The UK Geological Disposal Research Strategy

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Introduction

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• Fellow of the Institute of Physics
• Over 25 years’ experience in geological disposal
• Expert peer reviewer of international safety cases
• Leading roles in NEA, IAEA and EC projects
• Over 40 publications covering the safety case and other technical and societal aspects of geological disposal
Outline

• Current status of UK programme – GDF siting
• UK research strategy during early siting
  – Importance of building understanding – Scientific Readiness Levels™
  – Presenting understanding – claims, arguments and evidence
  – Integrating and visualising system information (ViSI tool)
  – Identifying knowledge gaps and research priorities
• The Research Support Office
  – Delivery of focused research through strategic, coordinated relationships
• Value of international collaboration
  – Building trust
• Conclusions
Overview of the UK GDF siting process

Latest update: Copeland Borough Council – Sellafield is located in this borough – publicly announced intention to work with us and form a Working Group
Who’s in a Working Group?

- **WG Chair (independent)**: part time, chairs all formal meetings, spokesperson
- **WG Facilitation (independent)**: full time, designs the dialogue with community, coordinates stakeholder map
- **WG Secretariat (independent)**: part time, general admin
- **Regional Manager (RWM)**: full time, manages whole WG process
- **Siting Manager (RWM)**: full time, manages site evaluation process
- **Comms Lead (RWM, IP or 3rd party)**: delivers comms & engagement plan – supported by RWM Comms team
- **Other WG members**: Interested Parties, Councils, community groups
Working Group: public communication

Key WG responsibilities:
- Identify a Search Area (and hence a community)
- Identify prospective members of a Community Partnership
- Engage with Relevant Principal Local Authorities

Microsite includes:
- Key facts about GDF
- WG contacts
- Newsletters
- WG events schedule
- FAQs

*The website transfers from WG to CP*
Research strategy during early Siting: building confidence in safety

Through developing understanding of:

- Evolution of GDF barriers in terms of their safety functions
- What FEPs affect the safety functions
- Radionuclide release and transport to accessible environment
  - Groundwater
  - Gas
- Engineering design
- Operations
  - Construction
  - Hazard identification and mitigation
- Transport
  - Robustness of transport containers to accidents
  - Dispersion of particulates through seals
Technology Readiness Levels

- Technology Readiness Levels – a risk mitigation tool – immature technology is a prime cause of cost growth and schedule delay
- Invented by NASA in 1974, widely used across defence and technology, including nuclear decommissioning in the UK
  - Provide common understanding of technology status
  - Key driver is risk management
  - Used to make decisions concerning technology funding
  - Used to make decisions concerning transition of technology
Application of TRLs to Geological Disposal?

- TRLs are a useful tool where Siting has progressed, a disposal concept has been agreed and the site has been characterised.

- However:
  - Readiness does not necessarily fit with appropriateness of technology.
  - Without a site, and with purely illustrative concepts and designs, our need is to develop understanding, not technology.
  - For the purposes of calibrating the scientific maturity of underpinning science, identifying the requisite level of scientific maturity and plotting a route to attaining that robustness in understanding, TRLs have proven intractable.

A ceramic spent-fuel matrix is a part of the multi-barrier system.
- It therefore provides a safety function.
- Need to identify whether further research is required on the dissolution of radionuclides from spent fuel.
- TRLs cannot be applied at this level.
- Need a means of calibrating scientific understanding.
Scientific Readiness Levels™

- Developed by UK’s National Nuclear Laboratory – looking at Gen IV new build.
- A useful tool for assessing:
  - current understanding
  - what understanding is required / sensible at the generic stage.
  - measurement of success
- Support policy development and WMO research planning and prioritisation
- Help to challenge adequacy of current plans
- Assist our Regulators in understanding critical knowledge gaps
- Defend the WMO from the “search for all knowledge” (at infinite cost and time)
- Assist dialogue with academia / Research Councils by explaining when sufficient understanding has been gained to bound an uncertainty
- SRLs™ provide focus on real needs by examining our level of understanding
Presenting our understanding & confidence in safety – claims, arguments, evidence

• The environment agencies’ Guidance on Requirements for Authorisation (GRA) sets out the Principles and Requirements for demonstrating the post-closure environmental safety of a GDF

• Reflected in the Disposal System Specification (DSS)

• Addressed in Environmental Safety Case (ESC)
  – most recently as the published 2016 generic ESC, within the generic Disposal System Safety Case (DSSC)

• Now expressed more explicitly in terms of claims to be made against the regulatory requirements, arguments that explain how those claims will be met, and evidence to support the arguments
ESC high-level claims

We will show that assessed risks from the disposal facility after the period of authorisation are consistent with environmental safety standards (from GRA R6)

We will show that human intrusion after the period of authorisation is unlikely (from GRA R7)

We will show that the accessible environment is adequately protected from the radiological effects of the disposal facility (from GRA R9)

We will show that the disposal system will provide adequate protection against non-radiological hazards (from GRA R10)

We will show that site use and facility design, construction, operation and closure will not lead to unacceptable effects on disposal system performance (from GRA12)
ViSI – Visualisation of System Information

- Digital safety case management system, bringing together *and connecting* all relevant information, thus promoting traceability of arguments and evidence
  - Status of ViSI
    - Includes the ESC and all supporting documents, will be extended to include transport & engineering safety arguments
    - Widespread international interest in ViSI tool from sister organisations & Regulator

- A valuable tool for the RWM Research Support Office (RSO)
  - Identifying knowledge gaps & requirements
  - Demonstrating value of research in supporting safety arguments
  - All tasks in our Science & Technology Plan mapped into ViSI
The RSO – Driving our research strategy to deliver the GDF
RSO operation

- **Hub**: RSO Core management team, driven by GDF programme needs – coordinating & prioritising research
- **Spokes**: Academic Discipline Leads, working with RWM Subject Matter Experts – defining research scope
- **Wheel / tyre**: Universities, research centres, international bodies – delivering research
- **Together**: Delivering understanding to underpin GDF safety cases and developing an engaged, informed academic network
RSO objectives and outcomes

- Long-term **strategic** relationship with UK universities
- Better aligned academic research addressing **RWM needs**, with stronger delivery-focus
- Increased **engagement** with world-class cutting edge science
- Increased contextual understanding and enhanced **advocacy** within respected and influential stakeholder group
- A better co-ordinated **community** of RWM funded researchers
- Developing **next generation** of researchers
- Higher level of **economic gearing** from UKRI, universities and other funding sources
- A sustained and enhanced **multi-disciplinary capability** through collaborative long-term relationships
RSO management

Strategy Board
- Core team plus:
  - RWM Head of research & environment
  - UKRI representation
  - DL representative
  - Other representation

Programme Executive
- Core team plus:
  - RSO Discipline Leads
  - RWM SMEs
  - RSO Training Lead
  - Universities representation

Core team
- Head RSO: Bailey
- RSO Director: Morris
- UoS Co-Director: Hyatt
- UoM Co-Director: Shaw
- RSO Manager: Bayram

- Provide strategic guidance to PE
- Steer research and activity focus
- Oversight of research portfolio
- Foresight on funding landscape
- Prioritise RSO activity
- Review and report DL activity to SB
- Review and report risk register to SB
- Monitor and report KPIs to SB
- RSO operations and Discipline Leads
- Budget control
- Reporting to Programme Executive
- Reporting to RWM
Value of international collaboration

• Cost effective to collaborate, e.g. shared URL facilities
  – Stakeholder visits
• International consensus helps to build stakeholder trust
  – Common methodologies
  – Common tools, e.g. the NEA international FEP database
• Social science is important too
  – OECD-NEA Integration Group for the Safety Case (IGSC) working closely with the Forum for Stakeholder Confidence (FSC) – building and communicating confidence, engaging in the face of uncertainties
  – Safety Case is only as powerful as our ability to communicate it!
Concluding remarks

• Building **understanding** is the most important focus for research during early Siting

• **Communicating** understanding to all stakeholders is important for building **trust**

• **Integrating** and visualising system information facilitates the identification of knowledge gaps, to focus a **needs-driven research programme**

• RWM’s Research Support Office is building **collaborative networks** of researchers and promoting direct engagement with WMO expert staff

• International collaboration is cost effective and valuable for building stakeholder confidence where there is **international consensus** on state-of-the-art methodologies and tools
Radioactive Waste Management

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https://www.research-support-office-gdf.ac.uk/