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Review of Radioactive Waste Management Directorate's (RWMD) R&D Programme Issue 2

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About the Independent NDA Research Board

Despite its title, the Research Board has terms of reference which cover the Research and Development (R&D) interests for waste management and decommissioning of the UK, not just the that of the NDA. Given the scale of the NDA's work in this sphere however, much of its time is dedicated to the NDA's own programme. Although the Board works cooperatively with the NDA, which provides the secretariat, it is independent. Neither its programme of work or published opinions have to be agreed with the NDA. Its membership comprises experts in the field and senior representatives of key stakeholder organisations such as Government departments and regulatory bodies. Its role is advisory only, reporting to the main NDA Board and to Government departments via their Chief Scientific Advisors. Further information on the Research Board can be found on the NDA website (www.nda.gov.uk).

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1 Introduction

The reader is asked to note that the date of October 2014 on the cover page is the publication date of this document. The content, however, is based on evidence presented to the NDA independent Research Board (NDARB) up to the date of its sixth meeting (02/10/2013); any more recent developments have not been included in this review.

A key responsibility of NDA is the delivery of a geological disposal facility (GDF) for the disposal of the UK's radioactive waste that cannot otherwise be sent to a shallow land repository. That part of NDA charged with managing the programme to establish a GDF is the Radioactive Waste Management Directorate (RWMD)[1]. RWMD's Technical Programme in pursuit of this objective has been published on NDA's website[2] and this programme now includes discussion of the R&D necessary in support of the GDF development.

The NDA Research Board (NDA RB) has examined the RWMD R&D programme and has agreed this statement of its conclusions from that examination. In particular the RB set out to answer the following questions:

Q1. On the basis of the evidence available to the Research Board does the Board consider the process for developing the R&D programme is soundly based?

Q2. Does the Research Board consider the mechanisms for review of the R&D programme are at least adequate (they could be more than adequate)?

Q3. Recognising the extensive work of others (the RWMD's Technical Advisory Panel (TAP), Regulators and the Government's Committee on Radioactive Waste Management (CoRWM)), are there still areas where the Research Board believes there could be gaps in the R&D programme or where it would like to test for gaps?

Q4. Does the Research Board consider that the R&D programme is adequately communicated to RWMD's stakeholders?

[1] As of 1st April 2014, RWMD became a wholly owned subsidiary of NDA, Radioactive Waste Management Ltd. Given the "freeze date" of this document of 2nd October 2013, RWMD is used throughout.

[2] NDA, *Geological Disposal Technical Programme: Part A – Introduction*, NDA/RWMD/094, July 2013; NDA, *Geological Disposal Technical Programme: Part B – Delivery*, NDA/RWMD/094, July 2013 and NDA, *Geological Disposal Technical Programme: Part C – Research & Development*, NDA/RWMD/094, July 2013.

2 General Observations

- Previously the R&D programme was published as a separate document; it is now presented as part of the overall Technical Programme. The RB supports its presentation in this way, allowing the R&D to be seen in the overall context of the delivery programme.
- A key difficulty for RWMD is that there is no UK site yet selected, so that the geological environment and host rock formation of a future GDF are presently unknown. At this stage RWMD needs to have a generic programme that considers a range of potentially suitable host environments. The UK contains similar or analogous geological environments to those being studied by advanced disposal programmes in several European countries. A close relationship with the work being carried out in these countries provides a firm basis for RWMD's generic programme. The RB notes that a consequence of this uncertainty over geological environment is reflected in the Technical Programme Part A, which states, "For the most part, activities planned during underground operations (which will involve underground based investigations, construction and operations) are not discussed in this document. This is because RWMD anticipated that its plans for this stage are likely to evolve significantly over the course of the prior stages of the site selection process ..."
- A further difficulty for RWMD is that the inventory for disposal in a future GDF is not well defined. In particular, spent fuel, plutonium and uranium are currently not classified as wastes, but may subsequently be treated as such. In addition allowance must also be made for wastes arising from proposed new nuclear build in the UK. The volume of such wastes will depend on the reactor types built, how many there are and for how long they operate. The RB supports RWMD's approach of planning on the basis of bounding upper and lower inventories and developing its R&D needs on the basis of the upper inventory.
- The R&D components of the RWMD Technical Programme is "needs driven" with R&D requirements identified primarily from the iterative development of the Disposal System Safety Case. The RB supports the "needs driven" approach as a sensible means of targeting the R&D expenditure to the most appropriate areas.
- Good Practices; in addition to recording its responses to the four questions that it set for itself, the RB would also like to record that in conducting this review it was pleased to note a number of good practices that RWMD employs for setting up and managing its R&D programme and the very considerable information and data that this produces. Good information and data management is particularly needed given that the programme for GDF implementation will last a few decades and that for operation and post closure management will extend for a period of more than one hundred years. These noted good practices were:
    - As noted later in response to Q3, the Issues Register, for recording challenges or concerns from a wide variety of sources, ensuring that these are not lost and that answers are subsequently provided.
    - The RWMD Knowledge Base. The large number of documents produced underpins the technical basis for the programme. All documents published since 2007 are available to stakeholders to download directly from the NDA website. References to documents prior to that date are also provided and these documents are made available on request.
    - Data Management System. As RWMD state in their Technical Programme, "A large proportion of the data that have, and will continue to be generated as part of the work programme, is significant for nuclear safety and environmental protection. The data will support site identification assessment and investigation, disposal system specification,

design, safety case, sustainability and environmental assessment, cost estimates, and decisions about endorsement of waste packaging proposals.

RWMD is developing a management system approach to data management. The Policy and Principles for data management have been developed: these emphasise the importance of valuing data as an asset, managing its quality, integrity and security, ensuring it is traceable to source, and making data accessible to users ..."

3 Question 1

On the basis of the evidence available to the Research Board does the Board consider the process for developing the R&D programme is soundly based?

- In Part A of the Technical Programme publication, RWMD state, "This document has been produced so that ... (it) contains the necessary detail on the Technical Programme to demonstrate that the forward programme of work will provide a reasonable and credible route to achieving the necessary research and development." Also, "RWMD has developed a requirements driven iterative development process to ensure that all the necessary areas of technical work to deliver a GDF are identified. For long-term work programmes, this process allows them to be placed into a logical structure to ensure that relevant interfaces, and crucially interdependencies, can be highlighted."
- Firstly, are we spending unnecessarily? The RB notes that several billion dollars has been spent internationally on geological disposal R&D. Given the scale of this expenditure it is sensible to ask what remains to be done and when is enough enough? The RB's understanding of the justification for a continuing UK R&D programme is:
    - The importance of participating in the international programmes and benefitting from the knowledge gained:
        - As an example of the importance of such participation, other nations have underground laboratories or sites already selected. RWMD geosphere research is currently almost entirely undertaken through joint research projects in these facilities.
        - The willingness of international repository programmes to share information is a key benefit to the UK. In order to participate the UK needs to have an active programme that can contribute to the "club".
    - Given this scale of expenditure, what is left to be done in UK?
        - The UK inventory is unusually wide for a single GDF (e.g. uranium, ILW from reprocessing, bulk graphite from gas cooled reactor moderators, 'exotic' reactor fuels etc.). Characterisation, conditioning and packaging of some of these materials for disposal, and development of the GDF concept, design and safety case to include them, requires specific R&D work.
        - The need to meet UK specific regulations.
        - The need to link the GDF concept, design and safety case to experience and understanding from international programmes.
        - The need to optimise the design, operation and management of the overall disposal system for the types and times of arising of wastes, particularly given the expected lifetime costs (~£12B) of a UK GDF.

        - The need to have built up a solid base of UK expertise in order to succeed in the domestic implementation programme.

    - Two main types of Major Products are being produced in the R&D work area:
        - A prioritised R&D programme.

        The prioritised R&D programme, "... summarises current understanding associated with different research topics, and recent knowledge gaps that have been addressed, referencing more detailed discussion in underpinning contractor reports. It also describes, in detail, the planned/ongoing approach to undertake further work across these topics in order to address information needs and to move RWMD's understanding forward, and explains how work in each area has been prioritised as part of an overall R&D work programme."

        - A suite of research status reports.

        There are eight generic status reports:

            - Package evolution
            - Near-field evolution
            - Geosphere
            - Biosphere
            - Gas
            - Radionuclide behaviour
            - Waste package accident performance
            - Criticality safety

        These are to be followed in future by site specific status reports.

- RWMD explain the basis of their prioritisation process by answering a series of questions:
    - What is the driver for the R&D need (e.g. Disposal System Specification justification; assessment of packaging solutions; Disposal System Safety Case etc.)?
    - What needs to be known by when?
    - How important or significant is this topic area?
    - What is the knowledge gap?
    - What needs to be done to fill the gap?
    - How long will it take?
    - How urgent is the task?
- In Part C of the Technical Programme RWMD show matrices of Impact/Knowledge Gap/Urgency by which they evaluate R&D needs in response to these questions. This will soon lead to a fully prioritised programme with timescales for delivery set against the overall repository delivery programme. This is work still in progress, with an aim for publication mid-2014. All tasks rated as high urgency are currently being progressed.
- RWMD has also informed the RB that it is developing the concept of Scientific Readiness Levels (SRLs) as a means of identifying the current level of scientific maturity of each required task. It also assesses the level of maturity required at the generic stage in order to answer the question, "When is enough enough?"

3.1 RB's Response to Question 1

- Despite the very large expenditure internationally, the RB agrees that a significant UK based R&D programme is necessary to underpin the establishment of a UK GDF.
- The RB agrees that RWMD's R&D programme should be very largely needs based.
- The RB supports the development of SRLs, so that the needs at various stages of the GDF programme can be assessed against the then current state of knowledge.

Recommendation: Further engagement by RWMD with technical stakeholders on the development and adoption of the SRL approach is recommended. A comparison with existing approaches (*e.g.* Technology Readiness Levels) should be considered.

- The RWMD has set out a logical approach to establishing and prioritising the UK R&D needs in this area.

Recommendation: The RB encourages the further development of this approach to establish a fully prioritised programme with timescales set out against the needs at each stage of the overall GDF delivery programme.

4 Question 2

Does the Research Board consider the mechanisms for review of the R&D programme are at least adequate (they could be more than adequate)?

- Managing Radioactive Waste Safely (MWRS)[3] recognised the need for RWMD to have a focussed R&D programme and stated that the regulators, CoRWM and the NDA RB would have a role in reviewing and scrutinising the programme.
- There is a vast amount of information and documentation in support of RWMD's GDF programme. The RWMD's Technical Advisory Panel (TAP) looks in depth at the detail, while the RB itself maintains an overview. The TAP's independent membership comprises recognised international experts.
- The government's advisory body, the Committee on Radioactive Waste Management has as its key term of reference, "CoRWM's primary task is to provide independent scrutiny on the Government's and Nuclear Decommissioning Authority's (NDA's) proposals, plans and programmes to deliver geological disposal, together with robust interim storage, as the long-term management option for the UK's higher activity wastes."

  Encouragingly, in its annual report[4] it says:

  - The TAP is effective and suitably challenging regarding the detail and strategy.

[3] Defra, BERR, Welsh Assembly Government, Department of the Environment Northern Ireland, "Managing Radioactive Waste Safely: A framework for implementing geological disposal." Cm7386, June 2008. ISBN 0101738625.
[4] CoRWM doc. 3107, Ninth Annual Report 2012-2013, 30th June 2013. See also NDARB009.

- RWMD's understanding of the scientific and technical knowledge underpinning geological disposal is sufficiently comprehensive for the current stage.

- RWMD has a voluntary agreement with the regulatory bodies (ONR, EA) to be subject to their scrutiny. Again, encouragingly key recent conclusions[5] from the regulatory bodies are:
  - "From our analysis and recent discussions with RWMD, we are confident that RWMD is progressing R&D (or has work planned) in areas it identifies as high priority.
  - We consider that RWMD's approach to developing its R&D programme within the framework of a range of well chosen drivers enables a systematic approach, and that prioritising R&D against a range of criteria is a useful process."
- The RB also notes that the regulatory bodies are conducting their own "blank sheet of paper" exercise to develop the R&D needs for a UK GDF from first principles, which will provide a valuable cross-check against RWMD's own programme.

4.1 RB's response to Question 2

- RWMD's programme is already heavily monitored at considerable depth from three directions, Technical Advisory Panel (with the RB further supplementing the TAP with a higher level supervision), the regulators and CoRWM.
- The level of monitoring is already at least adequate. There was a suggestion in the recent government consultation[6] that an additional monitoring body could be created. Should such an additional body be created, the level of monitoring would be excessive.

Recommendation: The creation of yet another body to monitor RWMD's work is at best unnecessary.

5 Question 3

Recognising the extensive work of others (TAP, CoRWM), are there still areas where the Research Board believes there could be gaps in the R&D programme or where it would like to test for gaps? (The Research Board could, for example, ask the TAP to explore particular areas on which it is not yet satisfied.)

- The RB notes as a good practice that RWMD has developed and maintains an Issues Register, of which is says, "An issue is any challenge or concern that is raised by regulators and stakeholders, which could affect the implementation of a geological disposal system. Issues can be raised from external sources; for example, regulators, CoRWM, waste producers, NGOs and individuals with an interest in RWMD's work. ... Thus the issues management process enables externally raised issues to influence and help direct future RWMD work."

[5] Environment Agency letter: T&O Scrutiny Task 5: Review of RWMD's Research and Development Programme overview, Ref. EA/RWMD/2012/011, 21st August 2012. See also NDARB009.
[6]. *Consultation – Review of the Siting Process for a Geological Disposal Facility*, September 2013, URN 13D/250.

- The RB also notes, as in the response to Q2 above, that RWMD's programme is monitored from three separate directions.
- Also as noted above, the regulatory bodies are conducting their own "blank sheet of paper" exercise to establish and independent view of the R&D necessary.
- The RB is aware that a number of nations have now adopted deep geological disposal for some non-radioactive toxic wastes, but the disposal case for such repositories is judged on a different basis. There may be merits in a common basis for these assessments although it is important that the assessment of chemotoxic exposure demonstrates that the level of protection provided by the GDF is consistent with that which would need to be provided by conventional (non-radioactive) waste disposal facilities (this is a requirement of the UK environment agencies for any radioactive waste disposal facility).
- The RB notes and fully agrees with the TAP's view that it is typically societal aspects that determine a GDF project's timescale and progress, not the technical programme. Ensuring that technical work and its communication are capturing societal needs fully, as well as those of RWMD's 'needs driven' programme, is essential. RWMD is considering how best to manage the research to ensure that this requirement is being properly addressed. The RB recognises that this is a difficult issue and one where RWMD could easily be accused of trying to manipulate public opinion.

5.1 RB's response to Question 3

- Given the extensive monitoring it is unlikely that any significant R&D element is missing from the programme at this stage. If such an element is missing, it is likely to be revealed by the regulators "blank sheet of paper" exercise. The Issues Register is also a useful tool for identifying any missing element.
- Nevertheless:

Recommendation: The RB suggests that the TAP considers exploring two topics further with RWMD:

- The approach to non-radiological toxicity issues (i.e. potential chemotoxic exposure) in the GDF safety case.
- Societal issues: what R&D could usefully be undertaken and how this is best managed and funded (e.g. via academia)?

6 Question 4

Does the Research Board consider that the R&D programme is adequately communicated to RWMD's stakeholders?

- The RB notes that the TAP has frequently constructively discussed the communications issue with RWMD. Peer-reviewed R&D is seen as an essential underpinning of RWMD's programme and the TAP recommended that RWMD ensures that sufficient funding is available for contractors to publish work in peer-reviewed journals. RWMD's experience is that university suppliers routinely prepare journal publications but this was not the case for commercial research organisations, which carry out the bulk of the programme. RWMD now includes the requirement to produce papers in the contract specifications in addition to the normal contractor

reports. Further, journal publications now give access to original data in online databanks, allowing more concise publications and considerably improved transparency.

- The RB also notes that the Technical Programme document published on the NDA's website consists of Part A at 51 pages, Part B at 225 pages and Part C at 117 pages. These of course cover the full technical programme and not just the R&D aspects. The document is written for specialists in disposal, is extremely lengthy and a difficult read. The RB understands that the RWMD communications team has looked at the future development of the Technical Programme document, with the expectation of producing a short illustrated summary in a similar format to those produced for other RWMD reports.
- The RWMD has stated that, "In order to provide a greater degree of transparency of specific research needs, it is intended to publish a detailed Research Plan during 2014, which will provide greater resolution of specific knowledge gaps than currently exists. It is intended that this will facilitate universities and commercial research organisations in planning innovative targeted research, to be funded either directly from the NDA or via Research Councils UK."
- The RB also notes that, in addition to its own programme, RWMD co-sponsors some academic research on relevant topics.

6.1 RB's response to Question 4

- There is a good story to tell on the sound methodology by which RWMD's R&D (and more broadly its technical) programme is put together and prioritised. The RB does not believe that this is appropriately communicated at present.

Recommendation: Consideration should be given to producing more accessible and visual communications (e.g. brochures, displays, web site videos and other internet tools, modules for teaching establishments etc) to communicate the programme, more appropriate to a non-specialist audience. The availability of such material would seem to be especially important as the government's revised GDF siting process takes off.

- The RB applauds the push to have more RWMD sponsored work published in peer reviewed journals.
- As noted in the response to Q3, public acceptance is a key issue in establishing a UK GDF. The RB is supportive of RWMD's part sponsorship of independent academic work, both for the value of its content and because such academic work would help facilitate public trust. Research shows that academics are amongst the most trusted members of society.

7 Short Summary of Conclusions

The reader is asked to note that the date of October 2014 on the cover page is the publication date of this document. The content, however, is based on evidence presented to the NDA independent Research Board (NDA RB) up to the date of its sixth meeting (02/10/2013); any more recent developments have not been included in this review.

Q1. On the basis of the evidence available to the Research Board does the Board consider the process for developing the R&D programme is soundly based?

Yes, particularly with the addition of promised near term improvements.

Q2. Does the Research Board consider the mechanisms for review of the R&D programme are at least adequate (they could be more than adequate)?

Yes.

Q3. Recognising the extensive work of others (TAP, CoRWM), are there still areas where the Research Board believes there could be gaps in the R&D programme or where it would like to test for gaps?

It is unlikely that there are any significant gaps. Nevertheless the RB would like the TAP to consider further (i.e. test for gaps):

- Chemotoxicity in the safety case.
- Societal Issues and how these are best addressed.

Q4. Does the Research Board consider that the R&D programme is adequately communicated to RWMD's stakeholders?

No, current documentation is for experts in the field; long, detailed and a difficult read. A more accessible explanation is needed but this should be part of a broader GDF project communication package.