Driving solutions, delivering progress

Research, development and innovation at the NDA group 2025

We're the NDA group

We're responsible for keeping the UK's earliest nuclear sites and facilities, once at the heart of national defence and electricity generation, safe and secure, as we decommission them and overcome the challenges of managing legacy nuclear waste.

It's one of the most important environmental programmes in the world, protecting people and the planet. Our 17,000 employees work hard on behalf of the UK, working with partners to innovate and use technology to overcome the challenges of identifying and removing nuclear waste from ageing facilities, so we can store it safely and permanently dispose of it. The work is complex and challenging.

Dealing with the waste, dismantling hundreds of buildings and facilities, and developing a geological disposal facility for England and Wales, to dispose of the most radioactive nuclear waste, will take decades. By investing today in the challenges left over from the UK's proud nuclear history, we're removing the burden for future generations and delivering social and environmental benefits through jobs, knowledge, skills, technology and social investment.

Our group is made up of the Nuclear Decommissioning Authority (NDA), an executive non-departmental public body, and the following operating companies:

- Sellafield
- Nuclear Restoration Services
- Nuclear Waste Services
- Nuclear Transport Solutions

Other NDA group companies include NDA Archives Ltd, NDA Properties Ltd, Rutherford Indemnity Ltd and Energus.

Existing NDA group sites

1. LLW Repository
2. Sellafield
3. Hunterston A
4. Chapelcross
5. Wylfa
6. Trawsfynydd
7. Berkeley
8. Oldbury
9. Hinkley Point A
10. Dungeness A
11. Bradwell
12. Sizewell A
13. Harwell
14. Winfrith
15. Dounreay
16. Capenhurst
17. Springfields

Sites expected to transfer to the NDA group in the future

18. Hunterston B
19. Torness
20. Hartlepool
21. Dungeness B
22. Hinkley Point B
23. Heysham 1, Heysham 2
24. Vulcan

Our impact

- More than **£100 million** a year spent on RD&I across the group
- **Collaborating** with sectors such as defence, space, construction and oil and gas
- NDA group sponsors over **150 PhDs** at over 25 universities
- Over **£15 million** invested with Innovate UK, DASA and UKAEA
- **70% retention rate** of NDA funded PhD students to support our future mission
- Over **45 supply chain organisations** work on NDA's strategic research frameworks
- **Accelerating deployment of robotics** on our sites reducing waste and keeping people safe
- **Working as one NDA** through our groupwide technology demonstrator programme

"We're extremely proud of the progress brought about by our RD&I investments. Our challenges are unique and will continue to arise for many more decades, so we're keen to harness the expertise of our workforce, suppliers, academia as well as other industries. We also work with other public and private-sector organisations to share and maximise the level of funding available to deliver benefits to our shared challenges."

Professor Melanie Brownridge, NDA Chief R&D Officer

Research, development and innovation

Delivering our decommissioning mission is expected to cost over £100 billion and take us into the next century. The scale and timescale present many challenges, but also create a significant platform for research, development and innovation (RD&I), with an opportunity to do things differently whilst delivering value.

Progress depends on:

- developing a clear understanding of the issues
- finding the right solutions
- ensuring the cost to taxpayers is acceptable

RD&I provide the knowledge to demonstrate that the strategies we develop are underpinned. Therefore, we ensure our portfolio covers projects that shape and underpin the NDA's overall strategy, deliver innovation and develop technical expertise for the future.

Why RD&I is important

We need RD&I to:

- Understand the challenges and develop our strategies
- Underpin solutions and assure successful deployment
- Transform how we deliver our mission

Our investments have resulted in:

- **Development and deployment of innovative remote technologies, including laser-cutting, telexistence and improved radiation detection, helping to create safer working environments**
- **Reductions in cost and time through trialling robotic approaches and sharing across the NDA group**
- **More funding for the supply chain through our innovative collaborations and partnerships with other public organisations**
- **A diverse and vibrant supply chain working to solve long-standing technical challenges**
- **A sustained programme of academic research into nuclear decommissioning to develop a pipeline of experts for the future**
- **International collaboration on shared challenges to deliver shared benefits and skills**

Benefits

We evaluate the potential benefits that RD&I can deliver in our investments using the NDA Value Framework approach. Potential benefits include environmental, risk and hazard reduction, health and safety, security, socio-economics, lifetime costs and enabling the mission. By evaluating during delivery of the portfolio we can monitor the benefits being realised and ensure our portfolio is balanced.

NDA Value Framework

Our approach

NDA has a duty under the Energy Act (2004) to carry out and share research in nuclear decommissioning, clean-up and other relevant areas and to promote related research of others.

Most of this research is delivered by our operating companies, Sellafield, Nuclear Restoration Services (NRS), Nuclear Waste Services (NWS) and Nuclear Transport Solutions (NTS) and their supply chains targeted at specific challenges faced by their sites.

At the NDA we retain strategic oversight and lead a strategic portfolio of RD&I activities for groupwide needs and opportunities. We foster collaboration and new ways of working across the group and access additional external funding to deliver value for money and stimulate innovation.

Coordination

Our Future Challenge Board provides strategic guidance to help us identify and coordinate nuclear decommissioning RD&I. Its membership includes UK government, UK industry and regulators enabling us to access and share good practice.

Across the NDA group, the Nuclear Waste and Decommissioning Research Forum (NWDRF) promotes collaboration, ensuring research is delivered more efficiently, cost-effectively and avoiding duplication.

Working as a group is essential so we can share learning and accelerate deployment of novel approaches across our sites. It may be most efficient to test and trial innovations at one site before transferring for deployment at another.

Collaboration

We collaborate with other UK RD&I bodies to maximise available funding and bring benefits to the whole nuclear sector. We have also collaborated with international organisations on robotics RD&I. Our collaborative approaches have the potential to accelerate progress and maximise benefits.

Our collaboration partners include:

- Department for Energy Security & Net Zero (DESNZ) and UK Atomic Energy Authority (UKAEA)
- Defence Science and Technology Laboratory (Dstl) and Defence and Security Accelerator (DASA)
- Department for Science, Innovation and Technology (DSIT) and UK Research and Innovation (UKRI)
- UKRI bodies including Innovate UK, Engineering and Physical Sciences Research Council (EPSRC) and the Innovate UK Digital Catapult
- Department for Business and Trade (DBT), which supports UK businesses globally
- UK Universities
- National laboratories (including United Kingdom National Nuclear Laboratory (UKNNL) and National Physical Laboratory (NPL)
- International organisations e.g. in Japan and USA
- Other sectors, such as oil and gas, space, defence and construction and the Infrastructure Industry Innovation Partnership (i3p)

- **We encourage collaboration**
- **We support transfer of technology from other sectors**
- **We fund academic studies to develop knowledge and technical skills**
- **We support technologies from early concept to deployment**
- **We work with other public and private-sector organisations to increase available funding**
- **We seek to avoid duplication of work**
- **We support sharing between our sites and beyond**

How we invest

We invest through two main routes:

Via our group businesses

The bulk of funds are targeted at specific challenges faced by our sites, allocated as part of the annual budget set by the NDA. Most of the work is carried out by site workforces and supply chain contractors. Our operating companies use a detailed process to identify their specific on-site research needs and opportunities. The process ensures the NDA has a clear understanding across the group and confidence that plans can be achieved. The plans are required to:

- Link RD&I needs to a site's overall lifetime plan
- Outline any links with other on-site work
- Provide estimated timeframes and costs
- Describe technical risks, their management and possible opportunities
- Monitor progress and how projects are governed
- Use a consistent system for assessing the maturity of a technology, known as Technology Readiness Levels (TRLs)

The Sellafield site has the greatest level of complexity and uncertainties and accounts for the bulk of RD&I spending. RD&I targeted at Sellafield also offers the most potential to transform decommissioning.

Group case studies are on pages 22-27.

Via the NDA

Separately, the NDA directly funds a strategic RD&I portfolio on common RD&I needs and opportunities across the group to:

- Help shape and underpin our strategy
- Deliver innovation across multiple sites
- Develop vital technical expertise for the future of our mission

The NDA Research Portfolio (NRP)* shapes and underpins NDA's strategy development, develops skills for the future and delivers innovation on research issues that are common across our site. Projects are delivered through a series of framework contracts:

- University interactions
- Enabling waste management, decommissioning and remediation
- Spent fuel and nuclear materials

The current contracts, awarded from 2024-2028, involve five successful consortia comprising over 45 organisations including UK universities, small businesses and global corporations.

*formerly the NDA Direct Research Portfolio

Technical innovation and demonstration

This work is focused on supporting the supply chain to develop new ideas and technologies. Projects are usually joint funded with other public sector partners e.g. Innovate UK, UKAEA, DASA. Our aim is to accelerate the development of innovative solutions in transformational areas through to successful deployment. By demonstrating new approaches, we can engage our workforce and stakeholders as well as implement innovation. Recognising and rewarding innovation helps create an environment where it can thrive.

NDA case studies follow on pages 11-21.

Innovation matters

Innovation, alongside research and development, is a critical enabler of the NDA's strategy.

The scale and timescale of our decommissioning mission presents many challenges, but also creates a huge platform for innovation and opportunities to do things differently.

Sharing our approach, the challenges and being open about our successes and our setbacks – enables us to start new conversations, exchange information and explore what a different future could look like.

We need to make it easier to innovate. In 2020, we set out our Grand Challenges for technical innovation. Deliberately ambitious, they set out our aims to stimulate discussion and encourage the supply chain to develop technology to improve the way we work and help deliver our mission.

NDA's Grand Challenges:

Challenge theme	Interim innovation aims by 2025	Grand challenges for technical innovation (our 2030 aspirations)
Reducing our waste and reshaping the waste hierarchy	70% of all initial characterisation will be undertaken in situ, with results available within 24 hours, by 2025	50% of waste, produced from decommissioning and clean-up, being recycled
Intelligent infrastructure	All external monitoring of buildings should be carried out remotely by 2025	All new buildings to be self-monitoring and energy neutral by 2030 – with a 50% lifetime cost reduction
Moving humans away from harm	Remote decommissioning of gloveboxes by 2025	A 50% reduction in decommissioning activities carried out by humans in hazardous environments
Digital delivery – enabling data driven decisions	Accurate and up to date 3D virtual models (such as digital twins) exist for all key NDA sites by 2025	All data captured at source which is then used to drive decisions, planning and training

We published our Innovation Strategy in 2022 and are now working on our groupwide implementation plan. We are growing our groupwide in-house innovation management capability and are developing targeted improvement plans across the group,

NDA Innovation Strategy

Building expertise through university collaboration

Decommissioning the UK's civil nuclear legacy is a complex job that will require specialist resources over several generations.

Our Subject Matter Experts (SMEs) across the NDA group and within our supply chain play a key role in all parts of our mission. We carry out research in all aspects of our business from modelling the surface chemistry of plutonium through to how we manage risk and understanding the impact of decommissioning on local economies.

Our established university-based research portfolio is a key route for developing that expert community. We identify core topics aligned to our medium-term needs and fund research via PhDs and Postdocs aligned to those needs. We also fund industrial mentors from the NDA group to supervise the students, ensure the research outcomes are focused and to help our staff stay abreast of the latest thinking. Sharing research is key and through our established research events we generate a community for collaboration.

We are proud that our retention rate of students is over 70% in the decommissioning sector. The researchers that we support throughout their academic projects go on to become specialists and leaders in the NDA group, take up roles within our supply chain who are essential to supporting on-site work, or stay on in academia to teach future generations about the challenges of decommissioning.

Our postgraduate research portfolio helps us to:

- Create the subject matter experts and leaders of the future to support the decommissioning challenge
- Generate fundamental knowledge to improve our understanding of our challenges to develop appropriate strategies and management options
- Access novel and diverse technologies and solutions at an early stage from diverse subject areas
- Ensure the academic community understand our challenges and align research programmes and outcomes to our decommissioning needs
- Generate a community and provide opportunities to engage with our staff and future career opportunities in the decommissioning sector.

Over £5 million is invested in academic research each year from across NDA group, funding 30-40 new PhD projects. The NDA portfolio focusses on medium to long term R&D needs with more focussed needs-driven work supported by our operating companies.

In total, we're currently sponsoring around 150 PhD students and multiple post-doctoral researchers at universities around the UK.

Challenge: Ensuring that we have the right technical skills and talent in the medium term to deliver our mission.

Solution: A broad portfolio of PhD and postdoctoral academic research including NDA funded projects and co-funded projects with UKRI through schemes like Centres for Doctoral Training and Industrial - CASE awards.

Outcome: A pipeline of specialist skills to support our mission when we need them, bringing diverse thinking to our challenges.

Collaborator: UKNNL, UK universities.

Benefit: Enabling the mission.

NDA University Research Strategy

TRANSCEND Consortium

"It's very rewarding to see students flourish in delivering impactful research and develop as experts for the future. This skills pipeline is a key legacy from our funding as well as the knowledge generated."

Rick Short, NDA University Interactions Research Manager

Spotlight - where are they now?

Spotlight on three of our former PhD students who are well on the ways to success

Ahead of our time -The Time Magazine award winner

Dr Matthew Nancekievill
Co-founder & CEO of Ice Nine Ltd based at University of Manchester

PhD: Radiation tolerance and development of robotic platforms for nuclear decommissioning, University of Manchester 2018

"My PhD funded by NDA focused on understanding the radiation tolerance of electronic components, with an emphasis on commercial off-the-shelf systems that could be utilised in remotely operated vehicles (ROVs) for inspection of radioactive environments. My expertise was then applied to robotic platforms, such as Aqua Vehicle Explorer for In-situ Sensing (AVEXIS) and Lyra that have since been deployed in radioactive environments."

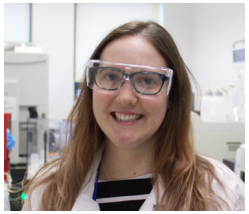
Matthew then spent six years as a post-doctoral researcher associate at The University of Manchester and set up a spin-out company Ice-Nine Ltd, to commercialise some of the robotic platforms developed by the university.

Matthew has worked in Japan, demonstrating AVEXIS with the Japanese Atomic Energy Agency (JAEA) and National Maritime Research Institute (NMRI). However, his biggest success to date is deploying the Lyra platform at Dounreay to inspect ventilation ducts and feedback radiological information, providing critical information for decommissioning planning in an area that was difficult and hazardous to access. Lyra was listed in Time Magazine's top 200 innovations of 2022.

Lyra: The 200 Best Inventions of 2022 | TIME

ICE9 Robotics | World Class Design and Manufacture of Robotic Solutions

The radioactive waste specialist



Dr Toni Yorkshire
Systems Engineer now at Nuclear Waste Services

NDA PhD: Understanding uranium (U), plutonium (Pu) and technetium (Tc) interactions with cement materials for radioactive waste management, University of Sheffield 2020

"My PhD funded by the NDA was a fundamental study of radionuclide speciation, after they are reacted with cement materials. This was done using specialist analytical equipment such as X-ray Absorption Spectroscopy (XAS) and Nuclear Magnetic Resonance (NMR) spectroscopy. The research helps us to understand the behaviour of actinides (U, Pu) and radionuclides (Tc) in the cement-based materials that are used for radioactive waste management and disposal." Toni was awarded the 'Best national PhD in Cement and Concrete Engineering' in 2020 by the Concrete Society. After finishing her PhD, Toni spent 18 months as a post-doctoral researcher, worked in the supply chain and then joined Nuclear Waste Services in 2023. She has managed research projects to underpin the design and safety case for UK geological disposal of radioactive waste.

"Whether you choose to stay in academia or move into industry, the NDA-led community events foster a great network and help develop your ideas further." Toni is now an industrial supervisor for PhD students herself, and has continued to publish her research, making it accessible.

The research technologist

Dr Elizabeth Sharp
Nuclear Instrumentation Research Technologist at the National Nuclear Laboratory in the Instrumentation and In-Situ Analysis Team

NDA PhD: In-situ Non-contact pressure measurement in sealed units using acoustic methods, University of Warwick 2023

"My NDA funded PhD focused on investigating a technique to measure the pressure of special nuclear material containment vessels. If containers become overpressurised it can damage their integrity and lead to failure, so finding new monitoring techniques that can be used non-intrusively could really support monitoring programmes.

A non-contact acoustic technique was developed using electromagnetic acoustic transducers to monitor the change in the vibrational resonances of the containment over a series of different pressures.

Elizabeth continued her research for an extra year as a post-doc in conjunction with UKNNL to take it from a laboratory-based technique to a prototype instrument. Her work is already being recognised - she was one of five finalists for the European Nuclear Society PhD award and presented her research to the High Scientific Council in Brussels in November 2024.

During her PhD, Elizabeth attended NDA's annual research conference and won best presenter two years in a row. "It was great recognition that my research was solving a real challenge in the nuclear sector." Attending these events inspired her to become a Research Technologist at UKNNL. "NDA gave me the opportunities to develop my communications skills, not just my technical knowledge – I think that is really important."

Paving the way for lower carbon nuclear waste encapsulation

Encapsulation in grout (a mix of cement, water and additives) is used across the NDA group for stabilising waste products in a solid form prior to future disposal. As the cement industry transitions to greener cements to achieve net zero carbon dioxide emission reduction targets, the availability of current materials will reduce. This could result in the NDA relying on expensive, bespoke cement powders to ensure that waste packages remain compliant with disposal specifications. This project tested whether the new lower carbon cement formulations will deliver the required properties for waste encapsulation and whether there are any impacts on how the encapsulation plants operate.

Ordinary Portland Cement (OPC) production is carbon intensive due to the high temperatures involved, fossil fuel usage and carbon dioxide released. Additives (Ground Granulated Blast-furnace Slag (GGBS)) can be used to lower the carbon footprint without compromising the cement's strength or durability. Historically, bespoke specifications of grout containing OPC mixed with GGBS were used to give the properties desired for nuclear waste encapsulation grouts i.e., high fluidity, low water demand and minimal bleed.

Production of these low volume bespoke components ceased in the supply chain 2023. By moving to the standard construction industry grade cement powder, security of supply concerns will be mitigated.

Changes in cementitious powder materials could also affect encapsulation plants operation (e.g. temperature to control grout viscosity and fluidity) and maintenance (e.g. abrasiveness of new powders).

The methodology developed to test the properties of grouts created with lower carbon cement powders found that there were minimal variations to current formulations providing confidence in their use. The project also built strong links with cement manufacturers to gather information on future cement industry plans to help us stay agile and aware of future supply risks. As the cement industry continues to transition such work will need to be repeated to ensure we too can keep up with the transition to net zero.

Challenge: The availability of cementitious materials currently used for waste encapsulation as the cement industry transitions to achieve net zero carbon dioxide emission reduction targets and the performance of lower carbon materials is unknown.

Solution: Experimental analysis of how alternative bulk materials will affect current waste encapsulation formulations and plant equipment set-up.

Outcome: The ability to adapt NDA waste encapsulation processes with the cement industry pathway to net-zero.

Collaborator: Galson Sciences Ltd, UKNNL, University of Sheffield, Orano.

Benefit: Environment, enabling the mission, risk and hazard reduction,

Status: A second phase of the work is planned this year.

"Research such as this is key in ensuring we are collaborating on environmental targets and maintaining management of our wastes."

Charlotte Parrington, NDA Environment Manager

Fingerprinting for asbestos

Development of realtime characterisation of asbestos utilising non-contact methods

There are over 800 buildings across NDA's sites that will need to be demolished over the coming decades, many of which were built in an era when asbestos was commonly used in buildings from offices to heat exchangers for insulation and fire protection. Safe methods to detect and confirm the presence and location of asbestos are needed to support decision making around waste management and decommissioning plans. Traditional screening methods for asbestos involve intrusive sampling and subsequent analysis off site. This is slow and difficult in radiologically contaminated areas.

Hyperspectral imaging is a technique that collects and processes information across the electromagnetic spectrum, allowing for the identification of objects and materials by analysing their unique spectral signatures. It is an approach used in other industries such as agriculture and food for detection of materials through their unique spectral fingerprints. This ongoing project with the University of Strathclyde explores the feasibility of designing an innovative non-contact method which will generate results in real time, removing the need for, and any delays in, sampling and offsite analysis. This hyperspectral imaging system could map a surface and flag the presence of different types of asbestos within radiological environments. Full surfaces can be mapped, not just point samples, providing much more spatial information.

A lab-based proof of concept is being developed. Following this, an on-site deployable system which can be paired with a remote monitoring capability such as an unmanned aerial vehicle (UAV) or quadruped robot will be created. This capability will provide the information needed to plan decommissioning safely and efficiently.

This is an exciting opportunity to use innovative techniques to help decommission multi-hazard areas safer, faster and cheaper, with the potential for use across many other sectors where asbestos may be present.

Challenge: Safe methods to detect and identify the presence and location of asbestos in multi-hazard environments across NDA's sites.

Solution: Designing a non-contact imaging solution to map a surface to identify the presence of different types of asbestos.

Outcome: A new way of identifying the presence of asbestos in radiologically contaminated areas to support onward decommissioning strategies that is non-contact and can be deployed remotely and benefit other sectors.

Collaborator: Galson Sciences Ltd, University of Strathclyde, UKNNL.

Benefit: Socio-economic, enabling the mission, risk and hazard reduction, health and safety.

Status: Demonstrating the technology in a non-radioactive environment and creating an on-site deployable system.

Fuelling safe storage

Active electrochemical measurements to support long-term storage of AGR fuel

Over the next two decades, the NDA's mission will expand to include the decommissioning of the seven Advanced Gas-Cooled Reactor (AGR) power stations that are currently operated by EDF Energy. The fuel from these reactors will be removed and transported to Sellafield for long term safe and secure storage in line with regulatory requirements.

Spent fuels are typically stored under water in ponds (wet storage) or in dry conditions in specially designed storage casks or vaults. Understanding how these materials may change over time is key to implementing our spent fuels management strategy.

Stainless-steel cladding of some (AGR) fuel elements can become susceptible to stress corrosion cracking (SSC) and corrosion during wet storage. This could affect the integrity of the fuel elements during periods of wet storage. To understand this better, the UK National Nuclear Laboratory (UKNNL) has carried out a range of experimental studies to generate data on the electrochemistry corrosion potential of the steel cladding. This data will be used as an input to an electrochemical model for AGR cladding being developed by the National Physical Laboratory (NPL) as part of the project.

This model could be used to predict the corrosion rates in AGR cladding of fuel currently in storage in spent fuel ponds at Sellafield. This will enable targeted surveillance of AGR fuel during extended wet storage which may be susceptible to corrosion during storage and to understand the future evolution of the cladding.

Electrochemistry data has been obtained from experimental work on non-active stainless steel cladding material in a range of solutions which simulate both reactor pond and Sellafield storage pond chemistries. This is to obtain values representative across the lifecycle of the fuel in storage. Future work will obtain electrochemistry data from a range of experiments on irradiated stainless steel cladding material, which will then be integrated into the model to help predict corrosion behaviour.

Challenge: Stainless-steel cladding of some Advanced Gas Reactor (AGR) fuel elements can become sensitised during operations which leaves it susceptible to stress corrosion cracking (SSC) during wet storage.

Solution: A range of experimental work to generate data on the electrochemistry corrosion potential of the steel, and supplementary model to predict corrosion behaviour.

Outcome: Use this model to predict the corrosion rates in AGR cladding of fuel which is currently in storage in spent fuel ponds at Sellafield. This will confirm integrity and anticipate if remedial action is necessary.

Collaborator: UKNNL, NPL.

Benefit: Risk and hazard reduction.

Status: Second stage of project currently being planned.

Model behaviour - supporting development of the Pu disposition strategy

The use of computer modelling to understand and predict helium behaviour in nuclear materials

The NDA is responsible for managing the UK inventory of separated civil plutonium, mostly in the form of plutonium dioxide (PuO2) powder in welded stainless-steel containers. The NDA is investigating options for disposition of this material which includes re-use as Mixed Oxide (MOX) fuel or immobilisation as Disposal MOX or Zirconolite ceramic. A technical challenge associated with both the storage and disposal of plutonium is helium arising from alpha decay, which has the potential to pressurise containers during storage and damage the structure of future waste forms.

The NDA has recognised a gap in capability and skills to support modelling of helium generation. This includes how it propagates from the plutonium structure, how that may result in pressurisation of the package and how the helium generated could damage the structure of any future waste form.

A review of potential approaches to modelling and simulation of helium generation has been carried out as part of the project. The review also considered how further experimental work may help inform and/or validate theoretical approaches. It identified the state-of-the-art approaches to modelling helium as well as the skills necessary to support this type of modelling work. This has aided our understanding of the skills and capability which may be needed to support future storage and disposal work to underpin our Nuclear Materials strategy and will shape future skills and R&D investments such as our PhD university scheme.

Mixed Oxide (MOX) fuel
A ceramic fuel pellet which comprises of a mixture of uranium oxide and separated plutonium oxide which has been produced through fuel reprocessing, this can be reused as fresh fuel for Light Water Reactors (LWR).

Disposal MOX
Similar in composition to MOX but not intended to be used as a fuel. Its primary purpose is for disposal - neutron poisons are included in the mixture to create a wasteform which is suitable for disposal in a geological disposal facility (GDF).

Zirconolite ceramic
A wasteform which is manufactured through Hot Isostatic Pressing (HIP), plutonium oxide and neutron poisons are added to a zirconolite pre-cursor powder. When subjected to the high temperatures and pressures they form a ceramic form which binds the plutonium in a stable form, suitable for disposal in a GDF, and puts it beyond use.

Challenge: How to model the impact on storage and disposal of plutonium from helium arising from alpha decay, which has the potential to pressurise containers during storage and damage the structure of future waste forms.

Solution: A review on potential approaches to modelling and simulation of helium generation and how it propagates from the plutonium structure.

Outcome: State-of-the-art approaches to modelling helium as well as the skills necessary to support. understanding of the skills and capability which may be needed to support future storage and disposal work.

Collaborator: Eden Nuclear and Environment Ltd.

Benefit: Risk and hazard reduction.

Status: Follow on work with academic partners is now being initiated.

Horizon scanning for emerging technologies

Identifying innovative and disruptive technologies is an important part of our research, development and innovation strategy. By raising awareness, we can investigate their applicability to our decommissioning mission and promote their use to deliver that mission more safely, quickly, cost-effectively and with less environmental impact.

NDA started a programme of horizon scanning in 2022. Two structured approaches have been used to provide a systematic and group-wide approach to researching and raising awareness of emerging technologies:

1. Broad, open-ended scanning for technology opportunities that are in early stages of development (open scan);
2. Directed, targeted research for a deeper-dive into specific technologies or sectors of interest (targeted scans).

Over 140 emerging technology signals have been identified since the programme started, with the most promising technologies selected for deeper analysis. This includes consideration of the contextual factors relating to technology adoption, such as the social, technological, economic, environmental, political, legal and ethical implications. Examples include quantum sensing, e-skins, smart dust and soft robotics.

By highlighting potential use cases and making recommendations for further work, we're prioritising the areas where the NDA can best use its resources for long-term benefits. Further research in these areas could be through the NDA Research Portfolio, commissioning of innovation trials or the sponsorship of a PhD project.

Challenge: Identify, investigate and analyse a range of technological solutions which could improve delivery of the NDA's mission.

Solution: Working with Frazer-Nash Consultancy Ltd, we have developed a horizon scanning capability for NDA group. Eight reports have been delivered within the first two years of the project.

Outcome: Increasing knowledge and understanding of technological development from other industry sectors that could aid in the delivery of our mission.

Collaborator: Frazer-Nash Consultancy Ltd.

Benefit: Lifetime costs.

Status: Continuing work programme, contract to be reviewed in 2025/26.

"Horizon scanning helps us be proactive in understanding potential innovations for the future. We can evaluate and prioritise, working in partnership with other stakeholders, which may provide opportunities for the future."

Colin Mair, NDA Head of Innovation

Our innovation portfolio

Our strategic technical innovation portfolio seeks out new collaborative opportunities, exploring early stage approaches which could have applicability across the NDA group.

The focus to date has been on identifying and accelerating the development of emerging technologies and novel integration approaches to generate new services and systems that can be deployed as part of our future mission delivery. We bring innovators and end users from across the NDA group together, showcasing new technologies, accelerating deployment on our sites and developing a vibrant R&D supply chain, particularly seeking to enable innovation from small and medium enterprises.

Partnering to fund innovation

A key part of fostering the right environment for technical innovation to succeed is sustained leveraged funding. We've collaborated with DASA, the Defence and Security Accelerator, to co-fund a series of innovation competitions on shared challenges such as remote monitoring in hazardous environments. DASA is the government-led innovation body run on behalf of the Ministry of Defence (MOD), Home Office and Security Services by the Defence, Science and Technology Laboratory. DASA exists to enable and accelerate innovation with the supply chain on topics of specific interest to the UK Government (particularly those with a military and security related applications like nuclear, cyber and critical national infrastructure). By working with DASA, we've been able to increase the breadth and diversity of our innovation portfolio, build strategic relationships with new stakeholders, encourage technology transfer from other sectors and leverage investment in research and development activities funded elsewhere, including across wider Government.

5 competitions run
telexistence, human augmentation, remote monitoring of sensitive sites

32 funded proposals

Over **£5.3m** invested to date

97% SME micro or academia participation in funded proposals

"The relationships we have built with our collaborators have enabled us to access a more diverse supply chain and take advantage of progress in other sectors."

Andrew Gray, NDA Innovation Delivery Manager

Protecting our operators

Telexistence

The first of our collaborative innovation competitions with DASA focused on telexistence, a capability that allows a human user to operate in an environment without physically being there, but with the feeling of actually being there. Our Grand Challenge to move humans away from harm sets out the ambition to remotely decommission gloveboxes and reduce the activities carried out by humans in high hazard environments.

Dstl Telexistence Phase 1 video

Dstl Telexistence Phase 2 video

We ran a two-stage competion co-funded with Dstl with DASA as delivery partner, inviting innovators to apply for funding to develop and demonstrate telexistence solutions for a range of defence, security and nuclear decommissioning use cases. Eleven different solutions were funded in Phase 1, including projects with Veolia, Cyberselves Universal, Createc, L3Harris Technologies, Holoxica, TNO, University of Leeds, Sheffield Hallam University and Digital Kinematics.

In Phase 2, technology suppliers were asked for integrated telexistence solutions, with four projects funded through further development and demonstrations tackling use cases including the handling and repackaging of nuclear materials within gloveboxes. Innovations were showcased at BattleLab, one of the Ministry of Defence's innovation acceleration facilities in Dorset. Demos increased awareness of the technology across potential end-users from NDA group, government and industry, whilst highlighting the nuclear, defence and security requirements to the technology developers.

Collaborating with Dstl and DASA allows us to tap into a more diverse supplier base, exploring common challenges across government and working together to achieve more.

Challenge: To understand the potential for technology concept of telexistence, including likely development pathways and exploitation opportunities.

Solution: A jointly funded £2.3 million competition with Dstl and DASA to develop cutting-edge telexistence technologies which allow people to complete tasks in hazardous environments without being physically present.

Outcome: New technologies have been successfully trialled which will reduce the risk to personnel, reduce the logistics burden and increase the efficiency and effectiveness of operations.

Collaborator: DASA

Benefit: Risk and hazard reduction, lifetime cost, safety.

Status: All projects are now complete.

Sorting out our wastes - autonomous sorting and segregation of waste

Innovating with Innovate UK

Significant quantities of legacy wastes already exist across the nuclear industry, with nearly five million tonnes of new waste yet to be produced from future decommissioning activities. At present these wastes are handled by operators wearing personal protective equipment (PPE), such as gloves or air-fed suits to manually dismantle equipment, or by operators remotely controlling robots to cut up waste. This is labour intensive and means people are close to the waste or use cameras to see what they are doing. Finding better ways to sort and segregate these wastes autonomously will lead to significant cost and time savings, improve operator safety and welfare and reduce the risk of human errors when identifying and classifying wastes in such challenging environments.

The NDA group collaborated with Innovate UK to launch the sort & seg innovation competition in July 2020 to develop an autonomous, integrated toolkit which sorts and segregates radioactive waste generated by nuclear decommissioning activities into compliant, optimised packages. Five companies and their diverse consortia were awarded contracts, each worth up to £900k, to build demonstrators for their ideas.

Demonstrators

- Optisort - Cavendish Nuclear Ltd, plus Structure Vision, Bristol Robotics Lan, Clifton Photonics, Babcock Data Science
- Innovative Sort & Segregate System - Barrnon Ltd, plus Royal Holloway University, Innovative Physics, Drisq, Nuvia
- ISOsort - Createc Ltd, plus Sileane, PaR Systems, EDF Cyclife
- Mobile Autonomous Sort and Segregate System - Atkins Ltd, plus CyanTec Systems, Pajarito Scientific, MTTC
- Blended Intelligence for Safe & Efficient Nuclear Sort & Segmentation -Veolia Nuclear Solutions (UK) Ltd, plus Faculty, Create Technologies, University of Lincoln

The competition generated an excellent response from the supply chain, including many SMEs. The diverse technology developments were showcased to a wide range of public and private sector stakeholders in March 2023. The next stage (Auto-SAS project) is to engage the supply chain to deliver trials in a radioactive environment at one of our reactor sites.

Challenge: Safer, faster, cheaper waste management using autonomous techniques.

Solution: 'Sort & Seg' innovation competition, launched in July 2020, to harness expertise from other sectors to meet our challenges.

Outcome: Successfully demonstrated integrated, autonomous toolkits which can sort and segregate radioactive waste in a non-active environment.

Collaborators: NDA, NRS Magnox, Sellafield Ltd, Innovate UK.

Benefit: Risk and hazard reduction, environment.

Status: Active demonstration project, Auto-SAS, due to commence 2025.

Innovate UK Sort and segregate competition video

Reaching international heights in UK and Japan - LongOps

Developing digital tools to enable faster, safer and more cost-effective decommissioning internationally

The LongOps programme was a £12M collaboration over four years between NDA, UK Atonic Energy Authority (UKAEA) UK Research and Innovations' Innovate UK and Tokyo Electric Power Company (TEPCO) in Japan to develop digital long-reach robotic technologies for use to address shared nuclear decommissioning challenges (fission and fusion).

LongOps set out to build capability, knowledge and relationships related to the de-risking of decommissioning operations using digital mock-ups and long-reach robotics. An integrated Digital Mock-Up (DMU) prototype was built to demonstrate how such long-reach manipulators and other equipment could be used over long timescales for decommissioning. This next generation of digital tools paired the digital and physical worlds for operator training through to the collection of data to inform decommissioning strategies. Such approaches are relatively low-risk, low-cost and scalable and accessible in the supply chain.

LongOps also supported the NDA strategy to foster international collaborations. By considering adjacent and similar end use cases (Sellafield in NDA group, Fukushima in Japan and JET at UKAEA) it supported delivering value for money and building skills internationally.

Engaging with the varied stakeholders, cultures and practicalities of working across the world was a key part of the programme. Wider benefits included an exchange programme bringing TEPCO secondees to the UK to train at UKAEA facilities.

"This unique international collaboration allows us to pool expertise and experience from Japan in robotics, working together and investing in cutting-edge ways to find solutions to our shared problems and benefit our clean-up mission."

Alan Hutchison, NDA lead for LongOps

Challenge: To collaborate with international partners to address similar challenges in decommissioning using robotic technology. To share knowledge and develop skills internationally.

Solution: NDA collaborated in £12M UK-Japan robotics programme for nuclear decommissioning and fusion research - LongOps.

Outcome: Digital Mock-Up developed to help us make informed decisions on the design of remote operations and long-reach manipulators to carry out decommissioning remotely to reduce the risk to our workforce and reduce costs and schedules. Successful exchange programme to develop skills internationally.

Collaborator: NDA, UKAEA and TEPCO, Sellafield Ltd.

Benefit: Reputation, risk and hazard reduction.

Status: Further collaborations are currently being planned.

LongOps Programme Website

LongOps Project Report

Robotics and Artificial Intelligence Collaboration (RAICo)

Accelerating the deployment of robotic solutions in nuclear decommissioning and fusion engineering

RAICo is a first-of-a-kind collaboration between NDA, Sellafield Ltd, UK Atomic Energy Authority (UKAEA) and the University of Manchester. It's a new way of working, bringing together end users, challenge holders, academics and supply chain across fusion energy and nuclear decommissioning to collaborate on shared challenges.

Our key aim behind the programme is to accelerate the deployment of robotics across the NDA group and UKAEA by developing and demonstrating RAI technologies to build awareness and confidence in them.

RAICo's technology development programme focuses on addressing the key operational needs and goals of end users around four technology themes: remote handling – size reduction; robotics & AI data (RAID); digital infrastructure; all enabled with academic research and stakeholder engagement.

Significant projects that have been developed to date via RAICo include:

- RoBox – next generation of teleoperated robots within gloveboxes
- Lirob – teleoperated through-wall manipulator to reduce cognitive load and physical burden on operators
- Single Point Operator Control Kit (SPOCK) – a digital platform combining virtual reality visualisation and operations management system
- Robotic solutions supporting health physics monitoring
- RAICo fellows – skills pipeline developing capability for the future

Challenge: To collaboratively accelerate the deployment of robotics and AI solutions to address common nuclear decommissioning and fusion engineering challenges.

Solution: RAICo, with Sellafield Ltd, University of Manchester and UKAEA to share expertise and trial new approaches quicker.

Outcome: Costs and schedule savings from deployments, scientific leadership and capability development, technology demonstrators and supply chain development.

Collaborators: NDA, Sellafield Ltd, UKAEA, The University of Manchester.

Benefit: Risk and hazard reduction, socio-economic, enabling the mission.

RAICo website

RAICO Review 2024

Scratching the surface – decontaminating our concrete structures

Demonstrating concrete scabbling of pond walls

Removing contaminated concrete top layers in key structures such as fuel storage ponds could help support accelerated decommissioning. Doing so in a way that minimises radiological dust issues will help to improve safety to operators and enable appropriate management of decommissioning waste.

Concrete scabbling is a method of using a mechanical device to remove a surface layer of concrete from a structure. The technology being developed for the NDA group is a remote system with local dust extraction and the capability to remove 50mm of contaminated concrete in a single pass. The final product could be deployed in contaminated ponds, removing the surface level contamination from the concrete without having to contain the environment with tents due to dust generation. This approach will result in a much cheaper method of decontamination, reducing lifetime cost, while keeping humans away from harm.

The project started as part of the Sellafield Gamechangers programme, a challenge-based innovation programme designed to identify and develop innovative solutions with the supply chain.

The successful idea was then taken forward with NRS, supported by Sellafield and funded by the NDA as a groupwide demonstrator project. Testing at NRS Dounreay will enable the technology to be trialled and then transferred, if successful, to other NDA group sites. This groupwide demonstrator approach is efficient in accelerating trials and capturing learning on barriers to deployment of innovation in operating environments.

Challenge: Remediate the Dounreay Fast Reactor (DFR) ponds with no radiological dust issues.

Solution: NRS Dounreay, in partnership with Sellafield Ltd, explored alternative technologies via Gamechangers. This identified several different methods and the most promising one, Barrnon concrete scabbling approach, was taken forward to a proof of concept.

Outcome: The final product will be able to be deployed in contaminated ponds and remove the surface level contaminated concrete without having to tent the ponds.

Collaborator: NRS Dounreay in partnership with Sellafield Ltd and Barrnon Ltd.

Benefit: Enabling the mission, risk and hazard reduction, environment.

Status: Trials are ongoing at NRS Dounreay

Game Changers Delivering innovation in the nuclear industry

Sensing Sellafield's nuclear materials packages in real time

Prototype sensor system for product container cans

Working with Sellafield, expert electrical engineers Sensor Driven have developed a sensor to overcome the challenge of monitoring nuclear materials packages in long term storage. Providing constant temperature and pressure measurements, instant alerts and frequent wireless feedback, the sensor is the product of four years of Gamechangers funded collaborative work between Sensor Driven and Sellafield technical and engineering teams.

The sensor components not only tolerate radiation, but they can also detect changes in pressure and temperature rapidly. They will be capable of functioning for decades without battery replacement. This longevity is critical when monitoring in areas with restricted access, and especially those in harsh environments.

Data from the sensors is transmitted wirelessly using encrypted radio transmissions from the packages to an internal secure wired network with no outside connections made.

It is essential that the sensors are compatible with the design of Sellafield's long term nuclear materials packages, ensuring that the precise sensor electronics can withstand the extreme temperatures used during can welding. Sensor components have also been optimised to ensure that the use of the sensors does not result in the loss of any package storage space inside vaults.

The use of this technology will result in less store access as physical inspections can be delayed or avoided entirely where no activity is detected. If an unexpected change in temperature or pressure is detected, physical inspections can be carried out on important packages sooner, mitigating risk.

The provision of continuous and instantaneous information on packages will provide new knowledge and methods of efficiently storing and handling different types of materials. Plans for active demonstration are now underway at Sellafield.

Challenge: Monitoring product container cans in long term storage.

Solution: Wireless sensor developed via Gamechangers by Sensor Driven and Sellafield Ltd technical and engineering teams.

Outcome: Constant temperature and pressure measurements, instant alerts and frequent wireless feedback resulting in reduced store maintenance, minimising unnecessary inspections.

Collaborators: Sensor Driven Ltd with Sellafield Ltd and FIS360.

Benefit: Risk and hazard reduction.

Status: Demonstrations in radioactive environment planned.

Long Life Sensors | Sensor Driven

Spotting better ways of working

Accelerating deployment of new technologies

'Spot', the robotic quadruped from Boston Dynamics, has undertaken trials on seven different use cases across the NRS Dounreay site to investigate ways it could support decommissioning plans.

In one, Spot negotiated pitch-black conditions and several flights of stairs to map out a four-storey cell, collecting important radiological data for the team to use when planning the decommissioning of the facility; and to gain useful experience on how the robot and survey equipment should be used.

A wooden mock-up of the evaporator cell entrance and temporary containment were constructed in a clean area to test the abilities of the robot and train the operators, before the work moved into the evaporator cell.

Covered in a protective suit, once inside the evaporator cell, the robot collected data to give the team a complete 3d map of the area. It also collected radiological data to create a full dosimetry map showing areas of higher radioactivity, enabling the team to develop a radiological fingerprint.

A team of twelve has been supporting the robot trials, mixing Dounreay staff and specialists from Createc, the systems integrator for Spot. Other use cases include 3d laser (LIDAR) scanning of site facilities and beach monitoring.

The work at NRS Dounreay complements and builds on the recent deployment of Spot at Sellafield, demonstrating how learning is being shared across sites to deliver better outcomes, move people further away from harm and decommission more efficiently.

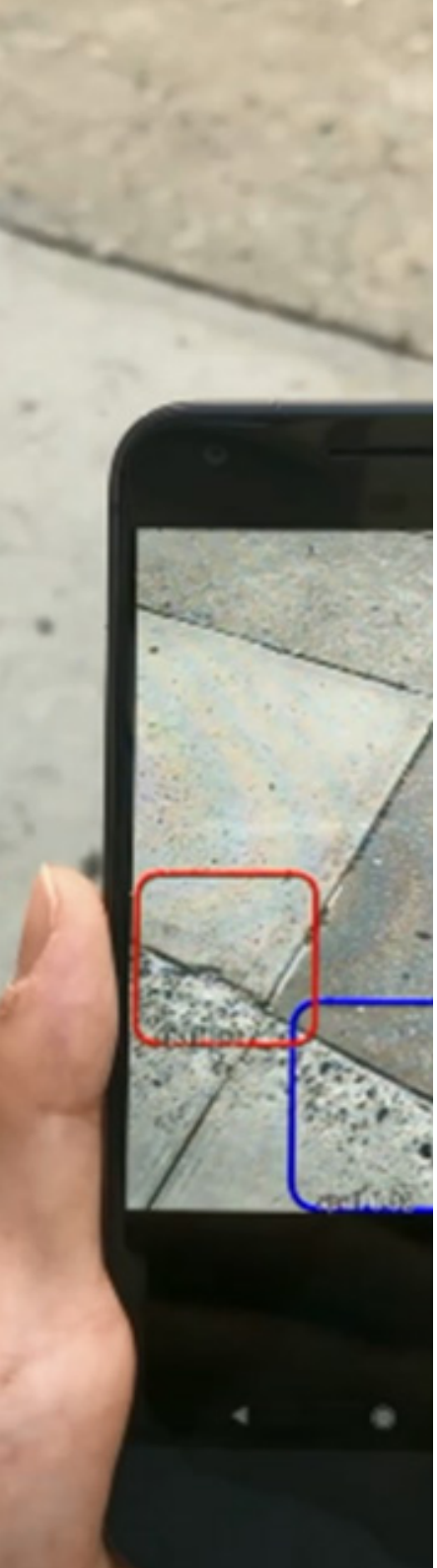
Challenge: To collaboratively develop and deploy new robotic technology, which improves safety and removes humans away from harm.

Solution: Trials of new robotics technologies at Dounreay in radioactive facilities.

Outcome: Understanding of the capabilities of new technologies, surveys of inaccessible areas enabling decommissioning plans to be developed. Training of Dounreay staff to deploy robotic solutions.

Collaborators: NRS Dounreay, Sellafield, Boston Dynamics, Createc.

Benefit: Risk and hazard reduction, safety.



Using AI for smarter asset maintenance

Concrete defect detection and analysis using AI software

Close Visual Inspection (CVI) has historically been the main method of inspecting concrete building structures on nuclear licensed sites across the UK. It relies on the skill, qualifications, and experience of the inspector to differentiate between structural and cosmetic defects and there can be many issues with consistency, variability, and subjectivity of the results. As part of the NDA Grand Challenge to understand how innovation can support decommissioning, with a focus on moving humans away from harm and digital delivery, NRS undertook a two-year project in collaboration with Thornton Tomasetti and T2D2. The aim of this project was to understand if Remote Visual Inspection (RVI) techniques, coupled with artificial intelligence (AI) in the form of automated damage detection using machine learning algorithms, could provide the same, or better, probability of defect detection as CVI.

The project used two sets of images, captured at least one year apart, to determine the rate of change in defects. These images were input into the bespoke automated damage portal and combined with machine learning algorithms and computer vision, to undertake concrete defect detection and analysis for structures located at two NRS sites.

Year one demonstrated, with a high degree of confidence, that most defects can be correctly and accurately captured, processed and assessed using this approach, with the year two data also demonstrating that defects have been re-captured, processed and assessed.

Combining real and artificial intelligence, significantly enhances the existing CVI technology for comprehensive condition assessment as the combination of both engineer and software assessments are less likely to miss defects than an engineer alone visually inspecting the structure. As many NRS structures are also large, using this approach eliminates any working at height or costly access requirements.

Adoption of this technique will provide a digital benchmark for future surveys, which can be used to accurately assess progressive degradation with time, allowing pro-active, cost-effective maintenance and decommissioning tasks to be planned. The technique has been trialled at Berkeley and Sizewell A sites with a multi-site specification in development to embed the system across NRS and add significant value groupwide.

Challenge: To see if remote visual inspection techniques, coupled with AI could provide the same, or better, probability of defect detection in structures as close visual inspections.

Solution: A two-year project to compare visual and remote inspection data.

Outcome: This approach significantly enhances the existing Close Visual Inspection, eliminating working at height or costly access requirements.

Collaborators: NRS Magnox with Thornton Tomasetti and T2D2

Benefit: Health and safety, lifetime costs.

Status: Extending the approach across NRS is planned.

Testing the geodisposal concept in Switzerland

International collaboration

A key part of the UK's multi-barrier geological disposal concept is using bentonite as a buffer or backfill material to restrict groundwater and gas movement within a future geological disposal facility (GDF). This is a common design feature with many other international geodisposal designs, and NWS has been working with their international counterparts on joint research to better understand bentonite performance.

HotBENT (hot bentonite) is a full scale mock-up of a High Heat Generating Waste disposal concept at the underground Grimsel Test Site in Switzerland. If bentonite can meet its safety functions at higher temperatures, then waste packages can be placed closer together, reducing the GDF footprint. Alternatively, the waste can be emplaced earlier, shortening costly interim storage of irradiated fuels at nuclear power station sites. The project could lead to significant financial and environmental cost savings for the UK GDF design and future nuclear power plant operators, but also shares the cost of long-term below-ground trials, sharing data and knowledge.

Replica spent fuel containers encapsulated in bentonite clay are being heated to 175-200°C. The evolution of temperature, pressure and relative humidity are measured in the bentonite and surrounding rock during the experiment.

These field experiments are challenging to undertake, because of their large scale and because it is in an underground environment. In this experiment, approximately 1500 sensors were installed which measure a variety of conditions. These sensors need to be able to withstand harsh environmental conditions (up to 200°C) for 20 years. They also need to be carefully installed to ensure they do not impact the experiment, for example by adding a water bypass route. NWS played an integral part in the design of the experiment, by ensuring that additional saturation boreholes were drilled. Without these boreholes the bentonite would not have re-hydrated fully by the end of the experiment and would not have been able to achieve the desired aims of the experiment.

NWS was heavily involved in the detailed design of the experiment in 2016. The first heated section will be dismantled in 2027 and analysed in 2028. The second heated section will be dismantled in 2042, in time to provide important understanding for the disposal of spent fuel in a future UK geological disposal facility.

Challenge: Optimising packing efficiency and footprint of a geological disposal facility.

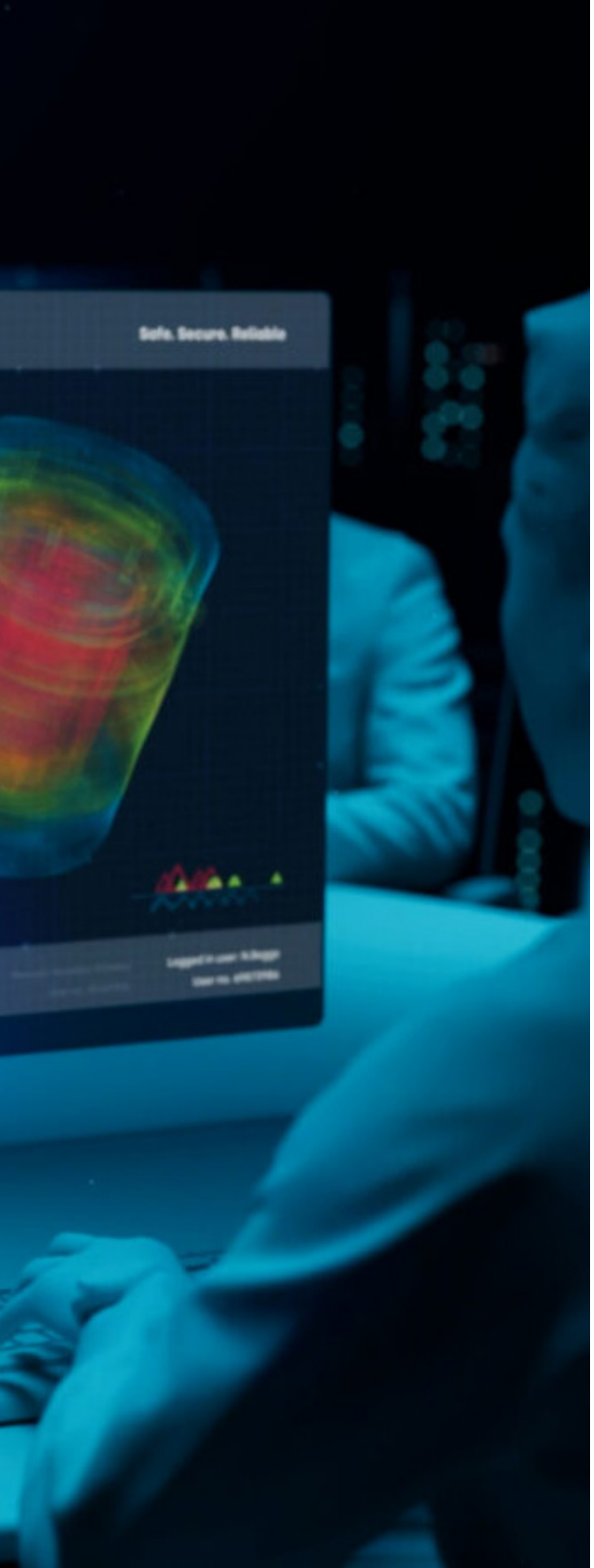
Solution: Collaboration with international counterparts to develop a full scale in-situ mock-up of a disposal concept for High Heat Generating Waste, working collaboratively to access broader skills and facilities.

Outcome: Sharing vital research data internationally to optimise geological disposal designs and save long-term trial costs.

Collaborators: NWS and international radioactive waste management organisations including Nagra (Switzerland), USDoE (USA), NUMO (Japan) and NWMO (Canada).

Benefit: Environment, lifetime cost.

Status: Project ongoing.



Transporting fuels of the future

The HALEU transport package

The UK is the first European country to launch a High Assay Low Enriched Uranium (HALEU) nuclear fuel programme. The programme will produce the enriched uranium needed for next generation of advanced modular reactors and provide jobs and investment in North West England.

Nuclear Transport Solutions (NTS) is developing a brand-new type of transport package for HALEU that meets IAEA regulations. The package is being designed to transport HALEU in multiple forms to support the front-end fuel cycle of the UKs Gen-IV Advanced Modular Reactor (AMR) development strategy. The work has been made possible thanks to additional government funding from the Department for Energy Security and Net Zero (DESNZ).

The HALEU Transport Package (HTP) is being developed through to preliminary design with the aim of demonstrating a Technical Readiness Level (TRL) of 4. The design philosophy of the HTP is for it to be manufactured using as much commercial off the shelf (COTS) material as possible to reduce unit cost and simplify procurement and manufacture.

For NTS, the HTP has been a fantastic opportunity to design a new package under a novel funding route and adopting an accelerated design process. Multiple design iterations were assessed quickly to determine whether the package meets design intent. The funding will allow NTS's team of experts to consider all aspects of the package design – radiological shielding, criticality, licencing, and meet all international standards and regulations.

The HTP will be readily available to transport HALEU powder and manufactured fuel to fuel fabricators and reactor sites by the time these facilities come on-line. There is an opportunity to break into international markets as well to provide competition to existing package designs.

Challenge: Providing safe, secure and reliable nuclear transport packages to support the UK HALEU programme.

Solution: Development of a new transport package which will support a new generation of nuclear reactors.

Outcome: A compliant HALEU package design to transport fuels for the UK's new nuclear reactors.

Collaborators: NTS, NPL, Nuclear Advanced Manufacturing Research Centre (NAMRC).

Benefit: Risk and hazard reduction, health and safety, socio-economic.

Status: Phase 2 due to continue under additional DESNZ funding from April 2025.

Contractors currently supporting the NDA research portfolio

This table highlights the diversity of supply chain organisations bringing excellence in innovation to our R&D programme

Contractors	Consortium
University Interactions	
National Nuclear Laboratory	Frazer-Nash Consultancy Ltd
Enabling decommissioning, waste management and remediation	
NSG Environmental Ltd	Abbott Risk Consulting Ltd, Cavendish Nuclear Ltd, KDC Veolia Decommissioning Services UK Ltd, Quintessa Ltd, RPS Consulting Service Ltd, Veolia Nuclear Solutions, University of Sheffield
Jacobs Clean Energy Ltd	AFRY Solutions UK Ltd, Ove Arup & Partners Ltd, Brenk-FZJ, CL:AIRE, Croft Associates Ltd, Decision Analysis Services Ltd, Galson Sciences Ltd, Gardiner & Theobald LLP, Longenecker & Associates, MCM Environmental Services Ltd, Strata-G LLC, Thornton Tomasetti Warrington Ltd, University of Bristol, Cambridge University Technical Services Ltd, The University of Manchester, Urenco Nuclear Stewardship Ltd
Eden Nuclear and Environment Ltd	Cyclife UK Ltd, Gardiner & Theobald LLP, Hydrock Consultants Ltd, IfM Engage Ltd, Integrated Decision Management Ltd, Lucideon Ltd, Onet Technologies ND, RAND Europe CIC, University of Bristol, WSP UK Ltd
Spent Fuel and Nuclear Materials	
Frazer-Nash Consultancy Ltd with National Nuclear Laboratory	Equilibrion Ltd, Henry Royce Institute: University of Manchester, Quintessa Ltd
Eden Nuclear and Environment Ltd	Eden Nuclear and Environment Ltd Cavendish Nuclear Ltd, Integrated Decision Management Ltd, Lucideon Ltd, NSG Environmental Ltd, Nuclear-21, Onet Technologies ND, University of Bristol
Jacobs Clean Energy Ltd	Brenk Systemplanung GmbH, Gardiner & Theobald LLP, SCK CEN, Thornton Tomasetti Warrington Ltd, Urenco, Croft Associates Ltd, DAS Ltd, Egis Group, Galson Sciences Ltd, GRI Ltd, Longenecker and Associates, Loughborough Materials, MCM Environmental Services Ltd, Strata-G LLC, Bangor University, The University of Manchester, University of Bristol, University of Cambridge

For more information:

NDA Research on gov.uk

NDA Areas of Research Interest

NDA group University Research Strategy

NDA Innovation Strategy