Cavendish nuclear

part of Babcock International Group

Waste management services

Contents

Introduction

Cavendish Nuclear is a company that offers our customers an integrated waste service and support, across the waste lifecycle.

We are proud to be part of the Babcock International Group where we have the opportunity to routinely collaborate on ideas that have cross sector benefit to our customers.

We also have a pre-qualified supply chain which can be rapidly deployed to support project delivery.

With approximately 110 specialists in our waste services, and over 1500 years of combined delivery experience, Cavendish Nuclear has the strength and depth across the waste lifecycle.

In addition, we also have almost 2000 mixed discipline engineers, project managers and safety case specialists capable of delivering waste projects from planning and preparation through characterisation, treatment, storage, disposal and site restoration.

Mick Gornall, Managing Director

Waste Management Services

Brief Overview

Cavendish Nuclear has over 60 years' experience of decommissioning and waste management.

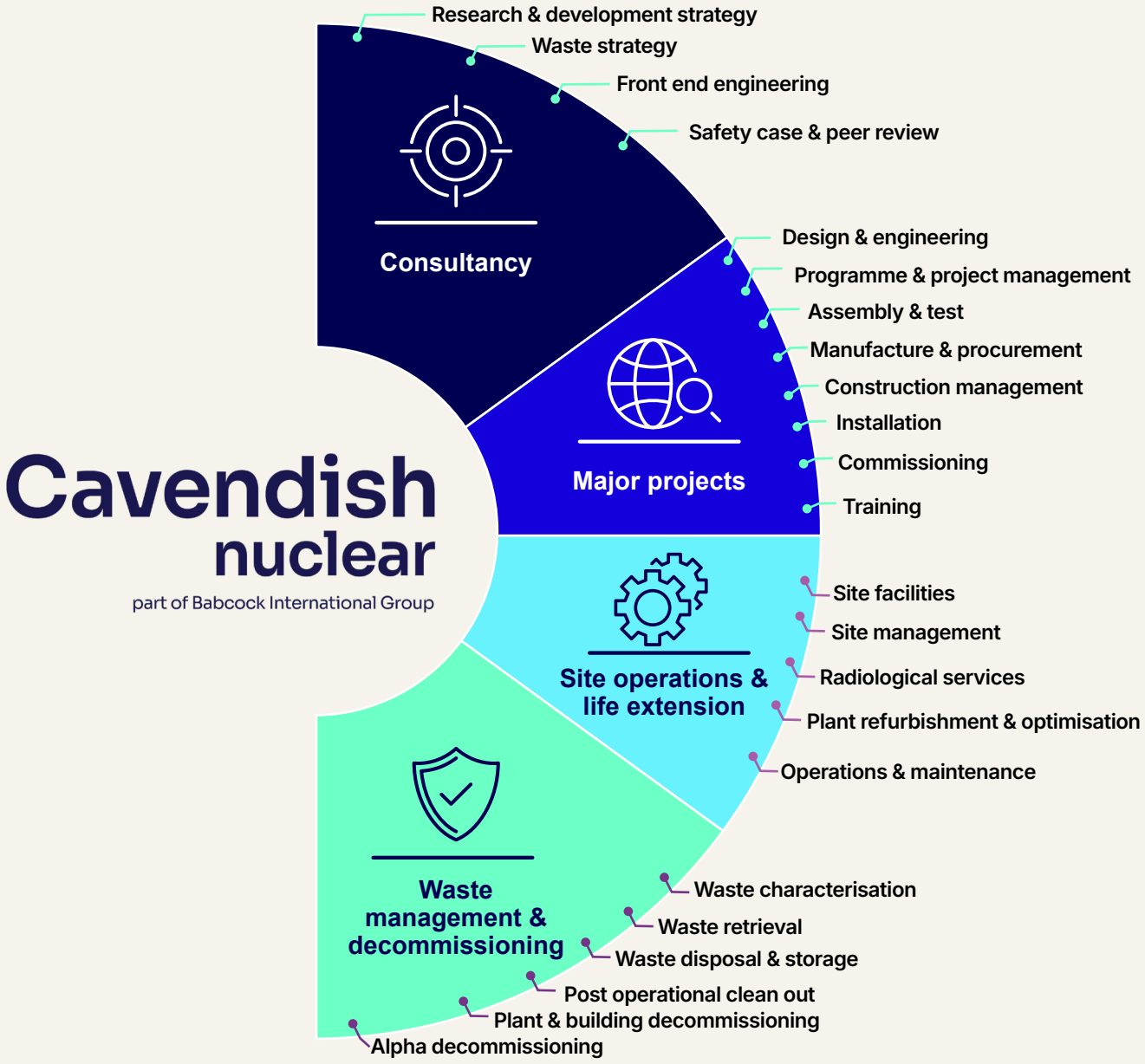
Cavendish Nuclear is a core part of Babcock International Group's Nuclear Sector. We provide a comprehensive range of critical nuclear solutions across the markets of Clean Energy, Defence and Civil Decommissioning, both in the UK and Internationally.

From decommissioning redundant nuclear facilities, through supporting the Continuous at Sea Deterrent, to supporting the operation of existing and build of new nuclear power plants, our role in Cavendish Nuclear is to clean up the nuclear legacy and create a world where nuclear plays a key contribution in protecting our nation, ensuring security of energy supply and meeting our net zero commitments.

We have over half a century of engineering and waste management expertise within the industry and are perfectly equipped to deliver effective solutions at every stage of the nuclear life cycle.

Our role in Cavendish Nuclear is to clean up the nuclear legacy of which delivery of waste solutions will be critical.

Our ambition is to be a major player in the decommissioning and waste management market.



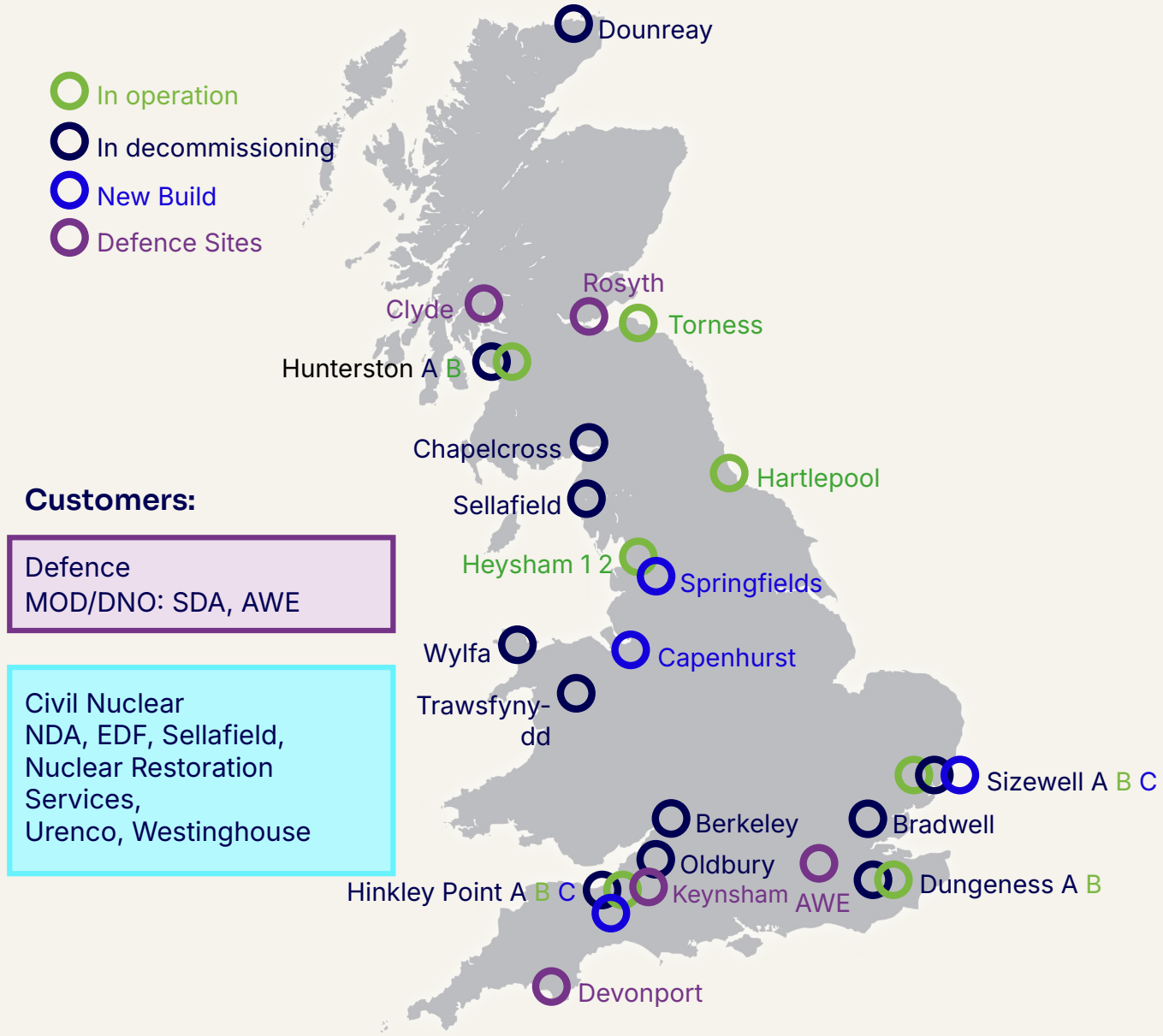
Waste Management Services

UK Locations

Cavendish Nuclear has managed Nuclear sites throughout the UK and beyond. We understand the industry needs waste led solutions.

Here at Cavendish Nuclear we have the expertise to lead waste solutions throughout the lifecycle of a project, across civil nuclear and defence.

Decommissioning and waste management is core to our business.



Customers:

Defence
MOD/DNO: SDA, AWE

Civil Nuclear
NDA, EDF, Sellafield, Nuclear Restoration Services,
Urenco, Westinghouse

Waste management services at a glance

1500+ Years of waste management experience

110+ Waste management, analysts, radiation protection, radiometric physics and shielding experts

60+ Years of experience of decommissioning, fuel removal, decontaminating and dismantling nuclear reactors

8000 Samples analysed at our laboratory every year carrying out 28,000 tests annually

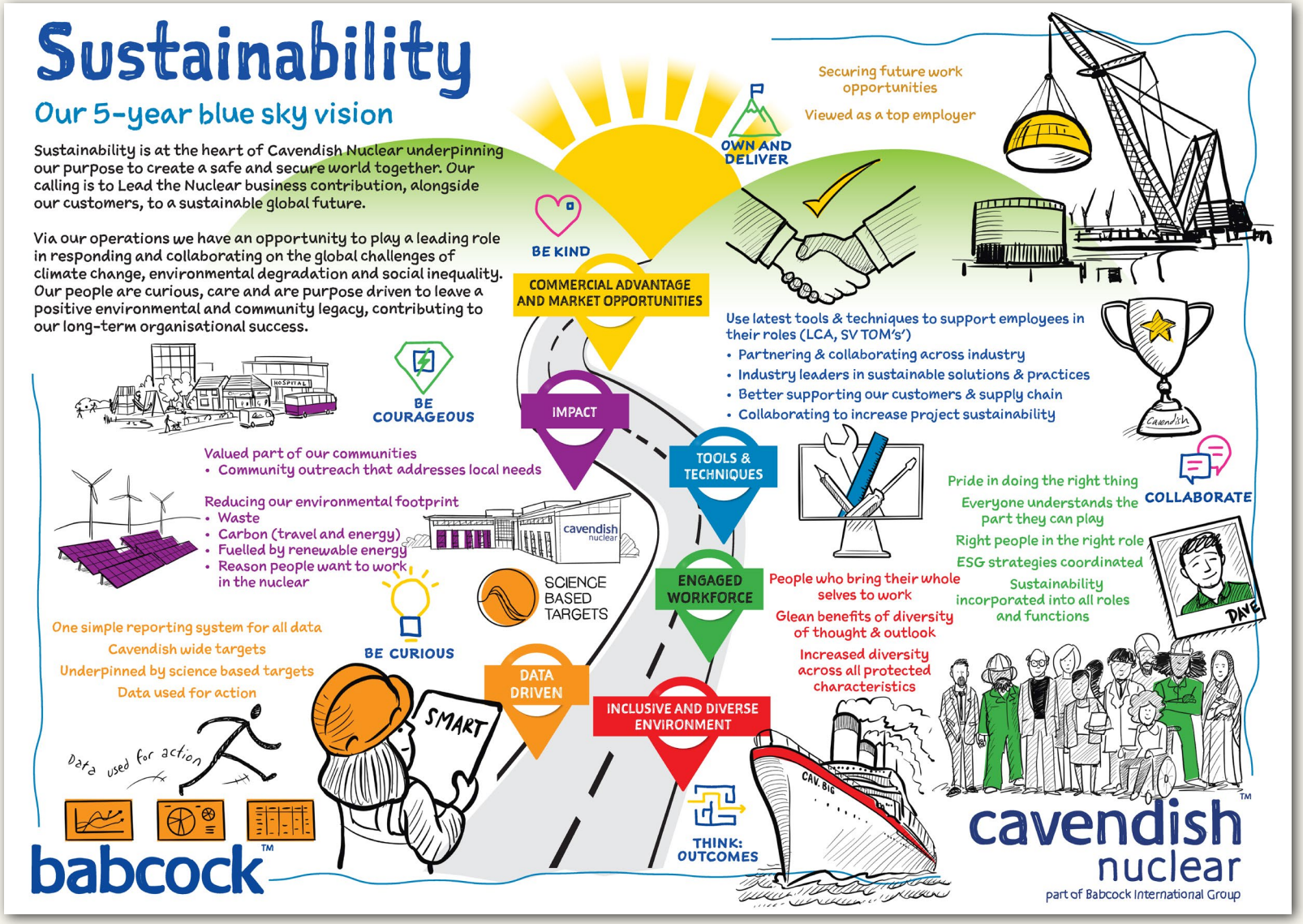
7 Patented inventions to enable unique, practical decommissioning

Sustainability Vision

A future vision of sustainability within Cavendish Nuclear was formed in 2023 considering internal stakeholder views.

The output was a blue-sky vision that has been used to inform this strategy and has also supported progress to date, on embedding sustainability into the business.

We will ensure our solutions, where possible, implement sustainable and efficient waste management strategies that provide benefit for people and the environment.



Sustainability Objectives

To minimise our impact on the environment we strive to reduce energy demand and the generation of waste, use cleaner energy sources and minimise the use of non-renewable resources. We aim to partner and support the places and people where we work, adding social value through community engagement activities. We know people and their wellbeing are critical in delivering our priorities and strive to create a safe, inclusive and diverse workplace. Being an ethical business means we can be a trusted partner up and down the value chain and have a diverse and robust supply chain ultimately helps to deliver for our customers.

Sustainability priorities for Cavendish Nuclear have been defined in line with focus specifically on what matters most to our business and its stakeholders and we also set out why they matter. Sustainability is such a broad, complex and ever-changing subject so it is important to identify key focus areas using our vision to check that outcomes will meet our overall purpose and where the opportunities are to make the biggest positive impacts.

SUSTAINABILITY OBJECTIVES

ENVIRONMENT PRIORITIES

WE WILL...

- Reduce our operational environmental footprint
  Reduce our own emissions and contribute towards Plan Zero 40
- Optimise energy & waste efficiency in design
  Analysis of designs to ensure lifecycle impacts are considered
- Protect & enhance the natural environment
  Seek opportunities to protect & enhance biodiversity at our sites and in the communities where we work

SOCIAL PRIORITIES

WE WILL...

- Tackle inequality within the workforce and local community
  Support EDI programmes internally and externally
- Promote health & wellbeing with all our stakeholders
  Strive for world class work environments
  Support initiatives that maximise positive outcomes
- Provide support, training & employment opportunities
  Address the skills shortage in the sector.
  Use local needs analysis to address key issues

GOVERNANCE PRIORITIES

WE WILL...

- Transparently report on sustainability performance
  Report against sustainability priorities & outcomes
- Sustainably procure our supply chain
  Procurement of sustainable suppliers & key materials
- Integrate sustainability into our business management systems
  Ensure accountability for sustainability at all levels

Waste Management Services

Waste Consultancy Capability

Cavendish Nuclear is a trusted partner providing technical and strategic integrated waste management solutions across the lifecycle.

We work with our clients ensuring our approaches are tailored to their requirements, proportionate and risk based.

Our technical excellence and experience in the management, minimisation and characterisation of radioactive waste produced during operational and decommissioning activities enables us to deliver integrated, sustainable, practical solutions that address the waste challenges.

Our capability spans sectors and disciplines serving a broad client base in the UK and internationally including:

- Planning, optioneering, feasibility and Provence assessments
- Characterisation and inventory definition
- Development of strategies and plans to underpin decontamination, retrievals, decommissioning and demolition
- Waste treatment strategies and evaluations.
- Storage and disposal.

APPROACHES ARE TAILORED, PROPORTIONATE & RISK BASED

TRUSTED PARTNER WORKING WITH CLIENTS

DELIVER INTEGRATED, SUSTAINABLE & PRACTICAL SOLUTIONS THAT ADDRESS WASTE CHALLENGES ACROSS THE LIFECYCLE

UK & INTERNATIONALLY RECOGNISED & SECURED

TECHNICAL EXCELLENCE & EXPERIENCE

Laboratory Capability & Scope

Cavendish Nuclear have the expertise and experience to provide chemical and radiochemical testing that can be applied to a wide array of environmental, biological, and effluent samples.

World-class testing modern, purpose-built facility in UK.

8000 samples are routinely analysed every year – over 28,000 tests carried out including:

- Environmental testing to low detection limits.
- Bioassay analysis - HSE Approved Dosimetry analytical service.
- Stack discharge sample testing.
- Site characterisation and clearance testing.
- Development Chemistry facility to provide verification and investigations for clients.

Robust quality control and management system accredited to BS EN ISO/IEC 17025.

Participation in rigorous proficiency testing schemes.

Measured Radioactive Isotopes

- Alpha emitting radio isotopes – U, Pu, ^{241}Am, ^{237}Np, and ^{244}Cm
- Beta emitting radio isotopes - ^{3}H, ^{14}C, ^{35}S, ^{36}Cl, ^{90}Sr, ^{99}Tc, and ^{129}I
- Gamma emitting radio isotopes - ^{60}Co, ^{106}Ru, ^{129}I, ^{131}I, ^{134}Cs and ^{137}Cs
- Non-radiological - heavy metals, cation, anion
- Quick turnaround analysis

8,000 SAMPLES ARE ROUTINELY ANALYSED EVERY YEAR

ACCREDITED TO BS EN ISO/IEC 17025

Radiometric Measurement Capability

Cavendish Nuclear has provided Radiometric measurement Services and consultancy to the nuclear industry for the last 30 years with in situ measurements supporting:

- Site characterisation
- Waste storage & treatment
- Emerging radiological operational challenges
- Identification of contamination
- Decommissioning strategy, planning and operations
- Quantify Pu, U, fission and activation product quantities
- Assay material and wastes.

Our Specialist Radiometric Measurement Experience includes;

- Alpha, Beta ,Gamma and neutron activity
- Dose measurements and mapping
- Fissile material assay
- Assay of fuel, retrievals and waste
- Real time plant monitoring
- Activity profiling (depth)
- Surveillance

Consultancy Services also supply, maintain and calibrate radiation detection, monitoring and measurement systems at nuclear sites across the UK.

Technology

Technology is at the core of everything we do. The nuclear industry is constantly advancing, that is why technology and innovation is at the heart of what we do.

As our customers' assets have grown in complexity, they're turning to us for their technology solutions. Our experts exert technical authority to make better decisions for – and with – our customers wherever they are in the world. We're ensuring our people have the right skillsets to take our business forward and support our customers.

AmCam

KEY INFORMATION:

Cavendish Nuclear's AmCam is a handheld, compact, lightweight device that combines a gamma ray spectrometry detector with a small video camera, capable of indicating radiation count rate alongside a corresponding video image of the area being surveyed.

- Quick identification of the location of material build up within gloveboxes
- Images can be used to pinpoint the origins of elevated dose / count rates
- Estimates can be made of the dose rates and activity levels of hotspots
- Aids quality assurance for the Post Operations Clean Out (POCO) characterisation or waste category segregation processes
- Used to plan / target future POCO clean-up operations
- Used to segregate waste items between PCM and ILW waste categories*

In-Cell Decommissioning System

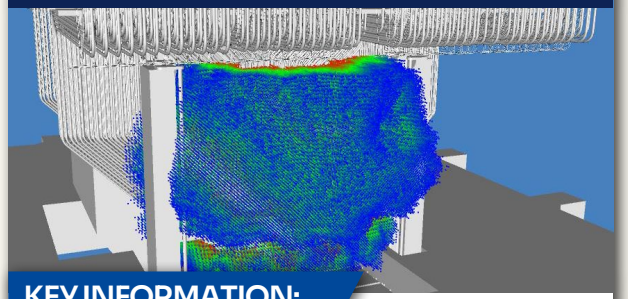
KEY INFORMATION:

Our In-Cell Decommissioning System is a Remote Deployment Device (RDD) which has increased the capability and speed with which redundant active reprocessing cells can be decommissioned by utilising a 'point and teach' approach controlled remotely by VR. The system has led to safer and more cost-efficient operations.

- Customer: Innovate UK, Sellafield Ltd, Nuclear.
- Decommissioning Authority & BEIS
- Potential Site: Sellafield
- Value: £1.5 Million
- Competition: Innovate UK – Integrated Innovation for Nuclear Decommissioning
- Capabilities – Design, Engineering, Manufacture, Assembly Commission, Test, Install and Demonstrate

Waste Management Services

PSIM



KEY INFORMATION:

Particle Swarm Imaging, or PSIM, is unique in the industry and is therefore a clear technical differentiator over 'conventional' analysis methods for Cavendish Nuclear's services and products.

- Accurate categorisation – More robust than conventional methods as no assumptions are made about the activity distribution.
- Activity Image – Provides an image of activity distribution within waste items, or around plant infrastructure to aid POCO strategy
- Verification Monitoring – Independent technique can provide robust interrogation of wastes
- Cost effective – No capital outlay, delivered as a service at low risk
- Versatile – Ideally suited to dense, high dose items and plant infrastructure with complex geometries
- Quick and easy deployment – Portable equipment, battery operated and weather protected.

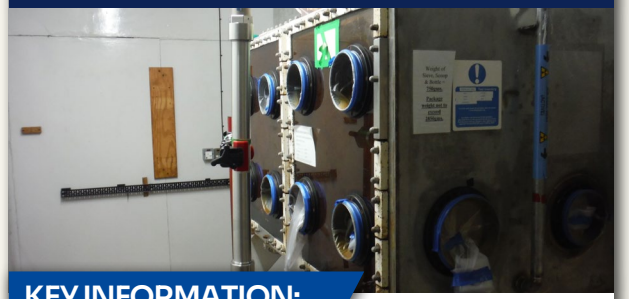
AWESIM

KEY INFORMATION:

Cavendish Nuclear has secured Government backing to pioneer advanced manufacturing and sensor technologies with the potential to deliver significant savings.

AWESIM, the Automated Welding Equipment System Inspection and Monitoring, is the first of its kind to combine machine learning, sensor development and advanced remote manufacturing processes to deliver welding, weld inspection and potentially weld certification all in near real time.

PHUMS



KEY INFORMATION:

Cavendish Nuclear's fast neutron detector based Plutonium Hold-Up Measurement System (PHUMS) is a lightweight, compact and portable assay system with the flexibility to measure the nuclear material content of a wide range of objects including process cells, facilities, gloveboxes, pipes and drums to inform Initial Decommissioning strategies.

- Unique, modular, mobile design for the in-situ assay of a wide range of object sizes and shapes
- Calculates both hold-up mass and distribution
- Determines information for use in pre-commencement safety cases
- State of the art fast neutron counting technology
- Novel analytical methods including likelihood expectation and clustering techniques
- Optional High Resolution Gamma Spectrometry system for Pu isotopics analysis.

Waste Management Services

Radiation Protection Capability

Providing Radiation Protection services to the nuclear industry for over 35 years.

Our experience spans clients from both UK nuclear and non-nuclear industries in a variety of areas involving work with ionising radiation.

Often working in close collaboration with our engineering capability, our multi-disciplinary team provide support both as part of an integrated engineering team and also as independent advisors in specialist areas.

Full experience encompasses a variety of fields including:

- Technical support to engineering design projects and industrial operational clients
- Decommissioning of nuclear power plant
- Reprocessing
- Spent fuel processing
- Radioactive waste management.
- Regulatory Support
- Optioneering Services
- Hazard Identification
- Radiological, Nuclear Safety and Consequence Assessment
- Environmental Modelling, Assessments & Safety Cases

Shielding Capability

Highly experienced radiation shielding team, providing design services for the full project lifecycle from concept design through to operation, plant modification and decommissioning.

Extensive experience of integrating with engineering design teams, working to UK regulations and industry best practice.

- UK industry standard radiation transport codes: MCBEND; MCNP; RANKERN and MicroShield
- Assessment of bulk and detailed shielding for simple and complex geometries (from waste packages to reactors)
- Optimisation of shielding to support engineering design solutions
- Determination of external radiation exposure to workers and members of the public from photon, neutron and beta-ray radiation sources
- Integrated into the wider Cavendish Nuclear Radiation Protection team.
- Neutron Activation and Source Term Assessments
- Assessment of neutron activation utilising a combination of MCNP/MCBEND and SCALE
- Complex source generation and decay (including fuel inventories) utilising SCALE

HIGHLY EXPERIENCED RADIATION SHIELDING TEAM

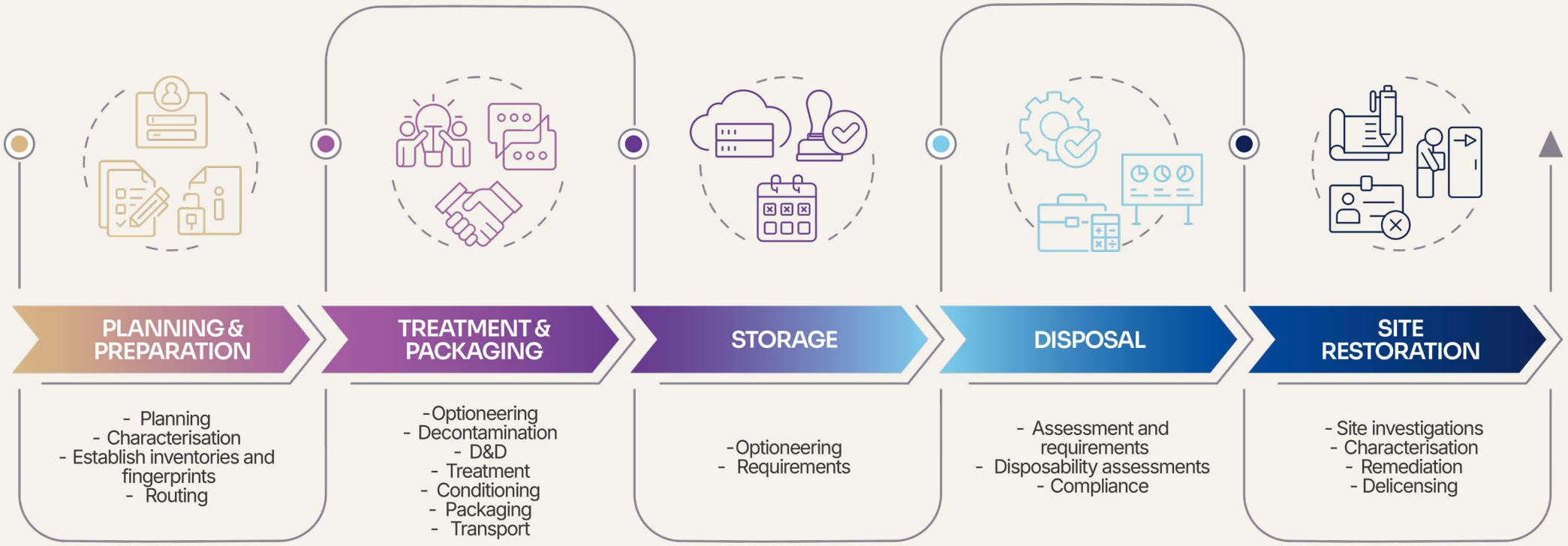
DESIGN SERVICES FOR THE FULL PROJECT LIFECYCLE

INTEGRATING WITH ENGINEERING DESIGN TEAMS

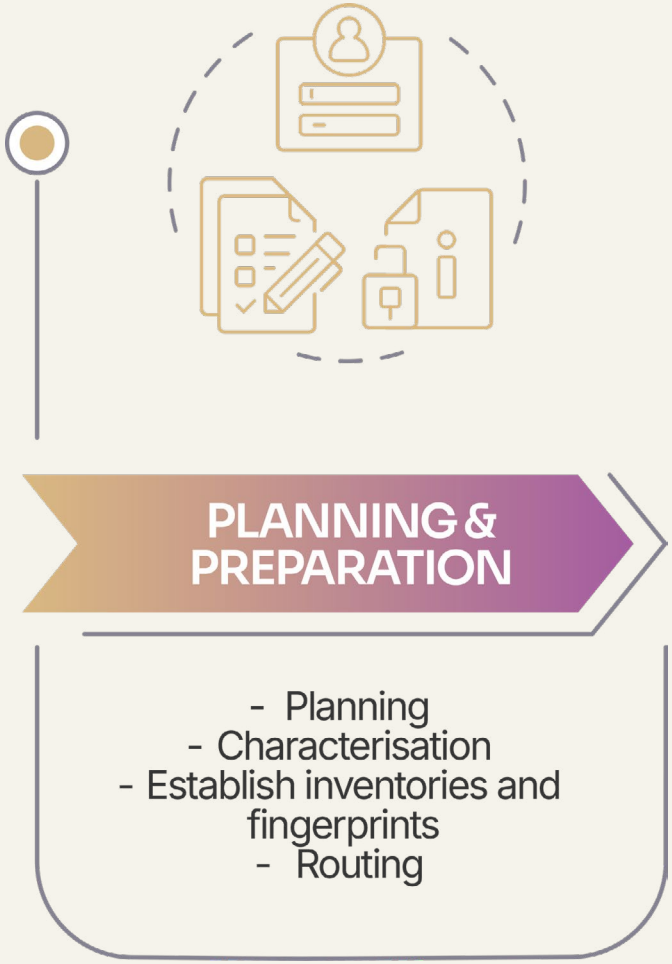
WORKING TO UK & INTERNATIONAL REGULATIONS & INDUSTRY BEST PRACTICE

Waste Management Services

Delivering Integrating Waste Solutions Across the Lifecycle



Planning & Preparation



Alpha Resilience & Capability Programme

CLIENT:

Sellafield Ltd, AWE & NDA

Duration – 2021
There was a UK need to improve the capability for Airborne Radioactive Particulate Instrument Type Testing. Cavendish Nuclear, with Westlakes Engineering, worked with Sellafield, AWE and NDA to develop the draft Strategic Outline Case using the 5-case model to inform the decision for future UK capability.

The Strategic Outline Case:

- Identification of required capacity and suppliers.
- Optioneering, developing a shortlist and identification of preferred approach.
- Development of transition plan, organisation and budget for new UK capability.
- Develop the resource and costing requirements.
- Identification of interfaces for three organisations and ensure independence.
- The Outline case provided the organisations with underpinned data to drive current UK Alpha resilience strategy.

Rolling Programme of Decommissioning Characterisation Support

CLIENT:

NRS

Duration – 2021 to 2023
Need to define the characterisation requirements to enable dismantling of the Trawsfynydd reactors.

Cavendish Nuclear's characterisation experts defined the requirements to fully underpin reactor decommissioning and waste management and provide transferable learning.

Tasks included:

- Review of Characterisation Information.
- Preparation of initial Data Quality Objective (DQO) planning reports.
- DQO Reports for reactor areas
- Detailed sampling and survey plans.

Project identified the need and opportunity to undertake characterisation to inform the later decommissioning program reducing uncertainty.

The plans are being used throughput the decommissioning lifetime.

Waste Management Services

Dounreay Material Test Reactor Decommissioning

CLIENT:

NRS

Duration – 2017 to 2022
Waste management and characterisation support was required to support the decommissioning of the DMTR and associated infrastructure.
Cavendish Nuclear developed the following:

- Waste inventory, waste management, Characterisation Strategy and plans
- BPM approach.

The team delivered radiological characterisation and waste sentencing expertise, providing benefits such as;

- Efficient Lifecycle Characterisation integrated across life cycle
- BPM complaint with SEPA requirements and EASR2018
- 95 T concrete and 9 T metals recycled.
- Lower cost and pragmatic design for equipment minimisation
- Materials Sustainability with local gritstone used - NWS LoC process

Radiometric Characterisation Services

CLIENT:

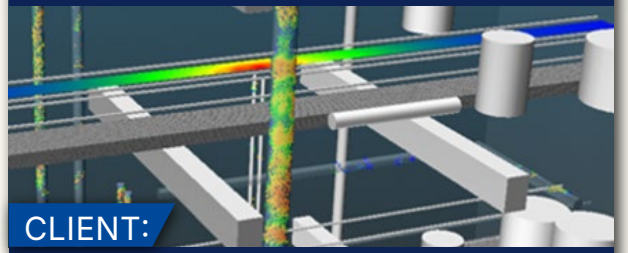
Sellafield Ltd

Duration – 2006 and ongoing
In situ measurements required to support Post Operational Clean Out of redundant facilities and transition from operations, surveillance and maintenance, and eventually decommissioning, in the safest, most effective way. Cavendish Nuclear provides on-site radiometric measurement services to support:

- Site characterisation
- Waste storage & treatment
- Address “issues” in operating plants
- Assess spread of contamination in facilities
- Decommissioning strategy, planning and operations including location and quantification of Pu, U, fission and activation products
- Assay of material and wastes

The project supports remediation, retrievals and decommissioning including the management of special nuclear materials and spent fuel.

RPAAdvice & Radiometric Measurements



CLIENT:

EA, SEPA & NRS

Duration – 2012 and ongoing
Waste Quality Checking Framework provides Regulators with access to characterisation experts, delivering independent reviews and audits of waste producers’ practices. We are currently delivering:

- Sellafield Combustible Waste Stream definition and demonstration of compliance with treatment site WAC.
- Sellafield Pile 1 Chimney Diffuser review of characterisation and measurements to confirm modelling and demonstrate compliance.
- EDF Heysham 1 Blowdown Filters characterisation and disposal approach review and assay of containers to underpin disposal.

The framework provides the EA, SEPA and NRW, with access to expert skills and knowledge.
The projects undertaken have demonstrated the suitability and provided confidence of methodologies, management of routes, and compliance with WAC and the EA with specialist Radiological Protection advise ensuring compliance with industry regulations (IRR 2107).

Waste Management Services

AGR Flask Shielding Calculations

CLIENT:

EDF Energy

Duration – 2019 to present
GEC Energy Systems Ltd, part of Cavendish Nuclear, were the original designers of the Mk A2 AGR flask and produced the original shielding substantiation calculations. Since the development there has been several changes to parameters and Safety Cases.

Cavendish Nuclear have subsequently performed multiple updates to the calculations considering revised payloads, modified fuel irradiation parameters, and changes in transport regulations.

We have extended the calculations to consider dose rates resulting from revised fuel inventories considering reactor Graphite Weight Loss.

The shielding analysis report was a key reference used for the updated transportation safety case and an important step in ensuring EDF Energy's commitments to the regulator could be met.

Laboratory Analysis

CLIENT:

Sellafield Ltd

Duration – 2014 and ongoing
Sellafield Ltd requires extensive chemical, radiochemical, and physical analysis to characterise materials and as part of the Site's regulatory obligations to the Office for Nuclear Regulation, the Health and Safety Executive and the EA.

Cavendish Nuclear's Laboratory carries out environmental, low level radiological and chemical analysis to support site operations and decommissioning activities.

The service provided has to be reliable, robust and efficient to ensure operations at Site are not impacted.

The laboratory currently has a delivery performance of 99.9% Right First-Time record and 'Acceptable' on-time for 40,000 results.

Site Characterisation & Restoration Records Management

CLIENT:

NRS in collaboration with NDA

Duration – 2021 and ongoing
Effective nuclear site decommissioning and restoration requires the collation of site usage, historical legacies, characterisation and monitoring data in a consistent format.

In line with decommissioning, restoration and release of land guidance Cavendish Nuclear has developed a new version of IMAGES and provides ongoing technical support.

IMAGES is a technical records management system that uniquely brings together desk study records and quantitative data on land, buildings, groundwater and structures in a fully integrated environment across the site lifecycle.

It provides an innovative solution for site operators demonstrating compliance, providing access to information to underpin decommissioning and new build projects.

Task-Based Support to Characterisation

CLIENT:

NWS

Duration – 2024 and ongoing
Cavendish Nuclear provide task-based support including Characterisation Subject Matter Experts to the Characterisation Enabling Studies Team, specifically the Characterisation Data Improvements and Technology and Innovation project.

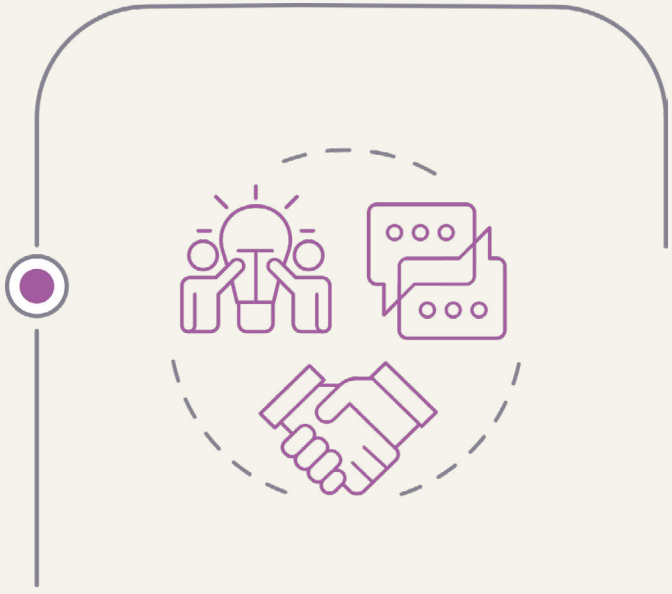
The Enabling Studies, part of the Integrated Waste Management Programme (IWMP) Characterisation Programme, aims to deliver immediate and long-term benefits, transforming the Characterisation services available to the NDA Group, to support delivery of their mission.

The Characterisation scope was developed collaboratively with experts across the NDA Group. Cavendish Nuclear is leading the validation of the programme's overall scope, assumptions and exclusions to define the scope of the Enabling Studies.

The team has continued to deliver beyond what was asked and came up with some great work proposals that adds significant value. The team is being proactive and delivering with minimal input.

Waste Management Services

Treatment & Packaging



TREATMENT & PACKAGING

- Optioneering
- Decontamination
- D&D
- Treatment
- Conditioning
- Packaging
- Transport

Submarine Dismantling Programme

CLIENT:

Ministry of Defence

Duration – 2021 – Present

The MOD have committed to fully dismantle the first Laid Up Submarine, Swiftsure by 2026 which includes the removal and storage/disposal of the RPV and all associated Low Level Waste (Stage 2). Babcock and Cavendish Nuclear have developed the Stage 2 approach, facilities and equipment for dismantling Swiftsure from pre concept to the latest ongoing stage, Engineering design.

Cavendish Nuclear's waste experts have been key to:

- Initial optioneering,
- Developing the waste inventory
- Identifying the waste processing, packaging, and disposal routes.
- Demonstrating Submarine Dismantling is ALARP and BPM.

The team work closely with on-site Waste management and engineering teams developing approaches to achieve a worldwide first of kind submarine dismantling and waste management approach.

Berkeley Vault FED Retrievals

CLIENT:

NRS

Duration – 2011 and ongoing

The Berkeley Active Waste Vaults retrieval programme includes the design and installation of mechanical handling and processing equipment to retrieve legacy Intermediate Level Waste from subterranean vaults containing loose and contained metallic Fuel Element Debris and hazardously pressurised sludge cans. Works included;

- Characterisation - bespoke HRGS system was designed and installed to determine the inventory and dose enabling real time decisions and removal of high dose items.
- Size Reduction - identified two technologies to enable remote size reduction of waste to comply with waste packaging.
- Waste Packing & Management - development of waste sentencing decisions.

Cavendish Nuclear effectively delivered to challenging timescales and value for money waste led solutions to enable complex retrievals in high hazard environments.

Waste Management Services

Radioactive Waste Treatment Lifecycle & Product Analysis

CLIENT:

NWS

Duration – 2022 to July 2023
NDA Group has diverted over 98% of lower activity metallic waste from disposal at the Low-Level Waste Repository.

Economic impacts of direct metallic treatment costs are understood. To inform optimisation, the wider lifecycle impacts needed to be quantified.

Cavendish Nuclear undertook a technical peer review of proposed routes for metal treatment that considered:

- Full lifecycle - social, environmental and economic impacts of current techniques.
- Opportunities and specifications for producing products manufactured using radioactive metal.

The project identified that decontamination of metal waste to conditional clearance by melting for reuse by the UK nuclear industry provided clear environmental, sustainable, and social benefits.

ILW Treatment

CLIENT:

NWS

Duration – 2004 - ongoing
Cavendish Nuclear provided Task-Based Support to NWS's ILW Treatment project. The project aims to treat ILW as Business As Usual in line with the Waste Hierarchy. This project included 5 main tasks with 'enabling' activities:

1. Inventory improvement/management.
2. Exploring how LLW is managed in the UK, and by NWS, to gain an understanding of how ILW treatment could be achieved.
3. Gap analysis of the inventory data that waste treatment providers require versus what is currently available.
4. Assessment and manipulation of inventory data to define 'Size of the Prize.
5. Stakeholder Management.

Due to the successful working relationship, the team are now exploring the cost and non-cost related benefits of diversion of waste from a Geological Disposal Facility, using the NDA Value Framework.

Treatment Strategic Review

CLIENT:

NWS for NDA

Duration – 2024 – ongoing
Supporting NWS to conduct a Treatment Strategic Review to define the current waste treatment baseline across the NDA Group and wider industry including;

- Established the current status of work across the NDA Group.
- Identified the key issues, risks and opportunities.
- Collected waste information from site licence companies.
- Identified opportunities to establish an improved approach.
- Developing a 'systems approach' to treatment capability across the NDA Group.
- Providing clear visibility of current status, issues, risks and opportunities.
- Establishing an underpinned position to progress specific tasks driving improvements and measurable benefits.

Waste Management Services

HAWTT Research & Development Thermal Treatment Programme

CLIENT:

Sellafield funded by NDA/NWS

Duration – 2021 to 2024
The Higher Activity Waste Thermal Treatment Programme is a National strategic project to define future nuclear waste treatment strategies.

Cavendish Nuclear managed and coordinated a multidisciplinary team, including supply chain companies, to investigate the holistic value and benefits of thermal treatment over cement encapsulation baseline options for:

- Plutonium Contaminated Materials,
- Pumpable Intermediate Level Waste,
- Mixed Solid Beta Gamma Wastes.

Conceptual plant designs, with underpinning data, cost, safety, criticality, environmental and carbon cases for all 3 options were defined with a summary to Government (Strategic Case for Change) produced. This document is currently going through assurance processes before delivery to government. It will form a seminal sign posting document for nuclear waste treatment in the UK.

Conditioning, Packaging & Disposal Strategy

CLIENT:

Hinkley Point C (EDF Energy)

Duration – 2018
To address regulatory needs a preconcept design of a facility for Spent Fuel Inspection and Packaging to enable disposal was required, including:

- Identification of fuel inspection techniques through-life requirements
- Underpinning requirements including high-level shielding assessment, radiation zoning
- Integration with on-site and off-site interfaces
- Description of operations and identification of plant and equipment with throughput model
- Facility layout underpinned by flow diagrams for the life processes
- Resource requirements and cost estimates for all phases including decommissioning.
- Risk register for implementation and operations

Final part of the HPC GDA submission which has been a key enabler to commencement of site works.

Conditioning, Packaging & Disposal Strategy

CLIENT:

Rolls-Royce

Duration – 2024
Concept design including hazard identification of a Facility for Wet Waste Conditioning, Packaging for Disposal was required to establish a baseline for the SMR GDA submission. Cavendish Nuclear considered requirements for borderline LLW resins, sludges and evaporator concentrates. The underpinned solution determined:

- Fleet assumptions, enabling shared infrastructure over different sites.
- Boundaries and interfaces for the process and between sites.
- Consideration and optimisation of space constraints and shared infrastructure.
- Operational model to underpin design
- Description of operations and identification of plant and equipment with throughput model
- Resource requirements and cost estimates for all phases including decommissioning.

Waste Management Services

Fleet Through-Life Transport Assessment

CLIENT:

U Battery (Urenco)

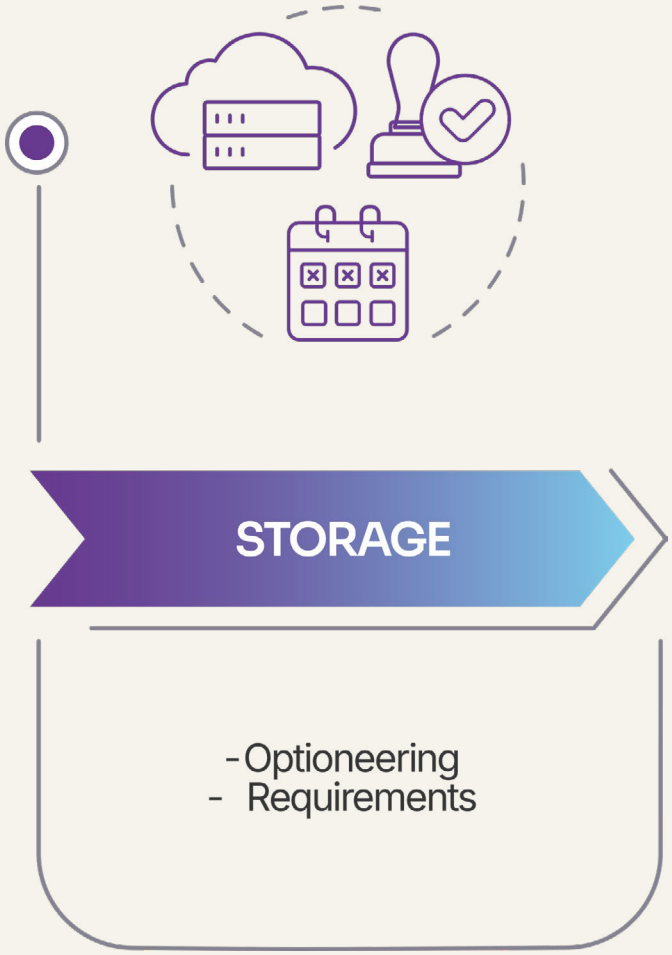
Duration – 2021 to 2022
Strategic assessment was required to define the number and type of transport activities through the lifecycle of a fleet U Battery reactor, including:

- Identify modularity of systems facilitates transport of the full fleet lifecycle
- Transport of construction modules, fuel, process equipment, and waste.
- Calculated the number of transports for a single reactor over all phases
- Development of transport process flowcharts for each phase
- Mapping of interfaces between transport functions and team sizes
- Define the fleet assumptions to optimise transportable operational and decommissioning items used by the fleet on a shared basis

The information contributed to Urenco's business case to assess viability of this AMR solution.

Waste Management Services

Storage



Chemistry Consultancy To Support Facility Build Design

CLIENT:

Defence Sector

Duration – 2022 to present

A high temperature production process which involves corrosive and reactive materials was to be housed in a new facility.

The combination of characteristics poses a unique challenge:

- Unknown kinetics, corrosion mechanisms and interactions of process and construction materials.
- Subsequent compatibility and design life of process materials.
- Storage, handling and supply arrangements for introducing corrosive reagents.

A comprehensive literature search and review was needed to provide underpinning corrosion, reactive material characteristics information to validate construction compatibility assumptions and inform design life calculations and maintenance schedules.

Feasibility Of The Refurbishment & Reuse Of The SSBs

CLIENT:

Sellafield Ltd

Duration – 2023 to 2024

Self-shielded boxes will be used to store metal uranic fuel bearing materials from the NDA Estate. The project was to assess the feasibility of SSB refurbishment and reuse including removal of liquor to facilitate long term fuel storage, as well as;

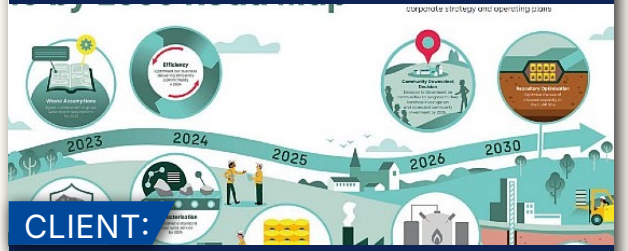
- Optioneering to define reuse approaches and possible locations.
- Technology Readiness Level (TRL) evaluating each option and next steps to increase maturity.
- Best Available Techniques and As Low As Reasonably Practicable using the NDA value framework.
- Create Technology and Engineering Delivery Plan.

Cavendish Nuclear received positive feedback from the client, who noted they worked collaboratively, delivering in a timely mannerThe project enabled Sellafield to demonstrate application of the waste hierarchy, assess potential cost savings and inform strategic decisions for reuse.

Waste Management Services

Disposal

Task Based Support To Higher Active Waste Framework



CLIENT:

NWS

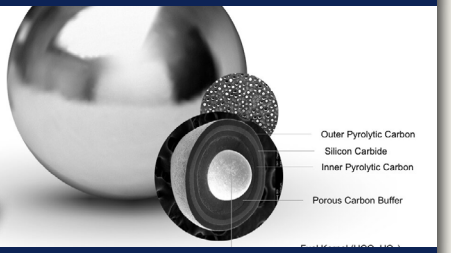
Duration – 2022 to 2023

Supported NWS to measure of performance (MOP) justifications for key requirements in the Waste Package Specifications (WPS) for Low Heat Generating Waste (LHGW), including;

- Scope definition, assumptions and constraints and management of programme and schedule ensuring delivery on time, to budget and quality.
- Stakeholder Engagement and Communication Plan, and Stakeholder Register management.
- Definition of MOP requirements from WPS Parts C and D under technical headings including conducting a review of all previous work associated with the justification of requirements.
- Production of a WPS Requirement Justification reports (Part C and D) and creation of Part E Justification Internal Deliverable.

As a result of the project key technical gaps with requirement underpinning were identified.

TRISO Fuel Disposability Assessments



CLIENT:

X Energy

Duration – 2024 and on going

Cavendish Nuclear worked with X Energy to produce a disposability assessment submission under the GDA process.

- Collation and enhancement of existing TRISO fuel data for submission including defining benefits
- Development of through-life strategy from operation of the first reactor through to decommissioning of the final reactor and disposal of the final fuel pebbles.
- Development of fleet assumptions to establish durations for packaging for disposal and transport windows and rates
- Identification and development of disposal scenarios to test the optimal approach
- Early and regular engagement with NWS to achieve a 'right first time' submission
- Confirmation that a disposal vault specific to the properties of spent TRISO fuel would be cost effective should a fleet of reactors be deployed.

Waste Management Services

Site Restoration

Site Restoration Capability

CLIENT:

Various

Duration – Ongoing
Final site clearance is the last lifecycle stage in the mission to clean-up the legacy nuclear sites to enable de-designation and re use for other uses.

Cavendish Nuclear has the following capacity to support this stage of the lifecycle:

- Site Investigations and Characterisation
- Soil and/or groundwater remediation
- Soil and/or groundwater sampling and field analysis
- Geotechnical Site Investigations
- Environmental Management and Planning
- Geographical Information System
- Records management/ IMAGES
- Nuclear Safeguards

Site Remediation

CLIENT:

RWE Grimsby

Duration – 2020 and ongoing
A UK site where naturally occurring radioactive material (NORM) residues resulting from historic titanium dioxide refining plant operations has undergone remediation.

To enable remediation and permit surrender Cavendish Nuclear have supplied Radioactive Waste and Radiation Protection Advice to support the:

- Management of solid and liquid radioactive waste arisings
- Permit variation for liquid radioactive waste
- Permit compliance
- BAT assessments
- Permit surrender process
- Transport assessments
- DQO assessment and sampling

The Site is planning for permit surrender and remediation to enable reuse of the area providing jobs for the local community.

Cavendish
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Creating
a safe and
secure
world
together