



NDA Group Technology Baseline Review

2025/26



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Cover image - A size reduction technology demonstrator at Sellafield

1. Executive Summary

This document provides a high-level overview of the current technology landscape across the NDA group. It outlines the NDA group technology baseline, current technologies being deployed, and the technology opportunities requiring development or adoption to underpin the delivery of our decommissioning mission.

Aligned to the NDA's strategic themes, each chapter provides an update on the theme areas since the previous Technical Baseline Review (2016) [1], highlights a selection of current baseline technologies adopted since 2016, and identifies technology opportunities which underpin the future baseline. These opportunities are illustrated using an area/capability wiring diagram showing where they reside within or influence capabilities.

Since the last Technical Baseline Review, the NDA has adopted a wide range of new technologies into its baseline capabilities, in areas such as: robotics; artificial intelligence (including large language models); drones; digital asset intelligence; laser cutting; additive manufacturing; remote handling and control systems; demolition and retrieval techniques; and sorting and segregation of waste.

The baseline areas requiring R&D are summarised in a high-level overview diagram (Figure 5). The diagram distinguishes between Technology Enablers which permeate all strategic themes, and near-term focus areas. The Technology Enablers are highlighted, as all our strategic themes require some expression of these enablers to underpin their R&D:

- Characterisation
- Asset Management
- Digital Technologies, Robotics and Artificial Intelligence

It also emphasises our near-term focus areas where development is most pressing:

- Disposal across all strategic theme areas linked to final Geological Disposal Facility (GDF) conditions
- Immobilisation selection for plutonium
- Sorting and segregation of Intermediate Level Wastes
- Treatment of Intermediate and High Level Wastes
- Dismantling of facilities for site decommissioning and remediation

This document is positioned alongside, and is complementary to, two other NDA publications: Areas of Research Interest [2] and Grand Challenges for Technical Innovation [3]. The Technology Baseline Review sets out our current capability and constraints, the Areas of Research Interest identifies the research and evidence needed to move the baseline toward our ambitions, and the Grand Challenges for Technical Innovation articulates long-term ambition.

This is the first update of the NDA group Technology Baseline, replacing the NDA group Technical Baseline published in 2016. It is planned to produce future updates at least every 5 years.

*If you have any comments please contact the NDA's R&D team at
technology@nda.gov.uk*

2. Introduction

2.1 The NDA group and how we work

Our group is made up of the Nuclear Decommissioning Authority (NDA) and four key component parts: Sellafield, Nuclear Restoration Services, Nuclear Waste Services and Nuclear Transport Solutions.



Figure 1: Map of the NDA's sites in the UK.

- The **NDA** is an executive non-departmental public body, created through the Energy Act 2004, sponsored and funded by the Department for Energy Security and Net Zero (DESNZ). UK Government Investments also provides strategic oversight of corporate governance and performance. We are accountable to UK Government and Scottish Government ministers for delivery of our mission through our subsidiary companies.
- **Sellafield Ltd (SL)** is responsible for decommissioning the Sellafield site, the UK's most complex and challenging nuclear site. The site houses around 85 per cent of all the UK's nuclear waste, on an area of less than two square miles. The Sellafield workforce is taking waste out of buildings as old as the site itself, looking after fuel so that nuclear power stations can continue to operate, and repackaging the country's stockpile of nuclear materials.
- **Nuclear Restoration Services (NRS)** is responsible for safely decommissioning the first generation nuclear and research sites across the UK. It brings together Dounreay and the sites previously branded as Magnox, as part of our work to simplify the way

the NDA group is structured, taking opportunities to get best value from working together as one team. NRS also operates a hydro-electric plant and is preparing to welcome the seven Advanced Gas-cooled Reactors (AGRs), currently managed by EDF Energy, for decommissioning, as well as other future missions.

- **Nuclear Waste Services (NWS)** is the UK’s leading nuclear waste management organisation, focused on managing the UK’s nuclear waste, safely and securely, for generations to come. Its work includes the programme to deliver a Geological Disposal Facility (GDF) and operation of the Low-Level Waste Repository (LLWR) site in Cumbria.
- **Nuclear Transport Solutions (NTS)** is our leading global provider of safe, secure and reliable nuclear transport solutions. It uses its specialist transport and logistics expertise to support our nuclear decommissioning mission and help customers and partners around the world solve their own complex transport challenges.
- Other NDA group companies include NDA Archives Ltd, NDA Properties Ltd, Rutherford Indemnity Ltd and Enerigus.

How we go about our work is very important to us and we must deliver results safely, sustainably and responsibly. Our commitment to creating environmental and social benefits builds on our long history of providing value for the UK and we want to ensure that our actions and decisions continue to have a lasting, positive impact.

2.2 What is the technology baseline?

The technology baseline is an assessment of the maturity of the technical foundation necessary to enable delivery of the NDA’s mission safely, securely and more efficiently. Although research, development, demonstration, and deployment of these capabilities requires a mixture of technical knowledge, skills, enabling infrastructure, and collaborative partnerships across the NDA group and the supply chain, the focus of this document is on technology.



Figure 2: Illustration of the five strategic themes with an indication of how they interact

We publish our strategy regularly [4], and use five strategic themes to describe all the activities needed to deliver the NDA’s mission.

The first four relate directly to decommissioning work and are referred to as driving themes: Spent Fuels, Nuclear Materials, Integrated Waste Management and Site Decommissioning and Remediation. This Technology Baseline Review is structured around these four driving themes.

The fifth strategic theme, Critical Enablers, describes the important activities needed to support the delivery of our mission (e.g. Research, development and innovation, Asset management and continuous improvement).

As our mission progresses, the technology baseline requirements will change – with new scope being added to our mission such as the AGR stations, or through the influence of new technologies (e.g. robotics and artificial intelligence) and knowledge providing better insights to the diverse nuclear legacy we are responsible for. By assessing the existing baseline and communicating anticipated technological requirements across our group, with our partners, the supply chain and wider stakeholders, we can ensure the correct capabilities for the NDA's mission are developed and deployed.

2.3 Changes since Technical Baseline Review 2016

Since the publication of the Technical Baseline Review (TBR) [1] in 2016, there have been changes in group structure and strategy, as well as completion of activities previously presented. These developments have changed the current technology baseline and influence the future baseline capabilities required to deliver our mission. Policy and strategy changes which influence the baseline are presented and discussed in context of specific strategic themes (e.g. Nuclear Materials Chapter).

2.3.1 Technologies implemented since 2016

Understandably, in the time since the previous review, technology has developed at pace, and this is apparent in the technologies and capabilities now deployed as business as usual across the group. These new capabilities include:

- Quadruped robotics
- Light detection and ranging (LiDAR) and structured light scanning
- Uncrewed aerial vehicles
- Remotely operated vehicles
- Virtual environments for software deployment
- Virtual reality training and twinning environments
- Additive manufacturing
- Laser cutting and ablation
- Concrete scabbling
- Remote handling and control systems – robotic and mechanical
- New demolition techniques such as explosive demolition

2.4 Why research, development and innovation is needed

Research, development and innovation (RD&I) is fundamental to ensuring efficient and cost-effective delivery of our mission. Through strategic investment, collaboration and sharing of good practice, nationally and internationally, RD&I can improve safety, security and

sustainability, thereby reducing costs, timescales and environmental impact. RD&I drives transformational change by helping us to:

- Understand the challenges and inform our strategy development
- Underpin our solutions and assure successful deployment
- Transform mission delivery

The NDA has a duty under the Energy Act (2004) to carry out and share research in nuclear decommissioning, promote and enable related innovation, share good practice and develop key skills.

The majority of our RD&I is delivered by our operating companies (SL, NRS, NWS, and NTS) and their supply chains through various contractual routes (e.g. Engineering Innovation Framework). NDA retains strategic oversight for RD&I across the group, supporting prioritisation and a balanced portfolio. We also lead a strategic portfolio of needs-driven RD&I activities, targeting group-wide needs and opportunities to inform and develop strategy, encourage innovation and support key technical skills.

As the technology baseline changes, existing capabilities may require development to expand their spectrum of applicability and remain effective, while new technology opportunities will need to be investigated, developed and, if beneficial, deployed across the group. Collaborating with NDA group colleagues, academics, other industries and the wider supply chain will be essential to identify, develop and deploy new technologies.

2.5 Shaping our research opportunities and aspirational goals: Grand Challenges and Areas of Research Interest

Our Technology Baseline Review outlines the NDA group technology baseline, the current technologies being deployed across the NDA group to deliver our decommissioning mission, it also identifies future technologies which are currently planned to be deployed. Our Grand Challenges for Technical Innovation and interim update define key strategic challenges and assign aspirational targets that are intended to encourage technological developments, ultimately improving the way we work and helping to deliver our mission more effectively. Alongside these, our Areas of Research Interest (ARI) document outlines the research questions and evidence needs that shape the research landscape and support alignment between academic, industry, and public sector partners with government priorities.

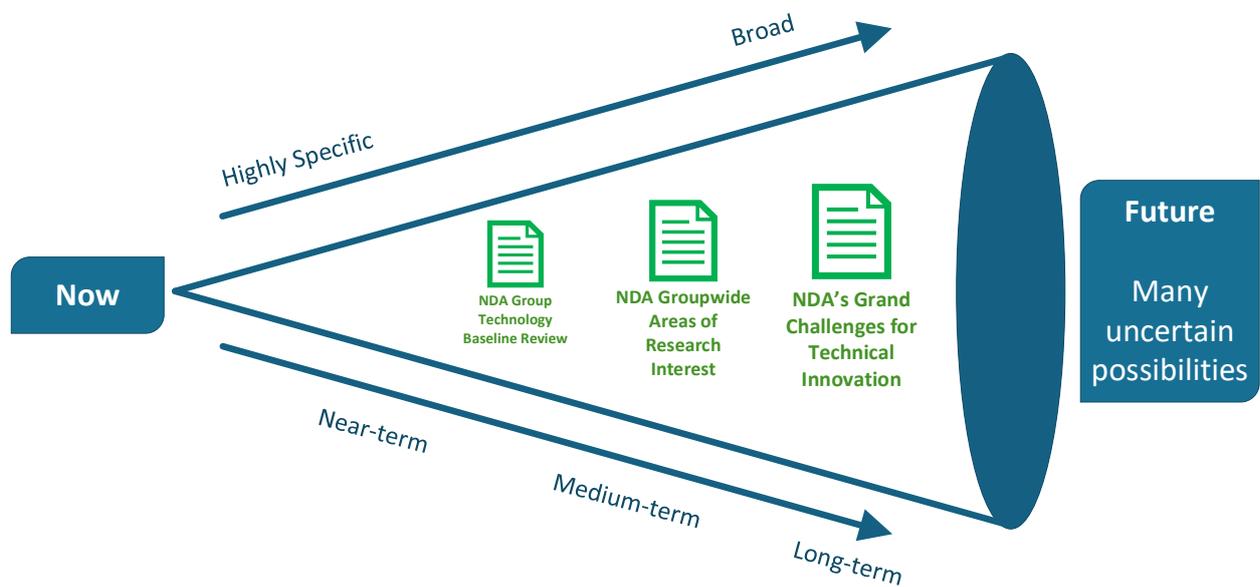


Figure 3: Strategic and decommissioning timeline positioning of the Technology Baseline Review, Areas of Research Interest, and Grand Challenges documents.

These documents present a triad of technology requirements, research interests, and forward-looking ambition, which interact through the pushing of R&D themes out to the ARI from the Technology Baseline Review.

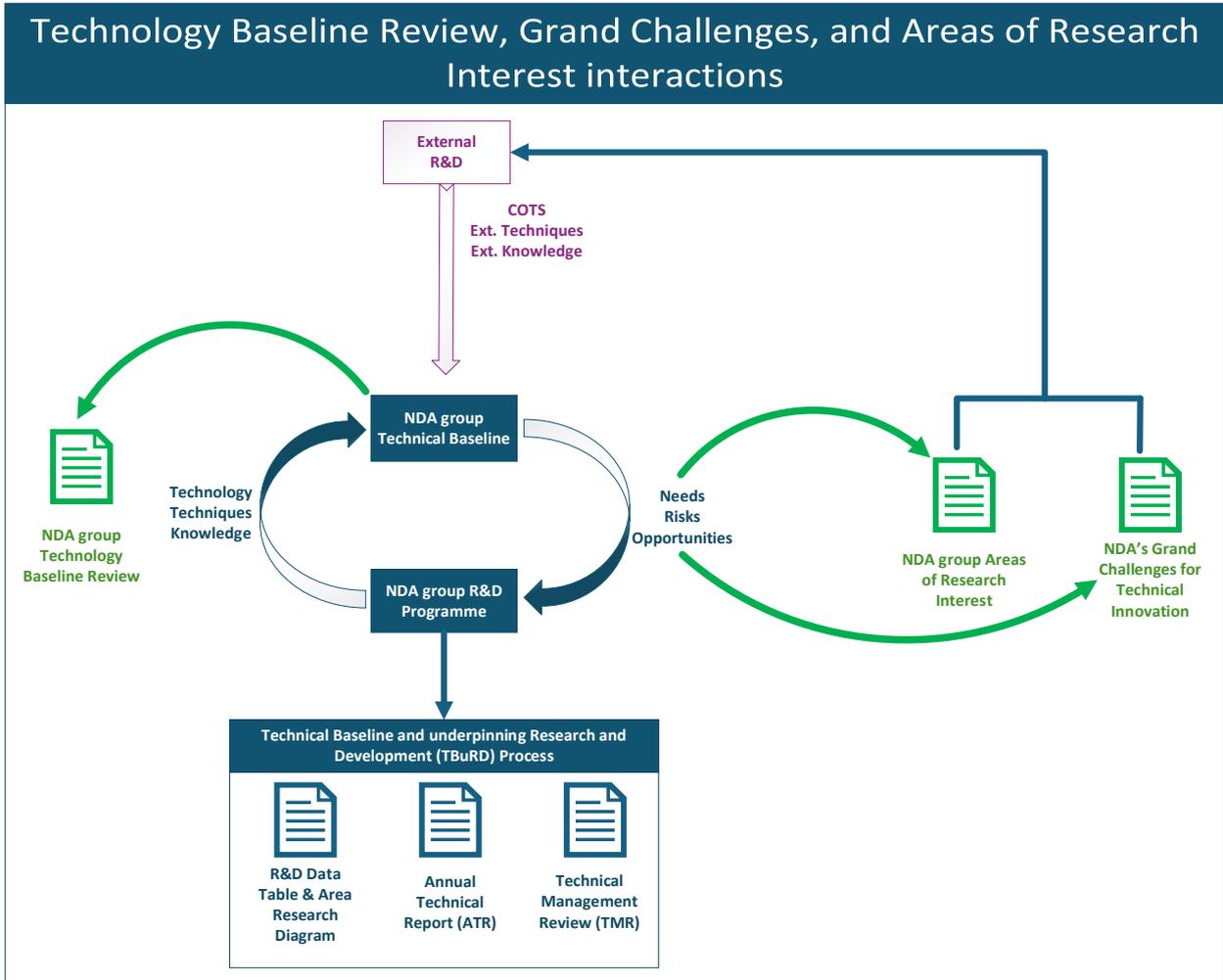


Figure 4: Technology Baseline Review and how it interacts with other group R&D documents.

3. Our technology baseline and technology opportunities

Our technology baseline forms the technical foundation that enables delivery of the NDA's mission. It presents the future high-level technical capabilities we need to deliver our mission; represents the applied technologies currently deployed across the NDA group to manage spent fuels, nuclear materials, radioactive wastes, and site decommissioning activities; and highlights potential gaps and opportunities in technologies and their scale and mission timing.

The timing and scale of baseline research and development needs vary across the group. Current priorities focus on legacy waste retrieval and hazard reduction, while future needs include environmental remediation and final disposal solutions. Technology opportunities exist within all strategic themes, each with distinct implementation timelines – for example, Magnox reprocessing concluded in 2022, yet opportunities related to spent fuel conditioning and storage exist prior to a GDF becoming available for final disposal.

The following sections, aligned with our strategic themes, provide a snapshot of the current applied technologies across the NDA group. Each section provides an update on the strategic theme since the previous Technical Baseline Review in 2016 [1]; presents a non-exhaustive list of baseline technologies; and outlines future technology opportunities that will enable continued delivery of our mission and their positioning in the theme area wiring diagrams.

Presented in Figure 4 is a high-level themed map of our needs. Each need has been categorised by anticipated research and development cost – some are also marked as “near-term focus” as these are areas we expect growth in for the duration of this TBR's lifecycle¹. The technology opportunities for each theme on the map are discussed in detail in the following sections of this baseline review, as well as suggestions of technologies or capabilities which may fulfil our needs. This is not an exhaustive list but exists to provide a flavour of the capabilities we are aware of and the needs to be addressed. Three critical areas span all our strategic themes and have been separated on the diagram to highlight their significance, these are discussed separately in Chapter 5 Technology Enablers.

Across our strategic areas, there have been significant advancements in the adoption of new technologies to progress our mission – a selection of these applications and outcomes are presented. More detail can be found in group publications such as *Sellafield Ltd Research, Development and Innovation Review 24/25* [5] and *NDA Research, Development and Innovation Review 2025* [6].

Further details can be found by referring to our *Areas of Research Interest* [2] and *Grand Challenges* [3] documents.

If you believe you may have technologies and capabilities which could fulfil our future baseline needs please contact the NDA's R&D team at technology@nda.gov.uk

¹ The lifecycle of this publication is five years.

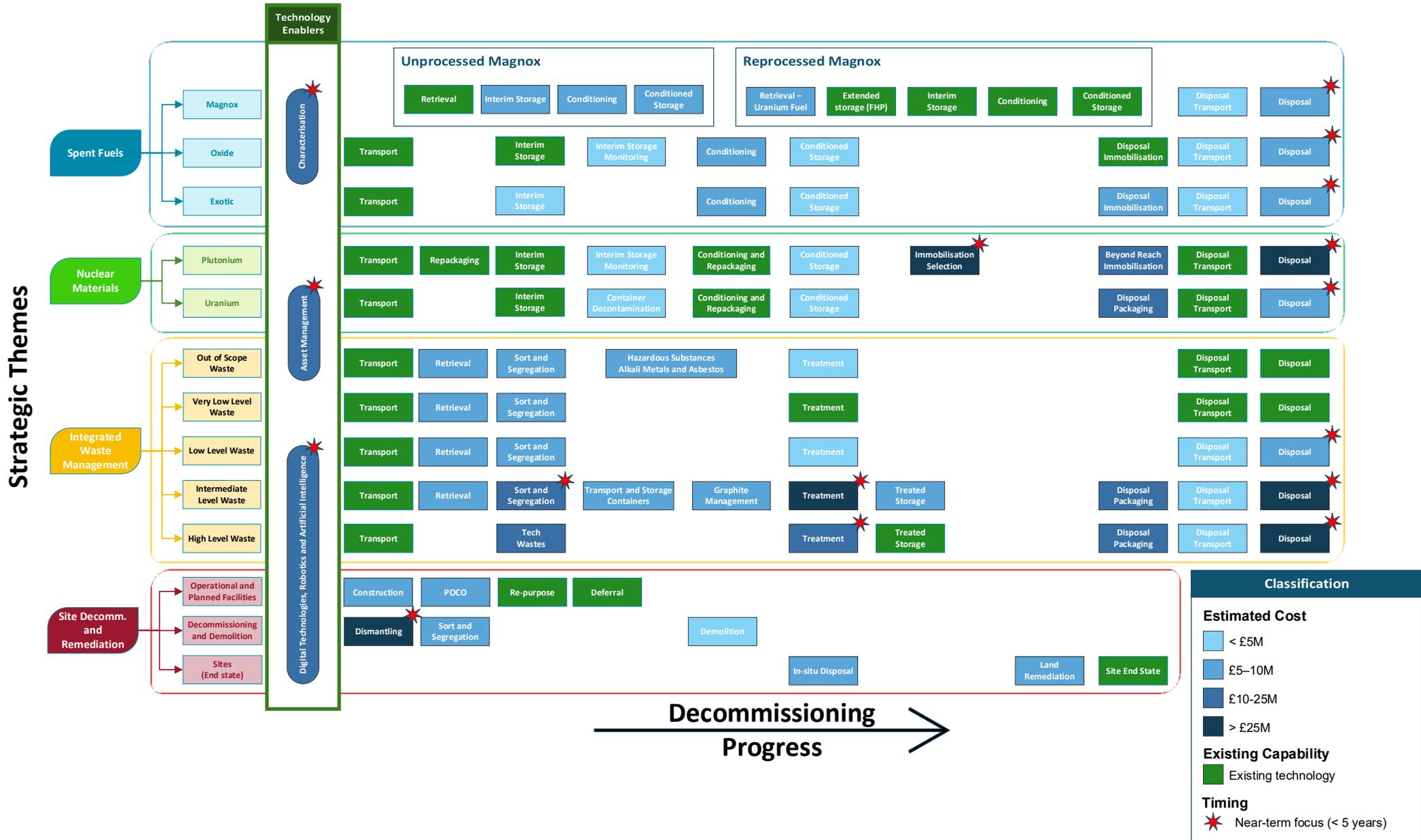


Figure 5: Overview of R&D needs required to underpin the NDA group's technology baseline and deliver the mission.

4. Spent Fuel

Our inventory of spent fuels consists of large quantities of oxide fuels, and smaller quantities of Magnox fuel and diverse non-standard fuel types that we refer to as exotic fuels.

The vast majority of spent oxide fuels come from the Advanced Gas-Cooled Reactors (AGR) owned and operated by EDF Energy. The Magnox spent fuel has come from the first generation of Magnox reactors. Most of the remaining Magnox material is degraded fuel that is in, or has been recovered from, the legacy ponds at Sellafield site, with a smaller amount of fuel that was not reprocessed following completion of the Magnox Operating Programme. The exotic fuels tend to have come from prototype, experimental or research reactors as part of the development of the nuclear power industry.

Our strategy for spent fuels has three phases:

- **Consolidation**
Consolidating all the spent fuels the NDA owns, or is contracted to manage, at Sellafield. This involves transportation of spent fuels from reactor sites across the group such as Dounreay. By consolidating spent fuels at Sellafield: we reduce the radiological hazards at reactor sites and enable further decommissioning and remediation of these sites; leverage the specialised facilities, capabilities, and expertise available at Sellafield for conditioning and interim storage of the spent fuels.
- **Safe and secure interim Storage**
Until a GDF is available, we are safely and securely storing our spent fuel inventory. Interim storage has different requirements depending on the characteristics of the spent fuel – as such there are opportunities for conditioning technologies, and in storage monitoring/characterisation techniques.
- **Disposal in a Geological Disposal Facility**
Packaging and final disposal of our spent fuel inventory will take place when a GDF is available. Packaging and treatment for disposal will take place when the necessary disposal requirements are fully understood based on the conditions of the GDF. Since the last TBR, all practicable reprocessing of Magnox material has completed at Sellafield, and there is no plan to restart reprocessing of spent fuels. We continue to manage our spent fuels as potential assets and are working with stakeholders to understand how and when spent fuels should be categorised as waste.

4.1 Spent Magnox Fuel

STRATEGIC OUTCOMES

- 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



Trawsfynydd nuclear power station

The Magnox reactors were the first generation of commercial nuclear power stations to operate in the UK. They have now all been defueled and the fuel consolidated at Sellafield, where the vast majority of it was reprocessed where practicable. The final reprocessing campaign was completed in 2022, with the Magnox Reprocessing Plant (MRP) reprocessing nearly 55,000 tonnes of spent fuel during its lifetime.

Our spent Magnox fuel inventory consists of 250 tonnes of spent fuel from commercial Magnox power stations and approximately 500 tonnes of other metallic fuels from the legacy ponds: First Generation Magnox Storage Pond (FGMSP) and Pile Fuel Storage Pond (PFSP).

Since the 2016 Technical Baseline, Sellafield Limited have developed the self-shielded box – a ductile cast iron container which stores Magnox wastes safely and securely in the Interim Storage Facility (ISF).

Although some of the fuel has already been recovered from FGMSP and transferred to another plant (Fuel Handling Plant – FHP), most of the fuels from legacy ponds are highly degraded and require further R&D for interim storage and treatment of the material. FHP will continue to store Magnox fuel following a regime which minimises corrosion until technologies are deployed to manage the inventory and prepare it for disposal in a GDF.

The Magnox reactor sites, having been defueled, are now managed within the Site Decommissioning and Remediation strategic theme as part of NRS's activities.

RELEVANT ORGANISATIONS



SINCE TBR 2016

All Magnox fuel consolidated at Sellafield

All practicable Magnox fuel reprocessed

Development of self-shielded box

Interim Storage Facility (ISF) constructed

4.1.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

- **Self-Shielded Box**
Novel manufacturing, Interim Storage
Developed by Sellafield Limited to store Magnox wastes, while providing suitable radiological safety mechanisms passively.
- **ROVs**
Used for ponds decommissioning, surveys and decommissioning support operations.
- **MSSS Sonar**
Aids retrievals from MSSS by providing a sonar map of the waste compartment.

4.1.2 Technology Opportunities

As the large-scale reprocessing of spent Magnox fuel concluded in 2022, there are limited opportunities to exploit new reprocessing technologies. However, there are opportunities to develop treatment technologies focussed on treating the 250 tonnes of spent Magnox fuel which was not practicable to reprocess at MRP. Some of this fuel will be unsuitable for disposal in a GDF without treatment, presenting opportunities for pre-disposal small-scale treatment and waste package storage. Further technology opportunities for the Magnox strategy are:

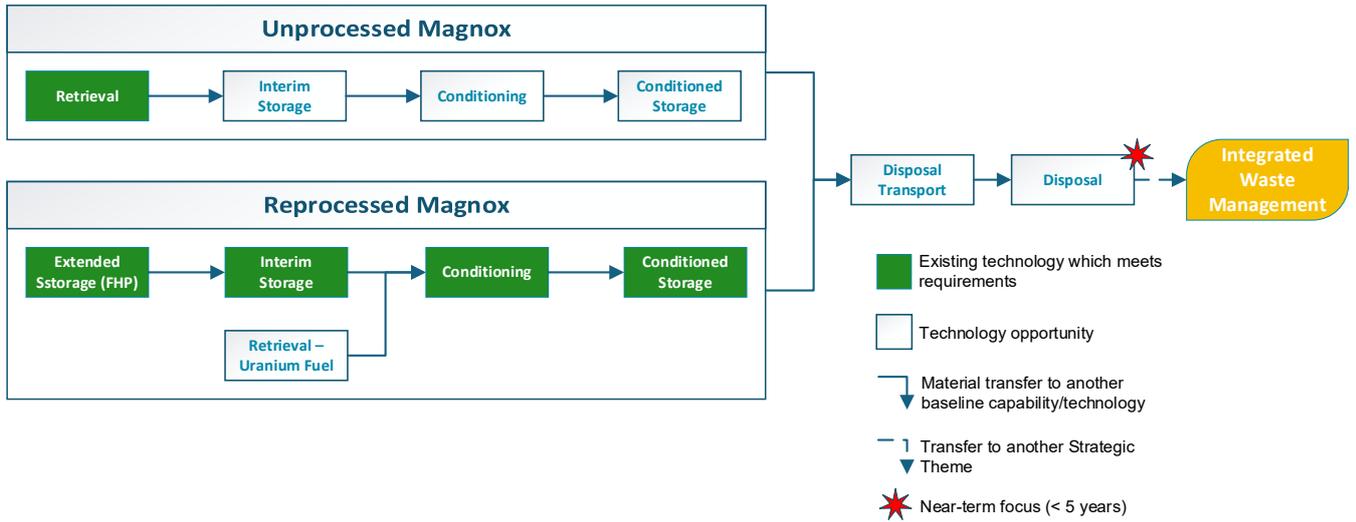
- **Retrieval (Reprocessed Magnox)**
Residual Magnox uranium fuel-like fractions are in a degraded condition and require retrieval techniques to process the residual material.
- **Interim storage: Packaging technologies (Unprocessed Magnox)**
Interim storage and disposal of the spent Magnox fuel will require evaluation of existing package solutions for long term storage suitability, container integrity evaluation, and underpinning of GDF acceptance.
Magnox fuel is prone to corrosion, which can lead to the generation of gases during long-term storage, which requires monitoring or abatement.
- **Conditioning (Unprocessed Magnox)**
Drying technology - Before final disposal, the spent Magnox will need to be dried. This could involve the translation of mature technologies used for drying of LWR fuel.
- **Conditioned storage (Unprocessed Magnox)**
Dry storage packages suitable for long-term storage of dried unprocessed spent Magnox inventory, and compliant with GDF acceptance criteria.
- **GDF acceptance and GDF disposal**
Long-term performance assurance of storage packages to ensure conditioned material is suitable for final disposal in a GDF and GDF post-closure behaviour.

Table 1: Strategic outcomes and target completion year for Spent Magnox Fuel.

Strategic Outcome	Description	Completion Target
SO 1	All sites defueled	Complete
SO 2	All legacy Magnox fuel retrieved	2045

SO 3	All Magnox fuel reprocessing completed	Complete
SO 4	All remaining Magnox fuel in interim storage	2045
SO 5	All remaining Magnox fuel disposed	2125

4.1.3 Area Wiring Diagram



4.2 Spent Oxide Fuel

STRATEGIC OUTCOMES

- 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

Springfields fuel production site

The UK's spent oxide fuel inventory is primarily made up of fuel from Advanced Gas-Cooled Reactors (AGR) operated by EDF Energy (EDFE), with a small quantity of other oxide fuels from the Thermal Oxide Reprocessing Plant (THORP) programme. While most of this fuel is owned by the NDA, a portion remains under EDFE ownership. EDFE has indicated that all AGR stations will stop generating electricity by 2030, though the NDA's strategy remains flexible to accommodate changes in closure dates.

All spent AGR fuel is either already consolidated - around 3,000 tonnes of AGR fuel are currently stored at Sellafield - or planned to be at Sellafield site. Total oxide fuel consolidated is expected to rise to approximately 5,000 tonnes once defueling of the AGR fleet is complete around 2035.

Except for a small amount of fuel, nearly all the oxide fuel at Sellafield is interim stored under water, in carefully controlled conditions, to manage heat and prevent corrosion. We expect that all spent AGR fuel will be consolidated into the THORP pond, where a new fuel storage container, known as the 63 can rack, has been introduced to significantly increase storage capacity, avoiding the need for new storage facilities.

Oxide fuels are expected to remain in some form of interim storage for several decades until a GDF is available. The NDA is working with Sellafield, NWS and EDFE to ensure records and knowledge are preserved to support future disposal. A disposal case for AGR fuel is currently being developed, and NWS continues to progress its geological disposal programme.

Currently, R&D is underway to support drying of AGR fuel, which is a necessary preparatory step for final disposal, and could serve as a contingency to pond storage. This work will utilise

RELEVANT ORGANISATIONS



SINCE TBR 2016

THORP reprocessing completed

63 can rack introduced

specialised facilities such as the Active Handling Facility, operated by United Kingdom National Nuclear Laboratory (UKNNL). Improvements to storage infrastructure at Sellafield will support long-term interim storage and may allow compatible fuels to be stored alongside AGR fuel.

4.2.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

- **63 Can Rack**

Novel manufacturing, rethinking packaging and storage

Allows the THORP pond to store 50% more spent nuclear fuel by triple stacking spent fuel containers in a 21x3 container array. This means Sellafield can safely store all the fuel expected from the UK’s currently operational nuclear power stations. Without the rack, a new storage pond would have had to be built, potentially costing billions of pounds [7].

4.2.2 Technology Opportunities

Due to the completion of reprocessing of oxide fuel at THORP, there are no opportunities to explore new reprocessing technologies for oxide fuel. However, opportunities exist for technologies to support safe, secure, and cost-effective interim storage and disposal in a GDF:

- **Material Surveillance: Interim storage monitoring, long-term Post-Irradiation Examination (PIE) and characterisation**

PIE and characterisation of AGR fuel during its ex-service lifetime: from reactor defueling, wet storage, drying, dry storage, and final disposal. AGR cladding behaviour – corrosion, sensitisation, and cracking during drying and storage.

- **Conditioning**

Drying techniques applicable to the transition of oxide fuel from wet to dry interim storage, and preparation for final processing for disposal. Interim dry buffer storage.

- **Wasteform Evolution**

Material behaviour monitoring and modelling which underpins the thermal and corrosion properties of wet and dry interim stored oxide fuel; evaluating processed wasteform behaviour, and supporting GDF suitability; GDF post-closure material behaviour.

- **Repurposing facilities**

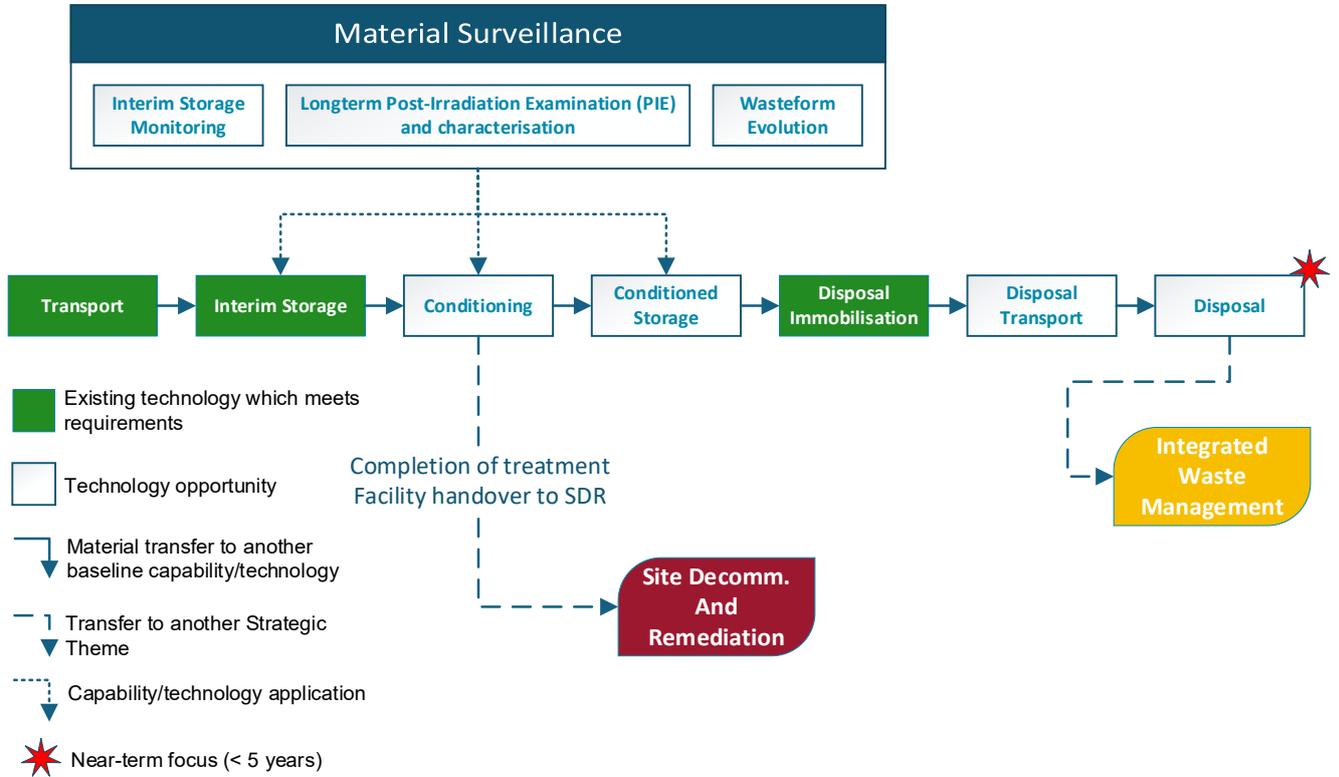
Once all oxide fuel has been received from EDFE, there will be facilities available for repurposing to support other strategic outcomes – e.g. AGR dismantler at FHP.

Table 2: Strategic outcomes and target completion year for Spent Oxide Fuel.

Strategic Outcome	Description	Completion Target
SO 6	All EDFE oxide fuel received	2033
SO 7	All legacy fuel retrieved	Complete
SO 8	All oxide fuel reprocessing completed	Complete
SO 9	All remaining oxide fuel in interim storage	2033

SO 10	All remaining oxide fuel disposed	2125
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4.2.3 Area Wiring Diagram



4.3 Spent Exotic Fuel

STRATEGIC OUTCOMES

- 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



Dounreay Fast Reactor

The NDA's exotic fuel inventory consists of a small quantity of non-standard fuels, including metallic, oxide and carbide materials. These fuels are a legacy of earlier nuclear industry activities, such as research, experimental and prototype reactor programmes. Notable sources include the Dounreay Fast Reactor (DFR), the Dounreay Prototype Fast Reactor (PFR), the Windscale AGR (WAGR), and the Steam Generating Heavy Water Reactor (SGHWR) at Winfrith. We also hold oxide materials from R&D activities which cannot be efficiently managed alongside standard oxide fuels.

Due to their diverse and sometimes unique physical and chemical properties, exotic fuels present specific challenges and require tailored storage solutions. These range from minor modifications to enable inclusion in current oxide or Magnox disposal routes, to bespoke solutions for more complex materials to enable safe disposal of exotic fuels in a GDF.

Exotic fuels are being consolidated at Sellafield to enable accelerated decommissioning and remediation of sites such as Dounreay and Harwell, and to reduce the overall cost of the NDA mission.

Some exotic fuels have been reprocessed, but others were deemed uneconomical or unsuitable for reprocessing and are being stored until a GDF is available. For example, Dragon fuel held at Harwell has been classified as waste and will be encapsulated using existing waste-processing facilities at Sellafield.

The NDA is also contracted to receive and store irradiated fuels from the Ministry of Defence (MOD), arising from the UK Defence Nuclear Programme. While interim storage is managed by the NDA, long-term management and disposal decisions remain the responsibility of the MOD.

RELEVANT ORGANISATIONS



SINCE TBR 2016

THORP reprocessing completed

4.3.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

- **Encapsulation**
Dragon fuel from Harwell has been fully processed through the Magnox Encapsulation Plant.
- **Self-Shielded Box**
Demonstrated to be capable of storing some fast breeder inventory for up to 50 years.

4.3.2 Technology Opportunities

Exotic fuels present specific technology opportunities driven by their unique properties, conditions, and treatment routes. The materials range in complexity from pyrophoric to highly enriched fuel. In essence, each fuel requires an amount of bespoke R&D to ascertain the route to disposal. Additionally, because of the bespoke requirements for each exotic fuel, there is a significant opportunity for characterisation and monitoring technologies which will be used to underpin regulatory safety cases and disposal assessments - this could involve a pre-treatment to enable processing through existing fuel processing routes.

Technology development opportunities exist in the areas of:

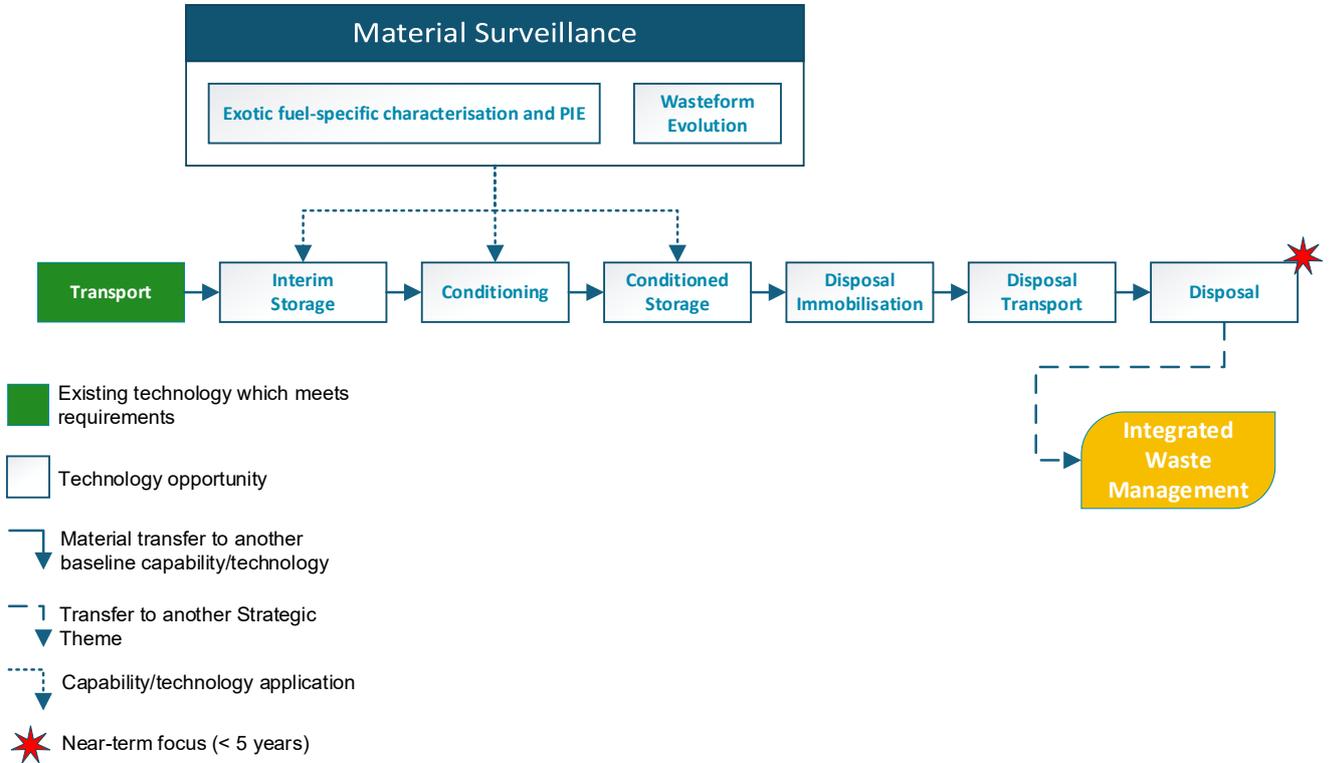
- **Material Surveillance: Exotic fuel-specific characterisation and PIE, and wasteform evolution**
Determination of the current condition of consolidated fuels in interim storage.
- **Interim Storage: Wet & dry storage behaviour**
For example cladding integrity, corrosion mechanisms, gas evolution, container integrity. Package monitoring techniques.
- **Conditioning and Conditioned Storage**
Prior to treatment for storage, exotic materials which have been wet stored will require drying. The drying techniques may not be a direct copy of those employed for Magnox or oxide fuels due to the unique properties of exotic fuels such as the presence of thermally reactive species.
- **Disposal Immobilisation**
Disposal package development and monitoring; encapsulation types – especially synergies with other fuel disposition routes; GDF compatibility (e.g. plutonium-carbide fuel suitability); metal container additive manufacturing. evaluating processed wasteform behaviour, and GDF post-closure material behaviour

Table 3: Strategic outcomes and target completion year for Spent Exotic Fuel.

Strategic Outcome	Description	Completion Target
SO 11	All exotic fuel defueled	2028
SO 12	All exotic fuel consolidated	2044
SO 13	All exotic fuel reprocessing completed	Complete
SO 14	All remaining exotic fuel in interim storage	2044

SO 15	All remaining exotic fuel disposed	2125
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4.3.3 Area Wiring Diagram



5. Nuclear Materials

We own large quantities of civil uranium and plutonium from nuclear fuel enrichment, fabrication and reprocessing. These nuclear materials are diverse in nature and properties. Managing them is essential for decommissioning our sites and delivering our mission.

Our inventory of nuclear materials consists primarily of civil plutonium and uranic materials, alongside smaller quantities of enriched uranium and residues from historic operations [8]. These materials are a legacy of decades of fuel fabrication, enrichment, and reprocessing activities across the UK nuclear industry.

The majority of plutonium was separated during Magnox and oxide fuel reprocessing campaigns at Sellafield, while uranic materials include Magnox Depleted Uranium (MDU), Thermal Oxide Reprocessing Plant (THORP) product uranium, and uranium hexafluoride (UF₆) from enrichment processes. These materials are stored safely and securely at licensed facilities such as Sellafield and Capenhurst. Packaging and treatment for disposal will take place when the necessary disposal requirements are fully understood based on the conditions of the GDF.

Since the last Technical Baseline Review, significant progress has been made in consolidating plutonium at Sellafield and Urenco has been contracted to transfer UF₆ into modern containers and then de-convert it into a form of uranium oxide which is much less hazardous and more suitable for long-term management. The UK Government has confirmed its policy to immobilise civil plutonium for final disposal, and work is underway to develop and demonstrate the necessary technologies [9].

5.1 Plutonium

STRATEGIC OUTCOMES

- 16 All plutonium produced
- 17 All plutonium consolidated
- 18 All cans not suitable for extended storage repackaged
- 19 All plutonium in interim storage
- 20 All plutonium put beyond reach and then disposed

THORP Product Store, Sellafield

Since the completion of fuel reprocessing, all separated civil plutonium has been consolidated at Sellafield where it is stored safely and securely. The plutonium inventory is a byproduct of Magnox and oxide fuel reprocessing at Sellafield and must ultimately be put beyond reach to mitigate the long-term security and safety risks associated with the inventory. 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) and the Office for Nuclear Regulation (ONR) safeguards requirements.

In 2025 the UK Government made the policy decision to pursue the immobilisation of the plutonium inventory for disposition and ensure suitability for disposal in a GDF – reducing long-term security risks and proliferation sensitivities for future generations [9].

Our plutonium strategy has two components: ensuring long-term safe and secure storage at Sellafield; and working with HMG and delivery partners to implement the disposition immobilisation policy decision.

To ensure the long-term safe and secure storage of plutonium, it needs to be repackaged and, in some cases, re-treated. Under construction at the time of writing, the SRP (SPRS Retreatment Plant) will re-treat and repackage existing material into more durable, long-term storage packages, ensuring safe and secure long-term storage in the Sellafield Product and Residue Store (SPRS).

Owing to the size of the plutonium inventory and the complexity of developing and delivering immobilisation options, any long-term management solution will require significant R&D and

RELEVANT ORGANISATIONS



SINCE TBR 2016

Government policy decision: Plutonium immobilisation

SRP & SPRS configurations finalised

Consolidation of plutonium at Sellafield

take many decades to fully implement. We have selected two potential options for immobilisation: hot isostatic pressing (HIP) where plutonium is immobilised within an artificial rock-like ceramic zirconolite matrix; and disposal mixed oxide material (DMOX) where plutonium is immobilised alongside uranium in a ceramic pellet. Subject to R&D and supply chain activities, we anticipate selecting a preferred immobilisation technology around 2030.

Defence plutonium material is not part of the NDA's inventory and is managed by AWE.

5.1.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

- **Cementitious Immobilisation**
Existing process capability applied to interim immobilisation of a new waste stream – plutonium residues.
- **Sellafield Product and Residue Store (SPRS)**
Modern engineered facility for secure plutonium storage.
- **SPRS Retreatment Plant (SRP)**
Retreatment and repackaging of plutonium materials [10].

5.1.2 Technology Opportunities

With the configurations of SRP and SPRS finalised, and construction due for completion during the lifetime of this review, significant technology opportunities related to treatment and repackaging at Sellafield site are unlikely to arise beyond automation of material management, and improvements to material analysis during operations in SRP and SPRS

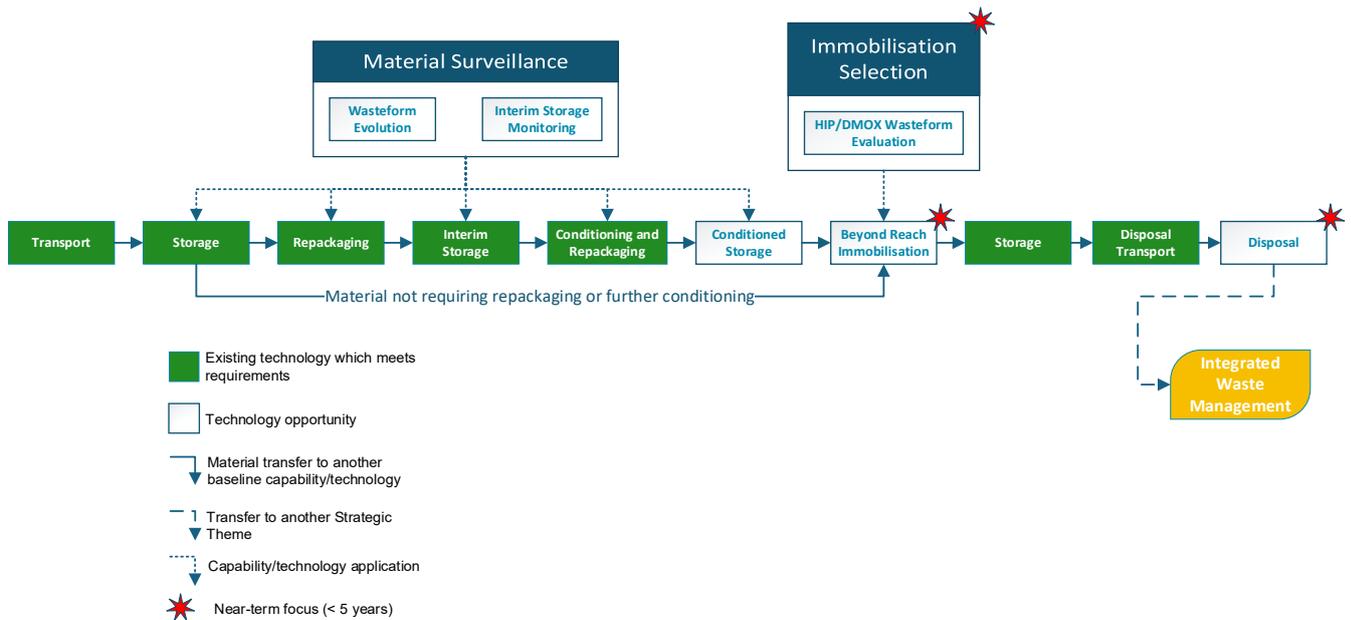
Opportunities exist for underpinning the selection of an immobilisation technology from HIP and DMOX:

- **Interim storage monitoring**
 - Process monitoring
 - Radiometrics
- **Conditioned Storage**
 - **Package evolution**
Helium evolution during storage and package aging; alpha-active package behaviour.
 - **In situ monitoring**
Package monitoring; live in-line process monitoring of immobilisation plant and process.
- **Immobilisation Selection: HIP/DMOX wasteform for immobilisation**
 - **Particle and powder processing**
Characterisation, characteristics, and compositional insight for powder and particle processing for immobilised material fabrication in a continuous process at industrial scale. For example, optimal ceramic pellet size determination and density enhancement, Pu loading.

- **Wasteform evolution**
Long-term storage behaviours – for example leaching, dissolution, and GDF post-closure behaviour.
- **Beyond Reach Immobilisation**
 - Combining information from storage monitoring and immobilisation technology selection to underpin regulatory, safety case, and acceptance criteria for disposal in a GDF.

Strategic Outcome	Description	Completion Target
SO 16	All plutonium produced	Complete
SO 17	All plutonium consolidated	Complete
SO 18	All cans not suitable for extended storage repackaged	2060
SO 19	All plutonium in interim storage	2060
SO 20	All plutonium put beyond reach and then disposed	2120

5.1.3 Area Wiring Diagram



5.2 Uranium

STRATEGIC OUTCOMES

- 21 All uranium produced
- 22 All uranium consolidated
- 23 All uranium treated
- 24 All uranium in interim storage
- 25 All uranium reused or disposed

Urenco Capenhurst site

The NDA's uranium inventory consists of approximately 70,000 tonnes of uranic material. A legacy from enrichment, fabrication, and reprocessing activities in the nuclear sector dating back to the 1950s, there are several different types of uranic material in our inventory:

- Magnox Depleted Uranium (MDU) in the form of uranium trioxide (UO_3), a product of spent Magnox fuel reprocessing, stored at Capenhurst. With all practicable Magnox fuel reprocessed, MDU is no longer produced.
- THORP Product Uranium (TPU) in the form of UO_3 , a product of spent oxide fuel reprocessing. The majority of this material is owned by our customers and could be recycled by them in the future.
- Uranium hexafluoride (UF_6 or colloquially 'hex') which is a by-product of uranium enrichment, stored at Capenhurst with small amounts at Springfields. Contained in cylinders, many of which are several decades old with signs of corrosion.
- Very small quantities of highly enriched uranium (HEU) from research reactor fuel development and production.
- Low-enriched (LEU), natural (nat-U), and depleted uranium (dep-U) in multiple forms – e.g. metal scraps recovered from fuel fabrication, powders and liquors.

The majority of the inventory is stored at Capenhurst, with smaller holdings at Sellafeld, Springfields, Dounreay and Harwell. Some of the uranium is owned by third parties including the Ministry of Defence (MOD), EDFE and overseas utilities, and is managed under contractual arrangements.

RELEVANT ORGANISATIONS



SINCE TBR 2016

All practicable Magnox fuel reprocessed

MDU consolidated at Capenhurst

THORP reprocessing completed

Completion of Urenco TMF

Due to the varied chemical forms and enrichment levels, uranium materials require tailored management approaches. Most of the inventory is in oxide form, suitable for long-term storage. However, hex is stored in ageing cylinders, some of which show signs of degradation. The NDA is working with Urenco to transfer hex into modern containers, remove selected impurities and deconvert it using Urenco's Tails Management Facility (TMF) into uranium oxide (U_3O_8), which is safer and more suitable for long-term management. The old cylinders will also need to be decontaminated and the metal recycled or disposed of appropriately. Highly enriched uranium and low-concentration residues are also being assessed for recovery or conditioning for disposal.

Uranium is being consolidated onto fewer sites to reduce long-term costs and enable decommissioning of redundant facilities. Capenhurst is the primary consolidation site – hosting MDU, LEU, dep-U, nat-U and hex - with enriched materials such as TPU and HEU consolidated at Sellafield. The NDA has recently taken ownership of MOD-owned hex, which is now part of the broader inventory.

Some uranium may be reused in future nuclear fuel cycles, depending on market conditions and technical feasibility. Reprocessed uranium may require specialised treatment before reuse, impacting its economic viability. The NDA is working with government and industry to explore reuse options, including new UK fuel-cycle facilities. Where reuse is not viable, disposal routes are being developed in collaboration with NWS and other UK uranium owners.

5.2.1 Current Baseline Technologies

As the management and processing of our uranium inventory is being conducted by Urenco on our behalf, since the previous Baseline Review, new baseline technologies are limited to what Urenco has deployed:

- **Tails Management Facility (TMF)**
Now-operational capability for converting hex into a stable uranium oxide form.
- **New Cylinder Storage Systems**
Upgraded containment and monitoring for legacy hex cylinders.

5.2.2 Knowledgebase Opportunities – NDA as an Intelligent Customer

Due to existing contractual arrangements and our shared strategy with Urenco for transferring hex into modern cylinders and de-converting it into a form of uranium oxide better suited to long-term storage, there are no direct technology opportunities available. However, there are R&D opportunities to add to our knowledge base as an *intelligent customer* and reducing our risk exposure:

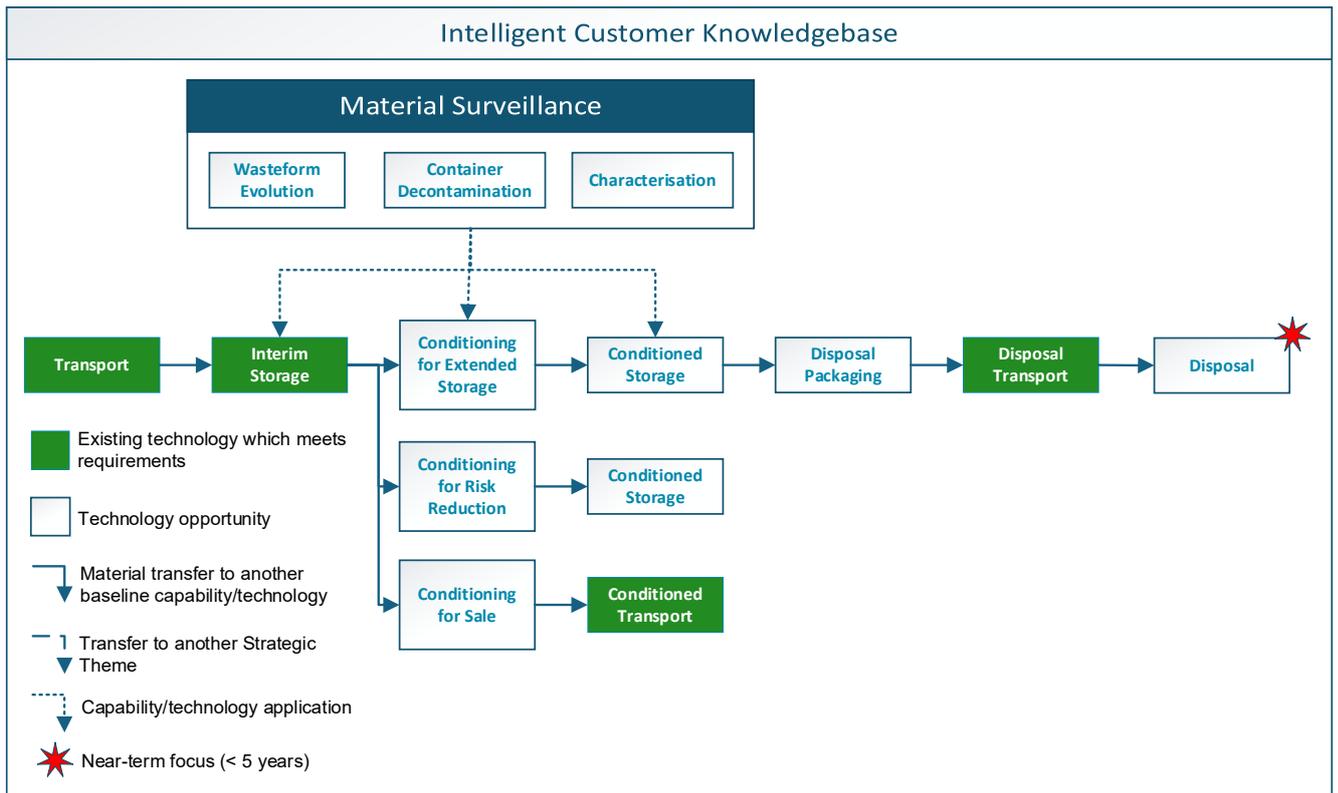
- **Efficacy of corroded container decontamination**
Measuring the efficacy of proposed container decontamination methodologies (e.g. chemical wash-out), for the reclassification of old hex containers as lower hazard waste.
- **Characterisation**
 - Characterisation and modelling of inventory - Confirming suitability of empty containers and associated decontamination products for recycling or disposal in an appropriate facility.
 - Cylinder characterisation without the need for handling or relocation.

Further, in contrast to other material inventory, our uranium inventory provides the NDA with a potential saleable resource. Therefore, technologies which could aid the reuse and resale of inventory, particularly if leveraging existing processing infrastructure, would be of interest, as well as characterisation and inventory modelling:

- **Uranium disposition**
Technologies for repurposing our uranium assets for sale or reuse.
- **Characterisation**
Improved chemical, physical and radiometric characterisation techniques to provide information to support disposition options.

Strategic Outcome	Description	Completion Target
SO 21	All uranium produced	Complete
SO 22	All uranium consolidated	2028
SO 23	All uranium treated	2055
SO 24	All uranium in interim storage	2055
SO 25	All uranium reused or disposed	2120

5.2.3 Area Wiring Diagram



6. Integrated Waste Management

The diverse radiological, chemical and physical properties of our wastes give us a broad range of risks to manage today and for decades to come. In 2016 we implemented an Integrated Waste Management (IWM) system that provides a range of treatment, storage and disposal capabilities. Central to the IWM is the waste hierarchy, which sets out five steps for dealing with waste, ranked according to environmental impact.

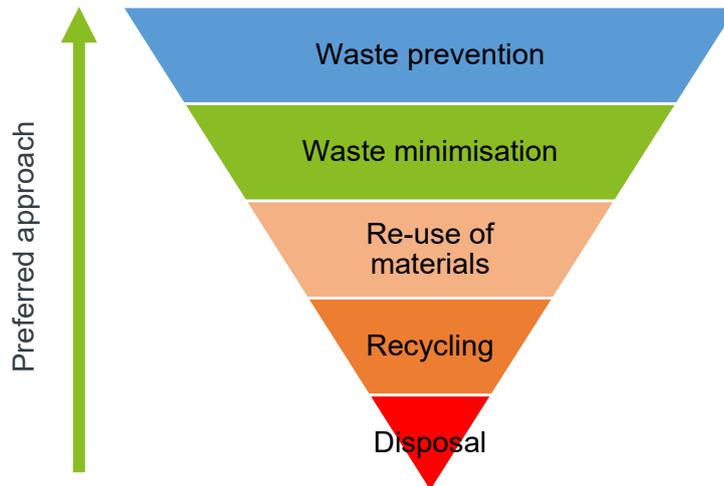


Figure 5: IWM waste hierarchy.

Depending on its radioactivity and whether or not it generates heat, radioactive waste in the UK has different classifications:

- **Out of Scope Waste (OSW)**
 This waste has a radioactive content which is below the level required to legally class it as radioactive. It is 'Out of Scope' of the Environmental Permitting Regulations and can be disposed of through normal hazardous or non-hazardous waste routes, depending on its other properties. An example of this would be construction and demolition wastes.
- **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 at specified landfill sites, subject to limits on radioactivity content.
- **Low Level Waste (LLW)**
 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 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.

- **Intermediate Level Waste (ILW)**

Waste which does not fit in the boundaries for LLW but also does not generate sufficient heat that it needs to be considered in the storage or disposal facility design.

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.

- **High Level Waste (HLW)**

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.

Many site operations require effluent treatment, which result in the production of waste that will need to be managed accordingly. This means effluent treatment capability is required and subsequent full lifecycle waste management, such as sentencing as LLW or ILW. We also have residues from processing and treating our plutonium and uranium inventories.

Since the last TBR, the companies LLWR Ltd., Magnox Ltd and RWM were consolidated to form Nuclear Waste Services (NWS) in 2022. NWS combines the UK’s nuclear waste management capabilities, bringing together the Low Level Waste Repository (LLWR), and the Geological Disposal Facility (GDF) programme under a single organisation in the NDA group.

Table 4: Reported and packaged waste volumes from the UK Radioactive Waste and Material Inventory [11].

	Reported Volume (m ³)	Packaged Volume (m ³)
HLW	1,670	1,470
ILW	249,000	496,000
LLW	1,580,000	1,340,000
VLLW	2,750,000	2,610,000

With such diverse wastes present in the group multiple technology opportunities exist, which can be found in Figure 5. The next sections discuss the technology baseline and opportunities associated with the waste categories directly related to strategic outcomes for delivering our mission.

For detailed information of the radioactive wastes and materials in the UK, the UK Radioactive Waste & Materials Inventory Data hub is publicly available [12], as is an accompanying report [8].

Packaging and treatment for disposal will take place when the necessary disposal requirements are fully understood based on the conditions of the GDF.

We are planning to update our Radioactive Waste Strategy [13] following the publication of this review document. Through the development of the Radioactive Waste Strategy and following public consultation, we will ensure continued alignment with the updated UK policy framework for managing radioactive substances and nuclear decommissioning.

6.1 Low Level, Very Low Level, and Out of Scope Wastes

STRATEGIC OUTCOMES

- 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



Low Level Waste Repository

Low Level Waste (LLW) represents the largest volume of radioactive waste managed by the NDA group – approximately 1,550,000 m³ [11]. It consists of a broad range of materials such as metals, soils, rubble, and lightly contaminated items like protective clothing, paper, and plastics. These wastes arise primarily from decommissioning, operations, and maintenance activities across the group.

The Low Level Waste Repository (LLWR) site is the UK’s national LLW disposal facility. Its role is to ensure that the LLW generated in the UK is disposed of in a way that protects people and the environment. Arising from the implementation of IWM, on-site disposal also takes place: Sellafield and Dounreay sites both have facilities which are capable of accepting lower-activity wastes from their respective sites.

At the LLWR, waste is grouted with cement in metal containers to make a robust solid. The grouted metal containers containing the waste are placed within the engineered vaults until the repository can be covered with an engineered cap and closed. Capping is a key part of the disposal lifecycle and will provide an engineered protective cover over the waste that has been disposed of in the trenches and vaults at LLWR. Comprising of layers of material, totalling up to 10m thick, the cap will permanently protect people and the environment.

Since the 2016 TBR, we have made significant progress to divert LLW from disposal. This includes the recycling of decontaminated metals and the reclassification of some LLW as Very Low Level Waste (VLLW), enabling disposal via alternative routes. By diverting materials, we can safely and securely extend the operational life and minimise the environmental impact of LLWR and other waste repositories.

RELEVANT ORGANISATIONS



SINCE TBR 2016

Introduction of IWM principles in 2016

Creation of NWS in 2022

Certain waste types fall outside the scope of LLW management, such as Out of Scope Waste (OSW) which are materials with radioactive content below the threshold required to legally classify them as radioactive under the Environmental Permitting Regulations, but present conventional hazards, for example: construction and demolition material that may contain asbestos or alkali metals. While not part of the radioactive waste inventory, these materials still require careful handling and disposal planning and present a technology opportunity for treatment, packaging, and disposal.

6.1.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

- **Grout Development Project**
Mitigation of pulverised fuel ash availability for LLWR grout.
- **Wet LLW/ILW Vacuum Retrieval System**
Vacuum retrieval of sand, gravel, sludge and resin wastes.
- **Universal Drum and Segregation System (UDASS)**
Applied to 1,810 drums of Plutonium Contaminated Material (PCM), allowing reclassification of a large proportion of the drums as LLW, VLLW and low-assay LLW [14].

6.1.2 Technology Opportunities

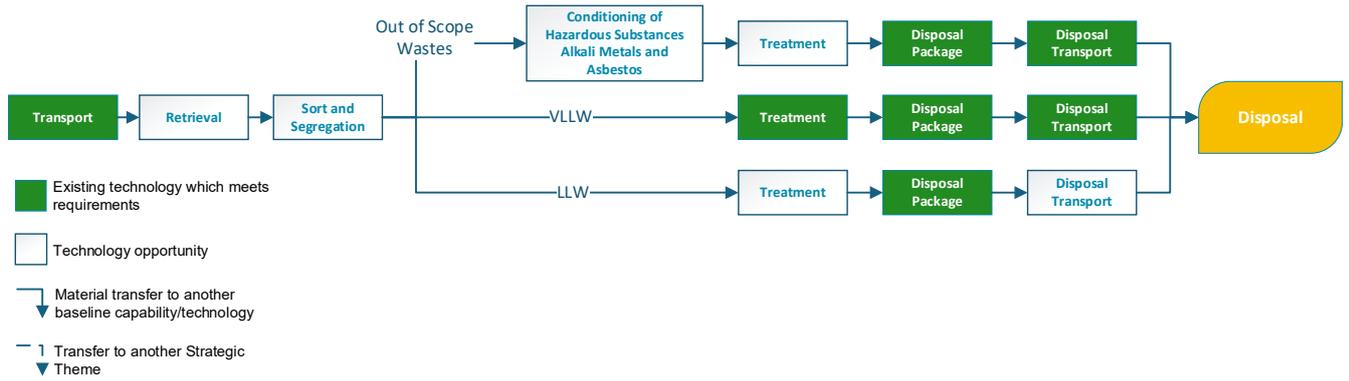
LLW is the least complex classification of waste we manage in the NDA, however it represents the largest volume requiring disposal. As such, technologies that enable waste diversion from disposal in line with the waste hierarchy and therefore reduce the volume of waste to be disposed of is of significant interest to the group.

Technology development opportunities exist in the areas of:

- **Retrievals**
- **Reduction and Reclassification: Sorting and Segregation**
Characterisation, identification, sorting and segregation of wastes and effluents into OSW, VLLW, and LLW.
- **Conditioning and Treatment of Hazardous Substances**
OSW conditioning and final treatment for disposal.

Strategic Outcome	Description	Completion Target
SO 26	All LLW produced	2127
SO 27	All LLW treated – to enable diversion or reuse	2127
SO 28	All waste suitable for disposal in NDA facilities	2127
SO 29	All waste suitable for permitted landfill disposed	2127

6.1.3 Area Wiring Diagram



6.2 Intermediate Level Waste

STRATEGIC OUTCOMES

- 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

Storage facility, Sellafield

Intermediate Level Waste (ILW) represents a smaller volume than LLW, but is significantly more complex due to its higher radiological hazard and the need for shielding and containment during handling and storage.

ILW comprises a number of different forms, with graphite and plutonium contaminated material (PCM) making up ~42% by volume [8] - most graphite is associated with Magnox reactor cores and anticipated future arisings from AGR cores. PCM is mainly from spent fuel reprocessing and future facilities decommissioning at Sellafield as well as plutonium plant decommissioning at Aldermaston. The remainder typically consists of materials such as steels, concrete, cement and sand, sludges, ion exchange resins and flocculants. These wastes arise primarily from historic operations, fuel reprocessing, and decommissioning activities across the NDA group.

ILW requires treatment before interim storage, and the majority cannot be disposed of in facilities like LLWR. However, sorting and segregation of ILW - for example with UDASS - can allow the disposal of less hazardous waste in a suitable near-surface facility, diverting waste from GDF and reducing the footprint demand.

Currently, a significant amount of ILW is conditioned for storage at nuclear licensed sites by encapsulation using cementitious materials. The materials are contained within stainless steel containers suitable for GDF disposal, where they remain in interim storage until a GDF becomes available for final disposal. Other capabilities applicable to ILW include retrievals, thermal treatment, raw waste storage, and alternative encapsulants, which may offer benefits in wastefrom performance and volume reduction.

RELEVANT ORGANISATIONS



SINCE TBR 2016

Introduction of IWM principles in 2016

Creation of NWS in 2022

Commenced waste retrievals from all four legacy ponds and silos at Sellafield

UK Alpha Resilience and Capability (ARC) Programme

6.2.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

- **3 m³ ILW Box**
Novel manufacturing, rethinking packaging and storage
- **Box Encapsulation Plant**
Robotic systems
- **MSSS “rake”**
New thinking, leveraging remote operation resources
Removed 70 tonnes of radioactive waste from MSSS using a custom-built, 1.4-tonne "garden rake" like machine to safely move the waste while maintaining structural integrity of the silo.
- **Quadrupeds**
Robotic systems, remote inspections, removal of hazard exposure
Inspecting hazardous environments and assisting in routine tasks while reducing human exposure to hazards.
- **Risk Reduction of Glovebox Operations (RrOBO) Programme**
Robotic systems, removal of hazard exposure
Reduction of exposure to radiological hazards
- **Development of grouting formulations from British Standard Cement and Ground Granulated Blast-furnace Slag (GGBS) powders**
- **Drying technology for wet ILW in Ductile Cast Iron Containers (DCICs) utilising Advanced Vacuum Drying System**
- **Scalable reference design for ILW stores for self-shielded packages**
Implemented at Bradwell, Berkeley, Chapelcross, Hinkley, and Harwell
- **Eddy Current Separator for ILW sorting**
- **ROVs**
For waste handling and retrievals, waste sorting and size reduction.

6.2.2 Technology Opportunities

With increased complexity compared to LLW, ILW presents some unique technology opportunities to aid with characterisation, treatment, and disposal and diversion of wastes.

Technology development opportunities exist in the areas of:

- **Retrievals**
- **Reduction and reclassification: Sorting and Segregation**
Characterisation, identification, sorting and segregation of wastes and effluents into ILW for reallocation to near surface disposal. Reducing uncertainties for waste streams in UKRWI. Addressing ILW metal wastes.
- **Treatment and Treated Storage**
Size reduction, treatment techniques, decontamination for recycling, reclassification or safer handling
- **Transport and Storage Containers**
Process development for volumetrically efficient loading storage packages.
- **Disposal Packaging and Wasteform Evolution**

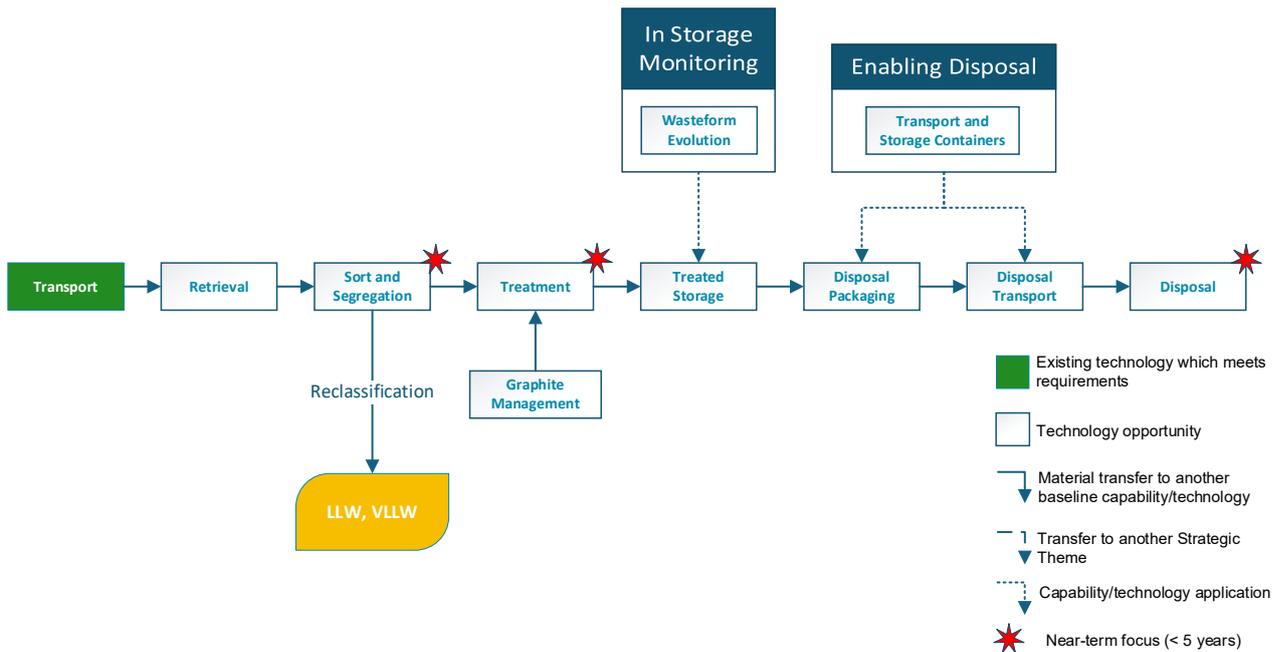
Disposal package development and monitoring; encapsulation types; GDF compatibility e.g. evaluating processed wasteform behaviour, and post GDF closure material behaviour.

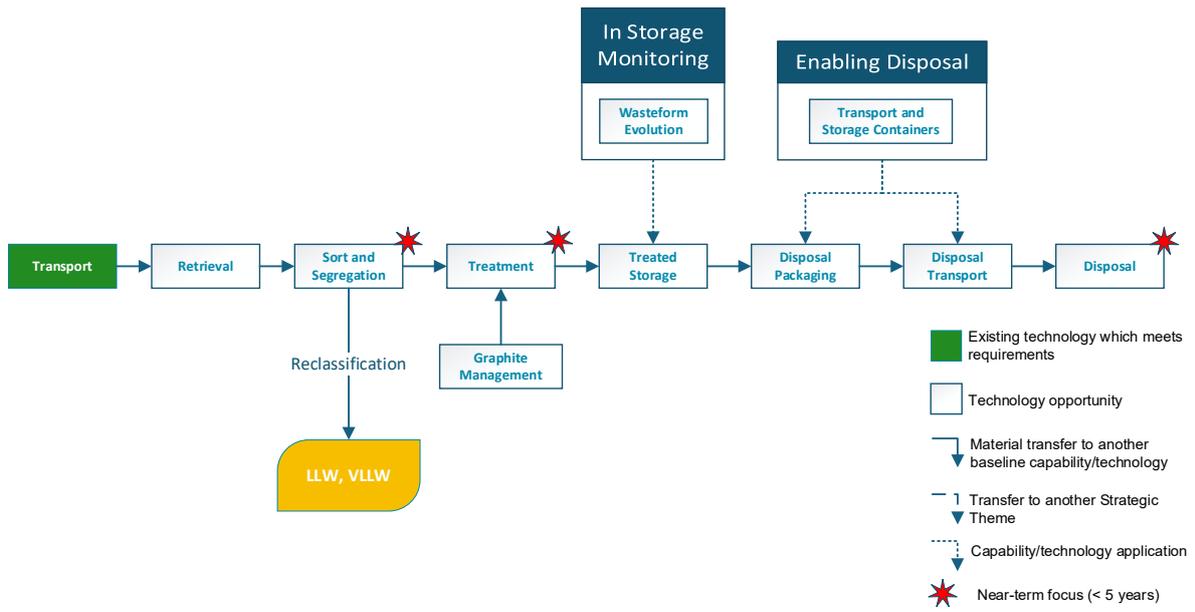
- **Graphite Management**

Alternative treatment options to reduce the volume of graphite waste, and the radiological hazards. This could involve thermal or chemical treatment, or alternative techniques which permit reclassification of some material to LLW.

Strategic Outcome	Description	Completion Target
SO 30	All ILW produced	2120
SO 31	All legacy waste retrieved	2059
SO 32	All ILW treated	2120
SO 33	All ILW in interim storage	2120
SO 34	All ILW disposed – final disposal operational	2379

6.2.3 Area Wiring Diagram





6.3 High Level Waste

STRATEGIC OUTCOMES

- 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

Sellafield site

High Level Waste (HLW) represents the smallest proportion of our waste inventory, less than 0.1% by volume [11], but it presents the highest radioactive and chemical complexity – containing fission products, actinides, corrosion products, process additives, and other impurities [15]. HLW primarily arises from historic fuel reprocessing activities and generates heat, and is managed only on the Sellafield site. Our strategy for HLW is mature – using a vitrification process [15] at Sellafield’s Waste Vitrification Plant (WVP) to enable long-term safe storage and onward disposal to a GDF. We anticipate this continuing until the late 2030s.

The vitrification process immobilises highly radioactive liquid wastes in a stable glassy form, reducing chemical mobility and ensuring stability over timescales suitable for geological disposal. The calcined HLW is mixed with crushed glass in a furnace to produce a molten product which is then poured into stainless steel canisters, which hold approximately 150 litres of waste. Once vitrified, HLW is stored on site at Sellafield in purpose-built facilities that provide passive safety and thermal management, pending the availability of a GDF for final disposal. To date, nearly 6,000 containers have been produced.

Certain materials fall outside of the scope of HLW management, such as spent fuels, which are managed separately and only transfer into the IWM area when suitably prepared for final disposal.

6.3.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

RELEVANT ORGANISATIONS



SINCE TBR 2016

Introduction of IWM principles in 2016

Creation of NWS in 2022

Commenced waste retrievals from all four legacy ponds and silos at Sellafield

- **Epoxy based polymer encapsulation of ion exchange material**
- **ROV inspections**
Highly active buffer storage tank inspections with ROVs across the highly active liquor evaporation and storage facility.

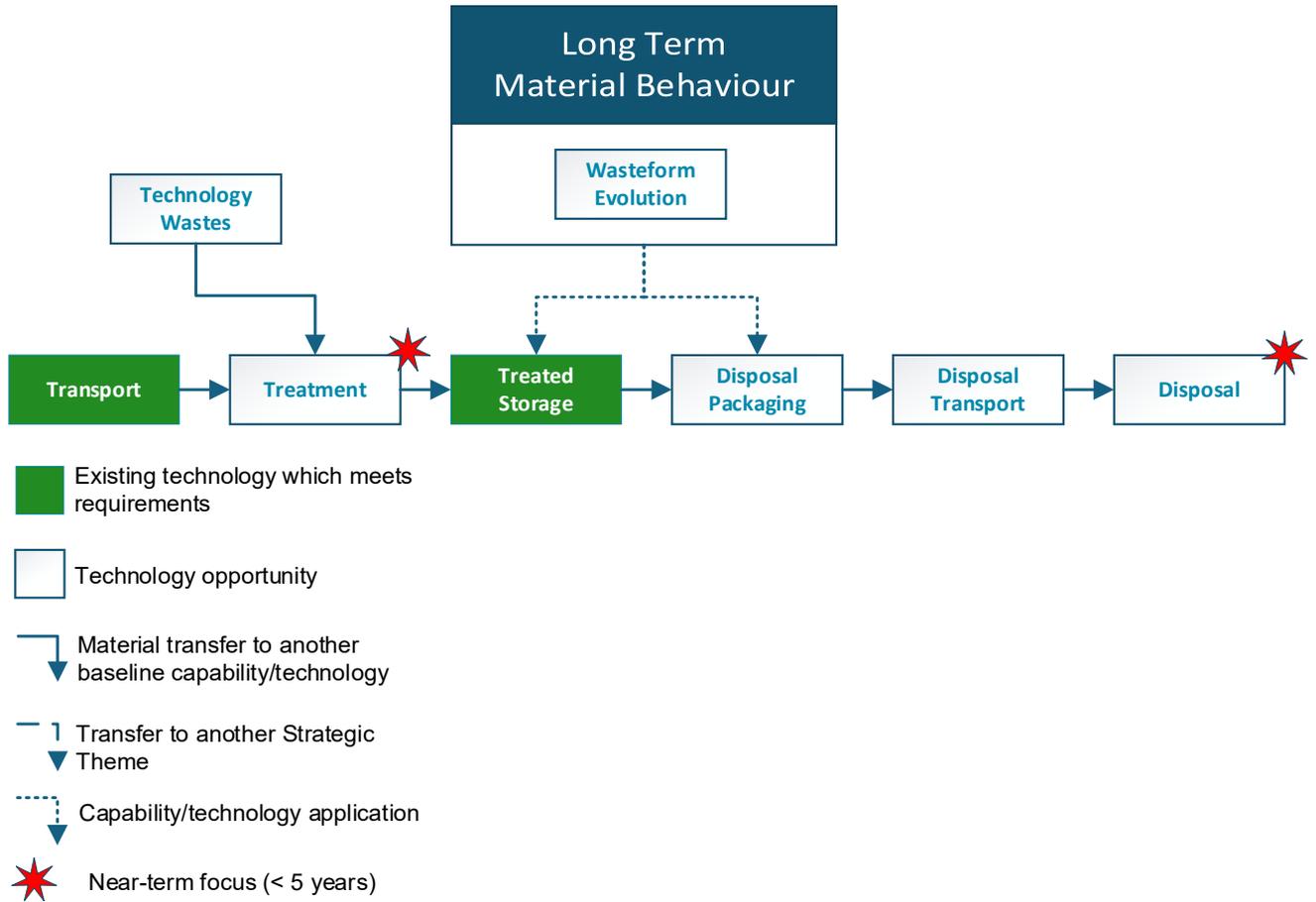
6.3.2 Technology Opportunities

HLW presents the most complex waste in our inventory, although treatment technologies and storage have existing technologies which are deployed, technology development opportunities exist in the areas of:

- **Technology Wastes**
Addressing a route to disposal of old/obsolete/non-operational deployed technology on plant e.g. through dismantling to fit within feed envelopes of existing waste handling plants.
- **Treatment**
For example vitrification product characterisation such as glass dissolution behaviour, glass durability.
- **Wasteform Evolution**
Characterisation of conditioned waste forms to underpin the GDF disposal safety case and long-term behaviour post GDF closure. Reducing uncertainties for waste streams in UKRWI and GDF acceptance.
- **Disposal Packaging**
Refinement to disposal packaging – e.g. manufacturability, volume reduction, process refinements.
Process development for volumetrically efficient loading storage packages.
Standardisation to aid disposal transport.
- **Disposal Transport**
Novel approaches to disposal transport which reduce the third party requirements, aid economic viability and UK infrastructure capacity, for disposal package transportation to a GDF while remaining compliant with security, safety, and environmental obligations.

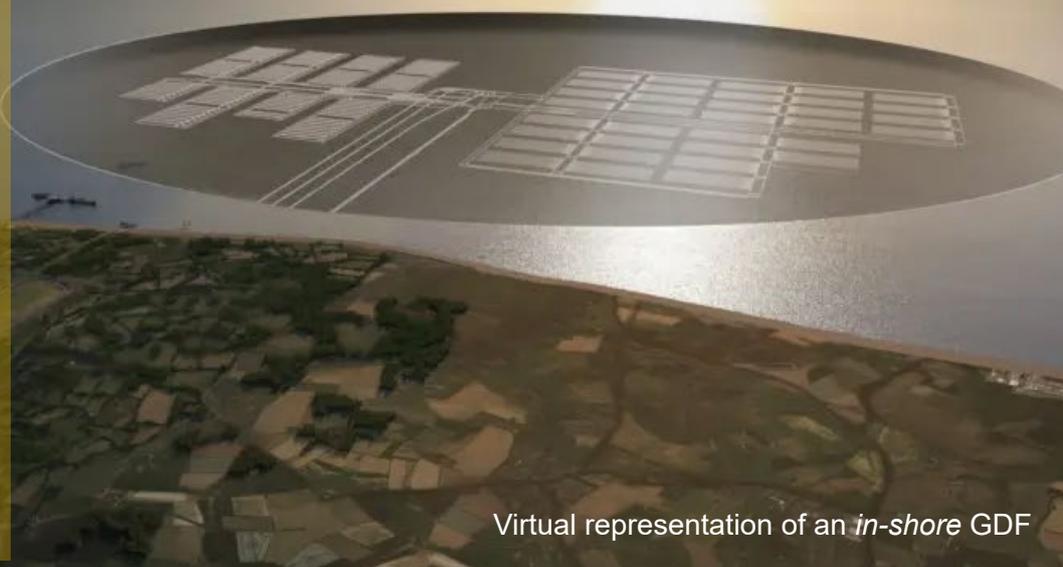
Strategic Outcome	Description	Completion Target
SO 35	All HLW produced	2039
SO 36	All HLW treated	2039
SO 37	All HLW in interim storage	2039
SO 38	All overseas HLW exported	2031
SO 39	All HLW disposed – final disposal operational	2104

6.3.3 Area Wiring Diagram



6.4 Geological Disposal Facility

Underpinning disposal in Integrated Waste Management



Virtual representation of an *in-shore* GDF

A crucial requirement for disposal of our most hazardous radioactive wastes is the availability of a geological disposal facility (GDF). A cornerstone of NWS's role in the group is the development of a suitable facility.

GDF construction will only start when a suitable site is identified by NWS, the local community has confirmed its willingness to host the facility through a Test of Public Support, and all the necessary consents and permits have been obtained. These steps could take approximately 10–15 years. The current planning assumption is that a GDF will be available for waste emplacement in the 2050s.

Various options for constructing a GDF are being considered including an inshore GDF where waste reception and access facilities are on land, but access tunnels and disposal vaults are sited within a suitable geological formation beneath the seabed.

6.4.1 Technology Opportunities

As a dependant capability for other strategic objectives, there are significant technology opportunities related to the GDF. These span the entire lifecycle of the facility and the wastes it will contain - although an essential component underpinning the GDF is the foundational understanding of conditioned wastefrom evolution on timescales relevant to geological disposal and the post-closure period, these opportunities reside in their respective strategic themes to underpin their specific disposal safety case.

In all cases, technology opportunities exist that must ensure compatibility with site-specific geological environments and enable a robust GDF design that enables the development of an associated Environment, Safety, Security, and Safeguards (E3S) Case. Technology development opportunities exist in the areas of:

RELEVANT ORGANISATIONS



SINCE TBR 2016

Creation of NWS in 2022

- **Site Characterisation**
 - Geological characterisation, mapping and screening.
 - Preparation and characterisation of drill-core materials and fluids, including porewater fluid extraction.
 - Automated drill-core characterisation using core imaging and deep learning techniques
 - Radiometric dating techniques for minerals, porewaters and groundwaters
 - Isotopic tracing and thermometry for minerals, porewaters and groundwaters
 - Sample logging and storage.
 - Borehole monitoring techniques and technologies.
 - Borehole sealing
 - Modelling techniques and approaches

- **Tunnelling and Excavation**
 - Underground tunnelling techniques and technologies
 - Underground disposal area concepts and excavation techniques and technologies
 - Materials for and approaches to tunnel lining and sealing
 - Approaches to underground Heating, Ventilation and Air Conditioning (HVAC)

- **Geological & Engineered Barrier Systems: Contaminant Pathways and Transport Mechanisms**
 - Assessment of transport and mobility mechanisms for radiological and non-radiological contaminants
 - Characterisation of key water, gas and non-aqueous phase liquid parameters, including those necessary to describe the mobility of species
 - Characterisation of key products and processes involving organics, colloids, corrosion products, complexants and/or microbes in disposal relevant conditions.
 - Characterisation and assessment of diffusion, sorption, and desorption processes relevant to geological disposal
 - Characterisation and assessment of the effects of contaminants on the biosphere, including human and non-human biota.
 - Modelling tools, techniques and approaches to support contaminants transport mechanisms, including numerical pore-scale modelling techniques for solute, contaminant and gas transport

- **Post-closure Wasteform Evolution and Packaging**
 - Waste packaging concepts and technologies
 - Characterisation of wastes and wasteforms
 - Characterisation of the long-term evolution of wastes and wasteforms to support and enable post-closure safety assessment

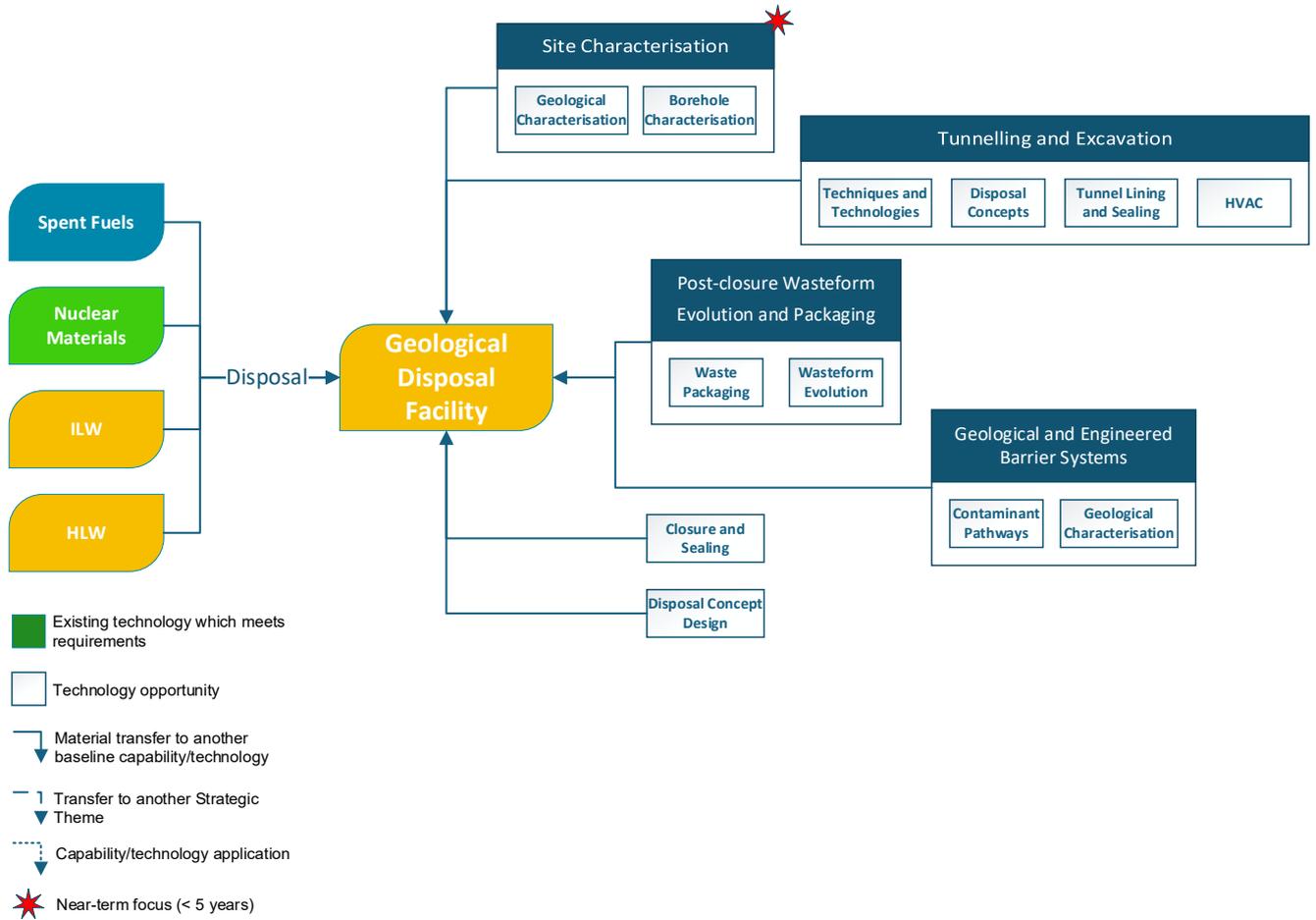
- **Engineered Barrier System (EBS)**
 - Disposal container optioneering, materials, manufacture and analysis techniques
 - Engineered barrier system materials for both high- and low-heat generating wastes (HHGW, LHGW), characterisation and analysis techniques

- **Closure & Sealing: Mass backfills, plugs, seals, and gas-permeable seals**
 - Optioneering, materials, manufacture and deployment of mass backfills, plugs, seals and gas-permeable seals
 - Technologies, tools and techniques for the analysis of materials for mass backfills, plugs, seals and gas-permeable seals.

- **Disposal Concept Design**
 - Technologies that enable disposal concept design for deep geological disposal and alternative concept options such as near-surface disposal.

Strategic Outcome	Description	Completion Target
SO 5	All remaining Magnox fuel disposed	2125
SO 10	All remaining oxide fuel disposed	2125
SO 15	All remaining exotic fuel disposed	2125
SO 20	All plutonium put beyond reach and then disposed	2120
SO 25	All uranium reused or disposed	2120
SO 34	All ILW disposed – final disposal operational	2379
SO 39	All HLW disposed – final disposal operational	2104

6.4.2 Area Wiring Diagram



7. Site Decommissioning and Remediation

Site decommissioning and remediation (SDR) is our primary focus, supported by all other strategic themes in the group, where we are focused on safely dismantling redundant nuclear facilities and restoring sites for future use. This work involves the removal of contaminated plant and infrastructure, management of associated wastes, and remediation of land to meet regulatory and environmental obligations.

The NDA group manages a diverse portfolio of sites, ranging from complex reprocessing facilities at Sellafield to former research and power generation sites across the UK. Each site presents unique challenges, and the need to maintain safety and security throughout decommissioning activities. Our decommissioning activities are delivered through a rolling programme of decommissioning (RPD). Under this approach, sites progress through decommissioning at different times, based on their specific conditions and priorities. Some sites are decommissioned continuously to final end state, while others enter a deferral phase. This allows us to:

- Apply lessons learnt across the NDA group
- Optimise the use of resources, technology and skilled workforce
- Reduce overall programme risks and costs

For deferral, we require robust interim asset management capabilities which allow us to monitor the condition of facilities in a deferred state, and plan the decommissioning roadmap for facilities where decommissioning and demolition aren't immediately practicable following completion of operations.

Since the 2016 Technical Baseline Review, significant progress has been made – such as demolition of redundant buildings, and remediation of contaminated land. These activities are supported by technologies such as remote handling systems, advanced characterisation techniques, and digital modelling tools that enable safe and efficient planning and execution, but also by applying current best practices from traditional demolition sectors.

SDR is closely linked to Integrated Waste Management, as decommissioning generates a wide range of waste streams that require treatment, storage, and disposal which relies upon the principles and capabilities in IWM. Where possible, application of non-nuclear technologies and techniques is crucial to make progress against our SDR mission.

7.1 Operational and Planned Facilities

STRATEGIC OUTCOMES

- 40 All planned new buildings operational
- 41 All buildings primary function completed



Sellafield site

When a nuclear installation or facility is nearing the end of their operational life, a phase of work begins to transition it from operations to decommissioning. This phase normally starts well before operations finish and includes post operational clean out (POCO) which removes most of the nuclear inventory, such as fissile material. New facilities are still to be built (109 planned new builds [16]) to support the decommissioning mission, for example to package and temporarily store waste and ultimately, these will be decommissioned once their operational life is complete. Existing facilities will be operated and maintained with decommissioning and waste management in mind, and new facilities designed for decommissioning. Our preferred strategy is to undertake the dismantling phase as soon as possible after operations end.

7.1.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

- **Development of a Waste Encapsulation Plant at Harwell for 500L stainless steel drums**
- **AI identification of concrete defects**
Deployment of drones combined with artificial intelligence to identify concrete defects in structures.
- **Unmanned Aerial Vehicles (UAVs)**
 - Use in confined spaces for surveys, inspections, and monitoring of plant and assets.
 - External asset surveys for roof and cladding inspections, inspection of high risk structures.

RELEVANT ORGANISATIONS



SINCE TBR 2016

Radioactive Substances Regulation Guidance for Decommissioning

ROVs used at PFSP

- Blimp-based UAVs for inspections in highly active environments

7.1.2 Technology Opportunities

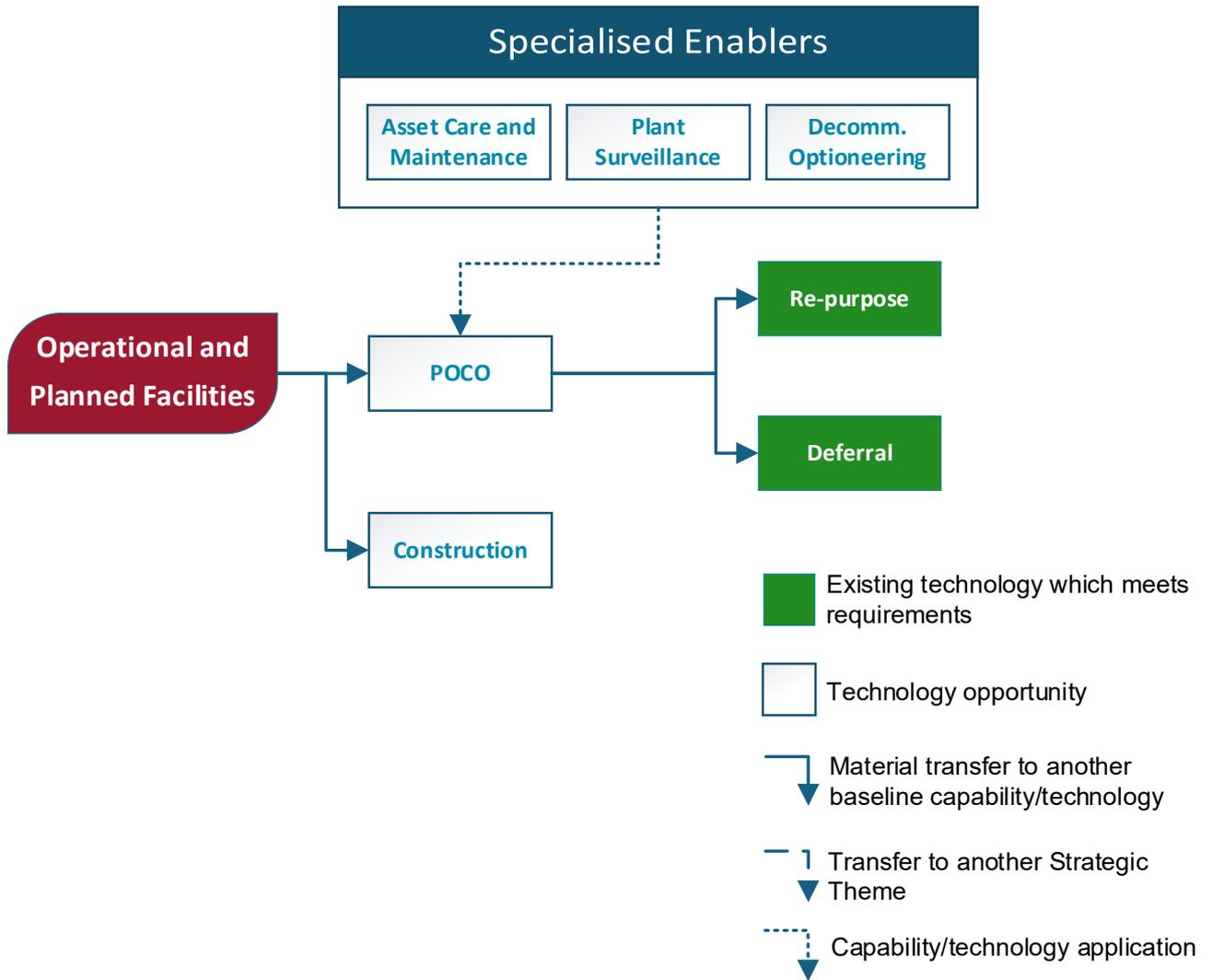
So that we can effectively implement our preferred strategy of dismantling facilities soon after operations cease, the group has a need for technologies which provide intelligence about the end state of facilities, and optioneering for their decommissioning.

Technology development opportunities exist in the areas of:

- **Plant Surveillance**
 Building information systems to guide decommissioning routes based on legacy use, characterisation of facilities and intelligent infrastructure.
 Surveillance and maintenance in a deferred care and maintenance state.
 For new buildings: Building Information Modelling (BIM), surveillance and asset management.
- **Decommissioning Optioneering**
 Techniques and tools, such as virtual modelling and machine learning, which can leverage our historical information and plant surveillance data to optioneer novel or unknown decommissioning routes and strategies.
- **Construction**
 Improved construction practices such as low-carbon concrete formulations, prefabrication of structures.

Strategic Outcome	Description	Completion Target
SO 40	All planned new buildings operational	2101
SO 41	All buildings primary function completed	2127

7.1.3 Area Wiring Diagram



7.2 Decommissioning and Demolition

STRATEGIC OUTCOMES

- 42 All buildings decommissioned
- 43 All buildings demolished or reused



Decommissioning is the final phase in the asset lifecycle where dismantling is completed to an agreed end state. The final stages of dismantling include demolition which is dominated by non-nuclear risks. Deconstruction typically generates large volumes of waste, a proportion of which may be contaminated with radioactivity. In line with UK Government strategy, NDA strategy is for nuclear facilities to be decommissioned immediately after cessation of operations. Sometimes however a decision might be taken to defer all or part of decommissioning in order to realise specific benefits such as radioactive decay or to manage a constraint (e.g. restricted access, a lack of waste management infrastructure or limited resources)

7.2.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

- **Polyurethane Foam for Containment**
Technology transfer, new ways of working
Hinkley Point A adaption of a polyurethane foam technology to create permanent blocks within pipework, define injection boundaries and immobilise residues and contamination during size-reduction activities, while maintaining pipe integrity.
- **Diamond-wire Cutting, Laser Cutting**
Technology development, new ways of working, hazard reduction
Multiple capabilities developed from laser cutting feasibility studies with TWI – led to LaserSnake for remote cutting of pipework, and remote operation laser cutting used for

RELEVANT ORGANISATIONS



SINCE TBR 2016

Radioactive Substances Regulation Guidance for Decommissioning

Quadruped characterisation of facilities

Explosive demolition of a Magnox building

Laser cutting deployed inside Dragon

reactor internals and contaminated structures. Provides remote operations and size reduction for wastes arising.

- **High-pressure Water Jetting**
Mechanical decontamination
- **Explosive Demolition**
Application of best practice from outside nuclear
- **Digital Twin Modelling for Reactor Dismantling**
Digital and virtual technology
Applied at Trawsfynydd for planning top-down vs. side-entry approaches to reactor dismantling
- **Non-destructive depth profiling**
Depth profile measurement of concrete to determine contamination variation with depth using high energy spectroscopy of caesium-137 beta (512 keV) and gamma (662 keV) decay.

7.2.2 Technology Opportunities

As no building or site shares the same legacy, effective decommissioning and demolition approaches must be tailored to each location. This creates opportunities for technologies that may apply across multiple sites within the same theme or opportunity area, while others will be specific to a single facility. The technology opportunities presented here reflect high-level needs rather than site-specific demands. Multi-site technologies will require a translation toolkit to support their adoption in different contexts. All techniques must be fit for purpose and should not introduce additional high-hazard waste streams as a consequence of their deployment.

Technology development opportunities exist in the areas of:

- **Hazard Reduction**
Reduction of conventional hazards during SDR delivery – this may include deployment of robotic systems, virtual environments for situational awareness, and human augmentation for assistive technologies.
- **Decontamination – Wet and Dry**
For example: high-pressure water jetting, chemical wash systems for surface contamination removal, abrasive blasting, laser ablation, and CO₂ pellet blasting for reducing contamination without introducing liquid effluents.
- **Ventilation Containment**
To aid application of decommissioning and demolition where airborne material may arise, by ensuring containment of ventilated materials.
- **Local Effluent Management**
Technologies and techniques to assist with management of effluents arising from specific activities on sites in the group – removing the requirement for new plant, or transport of hazardous materials off-site for processing elsewhere.
- **Plant Surveillance**
Digital, virtual, and unrealised traditional technologies which would assist in creating a complete representation of sites such that SDR activities can be performed where most appropriate, for example BIM and asset management.
- **Manual Decommissioning**

Improvements to activities where remote, robotic, or automated technologies are not practicable.

- **Characterisation**

Sorting and segregation of waste arising from decommissioning (radiological classification) or demolition (conventional materials and waste streams) activities. Additionally, identification of materials from demolition which could be reused or contribute to the circular economy.

- **Near surface management (Scotland)**

- **Dismantling**

Processes, techniques, and enabling technologies for both in situ and ex situ dismantling of reactor structures and associated facilities.

- **Hazardous Substance Removal**

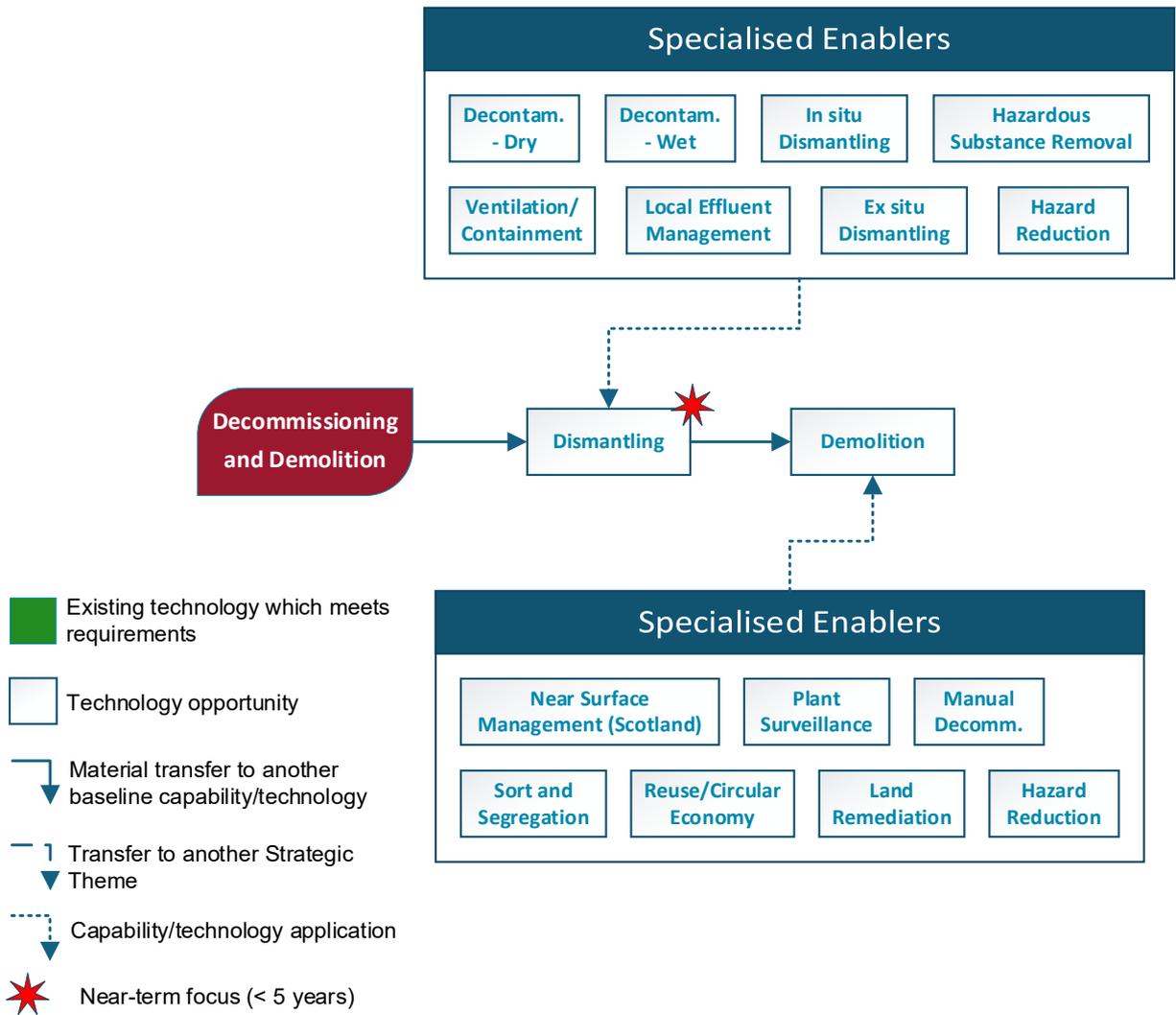
Demolition management of buildings which contain conventional hazardous substances, or non-radiological chemicals.

- **Land Remediation**

Land characterisation and modelling for remediation and release or decontaminated for reuse.

Strategic Outcome	Description	Completion Target
SO 42	All buildings decommissioned	2131
SO 43	All buildings demolished or reused	2133

7.2.3 Area Wiring Diagram



7.3 Sites

STRATEGIC OUTCOMES

- 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



Chapelcross Green Energy Hub

Site remediation focuses on achieving agreed end states through land delicensing, decontamination, and restoration. Activities include removal of residual contamination, demolition of redundant structures, and preparation for reuse or transfer. Technologies underpinning this include advanced land characterisation, in situ remediation techniques, and engineered containment systems.

7.3.1 Current Baseline Technologies

Since the previous Baseline Review, some of the novel technologies which have been developed, deployed, and integrated into the baseline are:

- **On site disposals at Trawsfynydd and Winfrith**
- **Antineutrino detection**
Monitoring strontium-90 and other beta decay products.

7.3.2 Technology Opportunities

For site end states, technology development opportunities exist in the areas of:

- **In situ Disposal**
Underpinning the criteria where in situ disposal of structures would be appropriate in line with safety case and regulatory requirements.
- **Structural and Material Modelling**
Insights to underpin safety case and regulatory obligations where site end states may include structures and materials.
- **End State Monitoring**
Systems for long-term monitoring of a site's end state.

RELEVANT ORGANISATIONS

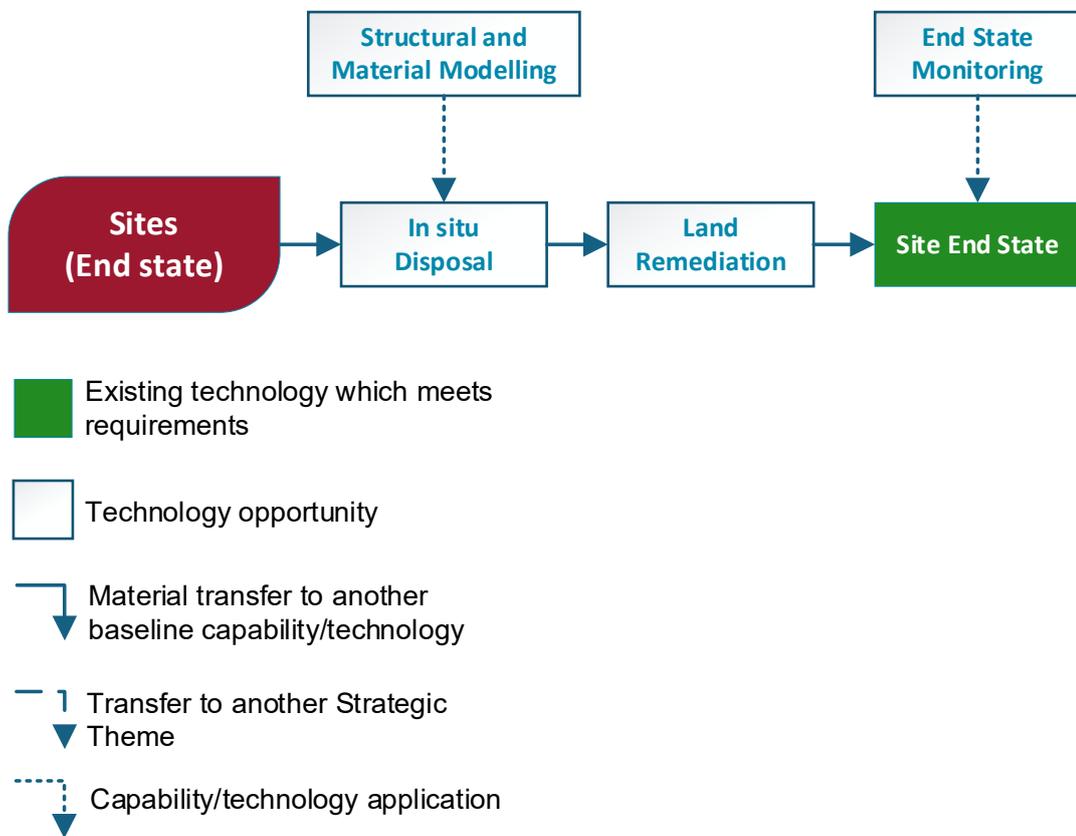


SINCE TBR 2016

Radioactive Substances Regulation Guidance for Decommissioning

Strategic Outcome	Description	Completion Target
SO 44	All land delicensed or relicensed	2135
SO 45	All land in End State – all planned physical work complete	2134
SO 46	All land demonstrated as suitable for reuse	2135
SO 47	All land dedesignated or reused	2380

7.3.3 Area Wiring Diagram



8. Technology Enablers

Across the strategic driving themes, which each have distinct technology requirements, there are enabling capabilities that underpin the technology baseline and support delivery of our mission. These technology enablers have a broad application across the strategic themes and are highlighted as near-term focus areas due to this breadth of applicability (Figure 5).

This section outlines these enablers, provides a non-exhaustive list of baseline technologies, and highlights technology opportunities where additional general capabilities could strengthen our overall technology baseline. The enablers are broad and general in their potential application.

8.1 Characterisation

Characterisation is the process of defining and describing the properties, structure, and composition of a material, substance, or system. It includes various stages: planning, sampling, analysis and reporting. It can range from highly systematic approaches to ad-hoc individual measurements. There are significant opportunities for improvement through the adoption of improved technology that reduces the number of necessary samples, reduces the analysis time, increases the accuracy or makes the results more accessible. The overall aim is to enable better data-driven decisions to be made. Some recent examples of characterisation technology include:

- Use of drone- and quadruped-mounted LiDAR for spatial characterisation of facilities
- Rapid ion exchange technique to qualify ion exchange material performance
- AI sludge rheology measurements
- Real-time Gamma Optical Video Imaging (GOVI)

Guidance on solid waste characterisation has also been produced [17].

8.2 Asset Management

Asset management is how we monitor condition, predict future performance, repair and maintain, and ultimately dismantle our facilities and their capabilities. Current approaches to physical asset management in the group often rely on periodic manual surveillance and maintenance, but with advances from other sectors becoming apparent, our future requirements will need a more integrated approach to asset management to deliver data-led insights about our infrastructure.

Opportunities exist in expanding long-term degradation monitoring of facilities and structures; enhancing our maintenance and inspection techniques; storage condition and package monitoring that does not require movement of packages or minimal direct interaction; and BIM and digital asset information models for facilities. Improvements in physical asset management have the capacity to provide the group with contextually aware predictive maintenance, risk-based inspection planning, and asset health modelling reducing operational risks across facilities in different end or interim states. Some examples of physical asset management technologies we have deployed include:

- Linking information technology and operational technology systems at Dounreay to monitor ventilation stacks
- Complex drone flights for asset surveys, e.g. roof and cladding inspections, hazardous environment asset surveys
- Additive manufacturing of specialised or unique components
- Internet of Things (IOT) sensor deployments for plant surveillance
- BIM platforms
- Systems for autonomous remote monitoring of sensitive sites
- Autonomous transport of materials with HGVs
- Acoustic imagery for plant inspection

Enhancing our digital asset management would develop our ability to manage the lifecycle of our technology - maintenance, obsolescence, decommissioning and disposal, and replacement. We would be interested in management of new-old stock for critical systems and designing replacement systems for modularity and replaceability from the beginning of the technology lifecycle. For facilities approaching end of life, digital asset records can support optioneering activities.

8.3 Digital Technologies, Robotics and Artificial Intelligence

Digital technologies, artificial intelligence, and robotic systems are re-imagining, transforming and repeatedly improving our ways of working; developing people and processes, and exploiting information, data, and technology, in the best ways possible to achieve the NDA mission [18] and our aspirational Grand Challenges. Our digital technology needs are broad, covering: data platforms, artificial intelligence and large language models, robotic and autonomous systems, and underpinning activities to enable new technology adoption. Some examples of existing digital technologies we have deployed include:

- Virtualised data systems
- Substantiation of low safety integrity level (SIL) smart devices for deployment on plant
- Bioshield inspections with quadruped robotics

Our approach to digital technology adoption often relies on site-specific tools and models, and in some ways laterally effective in other areas such as characterisation, but future requirements for the baseline will require integrated and interoperable digital platforms that support planning, operations and decision making across our strategic themes.

Some potential opportunities and benefits we are interested in as a group include:

- How data access can become seamless and collaborative between group organisations and individuals.
- Creation of specific automated applications, for example engineers and pre-operations teams can work in an agile way to build digital twins of facilities to model cost-reducing construction, operations, maintenance, and dismantling techniques.
- Remote access to digital tools, datasets, and information.

These benefits for the NDA group can be achieved through a variety of digital uses, in areas such as:

- Artificial intelligence/natural language models
- Augmented reality/virtual reality
- Data and analytics
- Data repository/knowledge management
- Digital twins

We are interested in the potential for AI to aid decision making, leveraging large multifaceted datasets, with auditable workflows while maintaining a human-in-the-loop for final decisions. Our primary interest in robotic systems is to remove humans from harm and hazardous environments, but can also be augmented with online characterisation and sensing technologies for example.

9. Summary

This Technology Baseline Review (TBR) provides a high-level overview of the current technology landscape across the NDA group and identifies technology opportunities requiring development or adoption to underpin delivery of the NDA's mission. The TBR is possible thanks to the data submitted by the NDA group operating companies in their annual Technical Baseline and underpinning Research and Development (TBuRD) reporting, and access to strategic and technical experts across the group.

Since the previous Technical Baseline Review (2016), the NDA group has adopted a broad range of technologies into baseline capabilities. These include (but are not limited to) robotics; artificial intelligence (including large language models); drones; digital asset intelligence; laser cutting; additive manufacturing; remote handling and control systems; demolition and retrieval techniques; and sorting and segregation of waste. These developments demonstrate our collective push towards safer, more cost-effective, and faster decommissioning.

The baseline areas requiring R&D are summarised in a high level overview diagram (Figure 5), which distinguishes cross-cutting Technology Enablers from near-term focus areas where advancement is most pressing. The Technology Enablers, which permeate all strategic themes are:

- Characterisation
- Asset Management
- Digital Technologies, Robotics and Artificial Intelligence

The timescale for our baseline and adoption of technologies is extremely broad by the nature of our mission's length, therefore in addition to these enablers, near-term focus areas point to our most pressing needs. These are:

- Disposal across all strategic theme areas linked to final GDF conditions
- Immobilisation selection for plutonium
- Sorting and segregation of Intermediate Level Wastes
- Treatment of Intermediate and High Level Wastes
- Dismantling of facilities for site decommissioning and remediation

These priorities are presented to aid the reader's understanding of our most pressing needs and demands, and to elicit interest in collaboration with the group.

Each chapter provides: an update since the 2016 review; examples of baseline technologies adopted; and a forward view of technology opportunities that may underpin the future baseline. Opportunities are illustrated using area/capability wiring diagrams to show where they reside within, or influence, NDA group capabilities.

This TBR aims to be both a snapshot of current capability and a practical tool for prioritisation and collaboration. It is positioned alongside, and is complementary to, two other NDA publications: Areas of Research Interest [3] and Grand Challenges [2].

If you believe you may have technologies and capabilities which could fulfil our future baseline needs please contact the NDA's R&D team at technology@nda.gov.uk.

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11. Appendix, Glossary, Abbreviations

AGR	Advanced Gas-Cooled Reactor
AI	Artificial Intelligence
ARI	Areas of Research Interest
ATR	Annual Technical Review
BIM	Building Information Modelling
COTS	Commercial Off The Shelf
DCIC	Ductile Cast Iron Container
dep-U	Depleted uranium
DESNZ	Department for Energy Security and Net Zero
DFR	Dounreay Fast Reactor
DMOX	Disposal Mixed Oxide
E3S	Environment, Safety, Security, and Safeguards Case
EBS	Engineered Barrier System
EDFE	EDF Energy
FGMSP	First Generation Magnox Storage Pond
FHP	Fuel Handling Plant
GBBS	Ground Granulated Blast-furnace Slag
GDF	Geological Disposal Facility
GOVI	Gamma Optical Video Imaging
HEU	Highly Enriched Uranium
Hex	Uranium hexafluoride
HGV	Heavy Goods Vehicle
HHGW	High Heat Generating Waste
HIP	Hot Isostatic Press
HLW	High Level Waste
HMG	His Majesty's Government
HVAC	Heating, Ventilation and Air Conditioning
IAEA	International Atomic Energy Agency
ILW	Intermediate Level Waste
IOT	Internet of Things
ISF	Interim Storage Facility
IWM	Integrated Waste Management
LEU	Low Enriched Uranium
LHGW	Low Heat Generating Waste
LiDAR	Light Distance and Ranging
LLM	Large Language Model
LLW	Low Level Waste
LLWR	Low Level Waste Repository
MDU	Magnox Depleted Uranium
MOD	Ministry of Defence
MRP	Magnox Reprocessing Plant
MSSS	Magnox Swarf Storage Silo

nat-U	Natural uranium
NDA	Nuclear Decommissioning Authority
NRS	Nuclear Restoration Services
NTS	Nuclear Transport Services
NWS	Nuclear Waste Services
ONR	Office for Nuclear Regulation
OSW	Out of Scope Waste
PCM	Plutonium Contaminated Material
PFR	Dounreay Prototype Fast Reactor
PFSP	Pile Fuel Storage Pond
PIE	Post Irradiation Examination
POCO	Post Operational Clean Out
RD&I	Research Development and Innovation
ROV	Remotely Operated Vehicle
RPD	Rolling Programme of Decommissioning
RroBO	Risk reduction Of Glovebox Operations
SDR	Site Decommissioning and Remediation
SGHWR	Steam Generating Heavy Water Reactor
SIL	Safety Integrity Level
SL	Sellafield Limited
SPRS	Sellafield Product and Residue Store
SRP	SPRS Retreatment Plant
TBR	Technical Baseline Review
TBuRD	Technical Baseline Underpinning Research and Development
THORP	Thermal Oxide Reprocessing Plant
TMF	Tails Management Facility
TMR	Technical Management Review
TPU	THORP Product Uranium
TWI	The Welding Institute
UAV	Unmanned Aerial Vehicle
UDASS	Universal Drum and Segregation System
UKNNL	United Kingdom National Nuclear Laboratory
UKRWI	United Kingdom Radioactive Waste Inventory
VLLW	Very Low Level Waste
WAGR	Windscale Advanced Gas-cooled Reactor
WVP	Waste Vitrification Plant

