



The UK Geological Disposal Research Strategy

Presentation to US NWTRB
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Radioactive Waste
Management

Working together to protect the future

Introduction



Lucy Bailey

Head of Research
Support Office

- **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

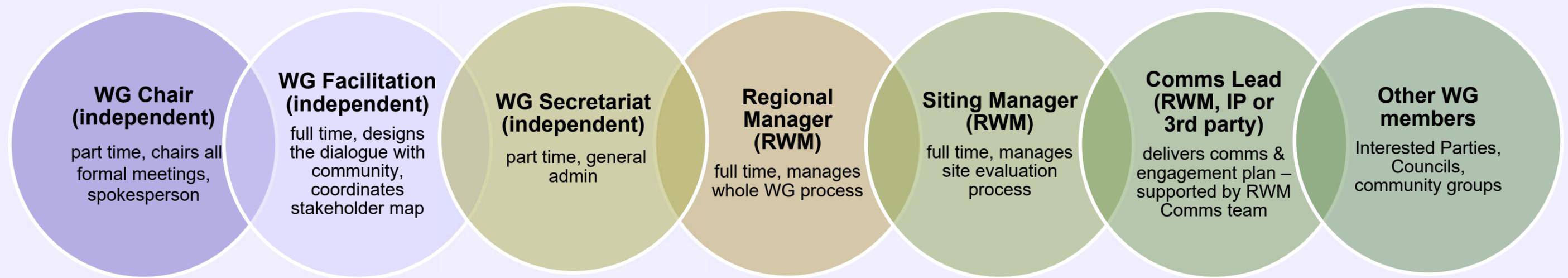
- **Current status of UK programme – GDF siting**
- **UK research strategy during early siting**
 - Importance of building understanding – Scientific Readiness Levels™
 - Presenting understanding – claims, arguments and evidence
 - Integrating and visualising system information (ViSI tool)
 - Identifying 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

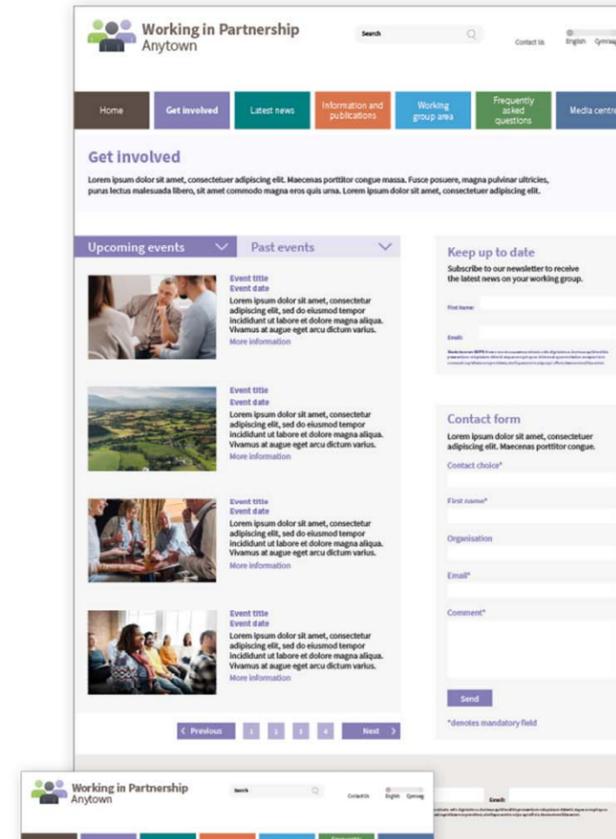
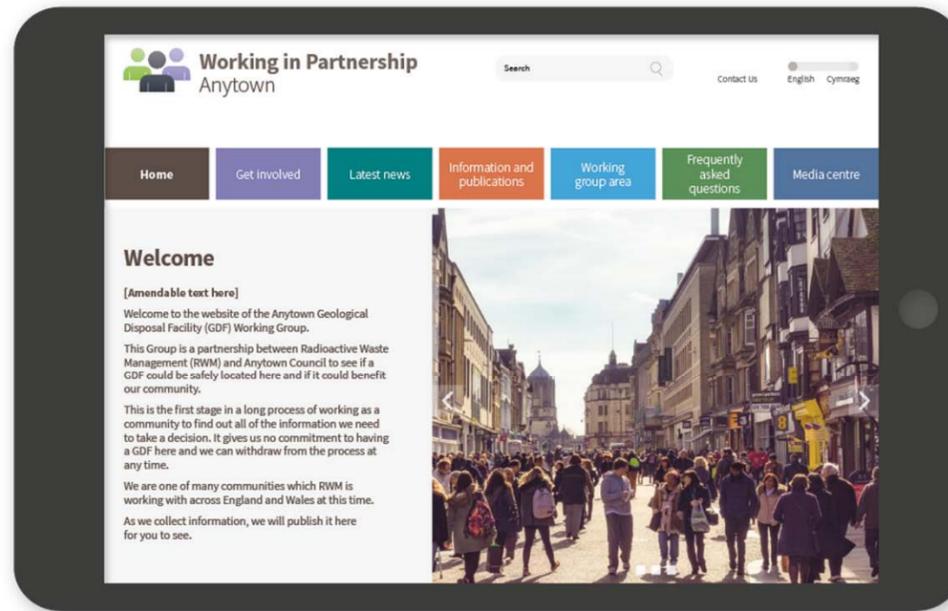
Who's in a Working Group?



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:

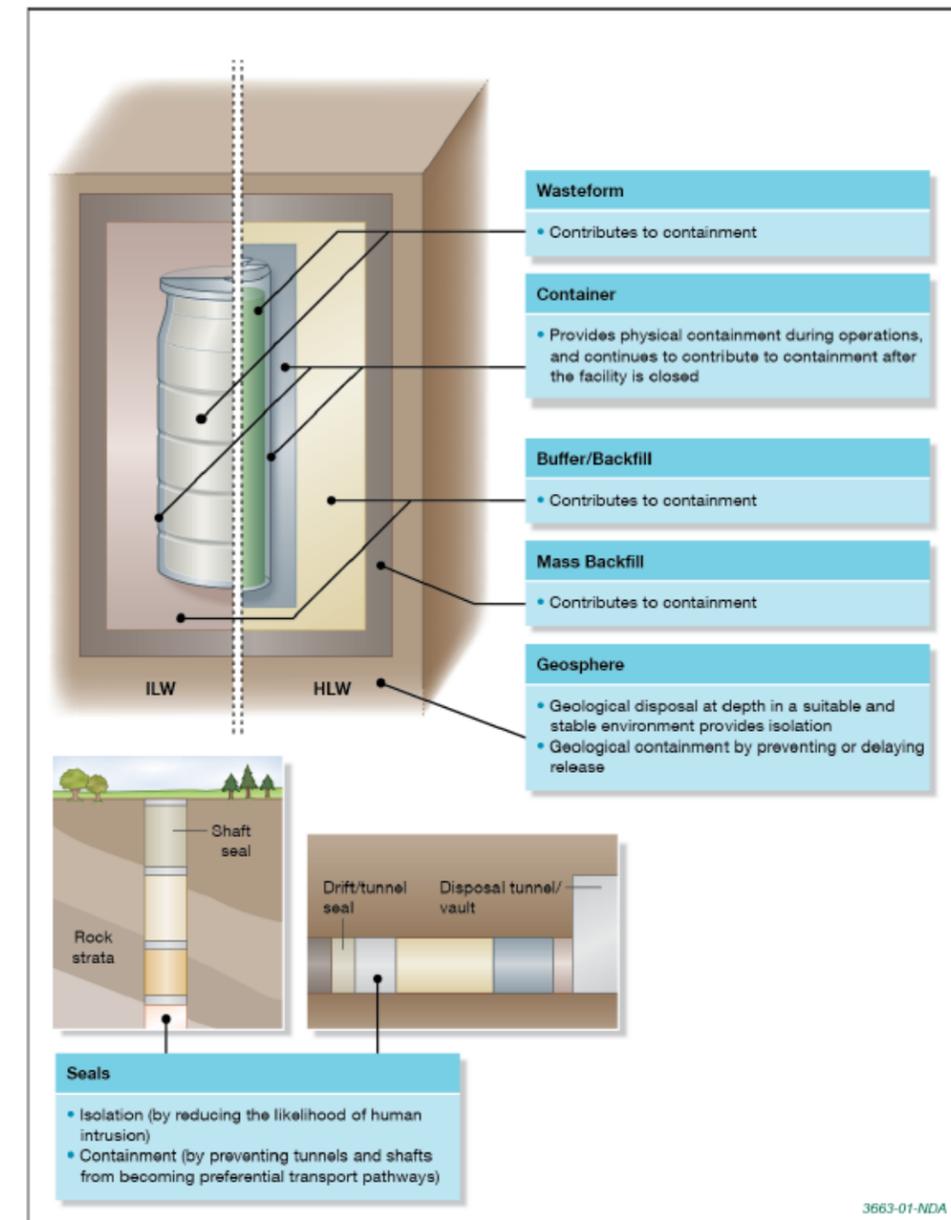
- Key facts about GDF
- WG contacts
- Newsletters
- WG events schedule
- FAQs

The website transfers from WG to CP

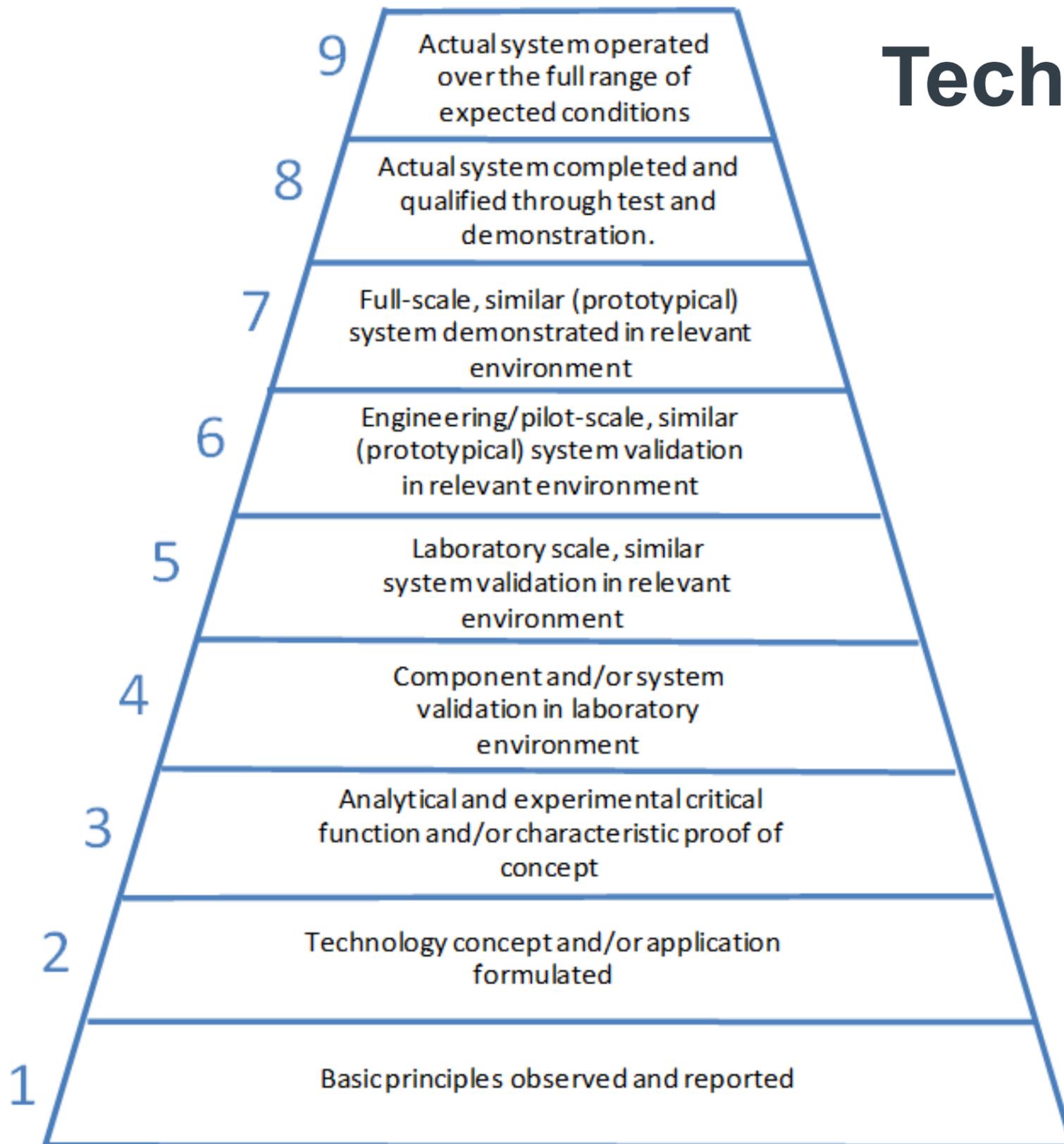
Research strategy during early Siting: building confidence in safety

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



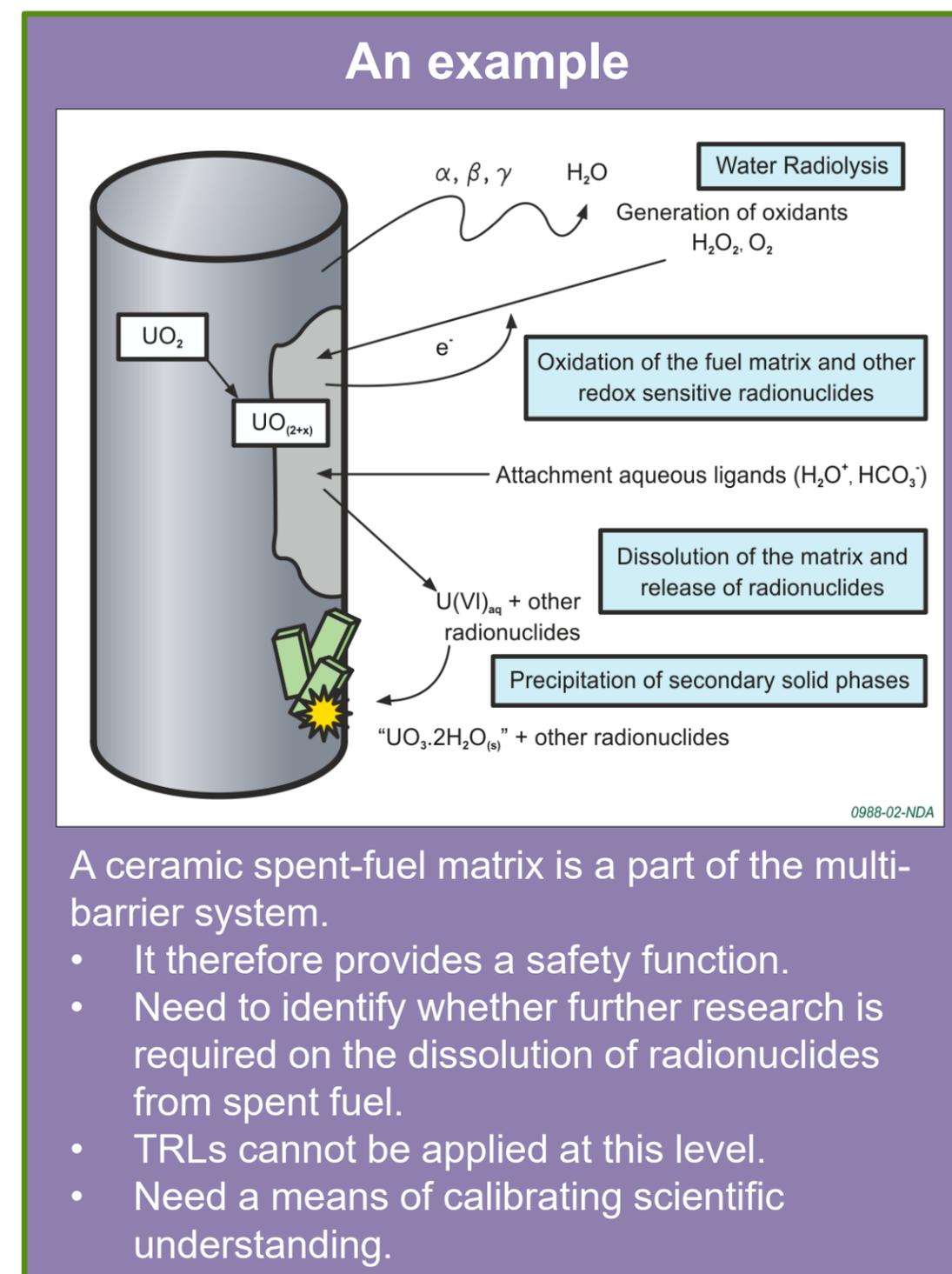
Technology Readiness Levels



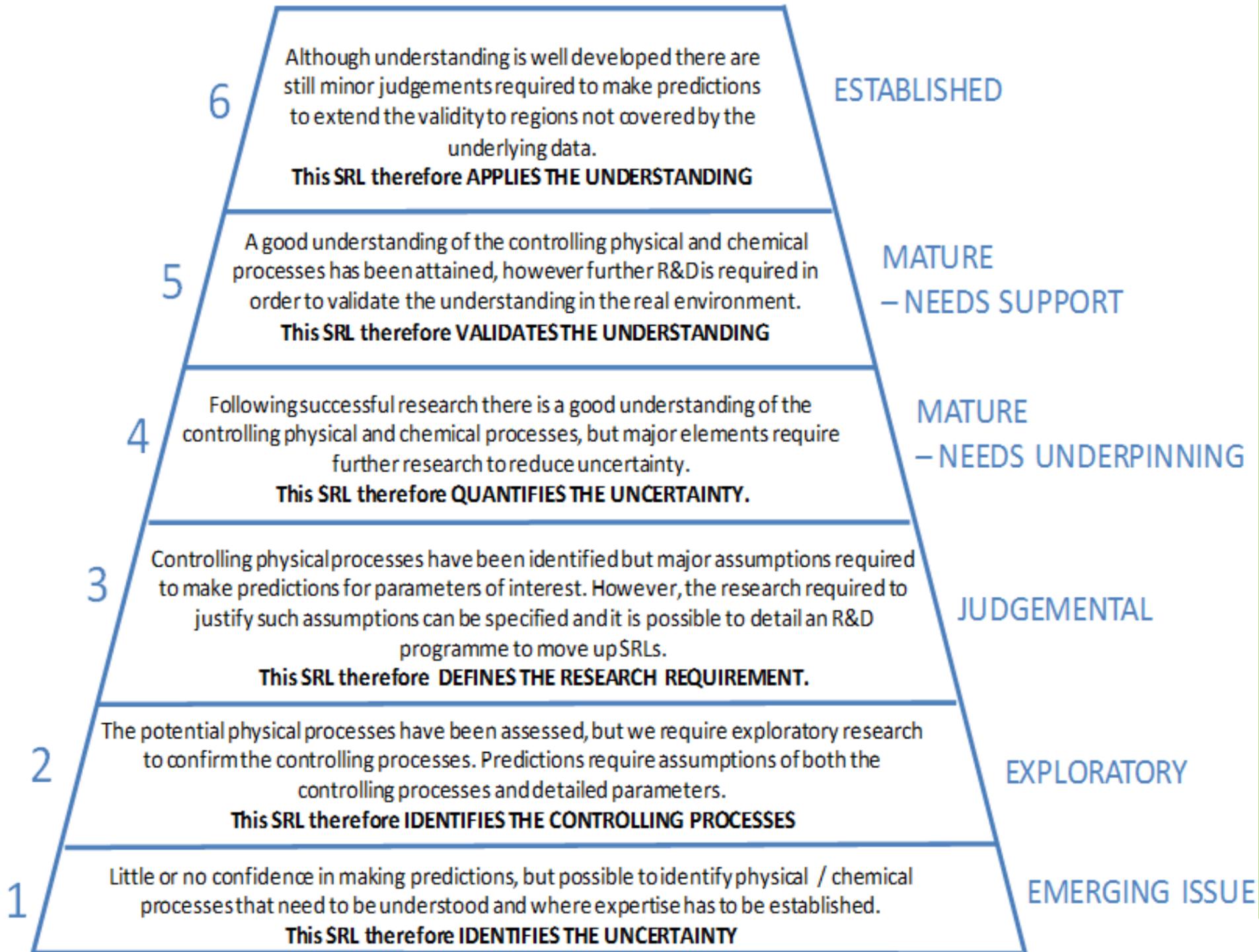
- **Technology Readiness Levels – a risk mitigation tool – immature technology is a prime cause of cost growth and schedule delay**
- **Invented by NASA in 1974, widely used across defence and technology, including nuclear decommissioning in the UK**
 - Provide common understanding of technology status
 - 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



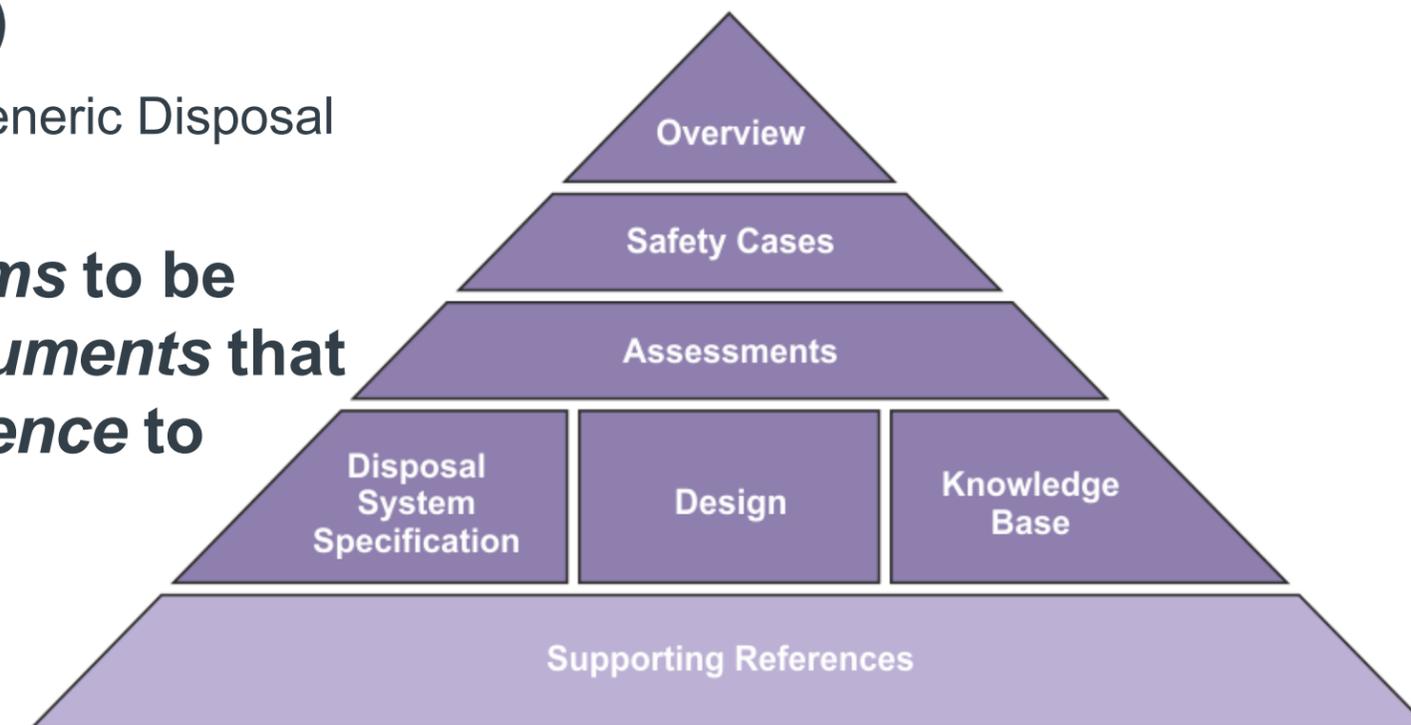
Scientific Readiness Levels™



- 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**

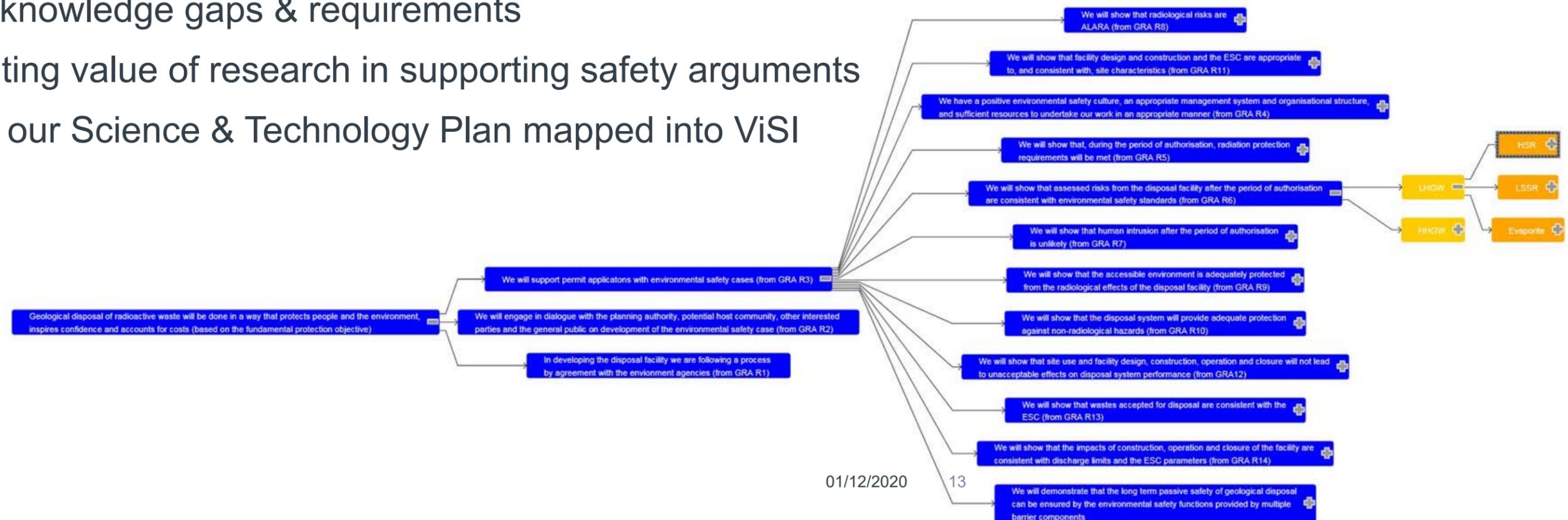


ESC high-level claims

- 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

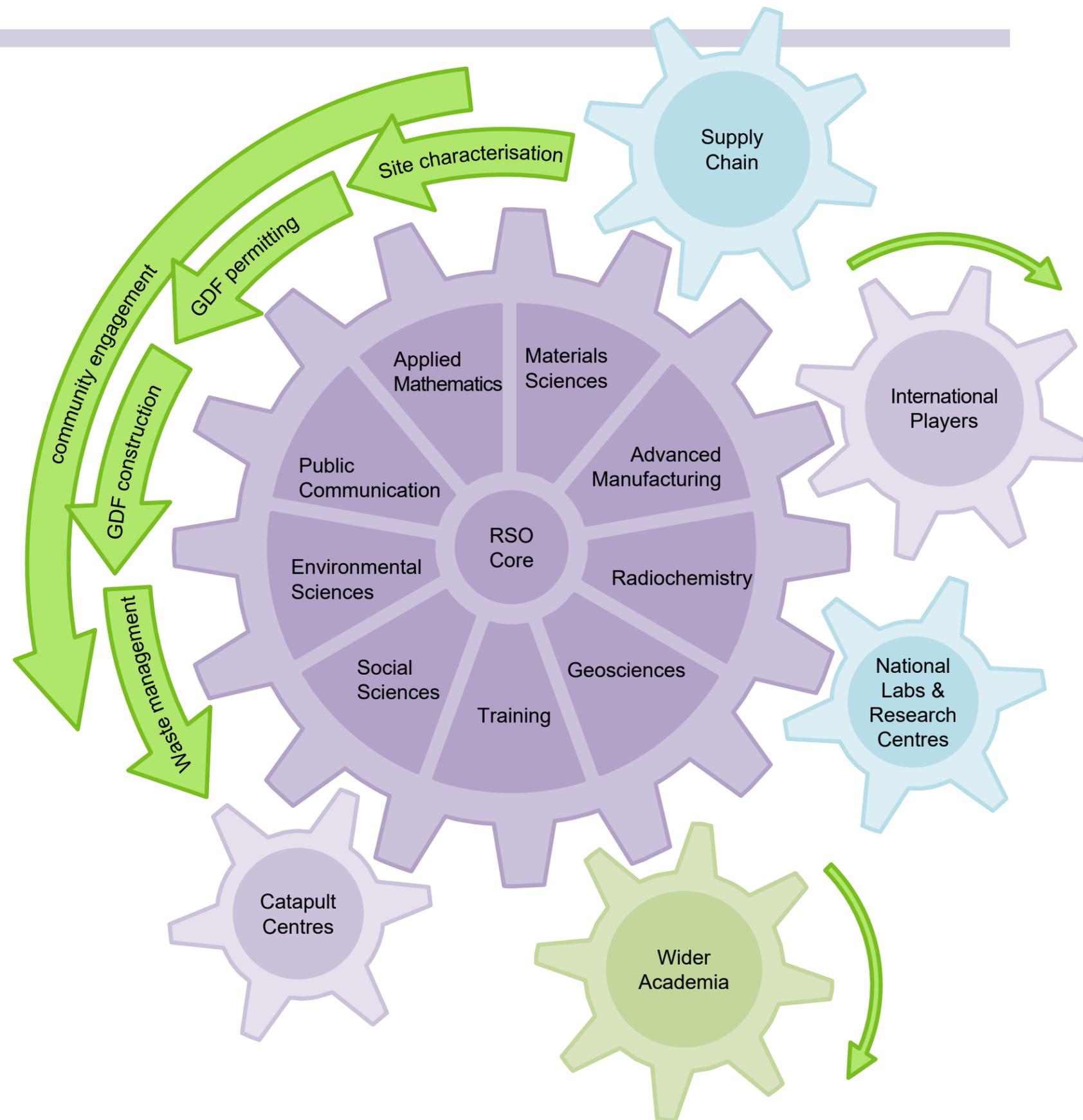


The RSO – Driving our research strategy to deliver the GDF



RSO operation

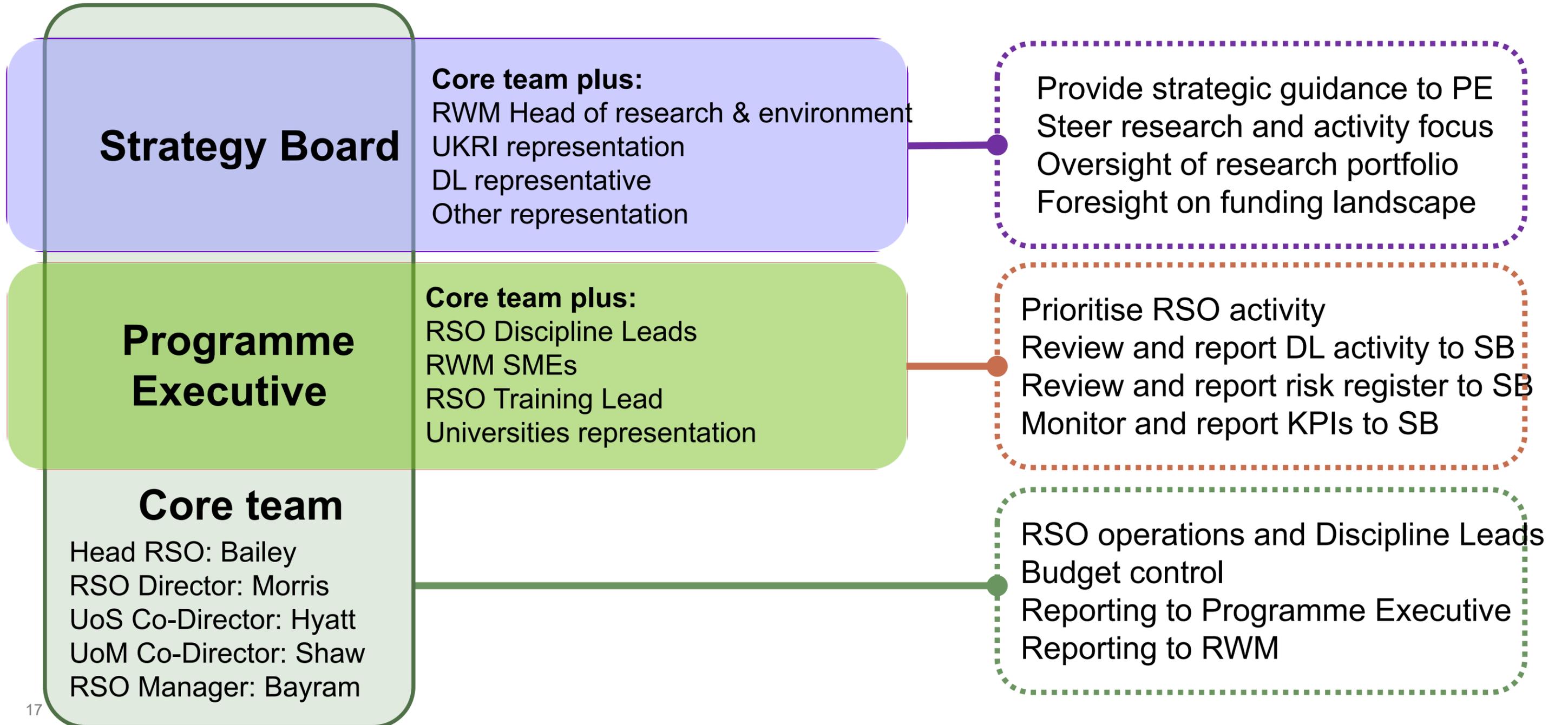
- **Hub:** RSO Core management team, driven by GDF programme needs – coordinating & prioritising research
- **Spokes:** Academic Discipline Leads, working with RWM Subject Matter Experts – defining research scope
- **Wheel / tyre:** Universities, research centres, international bodies – delivering research
- **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





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

Lucy.Bailey@nda.gov.uk

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