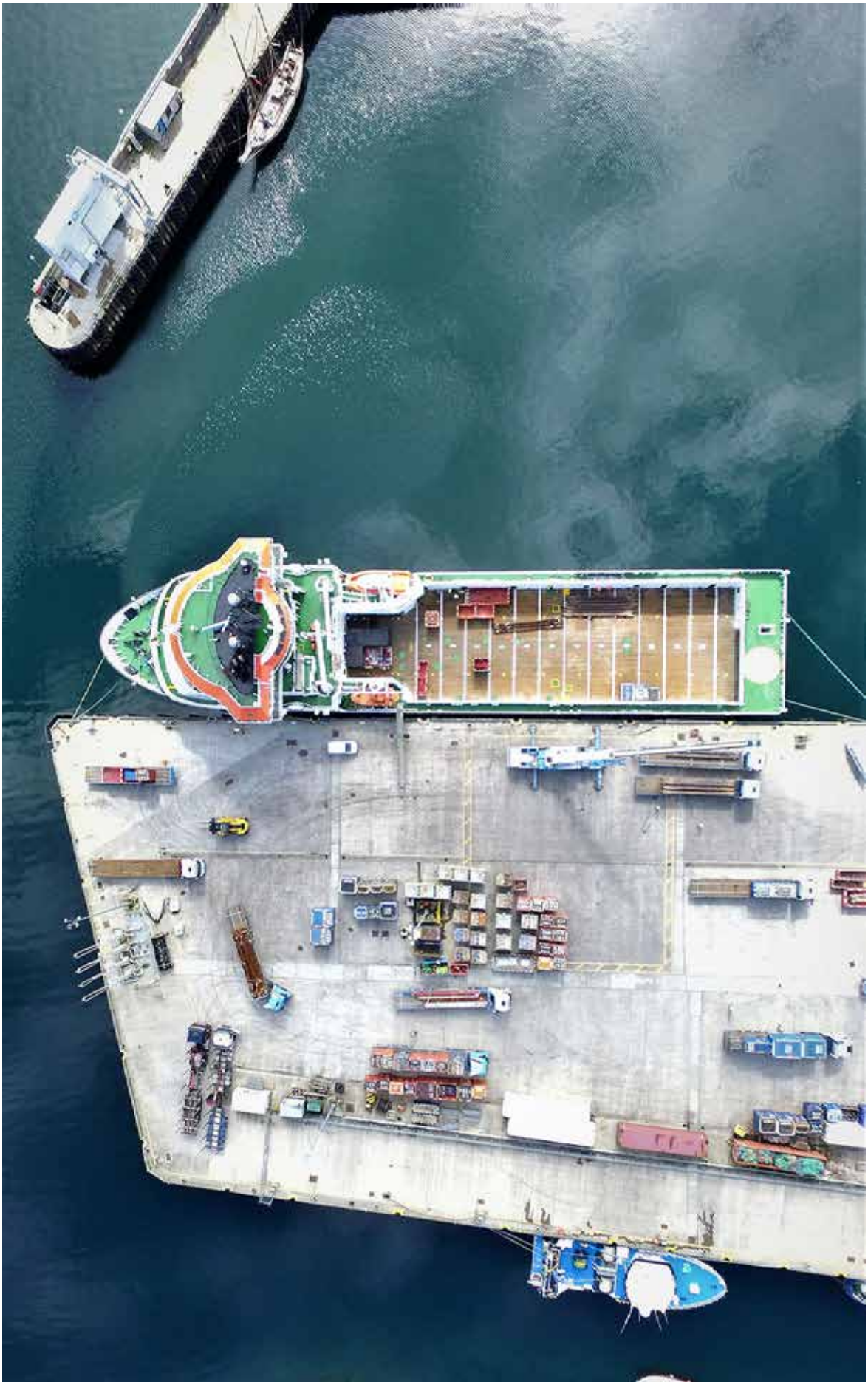
In Dounreay, decommissioning will reduce in the 2020s and 2030s with a consequent impact on employment. There are good existing mechanisms in place for local agencies to work together on economic support and diversification. The NDA is a member of the Caithness and North Sutherland Regeneration Partnership (CNSRP) which draws together major public sector bodies, including Scottish Government, the Highland Council and Highland and Islands Enterprise. This group provides advice at a strategic level and on individual projects.

Priorities for Magnox

The new strategy proposes that the NDA's work is integrated into priorities set out in economic strategies led by local government, but with particular focus on those sites, for example in North West Wales, which are significant local employers.

This approach is meant to give some focus and certainty to our work, but should not exclude community led smaller projects locally. We are therefore proposing that local projects continue to be funded, favouring those with clearly defined outcomes and objectives.

For further information on socio-economic support associated with each SLC and subsidiary *(see **Information on NDA Group**).*



Scrabster Harbour

Case Study: Scrabster Harbour (Caithness)

Since 2010, the NDA has been supporting the development of Scrabster Harbour, near Dounreay. The NDA's financial contribution helped Scrabster Harbour Trust secure additional funding from other sources to invest £20 million in developing its facilities. A new round of development is starting in 2020, with the development of the St Ola Pier.

The NDA has worked together with Scrabster Harbour Trust, Caithness and North Sutherland Regeneration Partnership, Highlands and Islands Enterprise, and Scottish Government on this development.

The investment has helped to secure a number of outcomes including:

- record revenues for the Harbour Trust in each of the last 3 financial years
- 68% growth in commercial vessel tonnage since 2013
- record oil and gas related vessel activity and tonnage in 2016-17
- involvement in nationally significant projects such as the first tidal energy development in the Pentland Firth
- greater economic impacts on the local and regional economy
- the harbour supports over 400 full-time equivalent jobs compared to 339 in 2009
- the Gross Value Added (GVA is the additional value created within Caithness as reflected in wages to employees and profits to company owners) to the Caithness economy is measured at £25 million in 2018 compared to £14.6 million in 2009
- the gross wages/salaries associated with activities supported at the harbour rose from £6.2 million in 2009 to £10.3 million in 2018
- total output of the harbour has risen to £48.2 million.

The NDA's initial investment supported redevelopment of an old fishing pier into the Jubilee Quay which provides increased quayside space, improved access, heavy lift facilities and services required by the oil and gas sector and the needs of other commercial vessels. The combination of improved infrastructure and close proximity to installations west of Shetland provides oil and gas operators with a fast turnaround option, saving time and money.

Earlier in 2017, the NDA and Scottish Government contributed £685,000 towards a £1 million plant providing ice for fishing boats to protect the quality of their catches. The energy efficient plant replaces an old one that closed after operating for 30 years, and ensures a reliable, fit for purpose supply of ice which is essential to maintaining Scrabster as a key fishing centre.

Current plans include:

- creation of a business/industrial park near the harbour
- redevelopment of a further deep-water pier, St Ola, which will target the energy and cruise ship markets
- seabed reclamation south of the main harbour to create additional storage space or industrial land.

The plans are aimed at connecting local businesses to future opportunities and attracting new investment in the area. Scrabster has become a key economic hub in the north of Scotland.

8.11 Public and Stakeholder Engagement

Objective: *To build a better understanding of our mission among the public and our stakeholders and maintain their support, confidence and trust.*

The Energy Act (2004) *(ref 1)* established the NDA as an open and transparent organisation with a duty to engage and consult with stakeholders on all aspects of its work.

Effective engagement is key to building support, confidence and trust among all our stakeholders and we continue to encourage two-way dialogue about strategic direction and when consulting on statutory documents. The open dialogue we have with our stakeholders has encouraged discussion of difficult and complex issues. We are committed to listening to and integrating a diverse range of views and giving confidence to stakeholders that their views and input will be considered fully as part of this engagement, helping to drive and influence progress in delivering the NDA's mission. This would not be possible without the support of our stakeholders and the trust we have built with communities and local authorities close to our nuclear sites.

It is important that the rationale for major decisions and the processes by which they are reached is open and transparent. Effective stakeholder engagement will remain central to our approach and we will continue to look for ways to encourage wider interest and participation in the NDA mission. We are fully committed to harnessing the most up to date and effective communication methods and consultation techniques and will look to learn good practice from others with the aim of making it as easy as possible for stakeholders to give us their views and widen the potential for a diversity of responses.

Acting as a conduit between the wider nuclear industry and regional and local communities we will endeavour to communicate up to date and accurate information on our mission using varied methods and focussing on enhancing our use of digital and social media. We have adapted to new ways of engaging because of the COVID-19 pandemic. Greater use of virtual meetings has been welcomed and has enabled more people to get involved.

We are also committed to evaluating our performance in stakeholder engagement by continuing to ask for feedback about our approach. The anonymised annual stakeholder survey provides an opportunity for stakeholders to tell us how well we perform in this area and where we could improve.

For clarity, this Public and Stakeholder Engagement topic strategy is focussed on the work that the NDA carries out, such as strategy development and business planning. It does not cover specific workstreams of some of our businesses such as the work to find a host community for a GDF, which is being led by our subsidiary RWM. We will work closely with RWM to share our knowledge and learn from their experience on an overall approach to stakeholder engagement.

Our Strategy

Our strategy is to pursue the goal of open and transparent engagement that is tailored and proportionate to the topic or issue. We aim to provide appropriate context and information for an individual audience, to assist them in formulating or finessing their views. Interaction with stakeholders can take various forms and cover different phases of dialogue, and it is therefore important that we are clear about whether the purpose is to involve, consult or inform.

Involve: Our goal is to work directly with stakeholders who have a declared and ongoing interest in our work and to encourage participation from harder to reach groups. We want to ensure that the concerns and aspirations of interested parties are consistently understood and considered. We do this in various ways:

Using existing fora, we engage on a one-to-one basis with key stakeholders such as local authorities, regulators and trade unions. We also plan for issue-led engagement on a particular issue or topic with a large number of stakeholders.

Engagement with Non-Government Organisations (NGOs) is important to us and we are creating a robust NGO forum, where members of the NDA group can engage directly with a wide range of viewpoints including critics of the nuclear industry. We will continue to build the relationship with this important group of stakeholders.

The main fora used for general updates and engagement with local communities is Site Stakeholder Groups (SSGs). Our national engagement is focussed around our annual Stakeholder Summit and supporting other external fora such as those arranged by the Nuclear Legacy Advisory Forum (NuLeAF) which allow us to engage directly with local planning authorities, elected members and economic development officers.

Consult: Consultation is the formal process of seeking stakeholder feedback and responses to specific questions or information placed in the public domain through statutory publications. From time to time we consult on other significant documents such as strategic options papers or revised strategy papers. Again, we will endeavour to ensure we use the most appropriate and inclusive materials to reach the maximum number of stakeholders, enabling them to understand the subject matter and to allow them to form a considered viewpoint.

Inform: Our focus here is how we communicate information to our stakeholders. The goal is to provide stakeholders with balanced and objective information to make them aware of, and help them understand, the issues and complex challenges we face and add insight to their own understanding or viewpoints.

We make extensive use of digital and social media such as Twitter and LinkedIn and refresh and update the NDA website to ensure its content is clear and relevant recognising that there is always more we can do. We also work with multiple media outlets to bring our mission to life via radio, TV and print. NDA staff are available to speak at a variety of conferences and events.

We are committed to reviewing how we engage with hard-to-reach groups and those members of the general public not currently aware of or involved in the NDA's mission. This includes exploring, in consultation with local communities, how to reach those who do not attend meetings or who do not have access to digital/social media.

Strategy Development

In reviewing our strategy, we have concluded that pursuing the goal of open and transparent engagement is still relevant. However, it is important to regularly review delivery of our engagement.

We want our engagement to be more proactive and will take an issue-led, planned approach, using existing fora. We also want to be flexible enough to be able to react to situations and stakeholder needs. Where existing mechanisms do not meet these needs, we will use bespoke approaches.

We want to expand our reach in order to engage with more people, including hard-to-reach groups such as those who are socially, geographically or digitally isolated. Given the multi-generational timescales of our mission, we will focus particular attention on increasing our engagement with younger people.

To help us to do this, we will carry out a review of how we engage with interested parties around our sites. This local arrangements review will help us to determine what works well, where improvements are needed and how we can get more people involved.

In support of national engagement, we will continue to host an annual Stakeholder Summit and look to continuously improve its format to meet the needs of as many stakeholders as possible. We will also aim to ensure that the range of stakeholders in attendance is as broad as possible to encourage more diverse discussion, allowing stakeholders to lead and inform some sessions from their own perspectives. We will also continue to host regional events, including regular roadshows, while looking at new techniques to encourage more young people to engage in a dialogue with the NDA and enable a more tailored conversation when required.

We need to continue improving our engagement with local authorities, in particular planners, who have an important role to play in enabling the NDA's mission, but who face significant resource constraints. We will work closely with NuLeAF and the Scottish Councils Committee on Radioactive Substances (SCCORS) to find the best way to engage with these important stakeholders and will continue to make use of the meetings that they host.

We will commit to an aim of ensuring we are the best regional partner we can be to communities, to help underpin their community vision, and to ensure their views on their own futures are fully integrated with the technical considerations of the NDA's overall mission.

Delivery

While the overarching strategy and principles of public and stakeholder engagement remain the same, our experience and the evolving circumstances in which we operate will influence the way we deliver engagement.

There has always been a clear distinction between our engagement and that of our SLCs and subsidiaries. We engage and communicate on group-wide strategic activities and our SLCs and subsidiaries continue to share information about their site performance and activities. However, we do aspire to greater coordination of engagement across the NDA group, as part of the One NDA way of working (e.g. improved coordination of meetings to minimise stakeholder travel, avoid unnecessary repetition and duplication, and ensure that messages and feedback are consistent and reach the right people at the right time).

We will also continue to engage with EDF Energy (EDF) and any relevant nuclear new build companies to exchange experience of community engagement where there are joint sites, and work together on future engagement needs in partnership with each community. It is especially important that we consider what new approaches the strategic development of site specific decommissioning strategies and the potential approach to decommissioning Advanced Gas-Cooled Reactor (AGR) stations might mean for local and regionalised engagement. We must also consider how we work with industry bodies and how we involve and engage the workforce across our estate.

We are committed to finding creative ways of involving people in our decision-making processes and looking at whether there are more effective ways of engaging with people from all age groups and backgrounds. We will also make better use of visual communications and social media to raise awareness among as many people as possible about the work that we are doing and the opportunities for people to get involved.

8.12 Transport and Logistics

Objective: *To ensure the effective, safe and secure transportation of materials to enable the successful delivery of the NDA mission.*

The effective delivery of the NDA mission relies on our ability to transport radioactive materials (e.g. spent fuel, radioactive waste, contaminated items) and bulk materials (e.g. spoil, concrete, raw materials) to, from and between our sites.

The development of our Mission Progress Reporting *(ref 8)* has made it clear that nearly half of the NDA strategic outcomes will require an effective transport capability in order for those outcomes to be delivered.

Radioactive material has been transported successfully for 60 years under IAEA Transport Regulations *(ref 66)*, implemented in UK law and regulated by the ONR.

Our transport infrastructure, assets, systems, processes and skilled workforce have evolved over this time to meet the requirements of the nuclear industry. The NDA has subsidiary companies which deliver safe, secure and reliable nuclear transport solutions.

Direct Rail Services Limited (DRS) is a world leader in the transportation of nuclear materials by rail and has safely transported spent nuclear fuel for over 20 years, travelling over 5 million miles.

International Nuclear Services Limited (INS) has provided project management and technical specialist capability for transport, both in the UK and overseas.

We are also the majority shareholder of Pacific Nuclear Transport Limited (PNTL), which has been operating marine voyages for more than 40 years between Europe and Japan, and has the most experienced nuclear transport crews in the world.

The vast majority of radioactive material movements are carried by road through the commercial frameworks of LLWR Limited Waste Services.

With world leading capability to transport sensitive nuclear cargoes, the NDA works with key stakeholders in partner countries worldwide in support of strategic programmes to improve global nuclear security *(see **International Relations**)*.

In our previous Strategy *(ref 3),* we reported that we had established the NDA Transport and Logistics Working Group (T&LWG) to help develop, promote and review our Transport and Logistics strategy, monitor progress and improve implementation. This group concluded that whilst transport was being successfully managed within the NDA's subsidiaries and SLCs, the demand for transport within the NDA was not being managed as effectively as it could be, and that it could be better integrated.

The NDA mission is changing as reprocessing comes to an end. Spent fuel from AGRs will still need to be transported to Sellafield for storage but movements of spent Magnox fuel are now complete. An increasing volume of *Low Level Waste (LLW)* will need to be transported for treatment and disposal as sites progress through decommissioning. There will be a requirement for large amounts of *Intermediate Level Waste (ILW)* and *High Level Waste (HLW)* to be transported for disposal. These transports will not be for some decades but decisions on future transport requirements and practices will have an impact on near-term waste packaging and storage practices. We are therefore taking the opportunity now to organise our transport capability so that it will be able to respond to the changing transport requirements.

The NDA is developing a carbon reduction strategy to support UK, Welsh and Scottish Government commitments on *net zero greenhouse gas emissions* and we will need to ensure that we minimise the carbon footprint of all our transport activities *(see **Sustainability**)*.

The development of travel plans for the transport of people to and from their places of work is led by our SLCs. There is an opportunity to expand these travel plans in consultation with local stakeholders.

Our Strategy

In order to integrate our transport capability more effectively, our strategy is to create a single nuclear transport division within the NDA group. Nuclear Transport Solutions (NTS) brings together the extensive transport and logistics expertise of INS and DRS to support the NDA group and provide value beyond the NDA mission, both in the UK and overseas.

NTS will continue to offer the transport capability that has been provided by INS and DRS. It will continually review and implement the optimum means to deliver all NDA group transport requirements. It will develop its existing rail and sea transport capability and, where necessary, acquire new road transport capability to ensure delivery of transport requirements through the most appropriate transport mode.

We will identify and implement opportunities to reduce our carbon footprint, e.g. by combining transports, or by switching transport from one mode to another *(see **Sustainability**)*.

We will invest in the people and skills required for the ongoing safe and secure transport of radioactive material *(see **People**)*.

NTS will build upon the INS capability to be a design authority, responsible for the design and licensing of transport packages that comply with transport regulations.

It is our intention that NTS will be a centre of excellence and a UK capability for the transport of radioactive nuclear materials and other critical materials.

We expect that NTS will continue to develop commercial activities outside the NDA group, both within the UK and overseas. This is essential to ensure that it can build and maintain its capabilities and assets, and exercise them *(see **People** and **Asset Management**)*, and it will also contribute towards funding the NDA mission.

The creation of NTS is aligned with the One NDA way of working *(see **Background**)*.

Strategy Development

We will ensure that the transport of radioactive nuclear materials remains as safe and secure as reasonably practicable, by:

- identifying and sharing international good practice, including through our membership of and support for industry groups. We will seek to ensure that the number and structure of these groups is optimised
- engaging effectively with regulators and influencing amendments to national and international transport regulations, where appropriate, to make these more relevant to the NDA mission.

The creation of NTS will be an opportunity to look at the environmental, economic and social impacts of our transport practices and how they could be reduced. We will address transport questions, including which mode is best for each transport, through the *NDA Value Framework (ref 17)*. In particular, we will look at the potential to move more non-nuclear freight by rail.

To ensure that we have the right set of transport packages available to meet future requirements we will identify:

- which packages have ongoing usefulness
- which packages can be repurposed within the NDA group or elsewhere
- which packages have no further use and can be decommissioned to release valuable space on our sites.

A new set of transport packages will be needed for the future movement of ILW and HLW for disposal and decisions on future packages will be made in conjunction with waste packaging and storage decisions *(see **Integrated Waste Management**, **Supply Chain** and **Asset Management**)*.

We will advise, support and consult government on matters relating to the transport of radioactive nuclear material, and promote our new transport division as an important UK asset and centre of excellence.

Within the UK, we will engage with local authorities, key transport bodies and the public, and we will seek to influence those groups that maintain and make improvements to rail, road and marine infrastructure that will be critical to our mission. We will endeavour to ensure that this also brings socio-economic benefits to communities living near our sites wherever possible *(see **Socio-Economics**)*.

Delivery

NTS will operate DRS and PNTL to deliver rail and shipping activities respectively. It will continue to deliver spent AGR fuel from EDF power stations, Dounreay Fast Reactor (DFR) and other irradiated fuels from Dounreay, Plutonium Contaminated Material (PCM) from Harwell, MOD fuel and sealed sources to Sellafield. It will also continue to return reprocessing products to Europe and Japan.

LLWR Limited will continue to manage waste services, transporting LLW between waste generating sites and treatment and disposal sites (such as compaction facilities, metallic waste recycling or smelting, incinerators, permitted landfill and the LLWR). LLW movements continue to represent the majority of our radioactive material movements by number.

NTS will work across the NDA group and with other stakeholders to develop a comprehensive overview of all projected nuclear and critical non-nuclear transports that are required to deliver the NDA mission and will look for opportunities to deliver the NDA's transport requirements more efficiently.

PNTL vessels at the Barrow Marine Terminal

Case Study: Consolidation of Spent Fuel and Nuclear Materials

Dounreay Exotics Consolidation Programme

In 2013 we concluded the development of our strategy to remove unirradiated nuclear material from Dounreay and consolidate it at Sellafield. This avoided the cost of securely managing the material at Dounreay and will enable that site to progress towards its end state; it also makes best use of the skills, capabilities and facilities at Sellafield as a single centre of excellence for the treatment and management of plutonium.

This was a collaborative programme, led by the NDA, which brought together licensees at the 2 sites (DSRL and Sellafield Limited), our transport subsidiaries, and many other organisations.

The materials were transported by road, sea, and rail (as part of this programme some High Enriched Uranium (HEU) material was also transported to the USA by air ***(see Case Study: Export of HEU in Support of Medical Isotope Production)***. This was carried out by our specialist transport companies (INS, PNTL, and DRS) under the protection of the Civil Nuclear Constabulary (CNC), with the support of police services in Scotland and England. All of the transport packages used to move the material were licensed by ONR, who also gave permission for each of the shipments.

The successful conclusion of this programme, in December 2019, completed *SO17*.

Spent fuel consolidation

Our strategy is to consolidate all of our spent fuels at Sellafield for long-term management. Consolidation brings benefits to the sites from which inventory has been removed, facilitating accelerated clean-up and decommissioning of those sites and reducing the security requirements. It also allows us to manage the consolidated inventory more efficiently, as we can concentrate the required assets and skills on one site.

Historically, this approach has been taken with Magnox and AGR fuels which were transported by road and rail to Sellafield for reprocessing. All Magnox stations have now been defueled and the fuel has been consolidated at Sellafield for long-term management. After reprocessing operations at the Thermal Oxide Reprocessing Plant (THORP) ceased, AGR transports have continued and spent fuel from the EDF AGR stations is being consolidated at Sellafield for safe and secure interim storage. We are expecting an increase in the need for AGR transport capacity when the EDF stations stop generating and the reactors are being defueled.

Between 2011 and 2013 we took a series of decisions to consolidate exotic spent fuels from Dounreay, Harwell and Winfrith at Sellafield. This includes the 44 tonnes of breeder material from the Dounreay Fast Reactor (DFR), and 11 tonnes of irradiated oxide and carbide fuels, principally from the Dounreay Prototype Fast Reactor (PFR). It also includes fuel originally from the *DRAGON* reactor at Winfrith which is now being transported from Harwell to Sellafield for encapsulation in the Magnox Encapsulation Plant *(MEP)*.

If spent fuels are declared as waste for disposal in a GDF, the inventory currently in interim storage would be packaged and sent to a GDF site. This would happen decades after the AGR stations have finished defueling and would require the spent fuel transport capacity to be increased again after a long pause.

8.13 International Relations

***Objective:** To be a world leader in facilitating international collaboration in nuclear decommissioning.*

The NDA's operating environment is inherently international and the risks we manage transcend national boundaries. The materials in our inventory have safety and security considerations on a global scale, and the policy framework in which our strategy is developed is underpinned by international standards and guidance.

Our previous strategies highlighted the importance of the global nuclear landscape and that our experience and expertise mean we have a great deal to contribute. The Energy Act (2004) *(ref 1)* places obligations on us to adopt good practice in the delivery of our mission, so collaboration with our counterparts is essential. Equally, as a pioneer in nuclear decommissioning, we have a responsibility to share our experience and demonstrate leadership globally to improve safety in the delivery of decommissioning and remediation. We have established an extensive portfolio of partnerships in fulfilling these obligations, and remain committed to developing these further.

Our previous Strategy *(ref 3)* also noted that we were being asked to do more by government to promote the nuclear sector's interests overseas and support the development of export opportunities. Since then, our involvement has continued to grow in line with our role as an expert partner organisation, as set out in the Nuclear Sector Deal *(ref 15)* and Export Strategy *(ref 14)* published in 2018.

This strategy makes explicit the dual role of our international relations in benefiting both our mission delivery and UK interests more broadly.

Our Strategy

Recognising the importance of international standards and guidance to collective nuclear safety and our operating environment, we will continue to leverage our capability and experience to fully contribute to, and influence, their development. In particular, we will pursue opportunities to optimise guidance that allows us to implement approaches that deliver better value for money. We will also use these collaborative mechanisms to actively seek opportunities to learn from others.

We will take a targeted approach to collaboration with counterparts to share experience and skills, access peer reviews, and conduct joint technology development projects. Our priorities will be driven by key strategic matters such as the Geological Disposal Programme, requirements defined by our SLCs and subsidiaries, and activity that further develops key partnerships with organisations in the USA, Canada, France, and Japan. This sharing of good practice and learning from successes and failures helps to avoid duplicating effort and improve safety and security and value for money.

The nuclear decommissioning market is growing globally and we will continue to use our experience and relationships to enhance the reputation of the UK nuclear industry. We will showcase the skills and technologies in the UK-based supply chain, supporting them to access international markets directly and indirectly (through support of the Department for International Trade (DIT) campaign groups). Where appropriate, we will provide NDA-owned information and knowhow to support these activities. Building on our successful work in supporting accident recovery at Fukushima, we will work with the UK government to identify other opportunities and priority markets.

As we develop our activity in support of wider UK interests, delivery of our core mission will remain our main focus.

Strategy Development

As the NDA's other topic strategies evolve, collaboration overseas is increasingly important. We will continue to develop our understanding of these growing interfaces and put in place an integrated approach that optimises international efforts across the NDA group.

Beyond export support, the NDA's world-leading capabilities are an asset that the government can use to enhance the UK's reputation internationally. We will work with government and other stakeholders to contribute to and develop appropriate opportunities, for example, for our transport division to play a bigger role in developing standards in the safe and secure movement of nuclear materials.

Delivery

Our strategy is now well established and recent organisational developments mean we are better equipped to engage proactively in the international arena.

The One NDA way of working allows us to access the breadth of capability across the NDA group and put the right people in the right fora. We have also expanded our International Relations team to ensure that international opportunities are more visible and accessible to group businesses.

We will work across the NDA group to develop a cohesive strategy, identifying opportunities and agreeing priorities in our approach to international relations. We will also investigate the benefits of creating a fund that can be accessed by our SLCs and subsidiaries to facilitate engagement in international activity.

We are a key contributor to the activities of international organisations such as the IAEA and Organisation for Economic Co-operation and Development – Nuclear Energy Agency (OECD-NEA) leading the discussion on topics such as site decommissioning and remediation *(see **Site Decommissioning and Remediation**)* and integrated waste management *(see **Integrated Waste Management**)*. We will develop this further involving more of our people from across the NDA group to build a strong and diverse cohort of contributors.

We will also continue to participate in international industry organisations such as the International Association for Environmentally Safe Disposal of Radioactive Material (EDRAM) and the World Association of Nuclear Operators (WANO).

Our expanded NDA International Relations team will continue to support UK interests, engaging closely with governments and other stakeholders to ensure alignment. The development of a Team UK approach that incorporates a coordinated effort by UK government, industry and the supply chain to develop opportunities in international markets has proven successful over the last few years. We will continue our support for this approach in partnership with DIT as it seeks to open up new markets.

Going forward, we will also investigate ways of improving how we communicate our international activities. For mission-related international activity, we will use the framework of our Mission Progress Report *(ref 8)* to demonstrate how each area of activity contributes to delivering our strategic outcomes.

We will facilitate the NDA group and our UK stakeholders to engage in international networks and conferences. We also facilitate site visits for them and continue to host visits by overseas organisations to our sites.

Case Study: Developing Relationships in Japan

The nuclear relationship between the UK and Japan is longstanding. The first reactor built in Japan in the 1960s was based on a Magnox design, and the 1970s saw the Japanese utilities sign commercial reprocessing contracts with British Nuclear Fuels Limited (BNFL), who later opened an office in Tokyo. The NDA inherited these complex commercial contracts and closing them out is an important part of completing our mission.

Since the Fukushima Daiichi incident in 2011, the UK has increased its support to Japan, using its experience to assist with decommissioning challenges. This has enhanced the reputation of the UK nuclear industry, and facilitated access to the Japanese market by the UK-based supply chain.

The NDA helped to lead seminars in Japan to share expertise in areas such as strategic planning and technical approaches to assist with the immediate response to the incident. The NDA also helped to establish the nuclear mission in the British Embassy in Tokyo, funding a full-time strategic and technical expert to assist with the development of ongoing relationships in Japan. Notably, the NDA helped advise on the establishment of the Nuclear Damage Compensation and Decommissioning Facilitation Organisation of Japan (NDF), which has responsibility for overseeing the work at Fukushima Daiichi.

We continue to seek to be a trusted partner for the nuclear industry in Japan, sharing our experience on a number of other challenges (e.g. sharing lessons learned at Dounreay in support of decommissioning of the Monju fast-breeder reactor, as well as our experience at Winfrith in support of decommissioning of the Fugen advanced thermal reactor). As the decommissioning programme in Japan develops, we will use our relationships to learn from growing experience and innovation.

This has helped build the reputation of the UK nuclear industry, allowing us to open doors to the Japanese market for the UK-based supply chain who have won substantial contracts in support of the decommissioning programme at Fukushima Daiichi.

As this export support activity has developed, the NDA, INS Japan, and Sellafield Limited, have also supported the DIT in establishing a Team UK approach to developing stronger UK-Japan relationships. Team UK is made up of businesses from across the nuclear market and directly supports the Nuclear Sector Deal *(ref 15)* objectives. Due to its success, we are looking at using this approach in other markets to unlock opportunities.

NDA colleagues visit key partners in Japan to observe the progress being made at the Fukushima Daiichi Nuclear Power Plant

9.0 Non-NDA Liabilities

Objective: *To identify, assess and decide how to manage non-NDA liabilities, whether public or private sector, to deliver greater value for the UK, while ensuring the successful delivery of our mission remains our priority.*

The NDA's primary function is the decommissioning and clean-up of our sites. However, some of our sites have third party-owned nuclear materials located on them as a result of historic activities and inherited contracts. In addition, some other UK nuclear operators, such as the Ministry of Defence (MOD) and EDF Energy (EDF), have existing and predicted future liabilities. These are collectively termed non-NDA liabilities. In some instances, it may be more appropriate for the NDA group to manage these liabilities where this would deliver benefit to the taxpayer by simplifying contractual arrangements, optimising the use of our existing facilities and ensuring each organisation's skills are focussed on their respective missions e.g. the management of a quantity of Atomic Weapons Establishment (AWE) *Higher Activity Waste (HAW).*

The ownership of non-NDA liabilities remains with the third party unless or until title transfer is agreed. Where we are contracted to manage such liabilities, we will consider the liability owner's needs in developing our strategy and *Lifetime Plans (LTPs)*. If title transfer takes place, the liabilities are essentially transferred to the NDA. The management of any non-NDA liabilities is incorporated in the *Site Strategic Specification (SSS)* and *Client Specification (CS)* for our businesses and addressed through the appropriate strategic themes *(see **Spent Fuels**, **Nuclear Materials**, **Site Decommissioning and Remediation** and **Integrated Waste Management**)*.

Additional Obligations

The NDA is already contracted to manage a number of non-NDA liabilities which include domestic (e.g. EDF and MOD) and overseas customers. The range of contracted services includes spent fuel and radioactive waste management as well as continued safe storage of plutonium and uranium.

Separate to these arrangements, the NDA has further duties placed on it to undertake specified tasks or to provide expert advice to the Secretary of State or to third parties in relation to non-NDA liabilities *(see **Our Evolving Strategy**)*. These additional duties cover both expert support and scope delivery.

Our Strategy

Our strategy for the management of non-NDA liabilities is focussed on 3 key themes:

- we will manage and deliver our existing contractual commitments, simplifying arrangements where possible
- we will take on additional liabilities where we are required to do so by UK government
- we will work with other organisations in considering opportunities where there may be wider benefits to the UK and present these to government for consideration.

Where any additional liability is identified to be beyond our current remit, this will be subject to governance and agreement. We will ensure that any liabilities that are taken on by the NDA do not detract from our mission and generate value to the taxpayer. We are currently managing existing contractual commitments, and this is reflected in the LTPs of our businesses.

Strategy Development

The strategy for non-NDA liabilities is being implemented.

We will continue to work closely with other government departments (e.g. Department for Business, Energy and Industrial Strategy (BEIS) and MOD) to ensure there is strategic alignment of the management of nuclear liabilities across UK government.

Delivery

The NDA has established Memorandums of Understanding with BEIS and MOD covering a range of activities where collaborative working and support is beneficial to the organisations and the taxpayer.

We are also working closely with BEIS and EDF on approaches to Advanced Gas-Cooled Reactor (AGR) decommissioning and other liabilities.

Any additional liabilities will be subject to a detailed assessment to determine their impact on our mission and topic strategies. The assessment will identify the appropriate arrangements, such as contracting options and pricing or title transfer for the management of new liabilities, to deliver value for the UK. These decisions will be managed using the NDA's existing governance arrangements.

Opportunities to work with other operators that may provide a wider benefit to the UK and the NDA will also be considered on a case by case basis.

HMS Resolution (decommissioned in 1994) in dry dock at the Rosyth Royal Dockyard in 2020

Case Study: Treatment and Storage of Atomic Weapons Establishment Higher Activity Waste

The UK has sustained a nuclear weapons capability for almost 70 years. This capability has generated *Higher Activity Waste (HAW)* that now requires treatment and disposal.

Since the 1950s, the UK has operated a number of fuel cycle and waste management facilities including waste handling, treatment and storage facilities. Since 2005, the NDA has made progress in reducing the risk and hazard associated with its own facilities and wastes and has capabilities (which are required to deliver the NDA's mission) that could be utilised to manage other nuclear liabilities from across the UK public sector. An example of this is the planned treatment and management of a quantity of the Atomic Weapons Establishment's (AWE) HAW.

MOD and the NDA have both made commitments to work together to manage nuclear liabilities in the national interest. As part of a study of *Best Available Techniques (BAT)* for the management of AWE's HAW, the NDA agreed to include the use of its own facilities as one of the credible options. Following a joint (NDA and AWE) assessment of the options, and taking into account many factors including safety, value for taxpayer money, and environmental protection, the preferred option was to use existing waste treatment facilities at the Sellafield site.

The preferred option has a number of advantages:

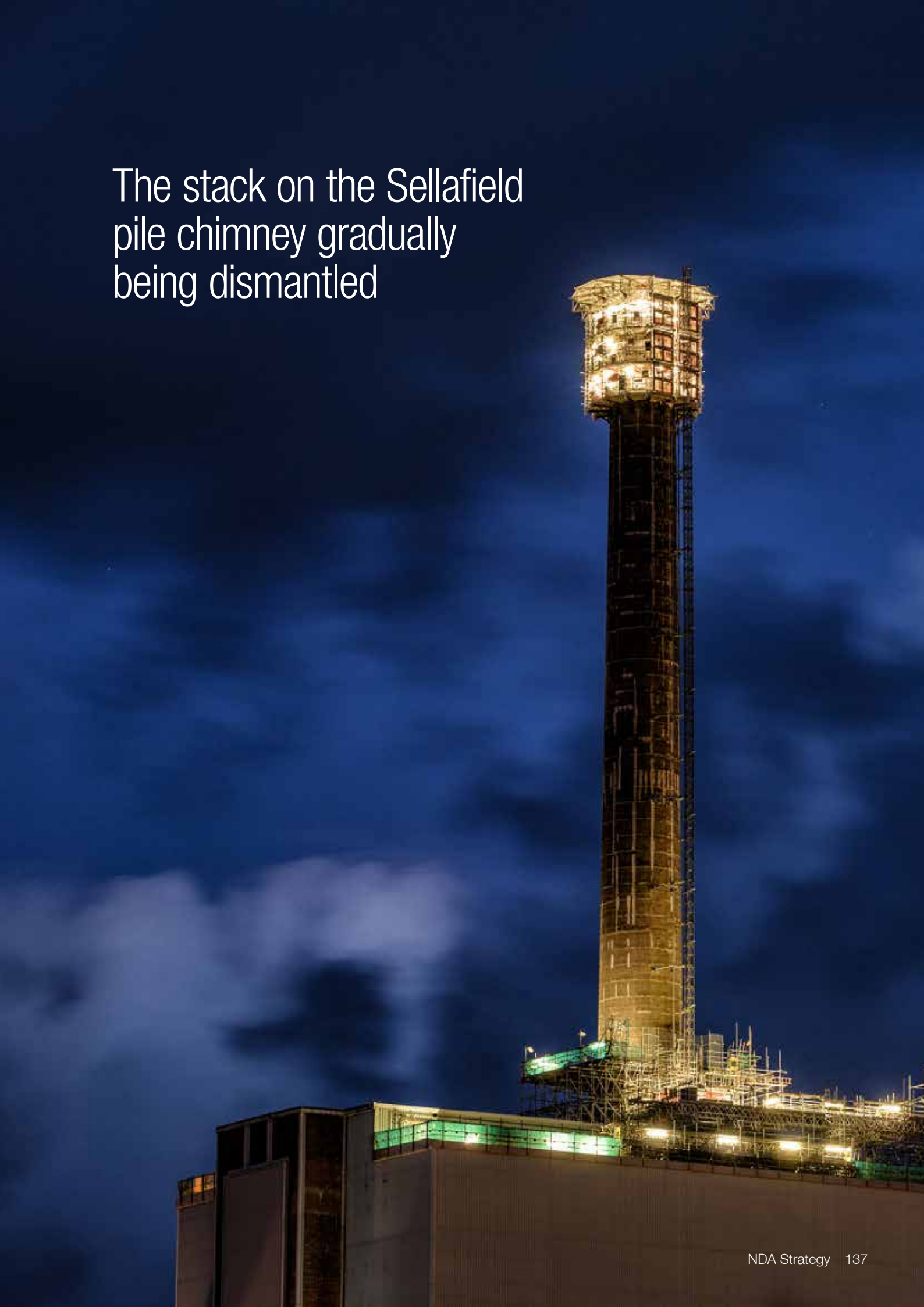
- it represents significant cost avoidance for the UK taxpayer. AWE's initial investment appraisal estimated the cumulative lifetime cost of an option sited at AWE was £600-720 million, whereas the preferred option will have a lifetime cost which is substantially lower
- existing plant and skilled resource would be sustained at the Sellafield site
- the environmental cost, capital investment, risk and additional liability for decommissioning associated with a new construction would be avoided
- hazard reduction at the Aldermaston site could be accelerated without adding to the risk burden at Sellafield
- AWE investment has increased the capability of HAW processing at Sellafield.

Furthermore, the retention of safely packaged HAW at Sellafield avoids operational, logistical and environmental issues associated with returning the waste to Aldermaston. This programme of work is being delivered through effective collaboration between MOD, BEIS, AWE, NDA, Sellafield Limited and Low Level Waste Repository Limited (LLWR Limited), despite challenges due to differences in departmental processes. There has been sustained regulatory and stakeholder engagement throughout. A monthly programme board and working group oversees delivery of the necessary interventions to ensure that the collaboration is successful and continues to be in the best interest of the UK. The first shipment is due for completion in 2021.

Effective collaboration has supported the resolution of a number of commercial, operational and logistical challenges, including:

- cross-sector commercial policy approaches
- title transfer of material at the appropriate point in time, to satisfy obligations under international safeguards
- enabling the transportation of HAW by sharing good practice.

Storage of the HAW



The stack on the Sellafield pile chimney gradually being dismantled

10.0 Information on the NDA group

Sellafield Limited

Site in Cumbria

265 hectares

Hectares de-licensed

0 hectares

Sellafield is our largest and most complex site and has played a pivotal role in the nuclear industry since the 1940s. Operations on the site have included electricity generation, reprocessing and fuel fabrication. These operations are now largely complete and the site is focussed on interim storage of fuel, waste treatment and decommissioning.

Mission Delivery

Sellafield Limited is the *Site Licence Company (SLC)* responsible for the operation of the site. Sellafield Limited is a wholly-owned subsidiary of the NDA. The transition from a contracted *Parent Body Organisation (PBO)* took place in 2016 to allow a greater focus on the long-term plan for the site. A number of mission enabling capabilities are in progress, including a new facility for chemical analysis, new electricity infrastructure and security improvements.

The following sections set out where progress is being made in implementing NDA strategy to deliver the mission. Further detail on delivery plans can be found in the Sellafield Corporate Plan *(ref 67).* Since our previous Strategy *(ref 3)*, the Sellafield component of 4 strategic outcomes have been completed *(SO1,7,8 and 17).*

The planned reprocessing of oxide fuels *(SO8)* has now been completed, allowing the new storage strategy to be implemented. All fuel arising from the existing Advanced Gas-Cooled Reactor (AGR) stations will now be safely managed on site pending a decision on its disposal *(SO9&10)*.

The fuel storage facility has been modified to allow long-term storage and the capacity of this facility is being increased to allow all future fuel arisings to be safely and securely stored *(SO9)*.

All fuel from Magnox powers stations (including Calder Hall located at the Sellafield site) has now been transferred to Sellafield *(SO1)* and shipments of Dounreay Fast Reactor (DFR) material are progressing *(SO12)*.

Operations at the Magnox reprocessing plant were suspended for several months due to the COVID-19 pandemic, which has delayed the completion of reprocessing.

Reprocessing of spent Magnox fuel restarted in October 2020 under COVID-19 secure working arrangements and, if performance is sustained, is expected to be largely complete by the end of 2021.

Regardless of this impact, it is possible that a small quantity of fuel will remain at the end of reprocessing operations and this will be safely stored *(SO4)*.

Arrangements are being put in place to transition legacy Magnox fuel from wet storage in ponds to dry storage in robust packages and the same approach is being pursued for any remaining Magnox *(SO4)* and DFR fuel *(SO14)*. To date, around 25% of the legacy fuel has been removed from its current location.

The site continues to store irradiated fuel on behalf of the Ministry of Defence (MOD). It will consolidate a small quantity of spent fuel from Dounreay *(SO14)*.

Nuclear material production will stop shortly after the end of reprocessing *(SO16&21)*. Plutonium packages will continue to be retrieved from older stores and consolidated in modern facilities *(SO19)*. A new plutonium repackaging facility *(SO18)* is currently under construction which will repackage the inventory to enable its continued safe long-term storage while a long-term *disposition* solution *(SO20)* is developed and implemented *(see **Plutonium**)*. It will also support the management of plutonium from Dounreay which has now been consolidated at Sellafield *(SO17)*. Prior to the new repackaging plant becoming available, smaller-scale facilities are being brought into operation to repackage some of the older plutonium packages. An increased focus is now on uranium storage *(SO24)* and over the next 5 years more optimised storage arrangements will be developed.

The Sellafield Limited Integrated Waste Strategy (IWS) was produced in 2019. This defines the approach that will be taken to manage waste arising from decommissioning the site. As reprocessing draws to a close, the focus is turning from managing waste to supporting operations to develop new waste capabilities required to support decommissioning.

Appropriate application of the *Waste Hierarchy* is a key focus for the integrated management of waste and work is continuing to look at opportunities to apply it more effectively. This means minimising waste as much as possible and looking for options to re-use it or divert it to a lower waste category through segregation or treatment. Work is progressing to look at how waste can be better segregated and how clean soils and bulk material can be used elsewhere. Robust management systems to support this work are key to its successful implementation.

Overseas *High Level Waste (HLW)* is progressively being returned to owners *(SO38)*, whereas UK HLW will be stored until a waste disposal route is available *(SO37&39)*.

Good progress is now being made on the removal of waste from legacy ponds and retrievals from the legacy silos will soon commence as new capabilities and stores are brought into operation *(SO31)* ***(see Case Study: Ponds and Silos at Sellafield).***

New treatment *(SO32)* and storage capabilities *(SO33)* are being developed. The projects to build 2 new stores for different types of *Intermediate Level Waste (ILW)* are being progressed. In addition, construction of demonstrator facilities for decommissioning waste treatment are underway and treatment routes for sludges and wastes arising from the site effluent treatment plant are being developed. New waste packages, which will be used to store this waste, are now being manufactured.

Across the ILW stream, work is progressing to re-examine the waste capabilities the site needs to support retrievals from legacy facilities *(SO31)* and for sustained decommissioning *(SO42)*. Short-term storage arrangements are being considered to avoid bottlenecks, until longer-term waste treatment routes are established.

Low Level Waste (LLW) diversion is progressing well *(SO27)*, with over 50% of the waste produced having been diverted for treatment instead of disposal *(SO28).*

Two key risk reduction activities have been completed. A significant change to the Sellafield skyline is the continued, progressive removal of a chimney that was contaminated by the 1957 Windscale fire. In addition, the high level stack on top of the first reprocessing plant has been removed *(SO42&43)*.

The focus now is on increasing decommissioning capability to facilitate transition of the site from reprocessing to decommissioning and remediation. Two programmes are being established. The first is for decommissioning facilities where the waste does not require shielding and the second for facilities where ongoing shielding to protect workers from radiation is required.

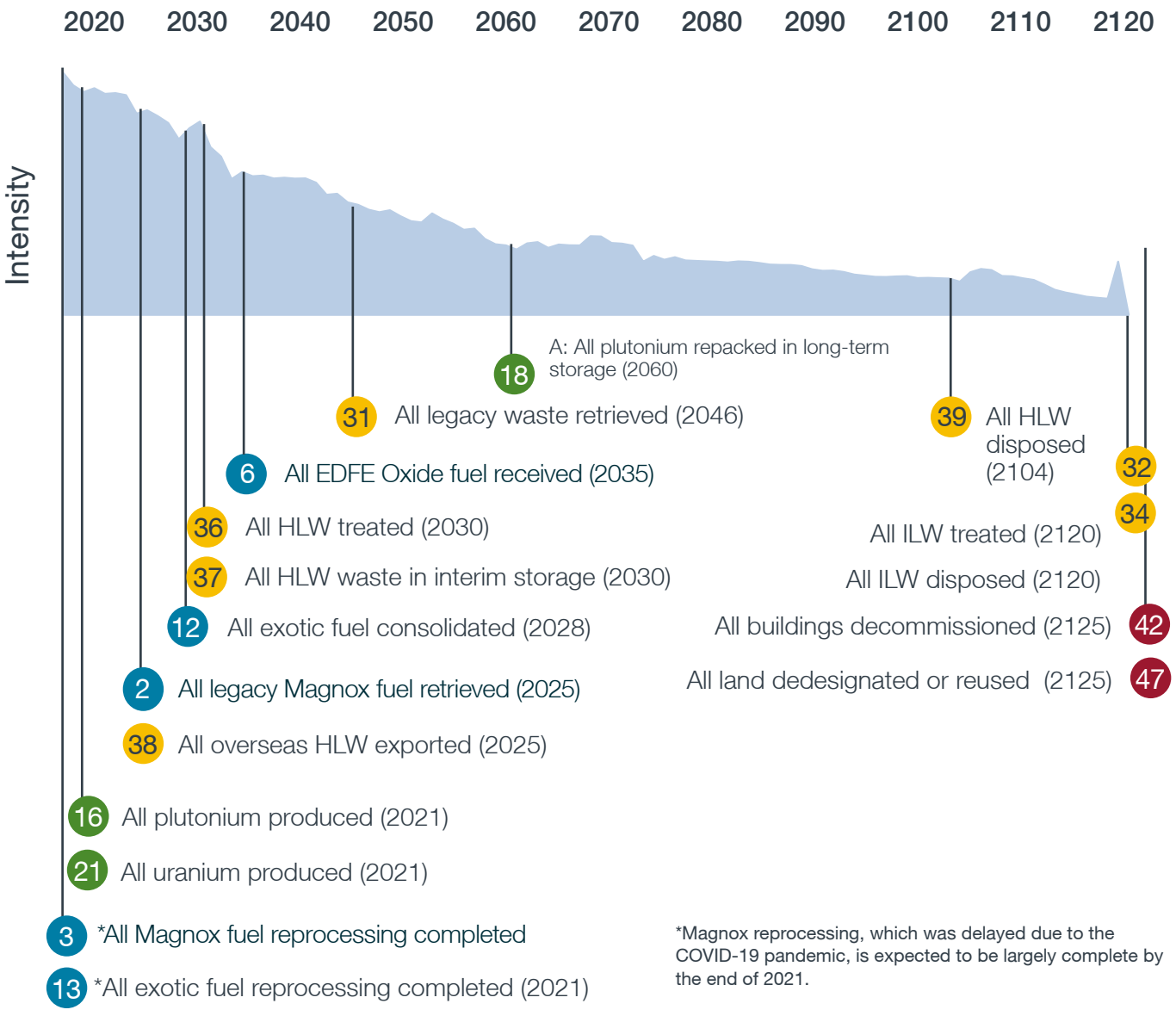
Without the critical enablers mission delivery would not proceed. The asset management programme is vitally important to ensure continued availability of the capabilities required to deliver the mission.

As aged assets reach the end of their operational life they may need to be refurbished or replaced. Replacement of some of the analytical services capacity and medium active effluent management treatment route are examples of work that is currently underway to ensure that enduring capability is in place.

Socio-Economics

Work has progressed on a strategic planning agreement with the planning authorities and we have continued to implement our socio-economic policy, with a socio-economic budget associated with Sellafield of £10 million per year over the last 5 years. This has supported key projects such as building Campus Whitehaven. Further details of projects we plan to support in the future can be found in the Local Social and Economic Impact Strategy Update 2020 *(ref 62)*.

Roadmap for mission delivery



*Magnox reprocessing, which was delayed due to the COVID-19 pandemic, is expected to be largely complete by the end of 2021.

Site end state

Our previous Strategy *(ref 3)* stated that:

'Sellafield Limited is working toward the clean-up of the Sellafield site based on a *site end state* assumption that was identified following a period of NDA-led stakeholder consultation carried out from 2006 to 2007 *(ref 68)*. This assumption splits the site into 2 discrete zones: the 'Inner Zone' and the 'Outer Zone'. The boundary of the Inner Zone is currently assumed to include the Separation Area and the Windscale Piles. Under the current *site end state* assumption any new disposal facilities or long-term storage activities would be located within the Inner Zone.

The *site end state* to be secured by the NDA for the Inner Zone comprises the following:

- the Inner Zone will be subject to *institutional controls* to manage risks to people and the environment
- remediation infrastructure will be used as necessary to ensure groundwater quality is consistent with the requirements of the relevant regulatory regime
- structures and infrastructure will be made safe or removed where necessary.

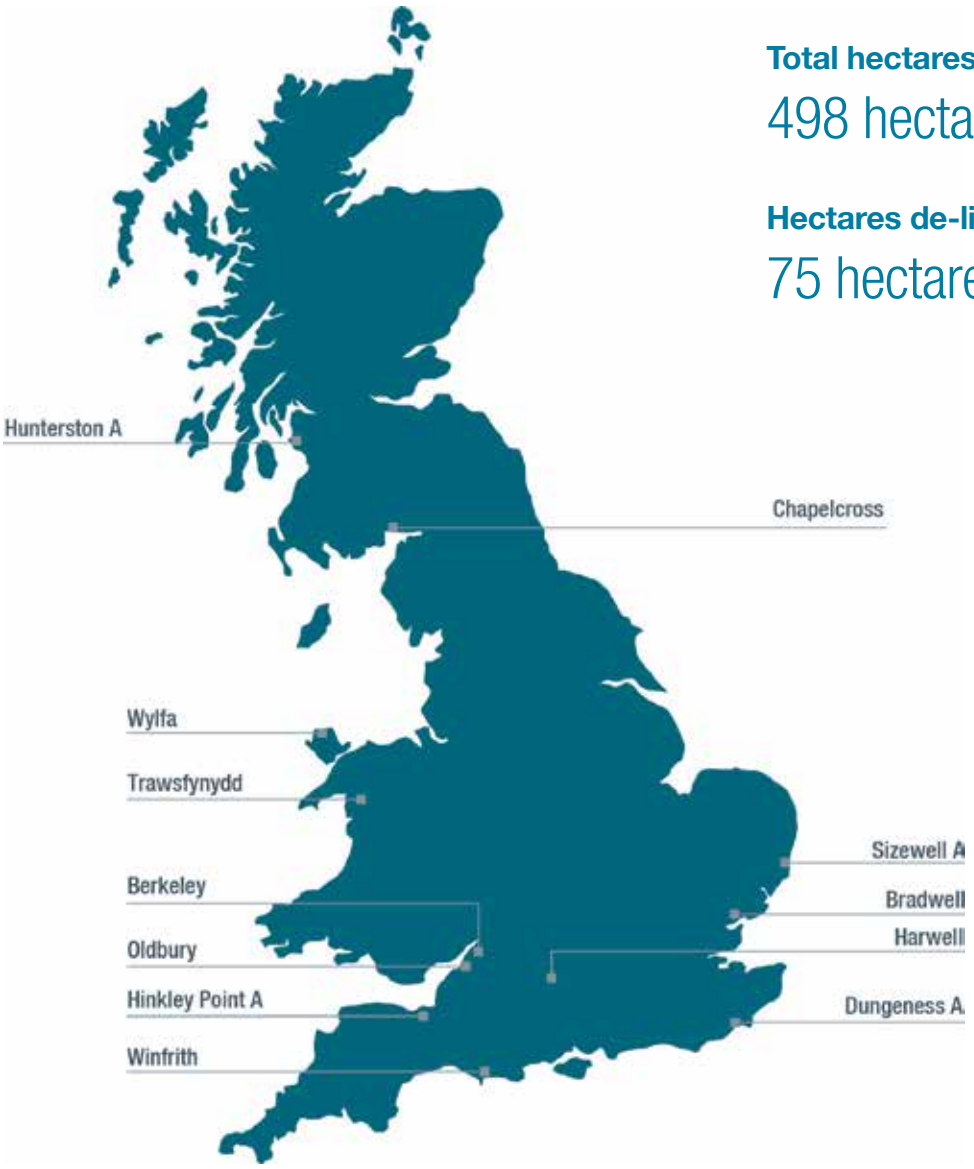
The *site end state* to be secured by the NDA for the Outer Zone comprises the following:

- radioactive and non-radioactive contamination will be reduced to meet the requirements of the relevant regulatory regime for the next planned use of the site and the current use of adjacent land
- where the next planned use does not require a *nuclear site licence* the licence may be surrendered with any residual radioactive or non-radioactive contamination being subject to appropriate *institutional control*
- the physical state of designated land will be made suitable for the next planned use of the site; structures and infrastructure will be made safe or removed where necessary, having first explored opportunities for their reuse.'

As part of an iterative and adaptive approach to end states planning, Sellafield Limited has initiated a decades-long programme of work to challenge the status quo, improve end state assumptions for the site and find the most sustainable solution. As we work through iterations of the end state, engagement with our key stakeholders will be essential to developing future solutions.

It has become clear that the Inner and Outer Zone concept is not feasible to deliver due to the location of landfill sites in the Outer Zone, so this concept will not be used in the future. It has become apparent that different approaches and assessment are required for different parts (components) of the site. Revisiting the end state in an iterative way means we can apply learning from delivery of the current end state assumptions and benefit from greater flexibility for end state options arising from recent changes in the regulatory framework. More detail on the progress being made by Sellafield Limited can be found in the ***Case Study: Optimising Site End States.***

Magnox Limited



Total hectares across 12 sites

498 hectares

Hectares de-licensed

75 hectares

Magnox Limited is the SLC responsible for delivering the NDA's mission at the Magnox reactor sites (Berkeley, Bradwell, Chapelcross, Dungeness A, Hinkley Point A, Hunterston A, Oldbury, Sizewell A, Trawsfynydd (including Maentwrog), and Wylfa) and the research sites of Harwell and Winfrith.

At the end of 2019 Magnox Limited and the NDA concluded their joint review of the Magnox strategy. The established strategy was to defer reactor decommissioning at reactor sites by placing facilities and land that was not required for other uses in a safe, long-term, quiescent state, after which facilities would then be fully decommissioned. In 2019, the quiescent state was achieved at the Bradwell site.

The review concluded that the fleet-wide deferral strategy might not be the optimal approach for all sites *(SO42&43),* and in some instances prevented alternative uses *(SO47)*. The strategy going forward is to develop and implement decommissioning strategies that best suit each reactor site ***(see Case Study: Timing of the Magnox Reactor Decommissioning Strategy).*** The strategy and plans for Harwell and Winfrith were not subject to review and remain unchanged.

Over the last 5 years, the Magnox component of *SO1* has been completed.

Mission Delivery

In September 2019, the PBO contract with Cavendish Fluor Partnership Limited terminated and a new executive team was appointed to manage Magnox Limited as a wholly-owned subsidiary of the NDA. The sections below set out where progress is being made in implementing NDA strategy to deliver the mission.

Following successful defueling of the Wylfa reactors at the end of 2019 *(SO1)*, all Magnox sites are now verified as being fuel free. This achievement completes Magnox's delivery of the spent Magnox fuel strategy and significantly reduces the nuclear hazard profile at Magnox sites.

Nuclear materials remain at the Harwell site. Consolidation of these materials to Sellafield and Capenhurst continues, and is currently scheduled for completion in the next 5 years, which will further reduce the nuclear hazard profile at the site *(SO22&24)*.

Magnox only has ILW to manage as part of its HAW inventory i.e. there is no HLW. The Magnox strategy for managing ILW is to retrieve it *(SO30)*, condition it into appropriate packages *(SO32)*, and then transfer those packages to purpose-built interim ILW storage facilities *(SO33)* at certain Magnox sites pending disposal *(SO34)*. However, disposal may not be the final outcome for HAW generated at Scottish sites in accordance with Scottish Government HAW policy *(ref 35)*.

To date, Magnox has built all of its interim ILW stores *(SO33)* and has implemented conditioning capability at selected sites *(SO32)*. In some instances, this is a modular capability that could be transferred to other sites in the future, and ILW stores are sometimes shared to deliver a variety of benefits. The programme for managing all of the ILW outside the reactor cores, along with bulk asbestos removal, remains the short-term priority. This is scheduled for completion in the next decade. ILW contained in the reactor cores, e.g. graphite, is a significant consideration when developing site-specific strategies for reactor decommissioning.

The remainder of Magnox's waste inventory is *Lower Activity Waste* (LAW) and non-radioactive waste. The non-radioactive waste is managed through the application of the *Waste Hierarchy* using conventional means. The same is true for the LAW, where unavoidable wastes are diverted away from disposal *(SO27)* or reduced in volume to enable more efficient disposal *(SO28)*.

Over the last 10 years, Magnox has consistently achieved >95% diversion of waste from disposal at the Low Level Waste Repository (LLWR) in West Cumbria. As with ILW, the development of site-specific strategies for reactor decommissioning could result in significant volumes of LAW being generated sooner than planned.

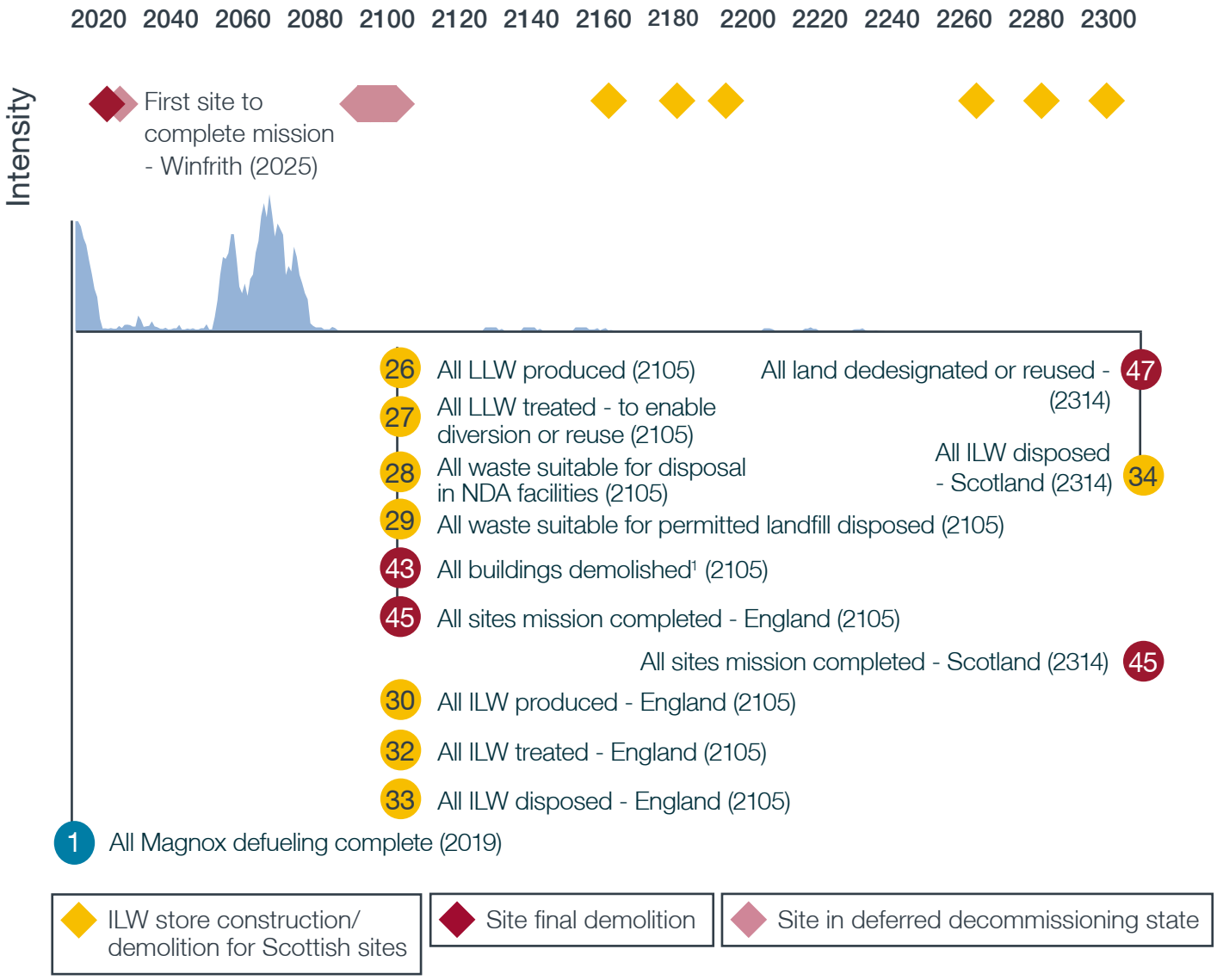
Magnox Limited is responsible for delivering the NDA mission to release all designated land by decommissioning *(SO42&43)* and remediating sites *(SO46)* so that they can be de-designated, or transferred to a third party *(SO47)*. In line with the move to site-specific decommissioning strategies, Magnox Limited will assess whether decommissioning should be progressed straight through to *site end state* or deferred i.e. placed in an interim safe and secure state for an agreed period. The intention is that together the site-specific strategies will result in a rolling programme of decommissioning that will commence at Trawsfynydd ***(see Case Study: Timing of the Magnox Reactor Decommissioning Strategy)***.

In preparation for reactor decommissioning, Magnox has completed many significant hazard reduction steps to date including the aforementioned ILW retrieval, removal of bulk asbestos at most sites, draining of water from cooling ponds (except at Chapelcross), and removal of plant equipment that is degrading.

Socio-Economics

We have continued to implement our socio-economic policy with socio-economic spend associated with Magnox of £9.5 million over the last 5 years. This has supported key projects such as Môn Communities Forward, The Outdoor Partnership, East Watchet Quay, Trawsfynydd Transition Programme Phase 3 and Morlais West Anglesey Demonstration Zone. Further details of projects we plan to support in the future can be found in the Local Social and Economic Impact Strategy Update 2020 *(ref 62).*

Roadmap for mission delivery



* Note dates may change once Magnox Limited has completed the process of selecting the optimum decommissioning strategy for each of the Magnox reactors.

[1] - except for ILW stores on Scottish sites

Site end state

Alongside site specific strategies, *site end states* are also being optimised to align with new regulatory guidance ***(see Case Study: Optimising Site End States)*** where it is envisaged that end state assumptions have been agreed for all sites over the next decade. Currently, the end states for all Magnox sites comprise the following:

- radioactive and non-radioactive contamination will be reduced to meet the requirements of the relevant regulatory regime for the next planned use of the site and the current use of adjacent land
- where the next planned use does not require a *nuclear site licence*, the licence may be surrendered with the management of any residual hazards being subject to regulation by the Health and Safety Executive, the relevant environment agency and local planning authority
- the physical state of designated land will be made suitable for the next planned use of the site; structures and infrastructure will be made safe or removed where necessary, having first explored opportunities for their reuse.

Wylfa, North Wales
where all reactor defueling has now been completed.

Dounreay Site Restoration Limited

Site in Northern Scotland

60 hectares

(plus 12 hectares designated for LLW facility) in Caithness.

Hectares de-licensed

0 hectares

(60 hectares remain covered by the nuclear site licence, the 12 for the LLW facility are designated but not licensed).

Dounreay was the UK site for the development of fast reactor research from 1955 to 1994. It supported a Materials Test Reactor (MTR), 2 demonstration fast reactors as well as nuclear fuel fabrication and reprocessing facilities. It also supported commercial MTR fuel reprocessing and fabrication around the world resulting in a range of nuclear and non-nuclear legacies including exotic fuels, nuclear materials and historic ILW and LLW disposal facilities.

Over the last 5 years, the Dounreay component of *SO17* has been completed.

Mission Delivery

Dounreay Site Restoration Limited (DSRL) is the SLC responsible for the operation of the Dounreay site in Caithness, Scotland. DSRL continues to deliver the programme for ending all physical decommissioning and remediation work on the site. A number of capabilities required to deliver the mission are in progress, including constructing a new facility for storing wastes *(SO33)* arising from the treatment of liquid waste streams *(SO32)*, and upgrading facility ventilation infrastructure. The sections below set out where progress is being made in implementing the NDA's strategy to deliver the mission.

We intend to consolidate all exotic fuels located at the Dounreay site at Sellafield resulting in significant hazard reduction *(SO12)*. This includes the fuels from the DFR and the Prototype Fast Reactor (PFR). More than half of the remaining radioactive fuel elements from the DFR have now been removed.

The Dounreay stock of civil separated plutonium is now consolidated at Sellafield *(SO17)* following completion of a phased transfer programme involving a range of organisations. DSRL will continue to transfer the remaining unirradiated exotics material, known as remnants, offsite or consign them to waste streams.

The DSRL 2020 IWS details the approach to managing the full range of waste identified on the site. The focus of the IWS has changed to include new opportunities to support decommissioning. Additional storage will be provided for ILW on site with the construction of the Cementation Plant Store Extension *(SO33)*. Offsite waste routes for LLW bulk metal have been opened up *(SO27)* and there is capacity to construct 4 more LLW vaults for operational and demolition waste at the offsite LLW disposal facility *(SO28&29)*.

There have been no significant increases in the scope of work since our previous Strategy *(ref 3)*. However, the effects of earlier scope increase due to security requirements and a change in the management of spent exotic fuels *(SO12)* has continued to impact decommissioning activities *(SO42&43)* in this period.

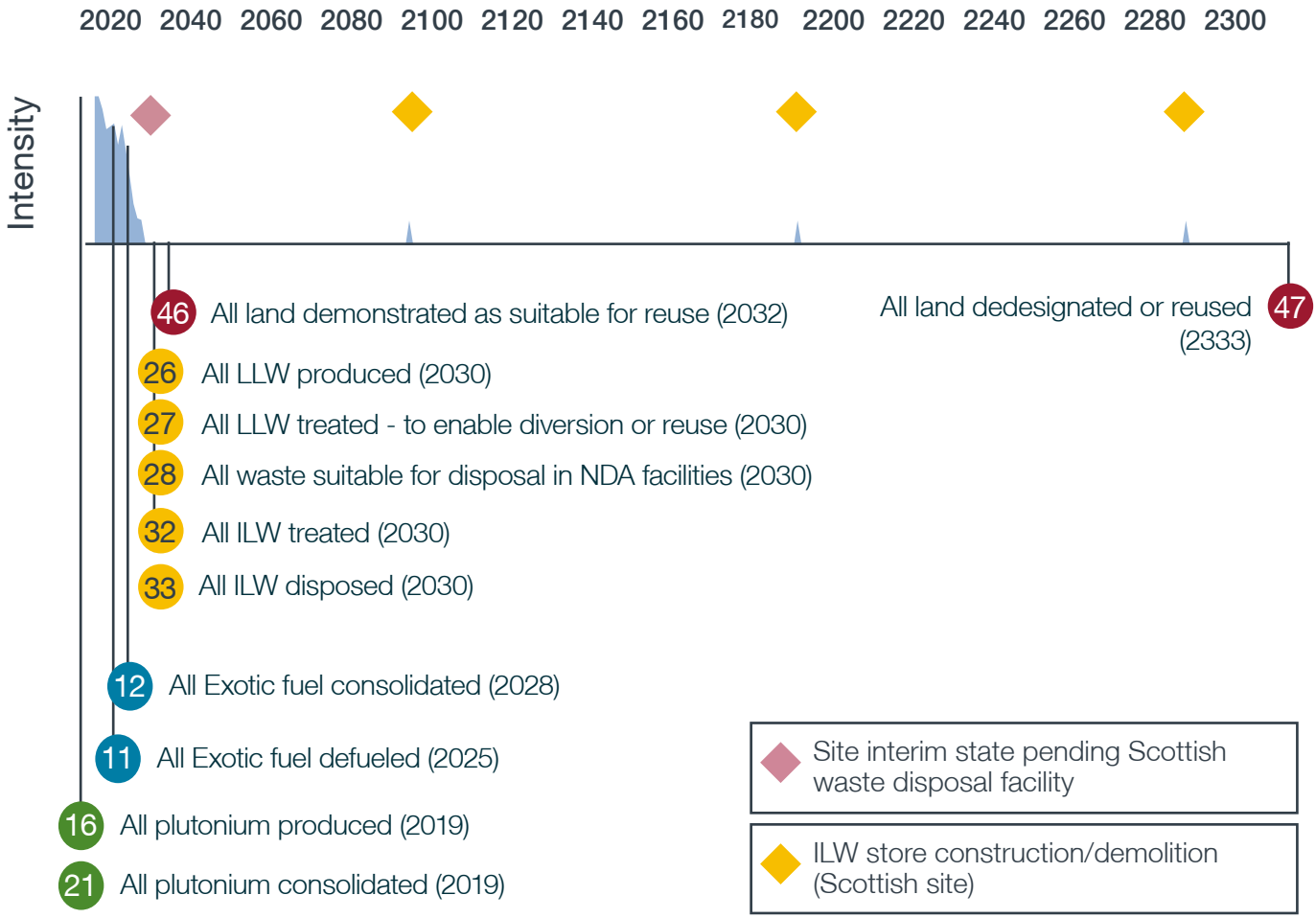
Two key risk reduction activities have been completed which have significantly reduced the hazard across the site. Highly active liquid raffinate from DFR fuel reprocessing has been immobilised and immobilisation of PFR raffinates will be completed by 2021 *(SO32)*. The bulk liquid metal coolant at DFR has been destroyed and work continues on residual alkali metal destruction in the PFR and DFR reactor vessels, with all residual alkali metal planned to be destroyed by 2023 *(SO32)*.

The focus now is on risk reduction of remaining high hazards. Emptying ILW from the waste disposal facilities at the shaft and silo will be completed in 2029 *(SO30)*, with final remediation of the shaft and silo area by 2031 *(SO46)*. Decommissioning of the Fuel Cycle Area will continue *(SO42&43)*, building on the experience gained in dismantling the Medium Active Cell in the former fuel reprocessing plant, the laboratories, and the High Active Cells in one of the Post Irradiation Examination (PIE) facilities.

Socio-Economics

We have continued to implement our socio-economic policy with socio-economic spend associated with Dounreay of £8 million over the last 5 years. This has supported key projects such as physical infrastructure improvements at Wick and Scrabster harbours. Further details of projects we plan to support in the future can be found in the Local Social and Economic Impact Strategy Update 2020 *(ref 62)*.

Roadmap for mission delivery



Site end state

The *site end state* for designated land at Dounreay comprises the following:

- radioactive and non-radioactive contamination will be reduced to meet the requirements of the relevant regulatory regime for the next planned use of the site and the current use of adjacent land
- where the next planned use does not require a *nuclear site licence*, the licence may be surrendered with the management of any residual hazards being subject to regulation by the Health and Safety Executive, the relevant environment agency and local planning authority
- the physical state of designated land will be made suitable for the next planned use of the site; structures and infrastructure will be made safe or removed where necessary, having first explored opportunities for their reuse
- existing waste disposal facilities will either be emptied or engineered for closure as determined by the relevant *environmental safety case*
- ILW will be stored on the site to comply with current Scottish Government HAW policy *(ref 35)*.

As the understanding of the site and its potential future use increases the *site end state* will be reassessed to ensure we are moving towards an optimised and sustainable solution ***(see Case Study: Optimising Site End States).***

The Low Level Waste Facility in operation at Dounreay

Low Level Waste Repository Limited

Site in Cumbria

99 hectares

Hectares de-licensed

0 hectares

The LLWR site is located in West Cumbria, to the south of the Sellafield site. It has operated as a disposal facility since 1959 and is of strategic importance to all producers of low level radioactive waste (including nuclear sites, hospitals and research laboratories) across the UK. Most waste arrives at the site by rail in large metal containers.

Before consigning the waste to the site, waste producers are required to ensure that it meets the waste acceptance criteria set out by Low Level Waste Repository Limited (LLWR Limited) and demonstrate that it is suitable for disposal at the site. After arriving at the LLWR site, any space left in the containers is filled with grout and, after the grout has set, the containers are transferred to engineered concrete vaults for final disposal.

Mission Delivery

LLWR Limited is the SLC responsible for the operation of the LLWR site. Since 2008 LLWR Limited has been successfully operated under the PBO contract model and during this time has seen significant positive change in the operation of the site and the management of LLW across the UK. In July of 2021 the contract will come to an end and LLWR Limited will become a wholly-owned subsidiary of the NDA. LLWR Limited will continue its role in leading the implementation of the UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry *(ref 2)*, supporting delivery of the NDA Radioactive Waste Strategy *(ref 9)*, along with operating, capping and eventually closing the site.

Over the last 10 years, LLWR Limited has brought about significant change in the way LLW is managed in the UK. This has preserved important capacity at the LLWR site *(SO28)* and has been achieved by working closely with waste producers through a National LLW Programme and by working with the supply chain to give access to new waste services *(SO27)*. Since our previous Strategy *(ref 3)*, LLWR Limited has worked with waste producers to make the application of the *Waste Hierarchy* to LLW standard practice. The introduction of a programme of peer assists and peer reviews by LLWR Limited's National LLW Programme has been recognised as an effective way of sharing and building on good practice and knowledge across the nuclear industry. In the last year, 98% of the waste that would otherwise have been sent to LLWR for disposal has been diverted to other safe routes for treatment or disposal *(SO27&29)*.

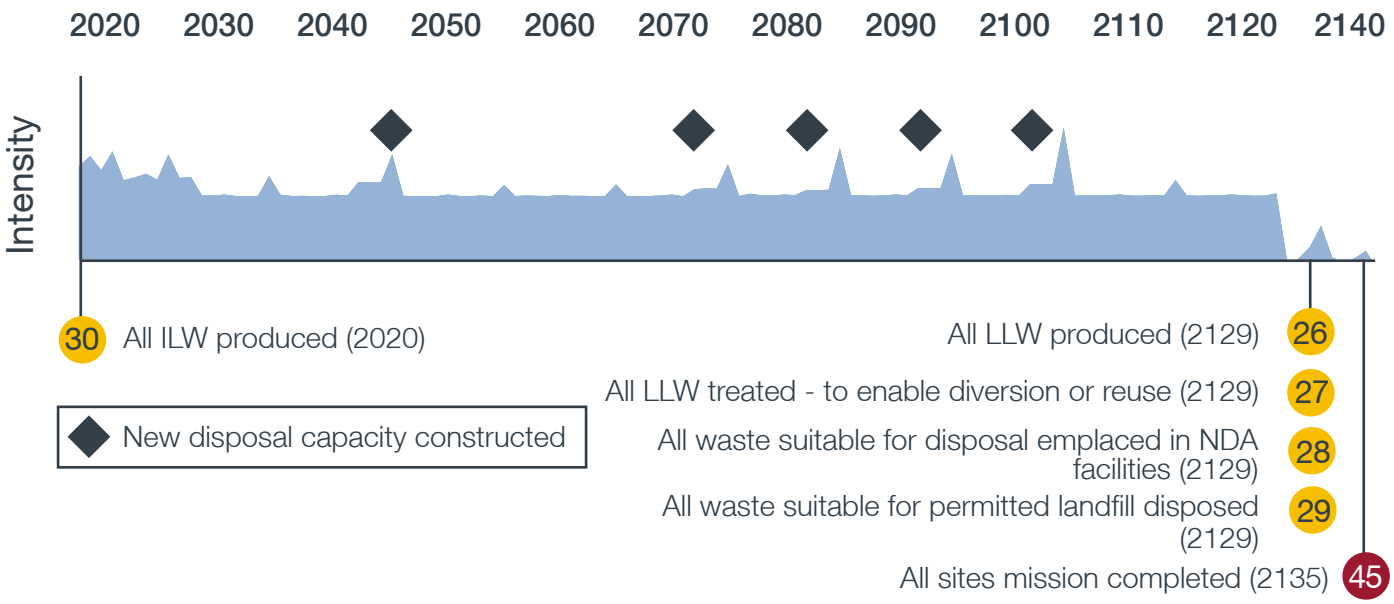
Since our previous Strategy *(ref 3)* LLWR Limited has also completed the decommissioning and clean-up of the historic plutonium contaminated facilities at the LLWR site *(SO30)*. This has been a huge achievement. LLWR Limited applied lessons learnt throughout the duration of the programme to make the work more efficient and completed it several years ahead of the original planned date. LLWR Limited is now sharing that learning across the NDA group and beyond.

LLWR Limited will continue its role in implementing the UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry *(ref 2)*. Additionally, LLWR Limited will continue to take a lead role, with RWM, in implementing the NDA Radioactive Waste Strategy *(ref 9)* through an Integrated Waste Management (IWM) programme. This role will be critical to realising the strategic objectives of the ***Integrated Waste Management*** theme described here and of the NDA Radioactive Waste Strategy *(ref 9)*.

Important areas of work that LLWR Limited will be undertaking over the next 5 years include:

- working towards final closure and capping of disposal trenches and the Vault 8 disposal area, which is important for managing waste that has been disposed of already and essential to underpinning the future disposal of waste at the site *(SO28)*
- continuing to provide waste management services to LLW producers, including waste packaging, treatment and disposals
- working with the NDA and RWM to develop the IWM programme and be a core contributor to the delivery of its scope
- considering options for how waste could be disposed of at the site in future, which could lead to new designs for disposal facilities
- working with waste producers to find effective ways to manage waste that is close to the LLW / ILW boundary, through better characterisation and segregation *(SO34)*
- a major review of the LLWR Environmental Safety Case, which will consider options for making the best use of the LLWR site *(SO28)*
- deploying its expertise to support the NDA as it considers options for developing a near-surface disposal capability for ILW *(SO34)*.

Roadmap for mission delivery



Socio-Economics

We have continued to implement our socio-economic policy, with socio-economic spend associated with LLWR Limited of £225,000 over the last 5 years. This has supported a wide range of projects in the area, including support to a hostel for the homeless, a community café and community projects across West Cumbria. This spend has been undertaken in the context of LLWR Limited's ever strengthening relationship with the local community around the site. The team at LLWR Limited are also very enthusiastic fundraisers, supporting a wide range of charities in the local area. Further details of projects we plan to support in the future can be found in the Local Social and Economic Impact Strategy Update 2020 *(ref 62)*.

The Copeland Community Fund is a separate socio-economic arrangement directly funded by LLWR Limited to the level of £1.5 million per annum. The Fund was established to recognise the service Copeland provides to the nation by hosting the LLWR site and it provides grants to a wide range of local organisations for the benefit of the local community. Further information and examples of past projects can be found here: https://copelandcommunityfund.co.uk/case_study/.

Site end state

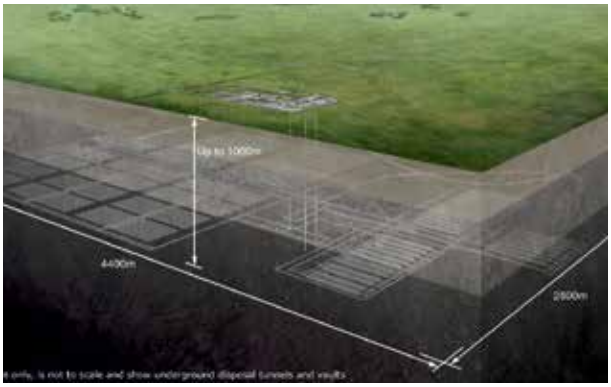
The *site end state* for designated land at the LLWR is as follows:

- waste that has been disposed of will remain in situ as determined by the site's *Environmental Safety Case*
- the physical state of the repository will reflect the optimised closure engineering described in the site's *Environmental Safety Case*
- access to the site will be managed in accordance with controls designed to protect people and the environment from residual hazards
- the repository will remain subject to controls for as long as required by the relevant regulatory regime to manage risks to people and the environment.

We are working with LLWR Limited to review these end state assumptions, in particular considering the options for parts of the designated area where current plans do not include disposal. Discussion with the local community will be an essential part of this process.

An artist's impression of Vault 9 after capping.

Radioactive Waste Management Limited



Radioactive Waste Management Limited (RWM) is responsible for implementing the UK and Welsh Government policy for *geological disposal* of *Higher Activity Waste (HAW)*.

Mission Delivery

RWM is a wholly-owned subsidiary of the NDA. RWM's core role is the development, operation and closure of a *Geological Disposal Facility (GDF)* for *Higher Activity Wastes (HAW)* in England and Wales (*SO5, 10, 15, 20, 25, 34, 39, 40&41*).

The Geological Disposal Programme will last for many decades. RWM is currently implementing actions set out in the UK and Welsh Government policies for working with communities to identify a willing community to host a GDF *(ref 42) (ref 69)* and preparing for the next phase of the programme in which work will be undertaken to assess suitability of sites identified with the communities, and develop a GDF design relevant to those sites.

RWM's fundamental role is to demonstrate that HAW can be safely disposed of in the future in accordance with regulatory expectations. This will be an essential component of the GDF programme in RWM's work with potential host communities and the regulators. In order to do that, RWM will develop site specific designs and plans for a GDF and use them to demonstrate suitability through site specific safety cases.

In parallel with delivering the GDF programme, RWM works closely with all producers of HAW to ensure that waste is conditioned and appropriately managed in a way that gives confidence that it will be acceptable for disposal when a GDF is available. This is an important part of the NDA's risk-informed approach to the management of radioactive waste *(SO33&37)*. Although Scottish Government policy *(ref 35)* does not support *geological disposal,* RWM works with Scottish waste producers to help ensure waste is packaged so that it will remain in a suitable form for long-term management. RWM and the NDA will work together to support the Scottish Government in the implementation of Scottish HAW policy *(ref 36) (SO34)*.

In parallel with the National LLW Programme led by LLWR Limited, RWM delivers a Strategic Waste Programme that supports waste producers to optimise the management of HAW and supports the development of NDA strategy for waste and nuclear materials. RWM will continue this role, as well as taking a lead role, with LLWR Limited, in implementing the NDA Radioactive Waste Strategy *(ref 9)* through an IWM programme. This new area will be critical to realising the strategic objectives of the ***Integrated Waste Management*** theme described here and of the NDA Radioactive Waste Strategy *(ref 9)*.

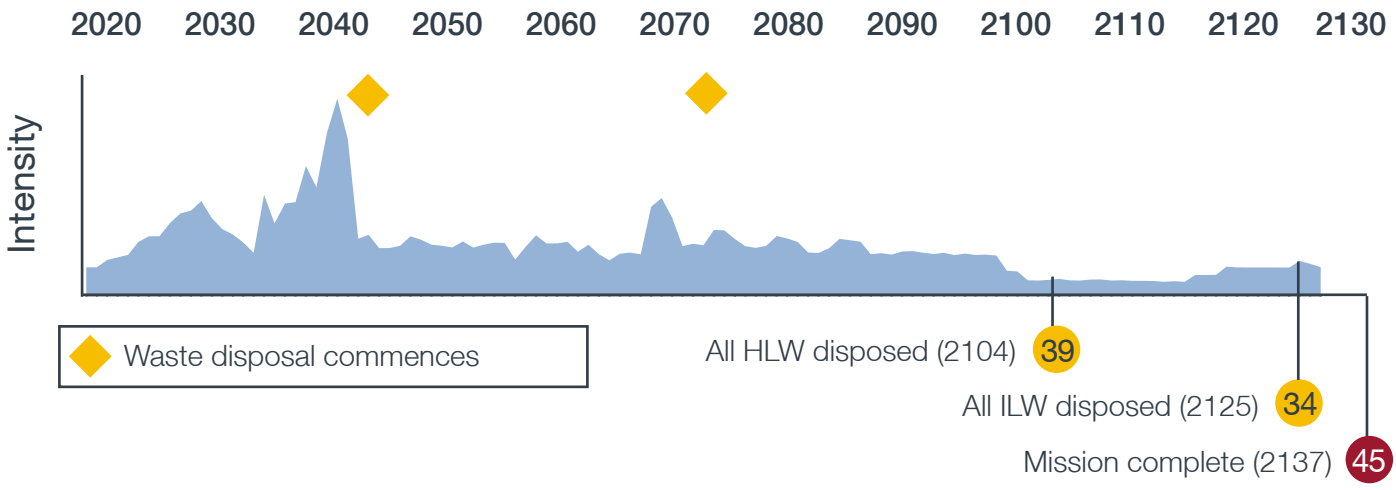
Important activities that RWM will be undertaking in the next 5 years include:

- continuing to engage with potential host communities in line with UK and Welsh Government policy for *geological disposal* (*SO5, 10, 15, 20, 25, 34, 39, 40&41*)
- working with the NDA and LLWR Limited to develop the IWM programme and be a core contributor to the delivery of its scope
- deploying its expertise to support the NDA as it considers options for developing a near-surface disposal capability for ILW *(SO34)*
- continuing to work with waste producers to ensure that the storage of HAW provides confidence that it can be disposed of in the future and that any risks associated with the storage of waste are well understood and managed *(SO33&37)*
- continuing to engage with regulators to ensure the availability of necessary capability, organisation, resources and arrangements to apply for, and then hold, environmental permits and a *nuclear site licence*
- building RWM's capabilities, in particular major programme delivery, and engaging with overseas waste management agencies to exchange knowledge and expertise.

Socio-Economics

The siting process for the Geological Disposal Programme is specifically designed to ensure that participating communities can experience immediate positive social benefits. This will be partly through access to direct community investment funding of £1 million, later increasing to £2.5 million, per annum for the duration of their involvement, and partly through indirect benefits of the local project activity creating opportunities for local businesses and service providers. A community that ultimately hosts a GDF will secure further transformative, long-term benefits both from direct employment and opportunities associated with GDF construction and operation. In addition, the UK government has committed to provide significant additional investment that will provide continuing socio-economic benefit to the area.

Roadmap for mission delivery



Springfields

Site in Lancashire

81 hectares

Hectares de-licensed

0 hectares

The Springfields site near Preston in Lancashire is owned by the NDA and leased to Springfields Fuels Limited (SFL), a subsidiary of Westinghouse Electric Company (WEC). SFL operates the site and manufactures a range of fuel products for both UK and international customers. The site also has historic liabilities in the form of uranium-bearing residues and redundant facilities.

Mission Delivery

SFL is the site licence holder responsible for the site. As owner of SFL, WEC can set the strategy for the site and invest for the future under the terms of a 150-year lease from the NDA.

The NDA has contracts with SFL to provide residue processing *(SO23)*, decommissioning and clean-up services to address historic liabilities *(SO42-43&46)* *(see **Site Decommissioning and Remediation** and **Uranium**)*. These services will be provided in accordance with NDA strategy to deliver the mission and are set out below.

The processing of legacy uranium-bearing materials through a number of enriched and natural uranium processing routes is covered by a Residues Processing Agreement. This work will ensure that uranium on the site is appropriately treated *(SO23)* and consolidated *(SO22)* in accordance with NDA strategy.

Post Operational Clean Out (POCO), decommissioning and demolition of historic NDA-owned facilities on the site and associated waste disposal are covered by a Decommissioning Agreement.

Site end state

The *site end state* for designated land at Springfields comprises the following:

- radioactive and non-radioactive contamination will be reduced to meet the requirements of the relevant regulatory regime for the next planned use of the site and the current use of adjacent land
- where the next planned use does not require a *nuclear site licence*, the licence may be surrendered with the management of any residual hazards being subject to regulation by the Health and Safety Executive, the relevant environment agency and local planning authority
- the physical state of designated land will be made suitable for the next planned use of the site; structures and infrastructure will be made safe or removed where necessary, having first explored opportunities for their reuse.

Capenhurst

Site in Cheshire

31 hectares

Hectares de-licensed

17 hectares

The Capenhurst site is located near Ellesmere Port in Cheshire and is home to both historic and operating uranium enrichment plants and associated facilities. Most of the site is owned by Urenco UK Limited (UUK), a subsidiary of Urenco Limited, with the remainder owned by the NDA and leased to UUK. UUK is the Site Licence holder responsible for the site and operates ongoing enrichment activities. The site also houses the NDA's largest uranium store and has historic liabilities in the form of redundant facilities.

Mission Delivery

NDA strategy to deliver our mission is implemented through 3 main contracts with Urenco Nuclear Stewardship Limited *(UNS)*, formerly known as Capenhurst Nuclear Services Limited, as set out below. These agreements will reduce the NDA's net liabilities for managing and clearing the Capenhurst site.

The Tails Management Services Agreement includes the processing of UK government-owned by-product material *(SO23)* (uranium hexafluoride tails, known as Hex) from historic uranium enrichment through Urenco's Tails Management Facility. This will contribute to the NDA mission in respect of treating our Hex to reduce its hazard and environmental detriment potential and placing it in safe and secure interim storage *(SO24)*.

In addition to this, the Uranic Storage Agreement provides for the ongoing safe and secure interim storage of other uranium on the site including uranium consolidated at Capenhurst from other sites *(SO22&24).*

The decommissioning of defined legacy facilities and remediation of part of the land leased to UUK is contracted through a Decommissioning Agreement. This contributes to the NDA mission by decommissioning buildings and facilitating the *de-designation* of land *(SO42-43, 46-47).*

Site end state

The *site end state* for the NDA's designated land at Capenhurst comprises the following:

- radioactive and non-radioactive contamination will be reduced to meet the requirements of the relevant regulatory regime for the next planned use of the site and the current use of adjacent land
- where the next planned use does not require a *nuclear site licence*, the licence may surrendered with the management of any residual hazards being subject to regulation by the Health and Safety Executive, the relevant environment agency and local planning authority
- the physical state of designated land will be made suitable for the next planned use of the site; structures and infrastructure will be made safe or removed where necessary, having first explored opportunities for their reuse.

Nuclear Transport Solutions

In 2021 the NDA brought together its extensive transport and logistics expertise into a single organisation known as Nuclear Transport Solutions (NTS).

NTS is a centre of excellence for the transport and packaging of nuclear materials. It brings together responsibility for transport and packaging, along with the operational, commercial, engineering, legal and regulatory expertise that underpin nuclear transport and logistics.

NTS operates Direct Rail Services Limited (DRS) and Pacific Nuclear Transport Limited (PNTL) who continue to deliver rail and shipping activities respectively, building on decades of experience of providing safe, secure and reliable transport solutions.

Strategy

NTS's primary objective is to provide effective transport and technical solutions that enable delivery of the NDA's mission. This includes transporting spent AGR fuel from EDF Energy (EDF) power stations, sealed sources to Sellafield, DFR and other irradiated fuels from Dounreay, Plutonium Contaminated Material (PCM) from Harwell, MOD fuel to Sellafield, and the return of reprocessing products to customers overseas.

NTS will work across the NDA group and with other stakeholders to develop a comprehensive overview of all projected transport activities that are required to deliver the NDA mission, and look for opportunities to deliver the NDA's transport requirements more efficiently and sustainably.

As well as safely transporting materials to, from and between NDA sites, NTS applies its world-leading nuclear transport expertise to deliver commercial activities outside the NDA group, both within the UK and overseas.

NTS also delivers additional value for money for the taxpayer by continuing to provide transport services beyond the nuclear sector (e.g. commercial rail freight contracts). This ensures its capabilities and assets are maintained and enhanced and generates additional revenue to support the NDA's mission.

NDA Archives Limited

The NDA owns all the records, with a few minor exceptions, held within and generated by the NDA group. We are obliged by various statutes, regulatory and business-led requirements to manage, protect and make available these records to the standards required of a responsible public authority (e.g. the Public Records Act (1958 and 1967) *(ref 70,71)*. The need to actively manage many of the records will outlive the organisations that created them and this has resulted in the requirement for a centralised service.

This is now managed by NDA Archives Limited (NDAAL), which provides a compliant, secure and effective system of controls to ensure appropriate access to records to support delivery of the NDA mission. NDAAL currently discharges its operational responsibilities via a commercial partner who manages the relevant facilities and processes on our behalf. The main archive facility (Nucleus: the nuclear & Caithness archives) has been established at Wick in Caithness, in a purpose-built facility that has achieved *Place of Deposit* status, as well as other relevant standards and accreditations.

The NDAAL Board approves 1 and 5-year business plans submitted by the commercial partner, in accordance with the NDA's information governance strategy and underpinning projects and programmes. These business plans will form the basis of both core and non-core activities managed by NDAAL, including the approval, or otherwise, of the commercial partner's plans to engage with third-party contracts. They will also include the management plan for the Highland Council's North Highland Archive collection, which is co-located at Nucleus.

NDA Properties Limited

NDA Properties Limited (NDAPL) was created as a wholly-owned subsidiary of the NDA in 2008. It is a commercial property company which owns and manages over a quarter of NDA land (circa 1200 hectares) and in excess of 100 commercial, agricultural and residential buildings. The company ensures this land and property is effectively managed, including completion of property portfolio projects for repair and enhanced economic and environmental stewardship as appropriate.

Where land and property is no longer required by the NDA group or parts of the wider government estate, we engage with the market and divest surplus land and property for commercial and socio-economic uses.

A number of NDAPL's commercial assets, such as offices and industrial premises, are used in partnership with wider NDA estate requirements to provide capacity to support mission delivery.

Strategy

NDAPL's strategy is to:

- manage NDAPL properties within the estate and complete property portfolio projects to maximise revenues, drive cost savings and minimise risk
- collaborate across the NDA group to explore creative ways to re-use assets
- engage with the market and divest surplus land and property assets for commercial and socio-economic uses *(SO47)*.

Rutherford Indemnity Limited

Rutherford Indemnity Limited

Rutherford provides insurance cover for the NDA and its estate. Its main focus is the provision of insurance cover at competitive rates to support the NDA mission, with particular focus on nuclear liability cover and provision of support for changes arising from expected revisions to the Nuclear Installations Act (1965) *(ref 72)*. Rutherford participates in a number of the NDA's insurance programmes, providing protection against a variety of losses including, but not limited to, property, nuclear liability and general liability.

Strategy

Rutherford aims to provide an efficient and financially stable insurance facility which assists in reducing the NDA's overall cost of risk and support to its wider business objectives. It will only underwrite risks which support the business objectives of the NDA. The company retains a prudent proportion of the risks underwritten where it makes financial sense to do so and sources reinsurance protection from organisations with approved security ratings for the more volatile risks. By demonstrating a significant financial commitment to the insurance markets, Rutherford is able to secure appropriate financial protection for the NDA estate on competitive terms.

Energus

ENERGUS.

Energus is a wholly-owned subsidiary of the NDA, based in West Cumbria. It was created as a hub of forward thinking business support in 2009.

Energus is focussed on:

Training and development

- The NDA's prestigious Nucleargraduates programme is managed by Energus. This programme has recruited over 400 graduates into the nuclear industry since 2008 and following its success, other graduate and apprenticeship programmes have been launched to support the NDA people strategy *(see People)*. These include degree apprenticeships in skills shortage areas, a cyber security apprenticeship and business and commercial apprenticeships
- Sellafield Limited apprentices spend the first 2 years of their training at the Energus workshop
- The University of Cumbria operate their 'Gateway West' programme at the Energus facility
- Cyber security training for the civil nuclear sector, its associated supply chain and the wider business community is undertaken at Energus through the provision and delivery of a portfolio of cyber security training programmes. Energus houses the only Cyber Lab in the North West which is used to upskill young and emerging talent as well as delivering commercial courses
- Health and Safety training is delivered.

A unique conference venue

The state of the art facility at Energus is capable of hosting regional and national conferences and events and has its own events management team and in-house catering.

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77. The Environmental Assessment of Plans and Programmes Regulations 2004 (S.I. 2004/1633)
78. The Scottish Parliament. Environmental Assessment (Scotland) Act 2005

Appendix A: Summary of the Integrated Impact Assessment

The Integrated Impact Assessment (IIA) (ref 73) for our previous Strategy *(ref 3)* has been reviewed and updated to align with this Strategy and the latest NDA Business Plan (2021-2024) *(ref 74)*. Underpinning data and the legislative context review in Volume 3 of the current IIA have been updated and options have been revised and reassessed in line with updates to the NDA Strategy outlined in Volumes 1 and 2 of the current IIA. The main changes are as follows:

- reprocessing at the Thermal Oxide Reprocessing Plant (THORP) has ended. As a result, the option to extend processing capability for spent oxide fuels has been removed
- credible options for the management of exotic spent fuel were under development at the time of the 2016 IIA. They have now been defined and have been assessed in the 2021 IIA
- in the 2016 IIA, the options for the decommissioning topic were continuous decommissioning and deferred decommissioning. In the 2021 IIA, the continuous decommissioning option has been split into 2 options: 'decommissioning at a pace' and 'decommissioning slowly but without interruption'
- the option to hold uranium as a nil value asset has been removed as no credible end point was identified (sale for reuse as a separate option has been retained)
- new government commitments have been introduced including the commitment to reduce emissions of greenhouse gases to net zero by 2050 and new clean air commitments to increase air quality
- environment agencies' Management of radioactive waste from the decommissioning of nuclear sites: guidance on the requirements for release from radioactive substances regulation (GRR) was published in 2018, which directly affects NDA sites
- environmental baseline data such as air pollution, biodiversity and carbon dioxide emissions have been updated
- health baseline data including cancer incidence, life expectancy at birth and deaths from coronary heart disease have been updated
- socio-economic baseline data such as site employment figures, business births and deaths and indices of multiple deprivation figures have been updated.

The current IIA for this Strategy comprises the combined assessment results of a Strategic Environmental Assessment (SEA), Health Impact Assessment (HIA) and Socio-Economic Impact Assessment (SeIA). This report details the findings of the IIA of the NDA Strategy (2021) to be used in statutory consultation alongside the NDA Strategy (2021) document. This report will also serve as a guide for future assessment work undertaken by the NDA, SLCs and other relevant parties.

For the purposes of this assessment, the potential impacts of our strategy are divided into generic phases and activities involved in implementing the preferred strategic options.

Construction of new facilities / modification of existing facilities

Construction of facilities such as treatment plants and stores could have a range of potential environmental impacts. This may include changes in air quality from the emission of pollutants, increases in noise and vibration from the movement and use of plant and machinery, and changes in the local landscape. The movement of construction traffic and activities such as excavation also have the potential to result in land and water contamination. Construction would involve the use of energy and materials which, given the extent of facilities that may be required under some strategic options, may be substantial and would lead to carbon emissions (with implications for climate change).

Environmental impacts such as these could lead to health effects. For example, changes in air quality have been linked to increased risk of cardiovascular and respiratory conditions, whilst increases in noise and vibration can cause disturbance and annoyance. The movement of construction traffic can affect the local road network, increasing the risk of road accidents and driver stress. Health effects may also occur if construction leads to a loss of, or decline in, recreational facilities and amenity spaces as this can affect the level of physical activity undertaken by the local population.

Construction would provide opportunities for employment, both in terms of construction jobs and specialist nuclear and engineering roles, and may create opportunities for education and training.

Operation of new facilities

During the operational phase of facilities, there would be ongoing energy use and carbon emissions, which might have implications for climate change. A number of strategic options would generate considerable amounts of waste material, which may subsequently increase in volume, depending on the technologies used to treat them.

New facilities may be operational for many years, which would have a lasting impact on the local landscape and may adversely affect the quality of views from locations surrounding our sites.

There may also be increased risks of flooding and, if the site is located in a coastal region, risks associated with changes in the coastal environment such as erosion, sea level rise and changes in wave patterns.

From a radiological perspective, all options set out in our Strategy are in some way designed to reduce the risk or hazard associated with radioactive materials, wastes and contamination in line with our mission. For some options, this will involve converting or conditioning the radioactive material into a safer and more secure form. Changes in the risk profile of radiological discharges over time may have implications from a health perspective.

Operation of new facilities would support jobs of various types, including specialist nuclear engineering and managerial positions in addition to general plant operation and maintenance roles. For some options, knowledge and skills which could be of national benefit may be developed, while education and training may be required to implement others.

Closure of facilities (existing and new)

The closure of facilities, which is required for a number of strategic options, could result in a range of environmental impacts. These would largely be associated with decommissioning activities such as excavation and demolition which can produce air and noise pollution, and may lead to or worsen land and water contamination. On the other hand, removal of structures and facilities can lead to landscape and visual improvements, as well as improving soil and water quality in the long term, thereby facilitating the reuse of land for other purposes.

During this phase there are likely to be substantial transport movements of plant, equipment and wastes. This may have implications from an air quality perspective, and may put nature and cultural heritage features near to site access roads at risk of impacts.

In terms of health, changes in traffic volumes on the local road network may increase the risk of accidents and lead to driver stress, which can trigger physiological responses such as elevated heart rate. Health effects such as annoyance and anxiety may also be caused by noise and vibration from traffic increases and demolition.

The closure of facilities may lead to a number of socio-economic effects, including potential loss of employment, knowledge, skills and in some cases national assets. However, the closure of facilities and other activities which facilitate decommissioning of a site may also free up land for alternative uses. If this land can be divested, it may become a local asset, potentially providing some form of environmental, economic or community benefit.

Maintenance of existing facilities

From an environmental perspective, the ongoing maintenance of facilities will require the use of materials and energy. This may be to renovate existing structures or to replace structures which have reached the end of their life. Such activities can lead to emissions of carbon dioxide and other greenhouse gases. Maintaining facilities may also continue to impact the local landscape.

Maintenance activities support employment and can create other socio-economic opportunities, such as improved knowledge and skills. An example of this is the knowledge and skills gained from developing techniques for extending the life of radioactive waste stores.

In terms of radiological risks, ongoing maintenance of facilities is undertaken to minimise radiological risks to the environment and the public. In some situations, the radioactive material being stored in such facilities may itself become more hazardous over time; in such cases, maintaining existing facilities indefinitely, as an alternative to developing a better long-term management route, could be seen as having a slightly adverse impact. This approach would only be adopted if it helped to ensure an overall reduction in risk for the site, work programme or facility in question.

Mitigation and conclusions

Many of the adverse environmental impacts identified above could be reduced or avoided if combined treatment or storage facilities can be developed, or if existing facilities can be reused. Some of the adverse socio-economic impacts of closing facilities may be mitigated by transferring staff to other facilities or sites.

There is considerable uncertainty regarding how preferred options will be implemented at a future time at site level and how our Critical Enabler strategies might mitigate these impacts. As such, the results of this assessment should be viewed as being indicative of potential impacts of our strategy but not absolute or certain. The nature and significance of identified impacts should be validated in the course of future assessment work when more detailed information is available. Such work would enable appropriate mitigation measures to be determined and applied. The results of this IIA should be used to inform this work, as well as future decision making across the NDA group.

Post adoption

The Integrated Impact Assessment Report was published alongside the draft Strategy for consultation. Feedback received has been considered and a Post Adoption Statement produced in order to address the comments received and to highlight the recommendations of the IIA. This document also describes how we will ensure that effects during the implementation of the strategy are monitored and what is likely to be additionally considered as part of the Integrated Impact Assessment for Strategy 2026. The IIA Report and the Post Adoption Statement are available on our website.

Appendix B: Summary of Expected Expenditure and Income

2019/20 Estimated Discounted Lifetime Plan

	£ million				
	Decom & Clean-up Costs*	Total Operations Costs**	Commercial Revenue**	Net Running Cost	Govern-ment Funding
Sites	A	Running Cost B	C	D = (B-C)	E = (A+D)
Magnox	20,142			0	20,142
Dounreay	2,705			0	2,705
Sellafield***	94,957	3,752	-8,314	-4,742	90,215
Capenhurst	1,521			0	1,521
LLWR	632	5,055	-5,055	0	632
Springfields	634			0	634
Geological Disposal Facility	10,657			0	10,657
NDA Central and Group	-74	3,090	-500	2,590	2,516
Total	**131,174**	**11,717**	**-13,869**	**-2,152**	**129,022**

* Figures from 2019/20 Annual Report and Accounts
** From Site Lifetime Plans or NDA Corporate Plan
*** includes Calder Hall and Windscale, and Energy Trading

Glossary

As Low As Reasonably Achievable (ALARA)
The ALARA principle is contained in the Euratom Basic Safety Standards Directive 96/29, which is transposed into UK law. Essentially, it means that all reasonable steps should be taken to protect people. In making this judgement, factors such as the costs involved in taking protection measures are weighed against benefits obtained, including the reduction in risks to people.

As Low As Reasonably Practicable (ALARP)
To satisfy this principle, measures necessary to reduce risk must be taken until the cost of these measures whether in money, time or trouble, is disproportionate to the reduction of risk. (Edwards v National Coal Board [1949]).

Best Available Technique (BAT)
BAT is defined as the most effective and advanced stage in the development of activities and their methods of operation, which indicates the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and impact on the environment as a whole.

Best Practicable Means (BPM)
BPM is a term used by the Environment Agency and Scottish Environment Protection Agency in authorisations issued under the Radioactive Substances Act (1993) (ref 75). Essentially, it requires operators to take all reasonable practicable measures in the design and operational management of their facilities to minimise discharges and disposals of radioactive waste, so as to achieve a high standard of protection for the public and the environment. BPM is applied to such aspects as minimising waste creation, abating discharges, and monitoring plant, discharges and the environment. It takes account of such factors as the availability and cost of relevant measures, operator safety and the benefits of reduced discharges and disposals. If the operator is using BPM, radiation risks to the public and the environment will be ALARA.

Beyond reach
Material is placed in a form which reduces the enduring security risks and burden during storage.

Broadly acceptable
Risks falling into this region are generally regarded as insignificant and adequately controlled. The level of risk below which, so long as precautions are maintained, it would not be reasonable to consider further improvements to standards if these involved a cost.

Brownfield land
Land that has been previously developed is known as Brownfield land. Previously developed land is defined in Planning Policy Guidance Document 3 “Housing” (2000) PPG3 as land which “is or was occupied by a permanent structure (excluding agricultural or forestry buildings), and associated fixed surface infrastructure.

Business case
Provides evidence and rationale to support decision making, and gives assurance to stakeholders that the NDA has acted responsibly. The process involves close scrutiny of all relevant financial and non-financial aspects of a proposed project, ensuring an optimal solution is selected for a given set of circumstances and that the identified benefits can be realised.

Circular economy
The elimination of waste and reduction in natural resources by design through the reuse, repair, repurposing and recycling of assets.

Continuous Improvement (CI)
An industry proven systematic approach to ensure businesses maintain control when delivering their outcomes having the added benefit of improving safety, quality, reducing costs and enabling quicker delivery.

Decarbonisation
The process of reducing the amount of greenhouse gas emissions made.

Deferred decommissioning
Comprises one or more periods when the plant/facility/installation is purposely kept in a state of quiescence as part of the programme for achieving the site end state.

Designation / de-designation
This is a shortened expression which means Designating Direction or a Revocation / Modification of it. Designations are made by the Secretary of State and for sites in Scotland by the Secretary of State in conjunction with the Scottish ministers and laid before the UK Parliament and as appropriate in the Scottish Parliament.

Disposition
Consignment of, or arrangements for the consignment of, material to some specified (interim or final) route or form.

Down-blended
The process by which the percentage composition of the uranium-235 isotope (written 235U) in uranium, also referred to as its enrichment, has been decreased by mixing it with uranium of lower enrichment.

Environmental safety case
A set of substantiated claims concerning the environmental safety of disposals of solid radioactive waste. It will be provided by the developer or operator of a disposal facility and should demonstrate that the health of members of the public and the integrity of the environment are adequately protected.

Geological disposal
A long-term management option involving the emplacement of radioactive waste in an engineered underground Geological Disposal Facility or repository, where the geology (rock structure) provides a barrier against the escape of radioactivity and there is no intention to retrieve the waste once the facility is closed.

Geological Disposal Facility (GDF)
A highly engineered facility capable of isolating radioactive waste within multiple protective barriers, deep underground, to ensure that no harmful quantities of radioactivity ever reach the surface environment.

Greenfield land
Refers to land that has not yet been built on.

Hazard
Hazard is the potential for harm arising from an intrinsic property or ability of something to cause detriment.

Hazardous waste
Hazardous waste is essentially waste that contains hazardous properties that may render it harmful to human health or the environment.The European Commission has issued a Directive on the controlled management of such waste (91/689/EEC) and hazardous waste is defined on the basis of a list drawn up under that Directive. Examples include asbestos, lead-acid batteries, oils and solvents.

Health Impact Assessment (HIA)
Assesses the potential effects of the NDA Strategy upon public health. HIA is undertaken as part of the Integrated Impact Assessment to understand the potential risks for health effects associated with implementation of NDA Strategy.

High Level Waste (HLW)
High Level Waste (HLW) is waste where the temperature may rise significantly because of the radioactivity. The design of waste storage or disposal facilities has to take this into consideration.

Higher Activity Waste (HAW)
Higher activity radioactive waste comprises a number of categories of radioactive waste – High Level Waste (HLW), Intermediate Level Waste (ILW), and Low Level Waste (LLW) that is not suitable for near-surface disposal in current facilities.

Integrated Impact Assessment (IIA)
The Integrated Impact Assessment of the NDA Strategy comprises the combined assessment results of a strategic environmental assessment (SEA), health impact assessment (HIA) and socio-economic impact assessment (SeIA).

Interim state
An interim state describes the condition of a site or facility (including land) at specific points en route to the site end state. It is a natural milestone or decision point in the decommissioning and remediation programme that typically represents a significant reduction in risk or hazard. An interim state does not automatically infer a period of quiescence; it can be followed by further decommissioning activities or a period of deferral.

Institutional control
Institutional control is a legal or administrative tool or action taken to reduce the potential for exposure to hazardous substances. Institutional controls may include, but are not limited to, land use restrictions, environmental monitoring requirements, and site access and security measures.

Intermediate Level Waste (ILW)
Waste with radioactivity levels exceeding the upper boundaries for Low Level Waste (LLW), but which does not need heating to be taken into account in the design of storage or disposal facilities. ILW arises mainly from the reprocessing of spent fuel, and from general operations and maintenance of radioactive plant. The major components of ILW are metals and organic materials, with smaller quantities of cement, graphite, glass and ceramics.

Irradiated fuel
Fuel assemblies taken out of a nuclear reactor after a period of energy production.

Intolerable risk
Above a certain level, a risk is regarded as intolerable and cannot be justified in any ordinary circumstance.

Lead and learn
Lead and learn is associated with undertaking the decommissioning of sites or installations in a planned sequential manner designed to realise specific aspects of learning, such as decommissioning techniques, which can then be applied to subsequent sites or installations.

Lifetime Plan (LTP)
The Lifetime Plan is produced by the site contractor to meet a contractual requirement of the NDA, and is revised annually. It gives details of the planned activities and costs of the work required to fully decommission the site to an agreed end state. The combination of all Lifetime Plans across the NDA estate yields the total cost of dealing with the NDA's liabilities.

Lower Activity Waste (LAW)
Comprises both Lower Level Waste and Very Low Level Waste.

Low Level Waste (LLW)
Low Level Waste which includes metals, soil, building rubble and organic materials, arising principally as lightly contaminated miscellaneous scrap. Wastes other than those suitable for disposal with ordinary refuse, but not exceeding 4 GBq/tonne (gigabecquerels) of alpha or 12 GBq/tonne of beta/gamma activity. Metals are mostly in the form of redundant equipment. Organic materials are mainly in the form of paper towels, clothing and laboratory equipment that have been used in areas where radioactive materials are used e.g. hospitals, research establishments and industry. The National Repository for LLW is near Drigg, Cumbria.

Monitored Natural Attenuation (MNA)
Monitored Natural Attenuation is an important, common groundwater remediation technology used for treating some dissolved groundwater contaminants.

NDA Value Framework
The *NDA Value Framework* comprises factors that stakeholders have told us they value in relation to the NDA's mission. These factors are considered when assessing the performance of alternative options in order to identify which option offers the greatest value. The *NDA Value Framework* captures the 3 pillars of sustainability and social value: the economy, society and environment.

Net zero greenhouse gas emissions
Net zero is achieved when the total greenhouse gas emissions made are equal to or less than the emissions removed from the environment.

Nuclear site licence
A formal notification of the authorised body which can operate a nuclear operation under the Nuclear Installations Act (1965) *(ref 72)*.

Oslo-Paris Conventions (OSPAR)
Oslo-Paris Conventions which established requirements on the level of nuclear and non-nuclear discharges to the marine environment of the North East Atlantic, the North Sea and the Irish Sea.

Parent Body Organisation (PBO)
Entities, competitively selected by the NDA, that own the SLCs for the duration of their PBO contract, responsible for bringing improvement in SLC performance.

Place of Deposit
A place of deposit is a facility, which has been approved by the Lord Chancellor, as being a suitable place for the storage and management of public records (under s4(1) of the Public Record Act).

Post Operational Clean Out (POCO)
An important part of the transition from operations to decommissioning involving hazard reduction activities (e.g. removing fuel) that are undertaken immediately after cessation of operations. POCO minimises future radiological and chemotoxic challenges during decommissioning.

Radioactive decay
Radioactive Decay occurs when an unstable atom loses energy. This decay occurs at a constant, predictable rate that is referred to as half-life.

Site End State
A site end state is the condition of an entire site (including the land, structures and infrastructure) once decommissioning and clean-up activities have ceased. It may be appropriate to define end states for components of the site, which must be brought together and assessed as a whole to determine the site end state.

Site Licence Company (SLC)
The term applied to operators of nuclear installations where NDA has been designated as having responsibility for decommissioning and has tasked the operator with carrying out the required decommissioning.

Site Strategic Specification (SSS)
Site Strategic Specifications define the required high level outcomes based on the NDA Strategy so that there is a clear link between NDA Strategy and what is delivered by the SLCs.

Small and Medium Enterprise (SME)
Small and medium-sized enterprises (SMEs) are defined in the EU recommendation 2003/361 *(ref 76)*.

Socio-economic Impact Assessment (SeIA)
Assesses the potential socio-economic effects of NDA Strategy. SeIA is undertaken as part of the IIA to understand the socio-economic effects associated with implementation of NDA Strategy.

Sophisticated attack
The NDA defines sophisticated cyber attacks as those conducted by advanced persistent threats (APTs). An APT is a stealthy threat actor, typically a nation state or state sponsored group which gains unauthorised access to a computer network and remains undetected for an extended period. These groups typically utilise traditional espionage vectors including social engineering, human intelligence and infiltration to gain access to a physical location to enable network attacks to install custom malicious software.

Strategic Environmental Assessment (SEA)
SEA refers to the type of environmental assessment legally required by the Environmental Assessment of Plans and Programmes Regulations (2004) (SI 2004/1633) *(ref 77)* and the Environmental Assessment (Scotland) Act (2005) *(ref 78)*. SEA for NDA Strategy is undertaken as part of the IIA to understand the significant environmental effects of implementing NDA Strategy.

Strategy Management System (SMS)
The SMS is a management tool used to develop, control and communicate our Strategy for decommissioning and cleaning up the UK's civil public sector nuclear sites. It also provides the basis for the periodic review of our Strategy which summarises the current strategy at the time that it is published.

Sustainability
Meeting the needs of the present without comprising the ability of future generations to meet their own needs.

Very Low Level Waste (VLLW)
A sub-category of LLW, comprising waste that can be safely disposed of alongside municipal, commercial or industrial waste, or can be disposed of to specified landfill sites, subject to limits on radioactivity content.

Waste Hierarchy
A hierarchical approach to minimise the amounts of waste requiring disposal. The hierarchy consists of non-creation where practicable; minimisation of arisings where the creation of waste is unavoidable; recycling and reuse; and, only then, disposal.

Abbreviations

AECL	Atomic Energy of Canada Limited
AGR	Advanced Gas-Cooled Reactor
AGROP	AGR Operating Programme
ALARP	As Low As Reasonably Practicable
AP	Additional Protocol
ARC	Alpha Resilience and Capability
ASLEF	Associated Society of Locomotive Steam Enginemen and Firemen
AWE	Atomic Weapons Establishment
BAT	Best Available Technique
BEIS	Department for Business, Energy & Industrial Strategy
BNFL	British Nuclear Fuels Limited
BPM	Best Practicable Means
CCFE	Culham Centre for Fusion Energy
CFP	Cavendish Fluor Partnership
CNC	Civil Nuclear Constabulary
CNCSS	Civil Nuclear Cyber Security Strategy
CNSRP	Caithness and North Sutherland Regeneration Partnership
CoRWM	Committee on Radioactive Waste Management
CS	Client Specification
CSRP	Cyber Security Resilience Programme
CTR	Cooperative Threat Reduction
DFR	Dounreay Fast Reactor
DIT	Department for International Trade
DRS	Direct Rail Services Limited
DSRL	Dounreay Site Restoration Limited
DTRA	Defense Threat Reduction Agency
EC	European Commission
EDF	EDF Energy
EDRAM	Environmentally Safe Disposal of Radioactive Material
Euratom	European Atomic Energy Community
FGMSP	First Generation Magnox Storage Pond
FHP	Fuel Handling Plant
GDF	Geological Disposal Facility
GMB	General Municipal & Boilermakers
GNS	Global Nuclear Security
GRI	Global Reporting Initiative
GRR	Guidance on Requirements for Release from Radioactive Substances Regulation
HAL	Highly Active Liquor
HAW	Higher Activity Waste
HEU	High Enriched Uranium
Hex	Uranium Hexafluoride Tails
HIAL	Highlands and Islands Airports Limited
HIP	Hot Isostatic Pressing
HLW	High Level Waste
HM	Her Majesty's
HSE	Health and Safety Executive
HSEW	Health, Safety, Environment and Wellbeing
HSSSEQ	Health, Safety, Security, Safeguards, Environment & Quality
IAEA	International Atomic Energy Agency
ICT	Information and Communication Technology
IIA	Integrated Impact Assessment
IIND	Integrated Innovation in Nuclear Decommissioning
ILW	Intermediate Level Waste
INS	International Nuclear Services Limited
INS Japan	International Nuclear Services Limited Japan
IPT	Integrated Project Teams
ISF	Interim Storage Facility
IT	Information Technology
IWM	Integrated Waste Management
IWS	Integrated Waste Strategy
LAW	Lower Activity Waste
LEU	Low Enriched Uranium
LLW	Low Level Waste
LLWR	Low Level Waste Repository
LP&S	Legacy Ponds and Silos
LTP	Lifetime Plan
LWR	Light Water Reactor
M3	Office of Material Management and Minimisation
MDU	Magnox Depleted Uranium
MEP	Magnox Encapsulation Plant
MHDG	Mental Health Delivery Group
MOD	Ministry of Defence
MOP	Magnox Operating Programme
MOU	Memorandum of Understanding
MOX	Mixed Oxide Fuel
MSSS	Magnox Swarf Storage Silo
MTR	Materials Test Reactor
NAO	National Audit Office
NATO	North Atlantic Treaty Organisation
NCSC	National Cyber Security Centre
NDA	Nuclear Decommissioning Authority
NDAAL	NDA Archives Limited
NDAPL	NDA Properties Limited
NDARB	NDA Research Board
NDF	Nuclear Damage Compensation and Decommissioning Facilitation Organisation of Japan
NDPB	Non-Departmental Public Body
NGO	Non-Government Organisation

NIF	National Inventory Forum
NIGLQ	Nuclear Industry Group for Land Quality
NIST	National Institute of Standards and Technology
NNL	National Nuclear Laboratory
NNSA	National Nuclear Security Administration
NPL	National Physical Laboratory
NPT	1968 Treaty on the Non-Proliferation of Nuclear Weapons
NSAN	National Skills Academy for Nuclear
NSIP	Nationally Significant Infrastructure Project
NSSG	Nuclear Skills Strategy Group
NTS	Nuclear Transport Solutions
Nucleus	NDA Archive Facility
NuLeAF	Nuclear Legacy Advisory Forum
NWDRF	Nuclear Waste and Decommissioning Research Forum
OECD-NEA	Organisation for Economic Co-operation and Development – Nuclear Energy Agency
ONR	Office for Nuclear Regulation
OSPAR	Oslo and Paris Conventions
PAC	Public Accounts Committee
PBO	Parent Body Organisation
PCM	Plutonium Contaminated Material
PFCS	Pile Fuel Cladding Silo
PFR	Prototype Fast Reactor
PFSP	Pile Fuel Storage Pond
PIE	Post Irradiation Examination
PLC	Public Limited Company
PNTL	Pacific Nuclear Transport Limited
POCO	Post Operational Clean Out
QMS	Quality Management System
R&D	Research and Development
RD&I	Research, Development and Innovation
RSS	Radioactive Substances Strategy
RWM	Radioactive Waste Management Limited
SAR	Security and Resilience
SCCORS	Scottish Councils Committee on Radioactive Substances
SED	Safety and Environmental Detriment
SEPA	Scottish Environment Protection Agency
SFL	Springfields Fuels Limited
SGHWR	Steam Generating Heavy Water Reactor
SIMRS	Safeguards Information Management and Reporting System
SLC	Site Licence Company
SLMWG	Strategic Land Management Working Group
SME	Small and Medium Enterprises
SMS	Strategy Management System
SPRS	Sellafield Product and Residue Store
SRP	Sellafield Product and Residues Store Retreatment Plant
SSAC	State System for Accountancy and Control
SSG	Site Stakeholder Group
SSS	Site Strategic Specification
STEM	Science Technology Engineering and Maths
T&LWG	Transport and Logistics Working Group
THORP	Thermal Oxide Reprocessing Plant
TPU	THORP Product Uranium
TR&S	THORP Receipt and Storage
TSSA	Transport Salaried Staff Association
UAV	Unmanned Autonomous Vehicles
UKRWI	UK Radioactive Waste Inventory
UKSRD09	2009 UK Strategy for Radioactive Discharges
UN SDG	United Nations Sustainability Development Goals
UNS	Urenco Nuclear Stewardship
UO_3	Uranium Trioxide
US DOE	United States Department of Energy
UUK	Urenco UK Limited
VLLW	Very Low Level Waste
WANO	World Association of Nuclear Operators
WEC	Westinghouse Electric Company
Y-12	Y-12 National Security Complex (Y-12)

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