Environment Agency scrutiny of RWMD's work relating to the geological disposal facility Annual review 2008/09

Issue 1, Jan 2010

NWAT/NDA/RWMD/2009/001

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Executive summary

This review was produced under the terms of an agreement between the Environment Agency and the NDA RWMD. This document provides a summary of the work we carried out in the financial year 2008/2009 under the terms of that agreement, and presents our plans for 2009/10.

We intend to take a more integrated approach in future with other key regulators – the Health & Safety Executive Nuclear Directorate (HSE/ND) and Department for Transport (DfT). We are progressing plans for a joint regulatory project office to facilitate this.

1. Introduction

The Environment Agency is responsible in England and Wales for regulating disposals of radioactive waste. The Nuclear Decommissioning Authority's (NDA) Radioactive Waste Management Directorate (RWMD) is currently charged with developing a geological disposal facility (GDF) to dispose of higher-activity solid radioactive waste. The programme to implement the GDF will take many years. Our involvement falls into the two categories described below.

1.1 Early engagement and advice

At present our role, prior to any formal application, is to provide advice. We have entered into an agreement with NDA to provide, and charge for, advice during the early stages of the development of a GDF. Our scrutiny of the work by RWMD during these early stages enables us to:

- advise on the requirements for, and preparation of, future submissions to the regulators;
- improve our understanding of the safety and environmental performance of proposals for the GDF and provide our views on improving safety and environmental protection;
- provide guidance on regulatory issues[1] that may arise;
- inform stakeholders of our requirements;
- inform RWMD of the work it will be required to carry out to meet our regulatory requirements during future stages;
- reduce the risk of unnecessary expenditure or delays during the formal regulatory stages.

We will ensure that our advice to RWMD, or information provided in dialogue with stakeholders, during the early stages of developing a geological disposal facility will not compromise our independence. Any such advice does not alter our ability to make regulatory decisions in the future.

1.2 Formal regulatory permissioning

[1] We generally describe matters to be addressed during regulatory interactions as "issues". This should be interpreted very broadly. It may for example include RWMD's proposed courses of action, new projects or activities, events and investigations of interest to regulators, including responses to regulatory requirements. On our part, it may for example include any specific regulatory concerns, investigations and audits and their outcomes, and changes to regulatory processes.

We expect that any future application for permission to build a GDF will be subject to regulatory consideration in successive stages. UK Government is planning to amend the legislative powers available to the Environment Agency to enable a staged regulation process[2]. Under staged regulation, RWMD would need to apply for an environmental permit before starting intrusive investigations at a candidate site. Staged regulation would then introduce a series of subsequent hold points, each requiring regulatory approval to proceed. At each hold point, RWMD would need to submit an updated environmental safety case (ESC) to provide continuing assurance that the site will meet regulatory requirements. If satisfied with the updated ESC, we would grant an amended environmental permit to allow RWMD to proceed with the next phase of work. The regulatory process is explained in our guidance [1].

This document presents a summary of the work we carried out in the financial year 2008/09, and presents our plans for 2009/10. We intend to take a more integrated approach in future with other key regulators – the Health & Safety Executive Nuclear Directorate (HSE/ND) and Department for Transport (DfT). We are progressing plans for a joint regulatory project office to facilitate this.

[2] The legislative process to amend the Environment Agency's powers is expected to be completed in April 2010.

2. Planning for implementing geological disposal

2.1 The application and authorisation process

We continued to work with RWMD to consider, in detail, the future process of regulatory scrutiny, based on a staged authorisation process. We provided advice to RWMD on the regulatory submissions required under such a process. We also commented on RWMD's developing Permissions Schedule [2] which we think is a useful attempt to explain the permissions, consents and decisions that will be required to satisfy various regulations and other decision processes. RWMD's diagram that maps these permissions onto the stages of Managing Radioactive Waste Safely (MRWS) [3] is helpful. We think that coordinating the various decision-making processes will be challenging. This applies to managing interactions between RWMD, government and regulators and to aligning with the decision-making processes in the communities. Early and ongoing engagement with all parties will be important and there is an opportunity now for RWMD to plan how to manage and co-ordinate these interactions.

2.2 Stakeholder Engagement

In October 2008 we provided written comments on RWMD's "Public and Stakeholder Engagement and Communications Framework For Geological Disposal". We suggested a number of changes and improvements to the proposed strategy and encouraged RWMD to work with stakeholders to agree clear, understandable ground rules for engaging with them. These ground rules should define the scope of the engagement process, RWMD's expectations for the process, and how RWMD will use input from stakeholders. We challenged RWMD on the apparent duplication of "engagement" and "communications" work with stakeholders. "Engagement" is a two-way process, so we queried why the strategy needed to draw a distinction between "engagement" and "communication".

We were uneasy about RWMD's suggested "needs-driven approach" to stakeholder engagement and communication. Experience from overseas geological disposal programmes demonstrates that effort expended to build and maintain stakeholders' confidence and trust can be a sound investment.

We supported the creation of a national stakeholder forum to discuss the geological disposal programme, particularly in its early stages.

We provided further comments on RWMD's developing engagement strategy in March 2009. For example, we challenged RWMD's statement that, '…paying for stakeholder's time to participate in an engagement activity changes the relationship and could be seen as turning the

stakeholder into a contractor'. We suggested that "paying for stakeholder's time" is a recognition that RWMD values stakeholders' contributions and could enable citizens and stakeholders to participate more effectively.

RWMD published its *Public and Stakeholder Strategy* in July 2009. Most of our comments have been addressed, for example, the reasons behind a "needs-driven" approach have been better explained and the position on payments to stakeholders has been clarified. We also note that engagement and communication are now seen as part of an overall process rather than distinct activities. RWMD recognises that the strategy will need to be revisited from time to time depending on progress with the geological disposal programme. We will maintain our interest in this through continuing dialogue with RWMD.

2.3 2009/10 programme

We shall continue to advise on RWMD's evolving plans and progress for implementing geological disposal. This will include review of its programme to deliver the documentation required to support an application for an environmental permit for a GDF.

We shall examine RWMD's plans for engaging with stakeholders, including potential host communities, the general public, planning authorities and other interested groups. We will continue to develop and implement our own plans for engaging with stakeholders.

3. Disposal system specification & design

3.1 Review of Nirex's understanding and representation of near-field processes in the phased geological repository concept

Our earlier review of Nirex's understanding and representation of near-field processes in the phased geological repository concept [4] identified a number of technical challenges and uncertainties. These are recorded on issue resolution forms (RWMD_IRF_2008_001 to 003), that will need to be addressed as the GDF programme progresses.

We recommended that RWMD should develop and present an analysis to enable the performance of the preferred concept design for the GDF to be judged against that of alternative designs. This analysis should take into account issues such as safety, environmental impact, practicability, social issues and cost (Nirex_IRF_06_022). RWMD has since indicated that its generic Disposal System Safety Case (DSSC) will include an assessment of options for the disposal concept, in the light of information obtained during the GDF implementation programme. It will consider a range of geological environments, each with a different disposal concept.

We also recommended that RWMD should identify and assess the impacts of possible changes to the near-field design that might improve performance. RWMD has indicated that its developing optimisation process [5] includes re-assessing and extending the options for the design concept to encompass a range of geological environments.

3.2 Repository design

We contributed to workshops, hosted by RWMD, to discuss and consider disposal in different geological environments and various design concepts in relation to the disposal of higher-activity radioactive wastes[3]. The outputs from these workshops has fed into RWMD's ongoing work [6].

We undertook two projects, through our science department (*Review of Technical Issues Associated with Deep Repositories in Different Geological Environments* [7] and *Understanding Controls on the Performance of Repositories for HLW and Spent Fuel*[4]). Output from these projects will inform our regulatory position and our advice to RWMD regarding the development of its Environmental Safety Case.

[3] Higher-activity radioactive waste means HLW; ILW; and such LLW as cannot be disposed of at the Low Level Waste Repository near Drigg or similar future facilities.

[4] This project started in November 2007 and will be reported in an Environment Agency Science Report, in 2010.

3.3 2009/10 programme

We will continue to advise on RWMD's ongoing programme to design and develop a GDF. In 2009/10 RWMD is developing a disposal system specification. This will set out what is required of the disposal system, the fundamental basis for engineering designs, and the safety & environmental assessments that will underpin the disposal system safety case. We shall provide guidance on RWMD's specifications and its developing generic geological disposal facility designs.

4. Safety case development

4.1 Nirex generic post-closure performance assessment

Our review of Nirex's generic (post-closure) performance assessment (GPA) [8] highlighted some key findings and recommendations. We are progressing these with RWMD through the issue resolution process. RWMD has published a response to our review and the issues it identifies [9]. We shall continue dialogue and review of RWMD's work in this area. This will include revisiting, in future years, comments we have previously provided to RWMD in the context, and at the appropriate stage, of GDF implementation.

4.2 Disposal System Safety Case (DSSC)

We have continued to discuss with RWMD its developing safety case and we have provided comments on RWMD's specification document [10]. In particular we welcomed the move to incorporate transport safety, nuclear safety and environmental safety under the one framework, which should help to ensure consistency. We stressed the need for integration across the safety cases to ensure cross-cutting issues are considered and addressed, particularly where there may be conflicting or competing requirements.

We agreed with RWMD's objective that the generic DSSC should '*identify the key technical challenges in making a safety case and develop confidence that they can be overcome*". We urged RWMD to devote proportionate effort to aspects that provide safety and those that might threaten safety or challenge the performance of the system. We welcomed the emphasis on developing the more qualitative aspects of the environmental safety case at this stage. We suggested that a generic DSSC could include an element of horizon scanning to identify and highlight emerging issues that may impact on the DSSC in the future, for example:

- issues associated with the timing of waste disposals from new nuclear build,
- any significant changes to statutory standards or requirements;
- new national or international developments.

We consider that the generic DSSC should explain how it will evolve into a site-specific DSSC. We note, in particular, that the transition from collecting and using data representative of a generic system to using the data for an actual site may not be a simple process. The generic DSSC should not constrain RWMD's thinking about what is needed for a site-specific safety case.

RWMD's proposal to consider different design concepts in different geologies, in addition to the "generic reference case", is useful at this

stage. In our view it is an improvement over Nirex's focus on the phased geological repository concept.

RWMD recognises the different information needs of different stakeholders, and has proposed a linked hierarchy of documents intended to address this. We noted that the arguments presented in the DSSC, which are often complex, should be clear and readily traceable for the variety of audiences. RWMD identified this as a key aim.

We have discussed with RWMD the regulatory submissions needed to support implementation of a GDF through the various stages in MWRS. We have commented on RWMD's generic assessment process paper [11] and developing permissions schedule [2]. We will continue to provide guidance here as the programme progresses.

4.3 Post-closure safety case (PCSC)

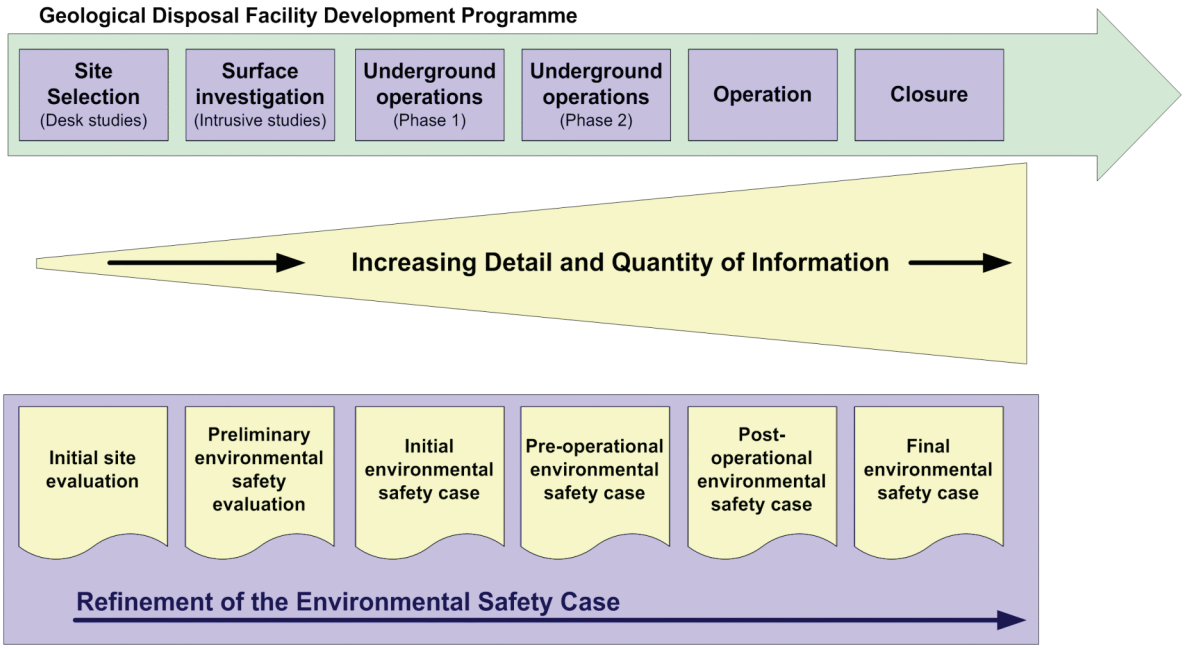
We commented on RWMD's draft contents for its *"Proposed methodology for the development of the post-closure safety case"* [12]. In particular, we noted that RWMD needs to address relevant comments made in our review of the Nirex generic (post-closure) performance assessment [8]. RWMD's response [9] indicates that it is addressing our comments as it develops the generic environmental safety case[5] (ESC). We shall continue to scrutinise developments when we receive further documents from RWMD.

4.4 2009/10 programme

The developer of a GDF needs to provide an environmental safety case (ESC) as part of the proposals to develop the facility [1]. Thereafter, an operator of a GDF is required to have in place a properly updated ESC.

The ESC needs to demonstrate that members of the public and the environment are adequately protected when the waste is disposed and in the future. An ESC is a set of claims concerning the environmental safety of disposals of solid radioactive waste, substantiated by a structured collection of arguments and evidence. The ESC should be consistent with the principles and requirements set out in our guidance [1].

[5] The ESC supersedes the PCSC



The figure illustrates how we expect the developer/operator of a GDF to develop the ESC as the programme progresses from site characterisation, through construction and operation, to closure of the facility. We do not make a special distinction between the ESC for the operational phase and for the post-closure phase because we regard each aspect as part of the case demonstrating overall environmental safety.

We shall continue to review RWMD's developing ESC and assessments. In particular, we shall check whether the generic ESC sets out environmentally-sound arguments in support of GDF concepts. We shall consider any fundamental environmental issues that could ultimately prevent us issuing an environmental permit for the GDF.

5. Sustainability & environmental assessment

We welcomed the opportunity to advise at an early stage of the assessment process, via the RWMD's consultation on the Framework for Sustainability Appraisal and Environmental Assessments for Geological Disposal. RWMD took our comments [13] into account for the final version. Our key messages were:

- RWMD needs to clarify in the framework what is being assessed, which assessment tool will be used and at what time. Sustainability appraisal (SA) and strategic environmental assessment (SEA) need to be iterative processes running alongside, and closely aligned with, the GDF programme.
- The SA/SEA and environmental impact assessment (EIA) should focus on promoting a sustainable outcome for the GDF programme and on achieving environmental outcomes.
- RWMD needs to clarify the assessment terminology and apply it consistently. "SEA" should be used for the high-level strategic assessment of options, and "EIA" for site-specific assessment activities.
- RWMD needs to link the framework with NDA's proposed Public and Stakeholder Engagement and Communications Framework for the GDF programme.

We also commented on the sustainability appraisal and environment assessment chapter of the permissions schedule [2]. We noted that the developer is required to undertake an environmental impact assessment (EIA) and to produce an environmental statement to accompany an application for planning permission. The planning authority assesses the information provided in the environmental statement to inform its decision to grant planning permission.

5.1 2009/10 programme

We shall continue dialogue with RWMD to provide guidance on its work in this area and review RWMD's developing approaches and methodologies for SEA and EIA. We shall also review any assessments associated with the non-radioactive characteristics of the proposed wastes.

6. Research and development

6.1 Strategy

In 2006 we reviewed and provided recommendations on Nirex's research and development (R&D) programme for 2006-2010 [14]. Our recommendations [15] were reflected in Chapter 3 of RWMD's proposed R&D strategy on which we commented via the formal consultation process during 2008/09 . Our views on how RWMD's proposed strategy addresses our earlier recommendations to Nirex are reproduced below:

- The strategy document makes a good start towards addressing our recommendation that "*a suitably detailed account of the future research programme*" should be produced to "*enable external review*". However, RWMD will need to provide much more detail.
- We called for the formulation of "*pre-defined research objectives*". The strategy document listed *"high-level research drivers"*, but RWMD needs to identify clear objectives that will help to establish whether suitable or sufficient research has been done.
- We recommended that Nirex should "…d*ocument more formally the process by which the research programme is defined and how that process is implemented.*" The proposed strategy identified the research drivers and priorities, and discussed the concept of a "needs-driven" R&D programme. It should also describe how the drivers and priorities are derived and how they relate to the "needs". RWMD needs to clarify the overall priorities for R&D.
- In 2006 we expressed our view that Nirex's work was too focused on the "phased geological repository concept" and the optimisation of that specific concept, rather than on choosing the best concept. The R&D strategy [in November 2008] did not give any indication that this position had changed[6].
- We suggested the NDA should strengthen its proposed strategy in the following areas:
    - quality assurance and peer review
    - building public confidence
    - co-disposal of high-level waste and spent fuel
    - the role of an "underground research laboratory".

6.2 Criticality screening levels

[6] RWMD's R&D strategy (March 2009) has subsequently identified work to explore a range of concepts. We will consider this work as part of our ongoing scrutiny programme.

In 2008/09 we began a review of RWMD's criticality screening level work using specialist contractor support. This review included a workshop (Feb 09) involving representatives from ourselves, HSE/NII, SEPA, DfT, NDA, Sellafield Ltd, and NNL. The workshop focused on identifying the key issues, the effects on particular waste streams of RWMD's proposed approach, exchanging information and determining the next steps. Key points of discussion were:

- Fissile limits must meet operational, transport and disposal requirements (in England & Wales) and the long-term, near-surface, near-site storage policy in Scotland. These might lead to different, and sometimes conflicting, drivers.
- A framework is needed for making regulatory decisions with respect to fissile limits where there are conflicting drivers. Setting more restrictive fissile limits would create more packages with an associated increase in handling and transport requirements, and is unlikely to remove the possibility of a post-closure criticality event. This should be balanced against setting higher fissile limits which has the potential to increase the likelihood of criticality events.
- The likelihood of a post-closure criticality event is believed to be low but is difficult to quantify. RWMD is concentrating on developing a better understanding of the consequences of criticality events, and on building confidence in the argument that the likelihood of a post-closure event and its potential consequence are low.
- The initial generic DSSC will include a criticality safety assessment (CSA) for geological disposal, focusing on ILW in a cement-based concept. The CSA will assemble many safety arguments to demonstrate that the probability of a criticality event is low. RWMD is currently preparing a criticality safety synthesis report (CSSR). This will feed into the CSA. RWMD's CSSR will bring together the key outputs of the extensive work programme on "understanding criticality under repository conditions" and any related implications for the disposal concept and packaging advice. We plan to review the CSSR at some later date.
- For disposal of ILW in a cementitious system located in a hard rock environment RWMD is confident in the low probability, low consequence argument with respect to criticality. Further work is required to consider high-activity wastes (such as spent fuel, Pu/U), different geological environments and other repository concepts.

6.3 Gas

We commissioned a review of RWMD's work relating to gas evolution and migration [16], which is available from our website (http://www.environment-agency.gov.uk/business/sectors/37483.aspx).

We shall consider the need to take forward any remaining issues, through our issues resolution process, once we have seen RWMD's response to our report and at an appropriate stage in the GDF programme.

6.4 2009/10 programme

We shall continue to review RWMD's developing R&D strategy and supporting documents, including aspects of its provisional implementation plan (PIP), R&D programme, and supporting documentation (TBURD).

We shall review RWMD's work in progressing specific technical and scientific issues identified to date, such as:

- package longevity
- criticality
- gas
- biosphere
- near-field evolution
- radionuclide behaviours
- groundwater
- alternative encapsulants
- use of superplasticisers (in waste packaging and repository design).

We shall also consider our own research work and how emerging issues will be addressed in RWMD's forward programme.

7. Site evaluation and characterisation

7.1 Review of RWMD's geosphere characterisation programme (GCP)

We reviewed a number of documents associated with RWMD's developments with respect to geosphere characterisation [17]. Our key messages were:

- We will expect all relevant aspects of a candidate site to be characterised, not just the geosphere. The use of the term "geosphere characterisation" may be misleading. We suggest the term "site characterisation" might be more appropriate.
- The success of the characterisation programme will rely heavily on interaction between different disciplines, and integration with the wider GDF development programme. This will require significant resource and effort.
- RWMD's approach to characterising a candidate site is unclear. In particular, RWMD should identify what information will be needed and what criteria will need to be met in order to support continued site investigation and to prioritise characterisation activities. These should be reviewed as the GDF design evolves and as characterisation activities move from generic to site-specific studies.
- We expect the performance of the GDF to be optimised. We will seek evidence that information from site investigation activities is being used to optimise the GDF design and barrier functions.
- RWMD recognises the role of peer review within the GCP, particularly with respect to uncertainties in geological data. It does not explain what work it intends to do on this topic.
- We expect the main objectives of the initial stages of a site characterisation programme will be to gather data and information to enable qualitative and quantitative assessment. As the programme proceeds and the level of understanding increases it is likely that additional site characterisation activities will be required to build confidence.

7.2 Review of non-intrusive geophysical techniques

We developed plans to review non-intrusive geophysical investigation techniques that could be relevant to siting a GDF in a range of geological environments. The objectives of the review are to:

- assess the role of non-intrusive geophysical techniques in improving the understanding of a potential GDF site, particular in the early stages of a site characterisation programme;
- identify, describe and assess the limitations of the available non-intrusive geophysical techniques, the information that can be acquired, and the understanding obtained from them;
- assess the current status of non-intrusive geophysical techniques and how they may be used to develop a case for the long-term safety of a GDF;
- assess the overall strategy and deployment of non-intrusive geophysical techniques proposed by RWMD.

This work is progressing using contractor support and will be completed in 2009/10. It will inform our decisions when we assess future submissions. In particular it will help us decide whether the developer has established and carried out an appropriate programme to characterise the potential site(s) in the initial stages. The developer would need to do this before we could agree to further investigations that might disturb a site.

7.3 2009/10 programme

During 2009/10, RWMD will be undertaking studies in preparation for the MRWS stage 4 desk-based studies, to provide information to Government and other stakeholders on the selection of a site(s) for surface-based investigation. It will examine the site characterisation activities that should be undertaken during MRWS Stage 5. We shall review information from these studies and advise RWMD before the desk-based studies begin.

We shall consider aspects of RWMD's site characterisation project and its plans and approaches in moving from desk-based studies to site characterisation.

8. Waste packaging advice and assessment

8.1 Letter of Compliance process

The NDA assesses the nuclear industry's proposals for treating, conditioning and packaging higher-activity radioactive wastes, and issues Letters of Compliance (LoC) and disposability assessments. We have raised a number of issues relating to the LoC process and are pursuing these with RWMD through the issue resolution process.

We participated in a workshop with RWMD in October 2008 to help us scrutinise the LoC process and its evolution. Our specific objectives were to understand:

- whether the LoC process is flexible enough to cover current and future packaging proposals, for example for novel waste forms or variations in GDF design;
- RWMDs plans for maintaining the currency of LoC endorsements;
- RWMDs plans to develop the LoC process to address treatment, conditioning and packaging of spent fuel and HLW.

RWMD provided a written response [18] to the questions we tabled in advance of the workshop. This will help inform our review of RWMD's document, *"For discussion: Proposals for Evolution of the LoC Process"*.

8.2 Longevity of ILW waste packages

We reviewed RWMD's work relating to container longevity and waste form stability. We published our findings in a report [19], available from our website (http://www.environment-agency.gov.uk/business/sectors/37483.aspx).

We shall progress our recommendations with RWMD, via the issue resolution process (RWMD_IRF_2008_004).

8.3 2009/10 programme

We shall continue to review RWMD's developing procedures and guidance relating to the LoC process. This will include coverage of:

- development of the process to address HLW, nuclear materials not currently classified as waste, and wastes arising from new nuclear reactors;
- procedures to address failure of waste packages;
- development of waste acceptance criteria.

We shall continue to monitor LoCs and assessment reports issued by RWMD, to identify and progress any generic issues as they arise.

We shall review RWMD's revised (generic) waste package specifications and guidance documentation. Our review will include any specific guidance being developed relating to, for example: non-encapsulation of wastes; packaging of sealed sources; waste container material; use of capping grouts; low-specific-activity material; fissile exception; and application of fissile limits to waste packages.

RWMD is advising requesting parties on the generic design assessment of new nuclear reactors. We shall explore the basis for RWMD's advice on the disposability of radioactive wastes expected from implementation of those designs. This will include RWMD’s assessment process for consideration of new nuclear build wastes and any potential implications for the GDF design.

9. Organisational development

9.1 Peer review

In our review of Nirex's generic post-closure performance assessment [8] we recommended that Nirex should clarify its position on peer review. We suggested it submits any future post-closure assessments for peer review prior to submission or publication (RWMD_IRF_2007_005). We note that CoRWM has also questioned RWMD's position on peer review as applied to R&D for the GDF.

RWMD has responded to this recommendation. To summarise, RWMD is preparing a summary of its oversight and peer review arrangements [20]. RWMD notes that these arrangements are strictly limited to the consideration of peer review for R&D, but that they could apply to other aspects of its work. RWMD recognises it needs to formalise the peer review process and to provide specific guidance on it. It will give us this guidance once developed. RWMD has summarised its approach to its related activity of preview [21], which typically involves an element of peer review by potential contractors and interested academics. RWMD will have all future documented post-closure safety assessments peer reviewed. It will do this through its project management arrangements for the Disposal System Safety Case (DSSC) project. RWMD's quality plan, which is currently being developed, will set out these arrangements.

9.2 2009/10 programme

We shall continue discussions with RWMD on its strategy for developing and implementing appropriate organisational and management structures and procedures for the evolution of RWMD into a prospective site licence company (SLC).

We shall review aspects of RWMD's management arrangements, including its detailed response relating to peer review and the associated documentation, as these continue to develop.

List of issue resolution forms scrutiny programme to date:

Nirex_IRF_06_001	Treatment of inventory uncertainty
Nirex_IRF_06_002	Identification of waste streams for which inventory uncertainty is a concern
Nirex_IRF_06_003	Derivation of the assessment inventory
Nirex_IRF_06_004	Waste package fissile limits: post-closure assessments
Nirex_IRF_06_005	Development of a post-closure criticality safety assessment (PCCSA)
Nirex_IRF_06_006	Role of the LoC process - principles and objective
Nirex_IRF_06_007	Definition of margins of safety in Nirex's packaging advice
Nirex_IRF_06_008	Role of the LoC process in options assessment
Nirex_IRF_06_009	Near-field performance objectives for waste packages
Nirex_IRF_06_010	Operation of the LoC process in practice
Nirex_IRF_06_011	LoC/LoA feedback and reporting
Nirex_IRF_06_012	Dealing with uncertainty in the LoC process
Nirex_IRF_06_013	Proportionality and consistency of approach in LoC assessments
Nirex_IRF_06_014	Flexibility of the conceptual repository design
Nirex_IRF_06_015	Leachability
Nirex_IRF_06_016	Chemical toxicity
Nirex_IRF_06_017	Identification of acceptable quantities of waste materials
Nirex_IRF_06_018	Other encapsulants and non cementitious waste forms
Nirex_IRF_06_019	Demarcation of waste streams for assessment
Nirex_IRF_06_020	Generation of carbon-14 labelled gases
Nirex_IRF_06_021	Use of simulants
Nirex_IRF_06_022	Choice of disposal concept
Nirex_IRF_06_023	Balanced use of technical information
Nirex_IRF_06_024	Waste package longevity and maintenance of appropriate storage conditions
RWMD_IRF_07_001	Defining an R&D programme to support development of a deep geological disposal facility
RWMD_IRF_2007_002	Purpose, scope and objectives of the Generic Performance Assessment (GPA)
RWMD_IRF_2007_003	Generic performance assessment (GPA): assessment context and intended audience
RWMD_IRF_2007_004	Assessment methodology

RWMD_IRF_2007_005	Peer Review
RWMD_IRF_2008_001	Near-field performance measures (draft)
RWMD_IRF_2008_002	The effect of near-field design on optimising repository performance
RWMD_IRF_2008_003	The representation of near-field features, events and processes within near-field assessment models
RWMD_IRF_2008_004	Longevity of ILW Packages

Summaries of technical reports we produced during 2008/09

Report Summary NWAT/Nirex/06/003/RS

The longevity of intermediate-level radioactive waste packages for geological disposal. A review

The Environment Agency's nuclear waste assessment Team (NWAT) has reviewed Nirex's[7] work relating to container longevity and waste form stability.

Nirex's waste package specifications set a target lifetime for the waste container of 500 years, which allows for a period of extended retrievable storage within a repository. We consider this is one of the more challenging parts of the phased geological repository concept because waste packages may have to remain intact for a long time.

If waste packages degrade such that they need to be reworked, this could have considerable impacts on the environment. If waste packages degrade significantly and are not suitably remediated while the repository is operational, they could adversely affect long-term safety and increase environmental impacts after the repository is closed.

We consider that the NDA RWMD should be cautious when estimating package lifetimes over several centuries, given the current state of knowledge and the uncertainties over waste package ageing. We have reservations that Nirex has introduced a container integrity target of 500 years, apparently without fully justifying the target or providing a basis for assessments against it.

Our recommendations following this review are:

- The appropriate target for package lifetimes needs to be kept under review in the context of plans for a national disposal facility and the practicality of producing durable containers and waste forms. The NDA RWMD should encourage debate on this issue with appropriate national stakeholders.
- The current waste package specifications include targets for waste form and container performance that differ significantly. The specifications should be reviewed to ensure they are consistent.
- The NDA RWMD should develop a standard approach to assessing package lifetimes. These assessments should be undertaken against specified failure criteria.
- The NDA RWMD should systematically review the waste inventory to identify those wastes most likely to present a challenge to package integrity and to identify the anticipated failure mechanisms. The NDA RWMD should support waste producers in developing durable waste forms and monitoring strategies for any existing and future waste streams that might be vulnerable.

Full report:
This is a summary of the following report:

NWAT report: NWAT/Nirex/06/003

Title: The longevity of intermediate-level radioactive waste packages for geological disposal: A review
August 2008

Author: P K Abraitis

NWAT project manager: S L Duerden

This project was carried out by the Environment Agency's nuclear waste assessment team (NWAT). NWAT provides technical support to the Environment Agency on the management and disposal of radioactive waste in England and Wales, to ensure that wastes are disposed of in the most appropriate manner to protect the public and the wider environment, and to contribute to the UK's aim of sustainable development.

Further copies of this summary, and the full report, are available from:
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Ghyll Mount,Gillan Way
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Environment Agency

[7] Responsibility for planning and implementing geological disposal has now transferred from United Kingdom Nirex Ltd (Nirex) to the Nuclear Decommissioning Authority (NDA). This report is based on a review of Nirex's work before this change. Our recommendations are now directed to the NDA's Radioactive Waste Management Directorate (RWMD) which has assumed many of Nirex's former responsibilities. The Environment Agency has an agreement with the NDA RWMD to scrutinise its technical work on deep geological disposal, pending any future application for a disposal authorisation.

Report Summary NWAT/NDA/RWMD/2008/002/RS

Title: Gas generation and migration from a deep geological repository for radioactive waste. A review of Nirex/NDA's work

The Environment Agency's nuclear waste assessment team (NWAT) commissioned Quintessa to review Nirex/NDA's work relating to gas evolution and migration in the context of disposing of higher-activity radioactive waste in a deep geological repository.

Significant quantities of gas (mainly hydrogen, carbon dioxide and methane) will be generated in a deep geological repository. Some of this gas is likely to be radioactive. If gas accumulates in a repository there will be a build up of pressure which has the potential to disturb the engineered structure of the repository and its host rock. If gas is not contained there will be other consequences, particularly on the local ground water flow regime.

The report concludes that Nirex has taken into account most of the processes likely to generate gas and the issues that may affect long-term safety. The report identifies key issues that need to be addressed including the challenge of modelling gas and its effects.

Our recommendations following this review are:

- The NDA RWMD should review and evaluate the significance of Quintessa's findings and recommendations.
- The NDA RWMD should explain the relevance of its current gas research and the questions being addressed. It should present a strategy for future work on gas, explaining what information is required and why.
- Many gas transport issues are site-specific. Continued detailed modelling for any particular geologic formation may not be the best use of resources. At this stage the NDA RWMD should identify key gas transport questions that need to be addressed to support the site selection and characterisation process.
- The NDA RWMD has developed one tool (SMOGG) to model gas generation through the lifecycle of a waste package. The NDA is funding development of similar models for nuclear sites (for example MAGGAS and models adapted specifically for the Low-Level Waste Repository near Drigg). We would encourage model inter-comparison studies, but suggest that NDA also considers rationalising the future use and development of such models.
- If un-reprocessed spent Magnox fuel were to be disposed of, its subsequent corrosion could produce significant amounts of gas. The consequences of this option should be investigated.
- We encourage the NDA to integrate the work of its corrosion specialists and gas modellers.
- A general challenge is the extent to which cautious or conservative assumptions influence decisions relating to package and repository design, and disposal concept. Conservative assumptions are used to build confidence that safety targets can be met. These same assumptions can, however, compromise design decisions. NDA RWMD should review the role of conservatisms in gas pathway safety assessment and highlight areas of tensions with design decisions.

This work will inform our ongoing dialogue with the NDA and scrutiny of its programme.

Full report:
This is a summary of the following report:

NWAT report: NWAT/NDA/RWMD/2008/002

Product Code: GEHO1108BOZN-E-E

Title: Gas generation and migration from a deep geological repository for higher activity radioactive waste. A review of Nirex/NDA's work

September 2008

Author: R Metcalfe, S P Watson, J H Rees, P Humphreys & F King (Quintessa Ltd)

NWAT project manager: D I Brazier

This project was carried out by the Environment Agency's Nuclear Waste Assessment Team (NWAT). NWAT provides technical support to the Environment Agency on the management and disposal of radioactive waste in England and Wales, to ensure that wastes are disposed of in the most appropriate manner to protect the public and the wider environment, and to contribute to the UK's aim of sustainable development.

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Environment Agency

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