

**TECHNICAL NOTE**

**Response to Comments on  
NDA RWMD's Proposed  
Research and Development Strategy**

**March 2009  
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### **BIBLIOGRAPHY**

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### **FEEDBACK**

Readers are invited to provide feedback to the NDA on the contents, clarity and presentation of this report and on the means of improving the range of NDA reports published. Feedback should be addressed to:

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### Executive Summary

This document presents our response to feedback we received on our proposed R&D strategy, which we published in June 2008, to support UK Government's White Paper on the management of radioactive waste.

Our proposed R&D strategy formed the basis for consultation; comments were invited during a six-month consultation period from June 2008 to November 2008. As part of the consultation process, we held an open-invitation workshop in November 2008 to discuss our strategy and programme for R&D.

In addition to the workshop feedback, we received 33 written responses in total from the following groups:

- Public sector: Government, non-departmental public bodies, regulators, advisory groups (7 responses)
- Site Licence Companies (2 responses)
- Consultancies, contractors, laboratories (14 responses)
- Universities and learned societies (6 responses)
- Individual members of the public (4 responses).

There was a wide range of style of response, varying from short emails raising a few general points on our strategy to much lengthier documents containing many detailed comments on specific aspects of R&D or on the MRWS process and geological disposal in general.

Generally, people welcomed the opportunity to provide input to our programme. There was very positive feedback on the workshop and we also received positive comments about particular aspects of our proposed R&D strategy. There were also many requests for clarification and suggestions for improvement.

The main suggestions are listed below.

- respondents identified a need for greater clarity in the purpose of the R&D strategy and its objectives in the context of the forward programme to develop a GDF. It was felt that the proposed R&D strategy contained some elements that would be expected in a strategy and some information on the proposed forward programme, but neither of these aspects was addressed fully
- we needed to explain more clearly the scope of the R&D programme, key drivers for R&D and the approach to identifying and prioritising R&D requirements
- a better description was needed of the ways in which we would ensure that project requirements would be met by work that is reliable and of a high quality. Information was requested on specification of R&D activities, procurement of services, contract management, quality assurance, evaluation of results, review, closing-out topics, communication of results and interactions with stakeholders

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- the R&D strategy should place a greater emphasis on the development of a skills base and research facilities to support delivery of a GDF
- there was a need to address more comprehensively the broad range of strategic waste management issues in the geological disposal programme. Comments were made relating to the need for R&D on specific wasteforms, disposal concepts, and host rock environments. In particular, issues associated with long-term storage of waste packages, disposal of high-level waste, spent fuel and other nuclear materials, disposal in a single co-located facility for all types of higher activity waste, and the technical challenges associated with retrievability and facility engineering were identified as topics that need to be effectively captured in the future R&D programme
- there were many comments on detailed technical issues associated with geological disposal.

In addition, there were a number of comments on topics that fall outside the scope of our consultation on our proposed R&D strategy, for example relating to Government policy or the MRWS process in general.

In this document, we have summarised the detailed comments and opinions raised under each of these themes and given our response, including, where appropriate, the section number in our updated R&D strategy document, where the topic is discussed.

We were pleased to receive so many thoughtful and constructive comments and opinions on the strategy during the consultation process and we value the time and effort that groups and individuals took in providing their reviews. We have produced this document to explain how we have drawn on these comments to produce our updated R&D strategy.

Looking ahead, we want to build on the foundations we have established and increase the involvement of our stakeholders in planning our R&D programme as our implementation programme proceeds towards site investigation, construction, operation and closure of a GDF. In particular, we will consider mechanisms for making the results of our R&D programme more accessible and enabling greater involvement of our stakeholders. We also plan to hold a series of workshops that will consider the technical issues related to particular research areas, and the comments received on our R&D strategy will form key inputs to these meetings. The points raised can then be considered by a range of subject experts and we will seek to capture their findings and advice in workshop records.

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# **Response to Comments on NDA RWMD's Proposed Research and Development Strategy**

## **1 INTRODUCTION**

As part of its Managing Radioactive Waste Safely (MRWS) programme, UK Government issued a White Paper in June 2008 setting out a framework for implementing geological disposal of radioactive wastes in the UK [1]. The White Paper sets out various requirements on the Nuclear Decommissioning Authority (NDA), which is responsible for planning and implementing geological disposal in the UK. The NDA has set up the Radioactive Waste Management Directorate (RWMD) to develop an effective delivery organisation to implement a safe, sustainable and publicly acceptable geological disposal programme. We use the terms 'we' and 'our' in this document to refer to RWMD.

The White Paper recognises the need for a continuing programme of research and development (R&D) to support the development and implementation of a geological disposal facility. We published our proposed Research and Development Strategy [2] in June 2008 to support the White Paper on the implementation of geological disposal [1].

We developed our proposed R&D strategy largely in-house, to form the basis for a consultation process that sought the views of a wide range of stakeholders. Comments were invited during a six-month consultation period from June 2008 to November 2008. We received a total of 33 written responses on the proposed strategy. Also, as part of the consultation process, we held an open-invitation workshop in November 2008, targeted at academics, consultants and interested individuals, to discuss our strategy and programme for R&D. We published a record of the workshop in March 2009 [3].

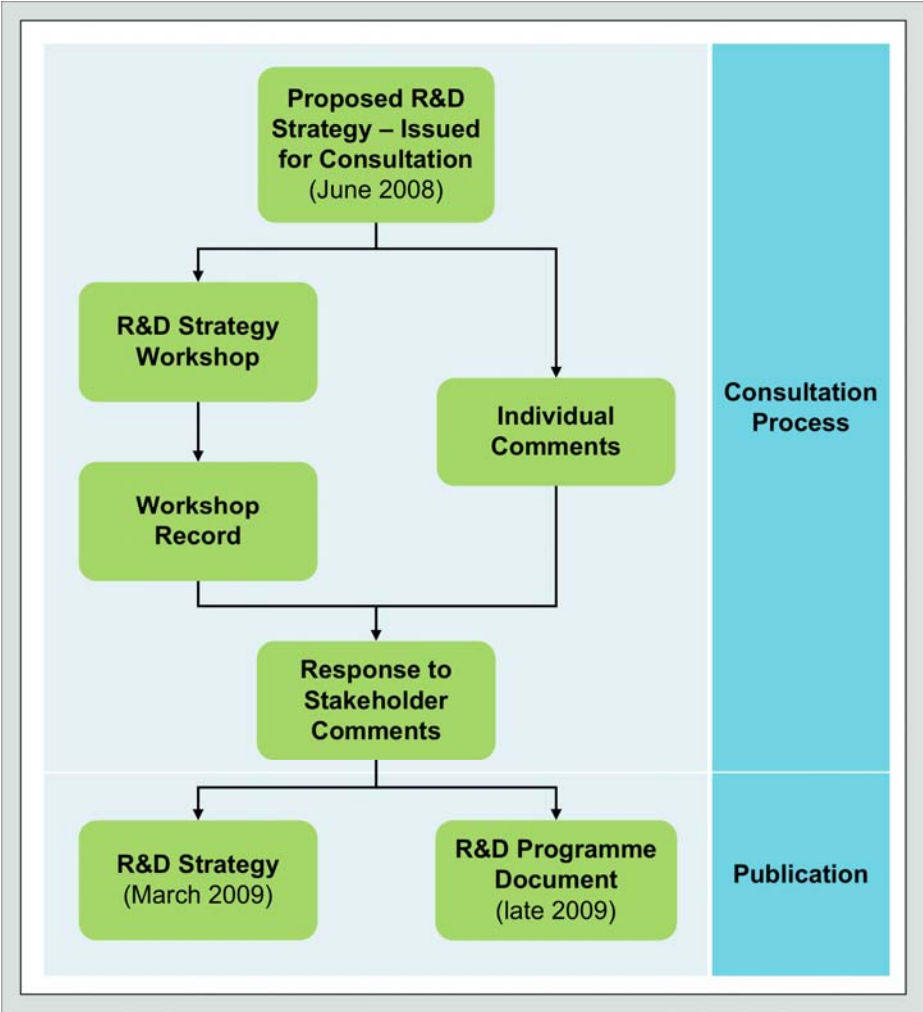
We have produced this document to explain how we have analysed the feedback received and how, in response, we have drawn on stakeholder comments as we prepared our updated R&D strategy. The updated R&D strategy is scheduled for publication in March 2009. Later this year we also plan to publish a separate R&D programme document. Figure 1.1 illustrates the steps in the consultation process leading to the publication of these two documents.

We greatly appreciate the time and effort that stakeholders have spent reviewing our strategy document and participating in the workshop. The consultation process has given us a welcome opportunity to understand stakeholders' views on our R&D strategy and programme.

We describe the R&D strategy consultation process and our approach to analysing stakeholder responses in Section 2 of this document. Section 3 provides a summary discussion of stakeholder responses, including our identification of six comment themes by which we have structured our analysis of comments and our responses. We have included a more detailed discussion of issues raised within each comment theme in Section 4. In Section 5, we summarise how we have responded to the feedback received during the consultation process, and set out the next steps in the development of our R&D strategy and programme.

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Figure 1.1: Steps in the development of our R&D strategy



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### 2 THE CONSULTATION PROCESS

We published our proposed R&D strategy in June 2008 to form the basis for consultation; the document was made available on the NDA's website and was sent to key stakeholder organisations, including the nuclear regulators and the Committee on Radioactive Waste Management (CoRWM). We invited comments during a six-month period until the end of November 2008 and held meetings with some stakeholders to discuss their comments.

We also held a two-day workshop in Loughborough on 17-18 November 2008 as part of our consultation process. 158 people attended, including 18 NDA staff and 7 independent facilitators. We received feedback from attendees during plenary discussion sessions, and from smaller breakout group discussions. Attendees were also given the opportunity to submit written comments during the workshop using a system of 'postcard' notes.

As well as the issues raised at the workshop, which have been documented in the workshop record [3], we received a total of 33 written responses on the strategy during the consultation process. Copies of stakeholders' responses are available from RWMD on request.

At the end of the review phase of the consultation process, we carried out a careful examination of the feedback so that we could prepare an updated R&D strategy that took on board stakeholders' views. We adopted the following approach to analysing comments:

- we studied each set of written comments and compiled a list of key points raised
- we added key points noted during the workshop sessions and in the 'postcard' notes
- we grouped key points into six main themes
- we captured the key points raised under each theme and have provided our response in this document.

We summarise the six main themes in Section 3, and give our response in Section 4.

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### 3 ANALYSIS OF COMMENTS

#### 3.1 Statistics

As we analysed the feedback on the proposed R&D strategy, we found it helpful to classify the responses by stakeholder group so that we could better understand the context in which comments had been made. The number of responses in each group is shown in brackets:

- Public sector: Government, non-departmental public bodies, regulators, advisory groups (7)
- Site Licence Companies (2)
- Consultancies, contractors, laboratories (14)
- Universities and learned societies (6)
- Individual members of the public (4).

In addition to the 33 written responses, we have included comments made at the consultation workshop and documented in the workshop record [3] and postcard notes as a single response to the consultation, effectively giving a total of 34 responses.

In our analysis of responses discussed in this document, we have attempted to gauge the strength of opinion on particular issues by considering how many of the 34 responses expressed views on the issue. This analysis can only be taken as indicative because a single response often represents the views of many individuals.

#### 3.2 General observations

There was a wide range of style of response, varying from short emails raising a few general points on our strategy to much lengthier documents containing many detailed comments on specific aspects of R&D or on the MRWS process and geological disposal in general.

Generally, people welcomed the opportunity to provide input to our programme. There was very positive feedback on the workshop and several of the written responses explicitly welcomed both the publication of the proposed R&D strategy and the opportunity to comment.

We also received positive comments about particular aspects of the proposed R&D strategy. For example, some commented that the document was well written and that its structure was clear and logical and contained the elements of R&D necessary to move forward in the programme to develop a GDF. Others specifically welcomed the openness and transparency of the process to develop the GDF, the needs-driven approach to identifying R&D projects, the intention to draw on international experience in geological disposal programmes, and the intention to publish the results of R&D to enable stakeholder review.

There were many requests for clarification and suggestions for improvement, which we analysed by grouping comments into themes, as described below.

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### 3.3 Main themes

We grouped the key points raised in the comments into six main themes which we discuss further in Section 4. These themes are:

- purpose of the proposed R&D strategy and its objectives in the context of the forward programme to develop a GDF. About one third of the responses contained comments on this theme
- the approach to identifying and prioritising R&D requirements. Approximately half of the responses included comments on this theme
- our processes for implementing R&D. This topic was mentioned in approximately a third of the responses
- skills and facilities to support delivery of a geological disposal facility. This featured in about half the responses
- strategic issues concerning the scope of our proposed programme. This topic was mentioned in approximately half the responses.
- detailed technical issues associated with geological disposal. Some two-thirds of responses included detailed technical points.

In addition, we received a number of comments that fall outside the scope of our consultation on our proposed R&D strategy, for example relating to Government policy or the MRWS process in general. We do not give responses to these comments in our document but have passed them on to those with the appropriate responsibility for their consideration.

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### 4 OUR DETAILED RESPONSE

In this section we present our response to each of the themes described in Section 3.3. For each theme, we have summarised the detailed comments and opinions raised and given our response, including, where appropriate, the section number in our updated R&D strategy document where the topic is discussed.

For clarity our responses are indented from the left margin of the page.

#### 4.1 Development, Purpose and Aims of the R&D Strategy

The general opinion on this topic was that there was a need for greater clarity in the purpose of the R&D strategy and its objectives in the context of the forward programme to develop a GDF. It was felt that the proposed R&D strategy contained some elements that would be expected in a strategy and some information on the proposed forward programme, but neither of these aspects was addressed fully.

Several responses included the comment that a clear distinction should be drawn between the R&D strategy and the programme of R&D work to be undertaken to implement the strategy; some, including a regulator, felt that the R&D strategy and work programme should be presented in separate documents.

We found these comments very helpful and in response, as we update our June 2008 strategy, we are preparing two documents:

- a revised R&D strategy document in which we set out our approach to identifying and implementing R&D activities to underpin geological disposal of the UK's higher activity radioactive wastes
- an R&D programme document in which will set out the detail of our forward programme of R&D activities.

We plan to publish our updated strategy document in March 2009 and our programme document in late 2009.

Some responses contained the suggestion that the process of developing the strategy should be better explained, with information provided on who contributed, the progression from previous strategies, and the internal review process.

We are very happy to provide this information. We have described the process we followed in revising our R&D strategy in Section 1.2 of the updated strategy document. The revised strategy has been reviewed internally by end-users of our R&D and by our senior managers. In addition we shared a draft version of the updated strategy with CoRWM, and with representatives from the learned societies. We also obtained review comments from some of our suppliers.

It was suggested that clearer statements should be made about the objectives and purpose of the strategy early in the R&D strategy document. Several responses included requests for a better explanation of the purpose of R&D, with suggestions that R&D could be described in terms of activities aimed at supporting decision-making, the management of uncertainties, and mitigation of risks in radioactive waste disposal. Some thought that the strategy should discuss the distinction between research, development, demonstration, site investigation, and site characterisation activities.

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These comments gave very useful guidance as we prepared our updated strategy document. We have drawn out more clearly how our R&D fits into the overall process of developing a GDF in Section 4 of our updated strategy document.

To improve the explanation of the purpose of our R&D, we have set out the framework in which we work in Section 4.1 and the drivers for our R&D programme in Section 4.2 of our updated strategy document.

The definitions of 'research' and 'development' have sparked extensive discussions and it has become clear that there are a number of interpretations in common usage. We have included our definitions of these terms in Section 1.3 of the updated strategy document. In setting out these definitions, we recognise that, in reality, research and development represent a continuum of activities and there will always be examples of specific activities which may be difficult to classify without ambiguity. We have not given a definition of 'demonstration', but have included some examples where we might include this type of study in Section 3.4 of our updated strategy, where we describe how our programme will evolve as implementation proceeds.

We have often used the terms 'site characterisation' and 'site investigation' interchangeably and now realise that this may have caused confusion. In our updated document we present our strategy for identifying R&D requirements for site characterisation in Section 5.5.

Some felt that links between the RWMD's R&D strategy and R&D carried out under the NDA's Direct Research Portfolio (DRP) and by NDA Site Licensees, and related R&D carried out elsewhere in the UK, should be described. In particular, comments received from the Site Licence Companies (SLCs) encouraged greater interaction and exchange of information with RWMD.

This comment was very helpful in showing where we have not communicated our responsibilities clearly to our stakeholders. In response, we have described the NDA's R&D funding streams in Section 1.4 of our updated strategy and explained how interactions with SLCs are formalised through the Letter of Compliance (LoC) process in Section 4.2. We have not, however, described the details of the programmes of these other organisations.

Our key relationships and interactions with SLCs and other organisations that fund related R&D, such as the research councils, regulators and learned societies, are described in Section 7.

We welcome the comment from the SLCs that they would like to work more closely with RWMD.

Some responses, mainly from members of the public, included requests for more information on research into, or the status of, alternatives to the construction of a geological disposal facility, such as long-term storage, isotope recovery, and disposal in deep boreholes.

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This is a request that we cannot meet as these topics are outside the scope of our R&D. As stated in the White Paper and in Section 3.1 of our updated strategy document, our remit is to consider geological disposal, which in the UK involves constructing an engineered facility at a depth of between 200 and 1000 metres, in which radioactive wastes can be placed and isolated from the biosphere. We keep options such as borehole disposal for certain types of waste under review.

Discussion was requested on how the GDF programme and R&D strategy would respond to programme uncertainties, such as in the site selection process and in strategies for reprocessing spent fuel, for uranium and plutonium management, and for building new nuclear power reactors in the UK.

In this preparatory phase of our programme, we respond to programme uncertainties by considering a range of possible inventories, disposal concepts and potential geological environments. We give more detail in Section 3 of our updated strategy.

In many responses it was suggested that there should be clearer links between the R&D strategy and the GDF implementation strategy, with a more considered discussion of how the focus and requirements of the R&D strategy will change as iterative safety cases are produced and the development of the GDF progresses from conceptual and generic studies to site-specific and engineering-specific work. In particular, it was felt that a discussion is needed of how R&D will support decisions on when objectives have been met at different stages in the development of the GDF. Such a discussion would provide an overview of what needs to be known and by when, and would serve as a basis for defining the questions and uncertainties that the R&D is seeking to address.

We agree that this link was not clear in our June 2008 strategy. In response, we have shown how our programme to implement a GDF aligns with the various stages of the MRWS programme in Figure 3.3 of our updated strategy document and we have explained how our R&D programme will evolve and support decision-making as the implementation of the project proceeds in Section 3.4 of our updated document.

Some felt that the R&D strategy should include a discussion of how the GDF development programme would respond to any negative or unexpected outcomes of R&D. Some asked if there were any contingencies in the GDF development programme in the event that R&D work had unexpected outcomes at key decision-making stages.

In writing our updated strategy, we have sought to provide the reassurance that implementation of the GDF requires regulatory permission. In the event that R&D work at any phase has unexpected outcomes, we will assess the implications for the performance of the GDF. If R&D were to indicate that the facility would not meet the regulatory requirements, a licence application would not be submitted.

Several responses expressed the view that accountability for R&D and the risks of associated decision-making should be discussed.

We value input from our stakeholders and will seek advice to assist us in our decision-making, but we, NDA-RWMD, are accountable for the implementation of a GDF and accountability for the R&D component also lies with us. We have included this information on accountability at the start of Section 6 of our updated document.

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We have not included a discussion of risk in our R&D document as the risks associated with decision-making are often programme-wide. In RWMD, we have a formal risk register where we record all risks to our programme and identify mitigating actions. We review this list every month.

### 4.2 Identifying and Prioritising Research

The main point raised was that we needed to explain more clearly the scope of the R&D programme, key drivers for R&D and the approach to identifying and prioritising R&D requirements. With regard to the needs-driven approach to identifying R&D, some asked whose needs were being considered and whether the needs of all stakeholders, including SLCs and volunteer communities, were being taken into account.

In order to respond to this comment we have spent significant time in clarifying and formalising our processes. We have dedicated all of Section 4 in our updated strategy to the topic of deriving our R&D programme. In figure 4.1, we show the internal drivers for our R&D and also the important role of our stakeholders in framing our programme. In Section 7, we set out our key relationships and again recognise the importance of waste producers and volunteer communities.

Several responses expressed the need for more comprehensive statements to be made about RWMD's current state of knowledge on geological disposal (e.g. in terms of understanding the performance of different barriers for different GDF concepts) and key past and ongoing supporting R&D. Such information would enable the reader to gain a better understanding of the knowledge gaps that lead to identification of future R&D work.

We recognise that we need to improve the visibility of our current understanding, our forward programme and our R&D processes. We have described our processes in our updated strategy document and will give more details on our proposed R&D activities in our programme document which is scheduled for publication late in 2009.

We are also preparing a number of synthesis reports as part of the Disposal System Safety Case, which is scheduled to be published in March 2010. The synthesis reports will summarise our current understanding of a range of key topics such as gas, criticality and radionuclide behaviour.

Various approaches to expressing knowledge gaps (perhaps using matrix-based methods) were suggested, such as by outlining information needed:

- to understand wasteform and barrier (engineered and natural) performance in the context of requirements on their performance for different disposal concepts in different geologies
- to understand the features, events and processes (FEPs), which are important to the safety of a GDF
- to understand uncertainties in the performance of a GDF and also in the durability of waste packages during storage
- to develop waste package transport and GDF operational and post-closure safety cases.

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Periodic conferences or workshops on repository issues were suggested as means of enabling stakeholders to participate in the identification of R&D requirements.

We found these types of comments particularly helpful as they gave specific suggestions for us to consider as we revised the document. We have included information on the way in which we measure knowledge or 'readiness' gaps in Section 4.3 of our updated strategy document. We have also committed to involving a wider range of stakeholders in the process.

It was also commented that the process of identifying R&D requirements should include consideration of knowledge available and experiences from overseas programmes on geological disposal and international projects (e.g. safety cases for the Swedish and Finnish concepts and their regulatory reviews).

We agree with the comment suggested above and already collaborate closely with overseas waste management organisations (WMOs) so that we can build on the experience and understanding that they have gained. It is important that we do not duplicate work that has already been carried out overseas as this would not represent a good use of public money.

However, it is also important that we are not over-reliant on overseas R&D and that we understand its applicability to the UK where the wastes and geological environments may be different. For that reason, our approach is to consider overseas R&D to extract that which is directly applicable to the UK and then commission additional R&D to address UK-specific knowledge gaps. You will find an example of this approach in Section 5.1 where we discuss our strategy for high-level waste and spent fuel disposal.

Some responses included requests for more information on how, having identified R&D requirements, the R&D projects would be prioritised, suggesting consideration of the staged needs of the GDF programme, importance to safety assessments (e.g. addressing key uncertainties), and reviews (peer reviews, regulatory reviews, other stakeholder reviews).

We welcome the suggestions made on this topic. In Section 4.4 we have described how we prioritise R&D according to criteria including those suggested above. We will seek to give greater clarity on this process by making available more information on the details of our prioritisation.

We have included information on our most recent programme prioritisation in Section 4.6 of our updated strategy document. The publication of our forward programme will also help to improve visibility of our planned activities.

Some asked how R&D project timescales and costs would influence selection of R&D projects and whether there would be opportunities and funding for long-term experiments and numerical modelling studies and large-scale demonstration projects.

In Section 4.4 of our updated document, we have described how we prioritise R&D including how we respond to resource and budget limitations. We have discussed how we manage scheduling of R&D activities, including long-term projects, in Section 4.5. We recognise the importance of demonstration experiments, which are useful for building confidence of the scientific community and other stakeholders. We are commissioning some demonstration experiments in our current planning phase (see Section 3.4) and demonstration experiments will play an increasing role in our R&D programme as it matures.

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Some asked for a discussion of opportunities for taking account of new innovations and technological developments that may increase the safety of geological disposal, but that may be outside the scope of the needs-driven approach to identifying R&D.

We agree that it is important to take account of new developments and innovation. We achieve this in a 'needs'-driven framework, by ensuring that we are aware of innovations and technological developments and consider these when assessing the scope of work required to address an R&D need (Section 4.4).

### 4.3 Implementing the R&D Strategy

The main comment on the implementation of our proposed R&D strategy was that a better description was needed of the ways in which we would ensure that project requirements would be met by work that is reliable and of a high quality. Information was requested on specification of R&D activities, procurement of services, contract management, quality assurance, evaluation of results, review, closing-out topics, communication of results and interactions with stakeholders.

We agree that the quality of our R&D is fundamental to successful implementation of a GDF and, in response to this request, we have significantly expanded the information on processes for delivering R&D in our updated strategy document. Section 6 is dedicated to this topic.

Suppliers noted that a lot of time can be spent preparing proposals for framework contracts and associated work and that such time should be reduced, perhaps by specifying broader R&D projects.

We recognise the need to move to specifying broader R&D projects and have committed to trying to achieve this. We are carrying out a broader procurement review and held a stakeholder workshop in January 2009 as an input to this process.

Regarding interactions with other organisations during the R&D programme, further information was requested on:

- organisation and management of collaboration with research councils, learned societies and other such bodies, and links with other research programmes
- the role and management of stakeholder engagement in the R&D programme
- the role of oversight boards
- regulatory interactions
- engagement with Government
- interactions with projects in the NDA's DRP
- interactions with SLCs
- interactions with GDF programmes in other countries and international collaborations (e.g. EU programmes).

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In response, we have significantly expanded the information on our relationships with other organisations in our updated strategy document. Section 7 is dedicated to this topic.

### 4.4 Skills Base and Research Facilities

Many responses expressed the view that the range of skills and facilities that would be required to implement the R&D strategy should be identified and that the availability of those skills and facilities in the UK and overseas should be assessed. Some considered that the skills needed by RWMD to manage the R&D projects should be identified and the availability of those skills should be assessed.

In response, we have described our strategy for developing and maintaining skills in Section 6.9 of our updated strategy document. Our strategy for skills development has two main strands:

- to encourage skills development in the supply chain through the way in which we procure work
- to support the NDA's skills development programme.

Some felt that the different roles of contractors, consultancies, universities, laboratories, etc in R&D should be described.

We have given more information on the way in which we engage with our stakeholders in Section 7 of our updated strategy document.

Our main suppliers of R&D are specialist commercial organisations and universities. We have often used the term 'contractor' to describe any organisation from which we procure services. However to respond to this feedback, we have used the word 'supplier' in our updated document.

In several responses, it was asked that our forward programme, including schedules and budgets, be made available in order that contractors, consultancies, and universities can identify the skills and facilities that need to be developed to achieve R&D objectives. Responses from universities and learned societies in particular emphasised the need for research funding to be available to develop the required skills and research facilities within universities.

As discussed earlier in this document, we plan to publish details of our forward programme later in 2009 and we hope that this increased visibility of our plans will help our suppliers to plan their resources more easily. Our plans to work with university departments to develop the UK nuclear skills base are discussed in Section 7.1.

One contractor noted that the practice of awarding framework contracts extending over several years to selected organisations limits the opportunities for organisations that do not have such contracts to develop new skills in the relevant areas.

We are currently reviewing our procurement strategy and will make sure that this comment is considered as part of the review process.

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Several comments pointed to the idea of setting up additional research groups to review activities in core areas of GDF development. For example, an engineered barrier system (EBS) review panel could be set up.

We welcome the interest of our stakeholders in helping us deliver a high-quality programme and are exploring ways to increase their involvement in the future. We discuss review of our R&D in Section 6.4 and oversight of our R&D activities in our description of programme scrutiny in Section 6.8 of our updated document.

With regard to research facilities, several responses included requests for a clearer discussion of why an underground research facility (URL) was not being considered. Several suggested that such a facility would provide essential information prior to making decisions about constructing a GDF and commented that, in the absence of a URL, underground construction work should be done to prove the results of surface-based site characterisation prior to GDF construction. It was also suggested that if results of experiments undertaken in overseas URLs were to be used, then the means by which such experiments would be judged to be applicable to a UK GDF should be discussed.

We describe our approach to underground research in Sections 3.4 and 5.5 of our updated strategy document. We will prepare for site characterisation by developing the required skills, tools and techniques through participation in collaborative international projects and carry out our own underground experiments as part of the construction of the facility.

Some asked that the type of work to be undertaken at laboratories that can work with active materials (e.g. the National Nuclear Laboratory) be discussed in more detail so that capabilities can be assessed.

We will include details of our proposed work on active materials in our programme document and this should enable the adequacy of facilities to be assessed. As a public sector organisation, we are required by law to consider suppliers from the rest of Europe as well as those in the UK; we give more detail on the rules governing our procurement in Section 6.2. A number of our current suppliers have facilities suitable for handling radioactive materials. These suppliers include university departments and commercial laboratories in the UK and elsewhere in Europe.

### **4.5 Scope of our R&D Programme**

The main comment under this theme was that there was a need to address more comprehensively the broad range of strategic waste management issues in the geological disposal programme. Many responses expressed the view that the R&D strategy placed too much emphasis on the Nirex Phased Geological Disposal Concept (PGRC) for the disposal of intermediate-level waste (ILW), a spent fuel (SF) and high level waste (HLW) disposal concept based on the Swedish KBS-3 concept for SF disposal, and a crystalline host rock. They considered that the R&D strategy should more clearly reflect the range of disposal concepts that could be optimised and implemented for the various radioactive wastes in the UK and for the range of potential geological environments in the UK. It was also suggested that, as part of the optimisation process, R&D projects should be undertaken that consider the options of using different types of engineered barrier within a GDF for different wasteforms and inventories.

## TECHNICAL NOTE

This feedback indicates that we have not communicated effectively the scope of our programme. We have not selected concepts for ILW, HLW or SF. For information on our current knowledge and understanding on a range of possible concepts, we suggest the following references:

1. T. Baldwin, N. Chapman, F. Neall, Geological Disposal Options for High-Level Waste and Spent Fuel, Galson Sciences Final Report to NDA, 2008.
2. T.W. Hicks, T.D. Baldwin, P.J. Hooker, P.J. Richardson, N.A. Chapman, I.G. McKinley and F.B. Neall, Concepts for the Geological Disposal of Intermediate-level Radioactive Waste, Galson Sciences Report to NDA RWMD, 0736-1, Version 1.1, 2008.

We have also sought to capture the breadth of our forward programme by describing our key themes in Section 5 of our updated strategy document.

It was commented that the R&D strategy did not provide a sufficiently balanced and thorough discussion of R&D on different wasteforms, with more information being required on research on HLW and the different types of reactor spent fuel (including fuel from research reactors). In addition, more information was requested on R&D projects relating to plutonium and uranium disposal, should such materials be declared wastes, and on the disposal of wastes associated with the operation of new nuclear reactors. Also, more research on the disposal of graphite wasteforms and legacy wastes was requested.

We hope that the description of our key themes, (Section 5) will provide reassurance on this topic. The balance between the various elements will also be described in more detail in our programme document and we welcome stakeholder views on the details of our forward programme.

Some commented that R&D on waste packaging should cover issues relating to the performance of the different standard waste containers, alternative container materials, grouted wasteforms, and alternative waste conditioning and immobilisation materials (e.g. vitrified ILW). In particular, the need for research into problems associated with using cementitious grouts to encapsulate reactive metal wastes was highlighted and the need for research into re-packaging of problematic wastes was noted. More research into the durability of waste packages during long-term storage and the impacts of alternative waste packaging concepts on GDF design and performance was also recommended.

Package longevity is a key topic in our R&D programme. We will summarise our current understanding in a synthesis report to be published by March 2010 and will include details of our planned R&D in our programme document.

With respect to packaging solutions such as alternative waste conditioning, we have described how we work with waste producers through the Letter of Compliance process in Section 4.1 of our updated strategy document.

Regarding disposal concepts, some considered that more research needed to be undertaken to demonstrate the suitability of the KBS-3 SF disposal concept for the disposal of UK SF and HLW in UK geologies (e.g. consider copper corrosion rates in UK groundwaters).

## TECHNICAL NOTE

As we stated above, the assumed selection of the KBS-3 concept is a misunderstanding. We have not yet selected a disposal option for HLW and SF in the UK. We realise that some published studies where we referred to a 'reference concept' have been misleading in this respect. Our R&D programme is considering a range of possible concepts, including a number of potential canister materials.

Several responses included requests for more information on the R&D that was being done on issues specific to the co-location of disposal facilities for HLW/SF and ILW (e.g. practicalities of co-location, potential interactions between different disposal modules). However, others felt that the R&D programme focused too much on co-location and that the option of implementing more than one GDF should be considered.

Our planning basis, as given in the White Paper is for a single facility for all higher-active radioactive wastes. Therefore we are carrying out R&D on the potential interactions between particular disposal modules and will give more information in our programme document.

The need for R&D into retrievability was questioned. Some noted that retrievability was not a requirement of a disposal concept. However, it was suggested that research into the effects of early and delayed backfilling be undertaken (e.g. effects of dewatering prior to backfilling, stability of openings).

This feedback mirrors the point made in the MRWS White Paper that there is a diversity of views concerning retrievability. Our R&D planning basis is that given to us in the White Paper, that 'the facility will be developed in such a way that the option of retrievability is not excluded' (see also Section 4.1 in our updated strategy document) and therefore we will commission the R&D required to fulfil this requirement.

It was also suggested that a greater emphasis should be placed on engineering R&D and that over-reliance on current mining practices for long-term stability solutions should be avoided. More research on facility engineering in different geologies was suggested.

We completely agree with this comment. We are commissioning R&D in facility engineering and will give more details in our R&D Programme document. When we build the facility, we will use best engineering practice, and will not be constrained by current mining practices.

### **4.6 Technical details of our R&D Programme**

We received many detailed and very useful specific technical comments and suggestions for our forward R&D programme. They covered topics such as:

- waste inventory characterisation
- durability of waste packages during storage, re-working of degraded waste packages
- the waste package as a barrier to radionuclide release after disposal
- GDF backfill and seal materials and emplacement
- groundwater flow and radionuclide transport in fractured rock

## TECHNICAL NOTE

- gas generation and migration
- human intrusion into a GDF
- effects of low-level radiation
- effects of non-radioactive hazardous materials
- the effects of radiation on non-human biota
- safety assessment methodologies and codes for different GDF concepts and geological environments
- experiments using realistic and active materials rather than analogues and simulants
- demonstration experiments
- blind predictive modelling
- engineering (e.g. waste transportation, waste handling, and GDF excavation)
- GDF monitoring (operational and post-closure)
- approaches to managing the GDF development programme through to facility closure (e.g. organisational structures, managing supply chains, and knowledge and requirements management).
- social sciences (e.g. stakeholder engagement, risk communication, confidence building).

There are many valuable points made on these topics but, in responding to the comments described in Section 4.1 we have removed the description of our technical programme from our strategy document and so a response to these comments will not appear in our updated strategy document.

Our forward programme of R&D activities will cover some of the technical issues raised above. In addition, we will summarise our current understanding of a range of key topics in a series of synthesis reports, which we are preparing as part of the Disposal System Safety Case and this will also give us the opportunity to address some of the points raised.

We also plan to hold a series of workshops that will consider the technical issues related to particular research areas, and the comments received on our R&D strategy will form key inputs to these meetings. The points raised can then be considered by a range of subject experts and we will seek to capture their findings and advice in workshop records.

Some of the technical points made suggest that a small number of respondents may not be familiar with the R&D activities that we have already completed. Information on specific topics can be obtained by searching and requesting documents from the NDA's Radioactive Waste Management Bibliography, which also includes the studies commissioned by Nirex.

## **TECHNICAL NOTE**

All of the technical issues raised during the consultation process have been recorded and will be considered when we next carry out a programme-level review of our R&D.

## TECHNICAL NOTE

### 5 SUMMARY AND NEXT STEPS

Our proposed R&D strategy, published in June 2008, formed the basis for consultation on our approach to identifying and implementing R&D activities in support of the development of a GDF for higher activity radioactive wastes in the UK. We received many thoughtful and constructive comments and opinions on the strategy from stakeholders and we value the time and effort that groups and individuals took in providing their feedback. We also received comments on the R&D strategy at a two-day workshop held during the consultation process. We would like to thank all those who contributed and expressed their views during the consultation.

We have now prepared an updated R&D strategy by drawing on the views expressed during the consultation process. We have produced a revised R&D strategy document that sets out our approach to identifying and implementing R&D activities, 'The NDA's Research and Development Strategy to Underpin Geological Disposal of the United Kingdom's Higher-activity Radioactive Wastes'. Later in 2009 we will produce a separate document giving details of our forward programme.

Looking ahead, we want to build on the foundations we have established and increase the involvement of our stakeholders in the planning of our R&D programme as our implementation programme proceeds towards site investigation, construction, operation and closure of a GDF. In particular, we will consider mechanisms for making the results of our R&D programme more accessible and enabling greater involvement of our stakeholders in evaluating our R&D outcomes.

We also plan to hold a series of workshops that will consider the technical issues related to particular research areas, and the comments received on our R&D strategy will form key inputs to these meetings. The points raised can then be considered by a range of subject experts and we will seek to capture their findings and advice in workshop records.

We wanted to reply to all those who had taken the time to give feedback during the consultation process. In order to manage and communicate our response to the broad range of comments received, we have presented a summary response under six main themes to be read in conjunction with our updated strategy document. We will send a copy of this response document to all those who commented. If any respondent considers that their comment has still not been addressed satisfactorily, we would welcome further discussion to enable us to understand and respond better to their concerns.

## TECHNICAL NOTE

### 6 REFERENCES

- 1 Defra, BERR, Welsh Assembly Government, Department of the Environment Northern Ireland, *Managing Radioactive Waste Safely: A Framework for Implementing Geological Disposal*, Cm7386, 2008.
- 2 NDA Radioactive Waste Management Directorate, *Proposed Research and Development Strategy*, June 2008.
- 3 NDA Radioactive Waste Management Directorate, *Record of Discussion at the NDA RWMD R&D Strategy Workshop*, March 2009.



