Environment Agency scrutiny of NDA RWMD's work relating to geological disposal of higher-activity solid radioactive waste: Annual review 2009/10

Version 1.0, October 2010

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Executive summary

In this document we provide a summary of the work we carried out in the financial year 2009/2010 to provide advice and scrutiny of the Nuclear Decommissioning Authority's (NDA) work to implement geological disposal for higher-activity solid radioactive waste. We explain what we have looked at, our key messages to NDA, and our planned work areas for 2010/11.

We carried out this work under the terms of a voluntary agreement between us and the NDA made under section 37 of the Environment Act 1995.

1. Introduction

Implementing geological disposal is an essential part of managing the UK's radioactive waste legacy, together with radioactive wastes that may arise from any new nuclear build. A geological disposal system will form a crucial part of the UK's radioactive waste management infrastructure.

The Nuclear Decommissioning Authority (NDA) is tasked by Government to plan and implement geological disposal for higher-activity solid radioactive waste. NDA's Radioactive Waste Management Directorate (RWMD) is responsible for putting in place a programme to take this forward and will, in time, develop into an organisation to implement geological disposal.

The programme to implement geological disposal will take many years. The Environment Agency, Health and Safety Executive (HSE) and Department for Transport (DfT), hereafter referred to as "the regulators", do not currently regulate NDA or its RWMD in this regard and will not do so for some time. The regulators are working together and engaging with NDA at an early stage to make sure that any future facility meets the required high standards for environmental protection, safety, security, waste management and radioactive waste transportation. The regulators want NDA to develop a successful programme for geological disposal, and to establish an organisation capable of applying for the environmental permits and the nuclear site licence it will need in due course. The Environment Agency (hereafter referred to as 'we') has entered into an agreement with NDA to provide it with, and charge for, advice and scrutiny on matters of regulatory interest, during the early stages of implementing geological disposal. We have a power to do this under the Environment Act 1995.

This report covers the work we carried out in 2009/10 to advise RWMD about regulatory matters in its ongoing programme. Our involvement falls into the two categories described below and is summarised in Figure 1.

We are also actively involved in the Government's 'Managing Radioactive Waste Safely' process (MRWS) which provides a framework for implementing geological disposal. We provide independent advice and regulatory comment to Government, NDA, local authorities and other people.

1.1 Early engagement and advice (Process by agreement)

At present the role of the regulators, prior to any formal application for a permit or licence, is to provide advice on regulatory matters. Scrutiny of RWMD's work during these early stages enables the regulators to:

- advise on the requirements for, and preparation of, future submissions to the regulators;
- improve the regulators' understanding of the safety and environmental performance of proposals for geological disposal and provide views on improving safety and environmental protection;
- provide guidance on regulatory issues[1] that may arise;
- inform people of the regulators' requirements;
- inform RWMD of the work it will be required to carry out to meet regulatory requirements during future stages;
- reduce the risk of unnecessary expenditure or delays during the formal regulatory stages;
- scrutinise RWMD's role in providing advice on packaging.

The regulators will ensure that their advice to RWMD and information provided in dialogue activities, will not compromise the regulators' independence and will not alter their ability to make regulatory decisions in the future. We will aim to make information relating to such advice available to a wide range of people, subject to any overriding commercial interests or matters of national security.

In response to the invitation for expressions of interest which accompanied the MRWS White Paper [1], Allerdale Borough Council, Copeland Borough Council and Cumbria County Council have, without commitment, expressed interest in participating in discussions about potential involvement in a Geological Disposal Facility (GDF) siting process. The West Cumbria MRWS Partnership was established in March 2009 to make recommendations to the local authorities on whether or not they should take part in the siting process. The Partnership has a broad membership in addition to the principal local authorities. The Environment Agency has been an observing member since May 2009. We have provided information and support to the Partnership on the roles and responsibilities of the regulators during the development of a GDF. We have attended meetings where we have explained our role and generally supported the Partnership's first round of Public and Stakeholder Engagement.

1.2 Formal regulatory permissioning (Staged regulation)

[1] The regulators 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 the regulators' part, it may for example include any specific regulatory concerns, investigations and audits and their outcomes, and changes to regulatory processes.

The Environmental Permitting (England and Wales) Regulations 2010 provide the Environment Agency with a power to regulate geological disposal in stages. Under staged regulation, the developer of a GDF must apply for an environmental permit before starting intrusive investigations (e.g. boreholes) at a candidate site, and will only be able to proceed if we grant such a permit. Staged regulation introduces a series of subsequent hold points, each requiring regulatory approval to proceed. At each hold point, the developer would need to submit an updated environmental safety case (ESC) to provide continuing assurance that the proposals will meet our regulatory requirements. If satisfied with the updated ESC, we would grant an amended environmental permit to allow the developer to proceed with the next phase of work. This regulatory process is illustrated in Figure 1 and explained in our guidance [2].

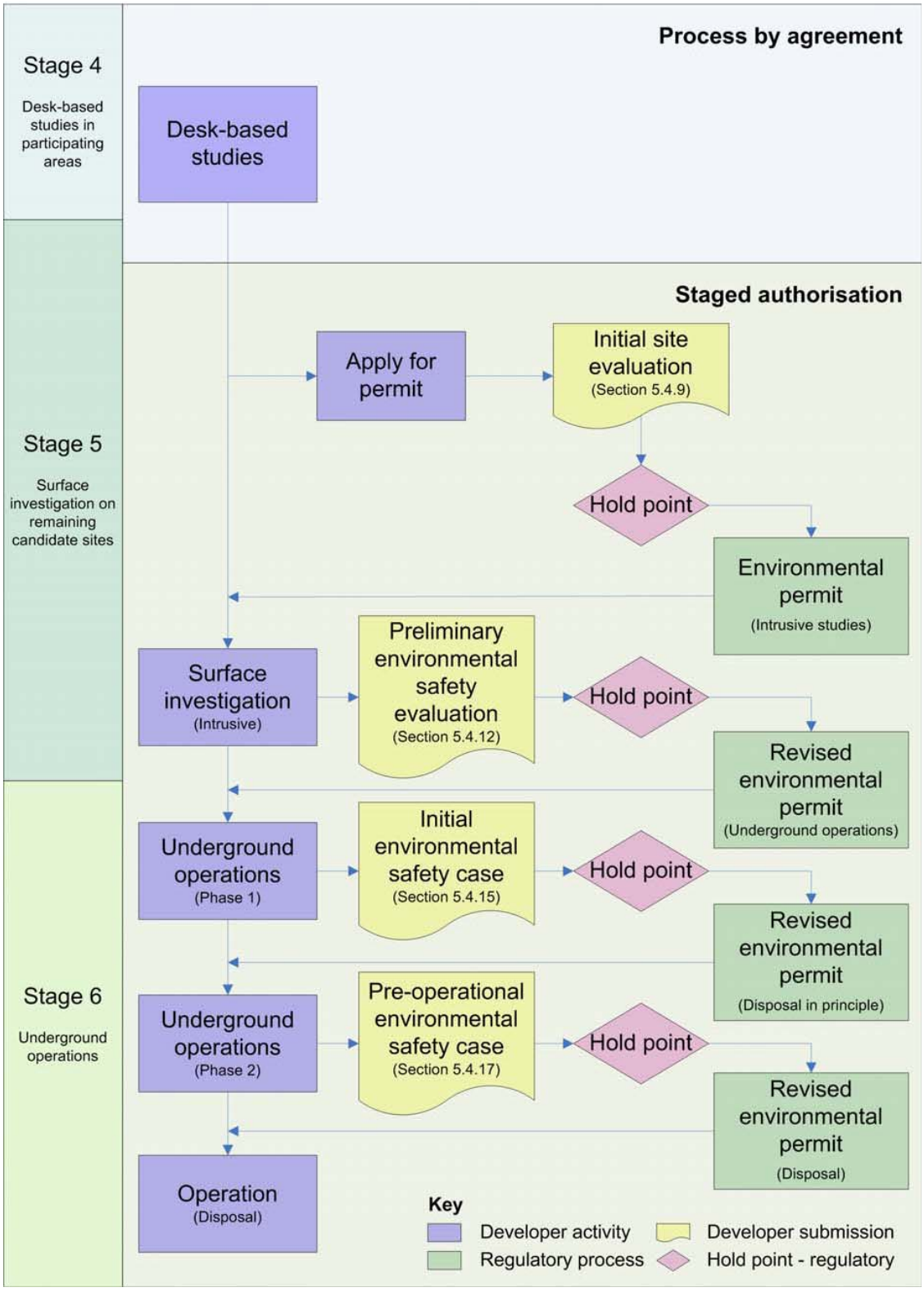


Figure 1 Indicative process for staged regulation of a geological disposal facility (from [2])

2. Planning for implementing geological disposal

We explored RWMD's overall plans and progress for implementing geological disposal, including its detailed work programme to deliver the documentation required for the regulatory process leading to an operational GDF. We also considered and discussed RWMD's plans for dialogue with third parties including potential host communities, planning authorities, other interested groups, and the general public.

2.1 The application and permissioning 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 about the ongoing planning of work to produce the regulatory submissions required under such a process. Further information on these interactions is provided below.

Frameworks for submissions and generic assessments (Permissions Schedule)

We reviewed RWMD's draft Permissions Schedule and the associated supporting documentation [3]. Overall we consider the Schedule is a useful attempt to scope and explain the numerous permissions, consents and decisions that will be required to satisfy the various regulations and other decision processes. The accompanying diagram mapping these permissions onto the sequence of MRWS Stages is particularly useful. We suggested a number of ways in which we thought the document could be improved [4]. These included suggestions on how to improve the clarity of the document, for example by identifying instances where the terminology used within our guidance [2] has been applied by RWMD in a different manner which may lead to confusion. We compiled a table correlating relevant sections of our guidance with specific sections of RWMD's Permissions Schedule and supporting documentation. This enabled us to establish that there were no major disparities, although there are differences of emphasis.

RWMD's subsequent revised Schedule (dated May'09) indicates that it incorporates changes to address regulatory comments. RWMD will continue to revise the permissions schedule, as implementation proceeds, and we will continue to provide advice and guidance on it, through dialogue and periodic review.

Geological Disposal: Steps towards implementation

We commented on an early draft of this document ('Planning for Implementation' dated June 2009). We consider that the draft provided a useful overview of the process and activities required for implementing geological disposal. The draft indicated that it is intended for 'a wide range of interested parties' but the content sometimes assumes a fairly detailed knowledge of, for example, the Letter of Compliance process and the role of Site Licence Companies. Most of our comments were aimed at improving the accessibility of the document to less knowledgeable readers. RWMD addressed our comments in the revised version. We consider that it now reads well and sets out the information clearly and in a way that should be understandable to all [5]. We have not reviewed the chapter on communities (which RWMD added since the previous version) since it was not included in the draft we received.

2.2 Public and stakeholder engagement

RWMD's programme has not included any documents on public and stakeholder engagement for regulatory review in the period covered in this report.

We continued to update our own webpages with new information, and we have established a joint webpage with HSE and DfT (http://www.environment-agency.gov.uk/business/sectors/111766.aspx). We have drafted briefing notes on our role in geological disposal including information on staged regulation and the environmental safety case. We shared these drafts with the West Cumbria MRWS Partnership, to help us develop them further. We are planning to publish final versions on our web site.

A brief overview of our engagement and activities undertaken in supporting the West Cumbria MRWS Partnership is given earlier in Section 1.1.

2.3 2010/11 programme

We shall continue to advise on RWMD's evolving plans and progress for implementing geological disposal and to examine RWMD's processes for engaging with people. We will continue to develop and implement our own plans for engaging with people, and supporting the West Cumbria MRWS Partnership and other interested potential host communities.

Planned RWMD deliverables in 2010/11:

Permissions Schedule

Steps Towards Implementation

3. Disposal system specification & design

RWMD is developing a Disposal System Specification to set out what is required of the disposal system and to provide the fundamental basis for engineering designs and the safety and environmental assessments that will support the Disposal System Safety Case. At the present stage, without a site for a GDF, we have explored the technical issues applicable in a range of different geological environments. This has included:

- understanding the inventory of waste to be disposed;
- the effects of particular waste streams on the performance of a GDF;
- identifying the basic principles that RWMD will adopt in the specification and design of a GDF;
- exploring how a disposal system functional specification will be developed and used; and
- how the approach to optimisation will be pursued and, related to this, the role of optioneering studies in the design process.

We have initiated work ourselves (section 3.1) and reviewed RWMD documents (section 3.2).

3.1 Work under the Environment Agency's Science Programme

We commission our own R&D to improve our understanding and to help shape and guide our advice to RWMD and others. We funded and implemented two such projects through our Science programme. The work was carried out with the help of Quintessa Limited as research contractor.

3.1.1 Technical issues associated with deep repositories for radioactive waste in different geological environments

We explored the associated technical issues that could be important to the safety of a GDF if it were built in a range of potential geological environments found in England and Wales. The work focused on the post-closure phase. We considered construction and operational matters only to the extent that they could affect the ability of a GDF to meet safety standards in the long term. The project concluded that there are many matters to be addressed in order to build and operate a GDF. Some of these matters are already being addressed, either in the UK or in other international disposal programmes. However, these studies will need to be re-evaluated in the UK context, and for the eventual site-specific conditions

and inventory. Furthermore, many matters can only be practically addressed once a candidate site is chosen. The outcome of the work was published in September 2009. Our summary of the project is available via the following link (350 KB file size):
http://publications.environment-agency.gov.uk/pdf/SCHO0809BQVV-e-e.pdf
The full contractor report is available via the following link (2.8 MB):
http://publications.environment-agency.gov.uk/pdf/SCHO0809BQVU-e-e.pdf

3.1.2 Understanding controls on the performance of engineered barrier systems on high-level radioactive waste and spent fuel repositories

We explored the current understanding of what controls the long-term performance in different repository designs for HLW and SF disposal, focusing on the role of the engineered barrier system (EBS). The work included:

- a literature review of disposal systems proposed by radioactive waste management programmes throughout the world, choosing some representative disposal concepts to illustrate the range of controls on performance;
- reviewing the safety functions attributed to different components of the EBS;
- identifying groups of features, events and processes (FEPs) that describe these safety functions and threats to these safety functions;
- using simple computational models to explore the significance of each of these FEPs as controls on the performance of barrier components.

We identified eleven key controls on the performance of a geological disposal facility. The relative importance of these different controls and their overall impact on safety will depend on the precise details of the site and facility design. Furthermore, the performance required of an EBS depends not only on technical issues connected with the EBS itself, but also on regulatory requirements and the characteristics of the surrounding geosphere (the geological environment in which the system is based).

We have provided RWMD with a draft version of our report prior to publishing it. Final publication was delayed due to the General Election, but we expect to publish the report shortly on our web site.

3.2 Review of NDA documents

3.2.1 Safety, environmental, security and safeguards principles for the design process [6]

We reviewed RWMD's document and provided our comments to RWMD by letter [7]. We questioned RWMD's statement that the principles apply to design and not to construction, operation or other activities except insofar as design must take them into account. We regard principles as being more general than this statement indicates, and that there should be principles that apply to all aspects of the work of a developer/operator of a GDF. RWMD is considering our comments in preparing its final version of the document, expected in 2010/11.

3.2.2 Disposal System Functional Specification [8]

We reviewed RWMD's draft report and provided our comments to RWMD by letter [9]. We expected a functional specification to describe the functions of the various engineered systems. We suggested that RWMD should, at this stage, explain the role of the functional specification and how it intends to use and develop it. We also suggested that RWMD could improve the document by including references to key documents (i.e. design principles and RPPM) and to explain how the Disposal System Specification supports, and is influenced by, optioneering work.

3.2.3 Geological Disposal - Key Aspects of RWMD's Approach to Optimisation of the Geological Disposal Facility [10]

We reviewed RWMD's draft document and provided our comments to RWMD by letter [11]. We disagreed with RWMD's definition of optimisation (*"the selection of the most appropriate method for implementing geological disposal of higher activity wastes, taking into account a wide range of factors"*). In our view, 'optimisation' is the optimisation of radiological protection, constrained by all the other factors (such as cost control, the NDA Value Framework and the design expectations of Community Siting Partnerships). Optimisation of radiological protection means ensuring that radiological risks to workers and members of the public, both now and in the future, are as low as reasonably achievable. RWMD should apply our definition of optimisation, to make properly informed design decisions.

3.2.4 RWMD's repository design optioneering studies

RWMD provided a number of reports, produced by its contractors, relating to disposal concept optioneering and development [12, 13, 14]. We reviewed these and their application, and provided comments to RWMD by letter [15]. Our main points were:

- We would like RWMD to clarify how it intends to use information derived from the five (illustrative) examples to guide its selection of disposal concept, and how this work relates to options appraisal in support of Strategic Environmental Assessment and the Letter of Compliance (LoC) process. RWMD should provide assurance that future concept optioneering will not be constrained by these five illustrative examples.

- RWMD should clarify whether the Phased Geological Repository Concept (PGRC), and the KBS-3V concept for disposal of spent nuclear fuel, still have the status of 'reference concepts' (for disposal of UK ILW and HLW/SF) and what this term now means and represents (e.g. whether these concepts are the basis for existing LoC advice).
- The Swiss disposal concept (designed for a single geological setting) is the only concept specifically designed for 'co-location' of waste spent fuel and other radioactive waste. If co-location is an option, we would expect RWMD to undertake a thorough identification and analysis of the issues relating to the interaction of the various different wasteforms, the Engineered Barrier Systems and the host environment.
- RWMD should develop a timeline setting out the information that needs to be known (or resolved) regarding deep borehole disposal, in order to assess deep borehole disposal as part of a consideration of alternatives to mined repository concepts.

3.2.5 Derived inventory

RWMD provided a number of documents relating to its derived inventory, covering LLW, ILW, HLW, spent fuel, plutonium, uranium and new build wastes. We discussed these, and the process for deriving the inventory, at a topic meeting in October. The aim of the meeting was to help us understand the following key points:

- How RWMD will modify the inventory to include high level waste, other materials such as spent fuel that may in future be declared wastes, and wastes from new build.
- How RWMD has derived the waste inventory for assessment purposes and how it will progressively enhance the quality of the derived inventory.
- What inventory scenarios RWMD will consider in the Generic Disposal System Safety Case (DSSC).
- Whether the inventory RWMD will used as a basis for assessment in its forthcoming DSSC includes any novel enhancements to deal with an expanded inventory.
- The extent to which RWMD will address inventory uncertainty in the DSSC.

RWMD presented the derived inventory documents and outlined the document structure, key assumptions and outputs, and highlighted the following points:

- RWMD's 2007 derived inventory is based on the 2007 UK Radioactive Waste Inventory (RWI). This represents a snapshot of radioactive waste that existed at 1st April 2007 and wastes projected to arise after that date.

- The derived inventory is an enhancement of the UK RWI that provides a greater level of detail on the wastes destined for geological disposal.
- The 2007 UK RWI is accompanied by a Materials Report that quantifies irradiated fuel, unirradiated fuel, plutonium, uranium and thorium, as well as other materials that are not currently classified as waste. It includes arisings from contaminated land and planned new facilities.
- The 2007 derived inventory is subject to review and enhancement. Review is the process of identifying omissions, differences and inconsistencies, where inconsistencies can be within the 2007 Inventory or between the 2007 Inventory and other sources of data. Enhancement is the process of filling gaps and providing fully substantiated data where these are not reported in the 2007 Inventory.
- The 2007 derived inventory includes a lower reference case and an upper Inventory
- RWMD will determine the implications of the 2010 UK RWI and any consequent changes to the 2007 derived inventory.

3.3 2010/11 programme

Planned RWMD deliverables in 2010/11:

Safety environmental security and safeguards principles for the design process

Sustainable design objectives for the geological disposal facility

Radiation Protection Policy Manual

GDF Outline Design Reports (evaporate rock, higher strength rock, and lower strength sedimentary rock)

GDF Design Reports (evaporate rock, higher strength rock, and lower strength sedimentary rock)

GDF Summary Design Report

Generic Transport System Design

Derived Inventory

Disposal System Functional Specification

Disposal System Technical Specification

RWMD's proposed approach to geological disposal facility optioneering

Keeping alternative waste management options under review

Report on concept options for disposal of UK stocks of separated plutonium

Report on concept options for disposal of UK stocks of separated uranium

Waste hierarchy report

Note: Many of these reports support the Generic Disposal System Safety Case and will be reviewed alongside that. The extent of the review of these

documents will largely depend on issues that we consider it is appropriate to explore in the current context of the project and stage of implementation.

4. Safety case development

In its entirety, a safety case for a GDF will need to address the transport of waste to the facility, the construction and operation of the facility, and the protection of people and the environment over the very long term – for many thousands of years. In 2009, RWMD took early steps towards presenting such a safety case.

RWMD provided us with a draft, high level document entitled “The Safety of a Geological Disposal System: An Overview” [16]. We provided comments on this document to RWMD by letter [17]. We noted that the report is aimed largely at potential volunteer communities and other ‘non-regulatory’ readers, and we reviewed it on that basis. Our comments were therefore largely editorial, aimed at making the document more understandable and ensuring that it provided fair and accurate descriptions of the issues.

RWMD also provided a working draft ‘storyboard’ document entitled “Generic Environmental Safety Case for a Geological Disposal Facility 2010” [18]. Because the document was at a very early stage of development, we pitched our review at a relatively high level. In many cases we simply highlighted points that we expect RWMD to clarify or elaborate upon in the full documentation of the Generic Environmental Safety Case (ESC). We provided our comments to RWMD by letter [19] in early October (to meet RWMD’s timescale for starting work on the Generic ESC).

Our primary concern, at this stage, was the need for RWMD to be clear about the purpose of, and intended audience for, the Generic ESC and the Generic Disposal System Safety Case (DSSC). In particular, we wish to see as much clarity as possible, as soon as possible, about how a Generic ESC/DSSC, produced at this early stage, would contribute towards developing a site-specific ESC/DSSC for a GDF in the future. The ‘storyboard’ provided some pointers, but there is considerable scope for clarification and elaboration.

In addition, we hosted a regulators’ Topic Day with RWMD, at which we discussed the process for developing the safety case. The aim of the topic day was for the regulators to understand: how RWMD plans to collect and assemble the information required to construct the safety case (as it develops from being generic and illustrative towards becoming site-specific in the context of the preferred geology or geologies); how the LoC process will continue to reflect the developing safety case; and what are the interactions between the Environmental, Operational and Transport safety cases at this stage. The regulators also hoped to get a better

understanding of the nature and detail of the RWMD's intended documents, in order to plan their scrutiny programmes, assess the resources needed, and prioritise their work.

RWMD presented the structure of the Generic DSSC which is due to be launched early in 2011, and explained how RWMD expected to progress from the Generic DSSC towards a site-specific DSSC for a selected site as the MRWS process progresses. Figure 2 summarises RWMD's view of this progression. RWMD also described the suite of documents that will make up the Generic DSSC. RWMD will send drafts of the documents to regulators (for brief review) and to RWMD's peer reviewers in Q2 of 2010/11, with final versions for full review scheduled for Q4 of 2010/11.

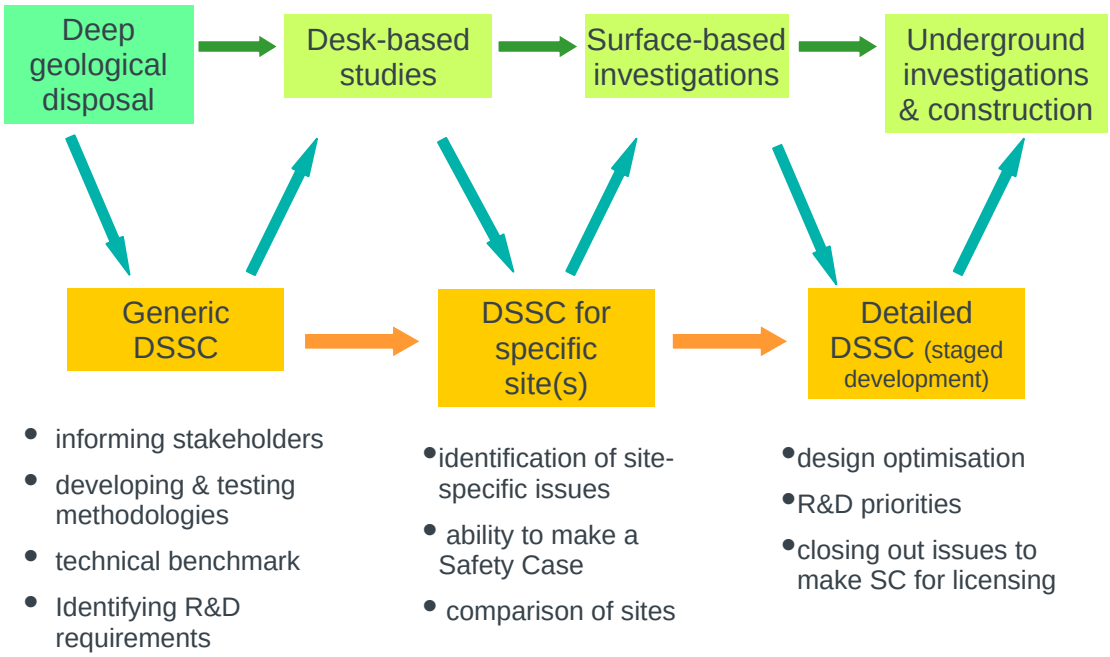


Figure 2 Development of the DSSC (Figure provided by RWMD)

RWMD highlighted some particular challenges of developing a Generic DSSC at this stage of the MRWS voluntarism approach and how RWMD was addressing them, notably:

- Undefined geological setting for a GDF – three broad geology types will be considered in the Generic DSSC;
- Undefined design – the Generic DSSC will address a range of concept designs for different geologies; and
- Uncertain inventory (e.g. inclusion or otherwise of spent fuel, uranium and plutonium, new build wastes) – the Generic DSSC will include a

number of variant inventory cases and will discuss different waste streams separately.

RWMD described how the Generic DSSC will further develop the 'qTF' approach to modelling a generic groundwater pathway used in previous assessments (see Figure3). RWMD considers this stylised approach is a useful tool for informing a range of stakeholders, developing and testing methodologies, and identifying R&D requirements. This approach will evolve as the programme progresses, with site-specific data progressively replacing generic data. However, RWMD recognises that it may not be the best approach for all possible geological environments. We thought the approach may be useful but noted that RWMD should take care that it doesn't imply, or lead to a bias or preference towards, one particular host geology.

RWMD clarified that its Generic Environmental Safety Case, Transport Safety Case and Operational Safety Case summary documents will each include a section discussing the inter-relationships between the cases.

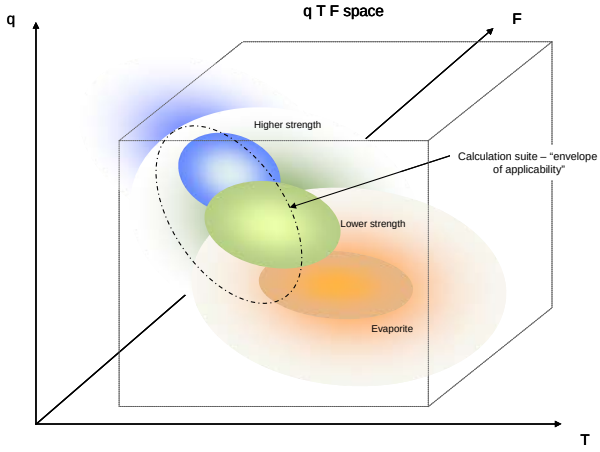
RWMD also explained that the DSSC will in future provide the baseline for Letter of Compliance (LoC) assessments and noted that it has put in place a programme to review existing LoCs against the Generic DSSC and future DSSC as implementation progresses. Eventually the LoC process will develop into a process to define waste acceptance criteria for a real GDF.

4.1 2010/11 programme

We will continue to provide advice to RWMD on its developing safety case. The extent of our review of RWMD's documents will largely depend on issues that we consider it is appropriate to explore in the current context of the project and stage of implementation.

Planned RWMD deliverables in 2010/11

The safety of a geological disposal system: an overview
Transport safety case: main report
Operational safety case: main report
Environmental safety case: main report
Transport system safety assessment
Transport package safety procedures / assessment
Safety case production and management
Operational safety assessment
Operational environmental safety assessment
Post-closure safety assessment



C - containment time (y) representing the performance of the disposal containers.

q – the specific discharge (m/y) through the undisturbed host rock

T – the groundwater travel time (y) from the GDF to the surface.

A - the area over which the contaminant is released at the surface (m^2), or the discharge area.

F – the groundwater mixing flux (m3/y) in the overlying rocks into which the contaminated groundwater plume leaving the repository may eventually rise from depth and mix.

Figure 3 Schematic representation of geologies in qTF space (Figure provided by RWMD)

5. Sustainability & environmental assessment

The MRWS White Paper [1] states that:

"Government is committed to ensuring that the NDA's geological disposal facility programme fully assesses and accounts for environmental impact and sustainability issues through the application of [Strategic Environmental Assessment] SEA, [Sustainability Appraisal] SA and [Environmental Impact Assessment] EIA. The Government expects the NDA to undertake sustainability appraisal, meeting the requirements of the SEA Directive."

The Environment Agency is a statutory consultee on implementation and application of the SEA Directive in England. We have continued discussions with RWMD on its sustainability and environmental assessment work, which allows us to influence the process and determine whether RWMD's assessments adequately address environmental issues. We provide advice and guidance to RWMD by participating and contributing to meetings of the NDA's Environmental Assessment Advisory Panel and by commenting on RWMD's developing approaches and methodologies. RWMD will produce Strategic Environmental Assessments (SEA) and Environmental Impact Assessments (EIA) to address legislative requirements. These assessments will also cover social and economic impacts, thus addressing the scope of Sustainability Appraisal (SA).

The Environmental Assessment Advisory Panel is chaired by NDA and attended by the Department for Communities and Local Government (CLG), statutory SEA consultees, and external experts. The panel meets regularly to consider SEA/EIA activities and to review outputs from those.

Our key comments on RWMD's SEA work to date have included:

- A number of SEA Studies are progressing in parallel; there is potential for overlap and information overload. RWMD should ensure, as far as possible, that its methodologies are consistent between all the NDA SEAs, and should co-ordinate consultation requests.
- The SEA reports should include a summary of the decision to adopt the 'geological disposal' option, by reference to the Government's MRWS consultation and White Paper [1], and how RWMD has considered and addressed 'alternatives to geological disposal'.
- Radiological assessments or impacts are not discussed in the SEA, but they need to be addressed. Clearly the developing safety cases are the primary vehicles for assessing and presenting these impacts, but we suggest RWMD could include a summary of results in the SEA.

Specific SEA and EIA work in 2009/2010 included the following items:

Carbon footprinting

We reviewed Entec's draft generic carbon footprint methodology report for RWMD [20]. In general we considered the methodology looks thorough for a generic approach. It could be improved in certain areas, for example by better definition of the purpose and scope of the work and how it will inform RWMD's decision making [21]. We were satisfied with RWMD's intended approach to addressing the comments received for this stage of implementation, noting that many issues could only reasonably be expected to be addressed in a site-specific context. RWMD also provided a carbon footprint summary report [22]. We chose not to provide written comments on the report at this stage, because we were satisfied with commenting on the methodology, but we discussed the report at the Environmental Assessment Advisory Panel meeting in March.

Generic SEA during Stages 1-3 (non-site specific review of impacts)

We reviewed Entec's draft report for RWMD [23]. In general, we agree with the methodology set out and the kinds of issues considered. We provided RWMD with some comments to help them address some improvements that we think should be made to the impact assessments [24]. Aspects of the SEA process which could be strengthened include:

- assessment of cumulative impacts of the proposed programme – both temporal and site-related;
- clearer distinction between temporary and permanent impacts of the programme;
- better indication and definition of short-term, medium-term and long-term impacts in particular, given the length of the programme;
- discussion of post-implementation monitoring of significant impacts identified;
- improving consistency with information provided by other RWMD teams and programmes.

Draft SEA methodology during GDF Stage 4 (desk-based review of sites)

We reviewed Entec's report for NDA [25]. In summary, the draft methodology closely follows ODPM's guidance on SEA, [26] and we consider it is sound and effective. It is only an outline methodology which is clearly in need of further consultation and development. Therefore, we provided general comments aimed at some of the suggested approaches and broad thematic areas, and highlighted some areas where RWMD could clarify the methodology for the benefit of the intended stakeholders [27].

At the Environment Assessment Advisory Panel meeting in February, we discussed how Entec intends to address comments on the Generic

Environmental and Sustainability Report, and the SEA methodology for MRWS Stage 4, and we were satisfied with the proposals.

5.1 2010/11 programme

We shall continue to provide advice and guidance to RWMD on its work in this area through participation on the Environmental Assessment Advisory Panel and we shall review RWMD's developing approaches and methodologies. We shall also review any assessments associated with the non-radioactive characteristics of the proposed wastes.

Planned RWMD deliverables for 2010/11:

Geological Disposal: Generic Environmental and Sustainability Report for a Geological Disposal Facility: Assessment Report and Non-technical Summary.

SEA Methodology for Stage 4, updated

Baseline Forecasting Report

Habitats Regulations Assessment Methodology

6. Research and development

R&D Strategy and TBuRD

In November we hosted an informal meeting with HSE and RWMD to discuss RWMD's research and development strategy [28] and draft Technical Baseline and underpinning Research and Development (TBuRD) document [29]. The meeting provided an opportunity for the regulators to provide early, high level feedback on RWMD's work. Some key points discussed included:

- The challenge of defining R&D for implementing geological disposal at this early stage in the project (i.e. before the geology of any potential site is known).
- The need to define research objectives clearly, to prioritise research and to present the basis for the prioritisation. RWMD recognised the need to give other stakeholders an opportunity to comment on its R&D programme and prioritisation.
- Research is needed on High Level Waste/Spent Nuclear Fuel (HLW/SNF) to bring knowledge up to a level at least equivalent to that of ILW.
- The need to apply internal and peer review to R&D output, and for RWMD to be more 'transparent' in the future.
- The importance of 'knowledge management', to avoid repeating R&D, and to ensure lessons are learned and steps taken to take them on board. Also to avoid duplication of effort elsewhere in the industry (by Site Licence Companies). Noting, however, that some historical R&D may not necessarily be reliable in the current context and may need to be revisited and updated.
- The need for, and timing of, underground research laboratories (URLs) and their value (e.g. for in-situ research, practising emplacement & backfilling, and building confidence through visits by stakeholders to the site).

We reviewed RWMD's documents thereafter, and provided a number of general comments and observations jointly with the HSE [30]. In summary the regulators' comments were:

- In the absence of an identified site and final design, we consider that R&D should support the near term requirements of the programme and provide a basis to underpin key decisions that will be needed at an early stage. Current R&D should focus on generic uncertainties that are independent of detailed design decisions and siting implications, and on

developing tools to use in the future programme. We think that RWMD's focus on near term aspects (e.g. next 5 years or so) in the draft TBuRD is appropriate. We think the TBuRD usefully outlines many of the key, longer-term aspects that will require work in the future, in so far as these can be known at present.

- The draft TBuRD document is well structured and provides the right level of information. The separation of baselines for "development activities" and "research" framed around the multi-barrier concept seems sensible. RWMD should recognise potential overlaps and ensure no R&D needs are missed.
- The TBuRD is one of a suite of documents that RWMD is producing to scope, define and support the R&D needs of the geological disposal programme. We encouraged RWMD to set out the relevant document hierarchy and to outline the purpose and intent of each document. We also encourage RWMD to describe the process by which it identifies and prioritises R&D.
- The TBuRD document would be difficult to understand in isolation without supporting information to provide the necessary context. We encouraged RWMD to publish as many aspects of its R&D programme as possible without compromising commercial and security requirements.
- RWMD should document the drivers for and purpose of the R&D more fully.
- We urged RWMD to outline how it will determine whether its final list of R&D tasks is comprehensive, and to present a summary of such reviews and how the findings have been addressed.
- We urged RWMD to publish the R&D programme (and its prioritisation) for wider scrutiny and input, especially from the scientific community.

Radionuclide Behaviour

In May we attended a workshop, hosted by RWMD, to discuss its proposed status report on radionuclide behaviour. The objectives of this status report are to:

- Bring the relevant safety arguments and research together;
- Consider system evolution (long-term changes);
- Justify key, related, parameters used in safety assessments;
- Identify gaps and a way forward.

We provided input to help shape the status report. In particular we suggested that the report may have a number of key audiences with different needs and levels of understanding. In particular, this report, and others in this series (see section 6.4), could be useful in discussions with

community groups at potential sites. In drafting the report RWMD will target a technically competent but non-specialist audience.

UK HLW glasses workshop

We attended a meeting in June with RWMD, representatives from the nuclear industry, and external experts, to discuss the R&D needed to provide assurance about the disposability of the UK's HLW. We pointed out that at present there is limited data to support an understanding of the behaviour of UK glass, specifically, in a disposal environment. We found it encouraging that RWMD is engaging with sites through the LoC process to address and resource the research needs in a co-ordinated way.

6.4 2010/11 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 the specific technical and scientific issues identified to date. We shall also consider our own research work and how emerging issues will be addressed in RWMD's forward programme.

Planned RWMD deliverables for 2010/11:

RWMD research programme
RWMD technology plan
Safe fissile mass methodology
Criticality status report
Package evolution status report
Biosphere status report
Near-field evolution status report
Gas status report
Radionuclide behaviour status report
Geosphere status report
Waste package accident performance status report
Radioactive wastes and assessment of the disposability of waste packages

7. Site evaluation and characterisation

Site evaluation and characterisation covers a range of desk and field based activities, previously described in RWMD's geological characterisation project. Our main aim at this early stage in the programme for implementing geological disposal is to provide guidance on RWMD's developing plans for its non-intrusive and desk-based site evaluation and characterisation activities. We shall start our formal regulation when the developer applies for an environmental permit to start intrusive site investigation activities (see section 1.2).

Our guidance [2] requires the developer to:

'carry out a program of site investigation and site characterisation to provide information for the environmental safety case and to support facility design and construction.'

This year, our work has focused on assessing a series of technical reports supplied by RWMD, and on our own research and development. Our own R&D is aimed at improving our understanding of the issues associated with site evaluation and characterisation, and helping to shape and guide our advice to RWMD and others, such as potential host communities and Government.

Assessing the characterisation of geological environments for a geological disposal facility

This work was undertaken for us by contractors, through our Science programme. The overall objective of this project is to help us plan for Stages 4 to 6 of the MRWS site selection process, so that we can carry out our duties in an informed, risk-based and timely manner. The study therefore comprises a high level review of matters, relevant to our role, that may arise during a programme of site characterisation for a GDF.

As part of the project we hosted a workshop (September 2009) which was attended by key individuals from RWMD, regulatory organisations, CoRWM, and experts with experience in site characterisation within the UK and other national programmes. We also involved people with relevant experience in areas other than radioactive waste disposal, such as hydrocarbon exploration.

The main conclusions of the study relate to:

- The importance of good planning for both the developer and us;
- The importance of timely interactions between the developer, us, potential host communities and other people;

- The need to develop or have access to appropriate skills and the significant challenge that knowledge management may pose.

The work is being completed and will be presented in a report [31] which we will publish in 2010.

Review of geophysical surveying techniques to characterise a site for a geological disposal facility

We reviewed the current status of geophysical surveying techniques relevant to geological disposal [32]. This work was carried out for us by a contractor, under the terms of our formal agreement with RWMD. The work sought to:

- Assess how geophysical surveying techniques could contribute to an understanding of a potential GDF site, particular in the early stages of a site characterisation programme.
- Assess any limitations of geophysical surveying techniques, the information acquired and the understanding obtained from them.
- Establish the current status of geophysical surveying techniques and how they may be used to develop a case for the long-term safety of a deep geological repository.
- Assess RWMDs proposed strategy and deployment of geophysical surveying techniques.

Geophysical surveying gathers subsurface data without disturbing a site. It can be used to develop an initial understanding of the sub-surface conditions, in order to define and focus subsequent (more disruptive) investigations. Seismic reflection is likely to be the main geophysical surveying technique used at the site scale. Other geophysical surveying techniques could yield valuable additional information at the regional and the site scales.

Several geophysical surveying techniques are currently being investigated and developed to improve data acquisition and interpretation. These improvements should result in more accurate surveys and the ability to make better use of integrated acquisition and interpretation strategies.

We consider that RWMD's plans need to recognise, explicitly, that flexibility is likely to be required when addressing the many challenges in characterising a site. In most circumstances we believe it is better to gather and interpret adequate geophysical data before drilling boreholes. At the appropriate time RWMD will need to clarify how it will integrate and use information from interpreted geophysical data and borehole investigations. We have identified some specific recommendations, as a result of this review. Our report will be published in 2010.

Approach to characterising a site for potential co-location

We have reviewed a report produced by Jacobs Engineering UK Ltd for RWMD [33]. We are currently considering this report against RWMD's activities carried out previously under its Geological Characterisation Project. We expect to produce our response by July 2010.

Sustainability appraisal of surface-based investigations

We have assessed sustainability appraisal methods for surface based investigations [34] and we shall provide our comments in our response to the RWMD Strategic Environmental Assessment documentation (see Section 5).

Sealing & decommissioning redundant boreholes

We responded to a request for advice from RWMD to help plan its review of matters related to borehole sealing. We have significant regulatory interest in this area of work. The main points we made are:

- RWMD should consider all relevant legislation including e.g. the Water Resources Act 1991.
- RWMD should consider undertaking a comprehensive review of up-to-date techniques in this area which takes into account a range of geological settings.
- It may useful for RWMD to assess whether there are significantly different challenges to sealing boreholes depending on variables such as depth, presence of casing, and the nature of any groundwater bodies intersected.
- Thought should be given to the lifetime information needs of the overall programme e.g. could the operational life of monitoring boreholes be extended, or could the importance of borehole sealing on the ESC be minimised, as part of the building of confidence in the long-term protective capability of the geosphere.

We consider it is essential that RWMD continues to update us on its developing work programme in this area. In particular, we would like to know when RWMD intends to provide information describing its methodology for borehole sealing and subsequent demonstration of it in relation to proposals for site characterisation.

7.2 2010/11 programme

Planned RWMD deliverables for 2010/11:

Paper on the proposed process for identifying potential candidate sites

Consultation document covering a framework for site identification and assessment methodology and the framework for site assessment

Paper on the implementation of the site assessment methodology

Site characterisation strategy (preparation for surface-based investigations)

Geosphere characterisation project status report

Other reports and technical notes to address areas of generic site characterisation R&D (preparation for surface-based investigations)

Note: The scope and nature of our 2010/2011 programme will be influenced by the timing of documents received from RWMD.

8. Waste packaging advice and assessment

8.1 Letter of Compliance Process

RWMD assesses the nuclear industry's proposals for treating, conditioning and packaging higher-activity radioactive wastes, and issues Letters of Compliance (LoC) and disposability assessments.

RWMD has made changes previously to improve the LoC process, in response to our suggestions. RWMD has an ongoing task to review the LoC process and propose further areas for development, such that it can evolve in line with the developing safety case. We are aware that RWMD intends to review and modify the standards and guidance for waste packaging after it has published its Generic DSSC. RWMD is also currently undertaking assessment of proposals to package a significant volume of waste into novel packages which would require changes to the proposed design of a GDF. We shall scrutinise any changes to the design of a GDF, intended revisions to the waste packaging specifications and guidance, and RWMD's operation of change control.

We continued to review and monitor RWMD's monthly returns of packaging advice and related information, in order to identify any issues arising in relation to operation of LoC Process.

8.2 2010/11 programme

Planned RWMD deliverables for 2010/11:

Response to our Package Longevity report

Review of conservatism in the GWPS

Review of conservatism in the LoC assessment process

(Generic) Waste Package Specifications 'Stakeholder engagement plan'

Disposability Assessment Policy and Principles

Revised template for Packaging Assessment Report

Guidance on the LoC process and making a submission for assessment

Annual report on LoC activities during 2009/10

9. Organisational development

Development of a Prospective Site Licence Company to implement a Geological Disposal Facility

We received a number of documents from RWMD in preparation for a joint regulatory review of the development of RWMD as a prospective nuclear site licence company (SLC). These provided key input to the review which we, together with the Health and Safety Executive and the Department for Transport, carried out in November.

We believe RWMD has made good progress in working towards becoming a prospective SLC. RWMD will need to take further steps to complete and fully embed its management arrangements, and to deliver the safety and environment management processes that the regulators will expect of a nuclear SLC. Following the regulatory review, RWMD decided to start operating as a prospective SLC under voluntary regulatory scrutiny, to address the issues we have raised. The report of our review [35] is published on our joint regulatory web site at http://www.environment-agency.gov.uk/business/sectors/114335.aspx

Key recommendations (from [35])

- The RWMD Board should be more challenging in its behaviours and consider how best to develop a deeper familiarity with the delivery of RWMD's overall mission and objectives.
- The RWMD Board should review and resolve the issue of staff retention and recruitment.
- RWMD should develop among its staff a clear understanding of, and ownership for, the potential nuclear safety and environmental impact of its work.
- The RWMD Board and Executive should develop leading indicators to allow it to review and understand nuclear safety and environment performance of the organisation, and arrangements that enable it to respond in good time to any issues that may arise.
- RWMD should review the remit and role of the various groups and committees with roles in governance and reflect these, where appropriate, within clarified arrangements.
- RWMD should review the basis for organisational design that links clearly to the activities needed to develop and implement a programme of geological disposal.
- RWMD should review its understanding of its core organisational competence requirements against the basis for organisational design, and consider what arrangements are needed to deliver and monitor this.

- RWMD should put in place arrangements to recruit to the key safety and environment positions currently filled by ‘interim’ contractors.
- We acknowledge RWMD’s aim to remain ‘lean’, but we recommend RWMD establishes a robust strategic human resource plan that includes arrangements to identify current and future competence and workforce needs and vulnerabilities, and develops appropriate succession, recruitment and contingency plans.
- We support the development of a competence management system in RWMD and recommend that its development continues to meet internationally recognised standards of a ‘systematic approach to training’.
- RWMD should review its arrangements for assurance to ensure that they are robust to consider nuclear as well as conventional issues of safety and environment performance.
- RWMD should review and develop its safety and environment management system to ensure the proper control and assurance of nuclear safety and environment issues.
- RWMD should establish formal arrangements to capture and share lessons learnt and to develop clear knowledge from individual projects and networking activities.
- RWMD should establish arrangements for considering ‘operational experience feedback’.

RWMD’s interactions with regulators as a prospective SLC

We reviewed RWMD’s related draft paper [36] and commented to RWMD by letter [37]. Overall, we consider the paper sets out a reasonable explanation of regulatory scrutiny of RWMD’s programme, and we provide a number of suggestions as to how RWMD might improve the paper before it is published.

Knowledge and Information Management

We continued to encourage RWMD to consider the range of its potential audiencesand how it presents its messages to them. We pointed out that certain documents might need to be intelligible to a number of audiences each with different needs, levels of interest, and understanding (such as regulators, community groups and NGOs). RWMD plans that all or most of its published documents will be aimed at a technically competent but non specialist audience (e.g. science graduate).

We continue to encourage RWMD to develop and implement its plans for managing the vast amount of information relating to the programme at the earliest opportunity, and to consider appointing specialists with responsibility for knowledge and information management.

9.2 2010/11 programme

We shall continue to work closely with RWMD on its development and implementation of appropriate organisational and management structures. Meetings are planned for July and November 2010, to discuss how RWMD intends to address the recommendations from the regulatory review.

Planned RWMD deliverables for 2010/11:

Safety & Environmental Management Prospectus

Organisational baseline document

Human resources competence management procedures

Governance arrangements review

Development of the management system

Data management

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