United Kingdom Nirex Limited

CONTEXT NOTE

2.9: Environmental Assessments

September 2005
Number: 484413

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Conditions of Publication

Bibliography

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FOREWORD

This Context Note is one in a series, prepared by United Kingdom Nirex Limited (Nirex), that summarises the issues, experience and status in each of 30 topic areas that are relevant to the phased development of a geological facility for the long-term management of intermediate-level and certain low-level radioactive waste in the UK – the Nirex Phased Geological Repository Concept (PGRC).

It is the view of Nirex that sufficient work has been done to demonstrate the viability of the generic Nirex Phased Geological Repository Concept: to support packaging advice; and to provide enough confidence to proceed with a site selection process in the UK. The aim of the Context Notes is to provide the documentation to support this view.

The starting point for the notes has been an identification of issues based on extensive examination of reviews and published scrutiny of Nirex work and programmes over the past 20 years. This has been supplemented by more recent discussion meetings with knowledgeable and concerned organisations and discussion meetings within Nirex. The issues have been analysed according to their importance with respect to the future implementation of a geological repository in the UK, screened and sorted into topic areas. Then, for each topic, a Context Note has been prepared that presents the key issues, relevant experience, directions for further development and overall status in the topic area.

The Context Notes are intended both for in-house use, to provide a focus for discussion of issues and priorities of future work within Nirex, and as a means of external communication. The notes support an Overview Report that presents the overall status of the Nirex Phased Geological Repository Concept.

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CONTEXT NOTE 2.9: ENVIRONMENTAL ASSESSMENTS

1 THE IMPORTANCE OF ENVIRONMENTAL ASSESSMENTS

The EC Directives on Strategic Environmental Assessment (SEA) [1] and Environmental Impact Assessment (EIA) [2] apply to specified types of projects in the EC that may entail significant impacts on the environment; this includes any facility for the long-term management of radioactive wastes. Both Directives have been implemented in UK legislation and, therefore, the environmental impacts of the Nirex Phased Geological Repository Concept will need to be determined as part of the programme of work for planning and building a facility.

The UK Government consulted widely on the implementation of the SEA Directive [3] and is proposing to integrate the assessments that have to be undertaken under SEA with the sustainability appraisals that already have to be produced for Plans and Programmes. This will mean that the assessments of programmes, plans, options and sites will have to consider:

- Environmental impacts;
- Economic impacts;
- Social impacts.

Following a review of international experience of administering the EIA Directive [4] and legal advice [5, 6] Nirex agrees that the two Environmental Assessment Directives should be interpreted widely. In particular, Nirex believes that radioactive waste management is a social, ethical and political issue as well as an environmental, economic, scientific and technical one, and that all these aspects and their interactions need to be considered within any environmental assessment.

SEA and EIA will apply at different stages in the development of a long-term solution to radioactive waste management in the UK:

- SEA should be used when strategic decisions are being made, i.e. when options are being evaluated and the preferred option(s) chosen. Based on legal advice [6] and investigation of how the SEA Directive could be interpreted and used, Nirex believes that the SEA framework should also be used at the beginning of the siting process when lists of potential sites are being identified. An Environmental Report is produced as part of the SEA process that will contain the assessments that are undertaken and would form the basis of robust decision making and consultation.
- EIA will apply when a specific option is being proposed at a specific site, for example, when a single site is being proposed for a specific waste management facility. EIA is required as a pre-condition to the granting of planning permission for significant developments. It may also be needed when applying for planning permission to carry out intrusive investigations at potential sites.
- An environmental impact assessment will have to be undertaken for any proposed waste management option, and each option will have environmental, economic and social impacts that will have to be analysed.
- The Environmental Impact Statement (EIS) that is produced, as part of the EIA process to propose a specific option at a specific site, will have to outline how alternatives have been considered and the reasons for choosing the preferred option over the alternatives that have been considered.

This Context Note outlines the work that Nirex has been undertaking in the area of environmental assessments. Context Note 2.2: Waste Transport Safety; Context Note 2.7: Repository Operation and Safety; Context Note 3.6: Human Intrusion; Context Note 3.7: Post-closure Performance Assessment and Context Note 3.8: Safety Case Arguments outline the work Nirex has been undertaking in relation to the impact of the Nirex Phased Geological Repository Concept on people and populations.

1.1 Objectives and requirements of the Environmental Assessment Directives

This section outlines the objectives and requirements of the Environmental Assessment Directives. The Directives and the legislation and guidance that implement them into UK law are not prescriptive, they outline what needs to be assessed, but not how the assessment should be done. It is up to developers to implement mechanisms to enable stakeholder involvement in the environmental assessment process, and to ensure that all the relevant aspects of the project are assessed.

SEA and EIA are umbrella processes for developing environmentally sound solutions to problems.

The objectives of the SEA Directive are:

'To provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment.' [1]

The aims of the EIA Directive are to ensure that:

- Environmental consequences of projects are identified and assessed before authorisation is given;
- The public are informed about plans and that relevant information is made available to them;
- The public are able to express comments and opinions before decisions on the plans are made;
- All results, including the outcomes of public participation, are taken into account in the decisions made;
- The public is informed of the decision afterwards.

The Environmental Assessment Directives outline what needs to be assessed as part of the process, this includes the direct and indirect effects on:

- Human beings, population, human health, fauna and flora, biodiversity;
- Soil, water, air, climate and the landscape;
- Material assets and cultural heritage, including architectural and archaeological heritage, landscape;
- The interaction between the factors outlined above.

Another key aspect of the environmental assessment processes is giving people the opportunity to influence the decision-making process, in line with the Aarhus Convention [7] which requires the provision of:

- access to environmental information;
- public participation in environmental decision-making;
- access to justice.

The SEA and EIA Directives have been written to meet the requirements of the Aarhus Convention. Therefore using the SEA and EIA frameworks will help to ensure that the decision-making process is in line with the principles of the Aarhus Convention.

One of the key lessons learned from past decision-making processes is that stakeholder involvement is a key part of the decision-making process, it is important that stakeholders' issues and concerns are identified and addressed and that they can influence the process. This should occur at each stage of environmental assessment, especially in the early stages, when the assessments are being defined. The environmental assessments involve several related stages:

- Scoping (develop objectives, evaluation criteria and options, write and consult on scoping report);
- Assess options and prepare Environmental Report (ER for SEA) or Environmental Impact Statement (EIS for EIA) including developing monitoring strategy;
- Consult on ER or EIS and proposed plans (incorporate outcomes of consultation in ER or EIS);
- Decision making;
- Monitoring of the implementation of the decision.

Environmental monitoring is another important aspect of the Environmental Assessment directives. Nirex has undertaken work to investigate how the repository can be monitored, see Context Note 4.2 – Monitoring. The monitoring will also have to include a watching brief on options to ensure that previous decisions are still robust to developments in science, technology and society.

Nirex has been investigating best practice in the application of the Environmental Assessment Directives to identify lessons that can be applied in the UK. This is outlined in the next section.

2 RELEVANT EXPERIENCE

Nirex undertook preliminary environmental and radiological assessments for the land-based locations short-listed in its 1987-89 site selection exercise to assess the impact of a repository on the local community, environment and economy. Specific factors which were explored included: proximity of people, nature conservation, natural resources and environmental factors such as transport, noise and visual impact. The results of the assessments for Dounreay and Sellafield, which were subsequently chosen for more detailed, intrusive investigation, were summarised in Nirex Report 71 [8].

In 1994, in accordance with the relevant guidance on Environmental Assessment published by the Department of the Environment and the Welsh Office, Nirex produced an Environment Statement in support of its planning application for a Rock

Characterisation Facility at Sellafield [9], and provided proofs of evidence and supporting documentation on each of the environmental subjects covered by the Statement at the ensuing Local Planning Inquiry. Detailed environmental impact assessments were carried out and Environmental Statements were submitted in support of planning applications to drill boreholes in the Lake District National Park and conduct other geological investigations, see [10] for example.

Nirex has reviewed the previous decision-making process to identify lessons that can be learned for the future, the lessons include:

- There need to be clear decision points;
- It is important to clarify up-front how decisions will be taken;
- All technical options need to be evaluated;
- Stakeholder consultation and involvement are essential throughout the process;
- There needs to be an open and legitimate site selection process;
- The assessments need to consider the impacts on flora, fauna and social and ethical impacts.

The SEA and EIA Directives, and related legislation, only provide frameworks for the environmental assessment processes, therefore Nirex is looking at how it can meet the requirements of the Directives. This is being achieved by using two mechanisms, the Nirex Stepwise Process and the Nirex Environmental Assessment Task Team.

Nirex has developed the Nirex Stepwise Process [11] that outlines the steps and work required to adhere to the SEA and EIA Directives at each stage of the decision-making process relating to radioactive waste management in the UK and enable stakeholder involvement in it. Research has also been undertaken on the types of dialogue and consultation mechanisms that could be used to engage stakeholders in each of the stages of the decision-making process [12, 13]. Nirex believes it is essential that stakeholders are involved from the beginning of the decision-making process, especially when the scope of the process is being decided. It is also important to use a range of engagement mechanisms to enable a wide range of stakeholders to participate including:

- Working groups at potential sites;
- Stakeholder workshops and events;
- An interactive website;
- Consultation papers.

Local involvement is very important throughout the decision-making process. However, it will become even more important when potential sites are identified. Nirex advocates using the mechanisms developed in Sweden and Belgium of setting up working groups, made up of local citizens at potential sites to enable direct local involvement in the development of a facility. All these activities would need to be co-ordinated during the environmental assessment process.

The stepwise process is updated annually as the project progresses and the associated externalities, such as policy, develop. A more detailed description of the social science research Nirex has undertaken and the impact it has had on the Nirex work programme is outlined in a Nirex report [14].

In 2001, Nirex set up an Environmental Assessment Task Team to investigate how the environmental assessment of the PGRC could be improved and how Nirex's work programmes could be developed to ensure that they will satisfy the requirements of

the Environmental Assessment Directives. Nirex has also initiated work on the non-radiological impacts of the PGRC and its radiological impact on non-human species.

Nirex has undertaken work on a range of waste management options for several reasons:

- To fulfil its Mission - *In support of Government policy, develop and advise on safe, environmentally sound and publicly acceptable options for the long-term management of radioactive materials in the UK*.
- To check the compatibility of the Nirex waste package specifications with other waste management options.
- To investigate what options can be used to manage additional radioactive wastes and radioactive materials that are not currently declared as wastes.
- To provide advice to Government and CoRWM on issues relating to a range of waste management options.

As the potential implementer of the Government's chosen option(s) Nirex will have to maintain a watching brief on options as required under the Environmental Assessment Directives. The aim of the watching brief will be to check that previous decisions are still robust to developments in science, technology and society.

The Government is currently undertaking the Managing Radioactive Waste Safely Programme (MRWS) to help to develop policy on the long-term management of radioactive waste in the UK. To help with this they have set up the Committee on Radioactive Waste Management (CoRWM) to oversee the evaluation of long-term waste management options. CoRWM are due to make their recommendations in July 2006, after which Government will make a decision about which long-term waste management option or options to implement. Nirex has been feeding its work on environmental assessments into the process.

The detailed work that Nirex has undertaken in relation to environmental assessments, to prepare for each of the decision-making stages, is outlined in the following sections.

2.1 The Nirex Environmental Assessment Task Team

Feedback that Nirex received when reviewing the previous decision-making process highlighted that its assessment work focussed on radiological impacts and did not cover all the issues of interest to a range of stakeholders. The feedback highlighted that there was insufficient consideration of the impacts of the facility on flora and fauna, and the non-radiological, social and ethical impacts of the facility. To consider these issues Nirex set up the Nirex Environmental Assessment Task Team.

The Nirex Environmental Assessment Task Team is comprised of staff from various Nirex departments. Its aims are to:

- Evaluate the legal requirements of the EC Environmental Assessment Directives;
- Research best practice in applying the Directives;
- Identify the lessons that Nirex could learn from other organisations' experiences of adhering to the Directives; and
- Make recommendations on how Nirex should adopt the principles and frameworks outlined in the Directives in its work.

The Task Team produced draft recommendations on how Nirex should adopt the approach and principles set out in the Directives in the context of the current situation

in the UK. These were discussed at a workshop to which Nirex invited a range of stakeholders including: national and local Government representatives, regulators, NGOs, academics, members of the public, contractors and members of the nuclear industry [15]. The participants agreed that Nirex should structure its work in line with the SEA framework and agreed generally with the approach recommended by the Task Team. Specific modifications were suggested and have been incorporated in the work programme that Nirex has developed [16]. Nirex is developing its assessments to incorporate the following:

1. An assessment of the impacts of chemically toxic materials.
2. A preliminary assessment of the impact of the repository on species other than humans.
3. A non-radiological environmental assessment of the Phased Geological Repository Concept.
4. A report setting out issues that have emerged from ongoing stakeholder dialogue and describes how those issues are being addressed.
5. Consideration of whether any of the criteria suggested or used by others for assessing waste management options should be used in the assessment of the Phased Geological Repository Concept.

Work has already been initiated on items 1 to 3, this is outlined in the following sections. The work that is planned on items 4 and 5 is outlined in Section 3.

2.2 Assessment of the impacts of chemically toxic species

Since undertaking the detailed assessments of the Sellafield site Nirex has developed the Generic Documents[1] for the Nirex Phased Geological Repository Concept (PGRC), these focus on the radiological impacts of the Nirex PGRC on humans and the non-radiological industrial safety impacts. They assess each stage of the Nirex PGRC in three separate assessments: Generic Transport Safety Assessment (GTSA); Generic Operational Safety Assessment (GOSA); Generic Post-Closure Performance Assessment (GPA).

The safety assessments are continuously under review and updated every few years to incorporate feedback and address stakeholders' issues and concerns, take account of new data, understanding and the inputs of the research Nirex undertakes.

Any submission to obtain permission for a radioactive waste management facility will require an assessment of the risks associated with the chemically toxic species present in the waste and any toxic materials used in the construction and operation of the facility itself. Details on the 2001 UK National Radioactive Waste Inventory and chemically toxic species present in it are given in [17, 18]. Nirex has undertaken some preliminary assessments of the impacts of chemically toxic materials on the environment after the facility is closed [19]. Appendix A outlines what further work Nirex is planning to undertake on this topic.

[1] The Nirex Phased Geological Repository Concept is detailed in six Generic Documents that set out the system specification, the designs for the transport system and the repository, and the three supporting generic safety assessments. These reports are generic in the sense that they describe a repository concept and supporting safety assessments that are not specific to a particular site in the UK. Together the documents describe what Nirex believes to be a coherent concept and a viable option for the long-term management of these radioactive wastes.

2.3 Assessment of the impact of the PGRC on non-human species

Any submission to obtain permission for a radioactive waste management facility will require an assessment of the risks to non-human species (flora and fauna) associated with the development and operation of the facility, as required by the Environmental Assessment Directives.

To date the Nirex generic assessments of the PGRC have not considered risks to non-human species. However, work undertaken in support of the GPA programme, but not reported in the GPA itself, does consider the radiological impact on the natural environment that could result from implementing a deep geological repository for the UK's ILW and certain LLW [20, 21]. This work is outlined in more detail in Appendix B.

Nirex commissioned a review of the current status of international research and guidance on the assessment of radiological impacts on non-human species and how Nirex could incorporate this into its work programme [22]. The review concluded that this area of assessment will become more important over time, but there is currently a lack of data relating to non-human species and the impact of radiation exposure on them. Further research and work is being carried out under the EC 6th Framework programme (the ERICA project[2]) and by the ICRP UNSCEAR[3] and the IAEA [23] which will influence and guide developments in this field. Nirex will continue to liaise with its sister organisations and keep up to date with developments in this field. In the next update of the generic assessment documents the impacts of the different stages of the PGRC on non-human species will be considered. The eventual aim will be to develop site specific assessments.

2.4 A non-radiological environmental assessment of the PGRC

Nirex has commissioned a scoping report for a non-radiological environmental assessment of the Nirex Phased Geological Repository Concept [24].

The aims of this non-radiological environmental assessment process are:

- to identify the likely non-radiological environmental effects of a long-term radioactive waste management concept, including the key social and economic issues, so that decisions can be made with knowledge of their expected consequences;
- to formalise an iterative design and assessment process, ensuring that the likely environmental effects of design and siting considerations are addressed as part of the development process;
- to allow the public and statutory bodies to comment on proposals taking account of the main environmental and sustainability considerations;
- to develop a management system to allow the environmental assessment to be continuously improved and to ensure that environmental impacts are addressed and mediated appropriately.

The report has been reviewed internally and was previewed at a workshop with a range of stakeholders in early 2005 [25]. The feedback from the workshop is being fed into the development of Nirex's work in this area.

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[2] See www.erica-project.org for more details.

[3] See www.icrp.org for more details.

2.5 Environmental assessment of packaging proposals

Nirex sets standards and specifications for the treatment and packaging of wastes. Nirex also undertakes assessments of waste producers' proposals to package radioactive wastes, and provides technical advice through the Nirex Letter of Compliance Process, see Context Note 2.1. As part of these assessments consideration has been given to the non-nuclear environmental effects that could arise from the packaging activity. Relevant issues can include raw material use, energy consumption, transport costs, and potential for re-use of materials or structures. Advice is provided to waste producers to encourage options with lower environmental impacts.

2.6 Assessment of the social and ethical impacts of waste management options

Nirex is undertaking preliminary assessments of the social and ethical impacts of waste management options, including the PGRC. This work is outlined in Context Note 1.7: Social Science. The work will build on international research into ethical issues relating to radioactive waste management, as outlined in reference [26], and work in the area of social impact assessments, see for example [27].

2.7 International experience

Environmental assessments have been undertaken for a wide range of projects including radioactive waste management concepts and facilities, see for example, [28] and [29], and the decommissioning of nuclear facilities.

The European Commission has sponsored two studies in which Nirex participated, to identify the lessons that can be learned from the experience of undertaking EIAs for waste management facilities [4] and decommissioning nuclear facilities [30]. There is also guidance from the European Commission [31, 32, 33] about how to undertake environmental assessments.

The Nuclear Energy Agency Forum for Stakeholder Confidence (FSC), of which Nirex is a member, has also held workshops in Finland [34], Canada [35] and Belgium [36] to evaluate lessons learned from the radioactive waste management programmes in those countries, and how they have undertaken their assessments of options.

3 FUTURE WORK

EC and UK legislation in the area of environmental assessments is constantly developing and being updated. Best practice in decision making and adhering to the Environmental Assessment Directives is also developing over time. Therefore Nirex will continue to undertake work to keep up to date with developments in the legislation, and to identify best practice in this area to incorporate into the approach Nirex takes to its work. The aim is to ensure that each stage of the decision-making process involves a systematic and robust analysis of alternatives and builds public confidence and support in a way that adheres to regulatory requirements.

Nirex is in the process of implementing the recommendations of its Environmental Assessment Task Team and the assessments of the Phased Geological Repository Concept are being developed to evaluate environmental and social impacts more thoroughly.

Nirex's environmental assessments will be developed iteratively as the UK moves from strategic decisions and generic assessments, under the SEA framework, to site specific assessments under the EIA framework. The aim is to continue to work with stakeholders to identify their issues and concerns and enable them to make inputs into the development of the assessments. Nirex will continue to use a range of mechanisms to preview and review its approach to the assessments and enable stakeholders to make inputs.

The current assessments do not use site-specific information, but include parameters that are consistent with regulatory risk targets [37], and are realistic and achievable in the UK. It is not possible, however, to assess some impacts in these generic assessments, for example the visual impacts of the facility cannot be fully evaluated.

Nirex's environmental assessments will evolve as the UK moves from considering alternative options, to considering possible sites in the UK, and then to the implementation of a preferred option. The aim is that, at each stage, the scope and level of detail of environmental assessment and its presentation is appropriate to the needs of decision makers and other stakeholders, in order to facilitate the decision-making process and any associated consultation.

3.1 Integration of the outcomes of Nirex's stakeholder dialogue into its assessment work

Nirex is undertaking work to integrate the outcomes of Nirex's stakeholder dialogue into its assessment work, a staged approach is being used:

1. An internal review of the dialogues and feedback received by Nirex has been undertaken to identify the issues, concerns and scenarios that have been mentioned.
2. An internal review of the current Nirex assessments has been undertaken to determine which of the issues are already addressed.
3. Consideration will be given to which issues can be addressed in the next update of the assessments, and what work is required to do this.
4. Research will be undertaken to enable issues to be addressed in the next update of the Generic Documents.

Stages 1 and 2 have been progressed, and relevant issues fed into the scoping report on non-radiological environmental assessment outlined in Section 2.4.

3.2 Inclusion of evaluation measures used in other people's assessments in Nirex's assessments.

Several steps will be undertaken to achieve this:

1. A literature review of evaluations of options undertaken by other people and guidance and legislation on the assessment of options has been undertaken to identify evaluation measures that people have used or suggested [38].
2. An internal review of the current Nirex assessments has been undertaken to determine which of the measures are already addressed.
3. Consideration of which issues can be addressed in the next set of assessments, and what work is required to do this.
4. Research to enable issues to be addressed in the next update of the Generic Documents.

Stages 1 and 2 have been progressed and the results fed into the draft scoping report outlined in Section 2.4.

3.3 Sustainability appraisal and social impact assessment

Nirex has been reviewing the principles that have been suggested in relation to achieving sustainable development and undertaking social impact assessments to investigate how these might apply to radioactive waste management.

This work will be used to guide Nirex's approach to Sustainability Appraisal and Social Impact Assessment and investigate how Nirex's assessments can be expanded to embrace best practice in these areas.

3.4 Update of the Nirex safety assessments

Nirex will continue to review and develop its safety assessments every few years. In particular, for the next update, additional sections on environmental assessment are planned. Appendices A and B detail some of the activities being undertaken to prepare for aspects of this work, namely, the assessment of chemically toxic species and impacts on non-human species.

As outlined earlier the Environmental Assessment Directives outline what impacts need to be assessed in relation to implementing a long-term waste management facility. Nirex's assessments already address the following:

- Radiological and non-radiological impacts on human beings and human health;
- Traffic impacts;
- Impacts on soil and water;
- Impacts on air quality;
- The land take requirements of the facility (footprint above and below ground);
- The visual impact of the facility (size and height).

Nirex is developing the following:

- A non-radiological environmental assessment of the PGRC including the non-radiological impacts already addressed, and new assessments looking at:
    - Employment figures;
    - Types of materials used including energy and water use;
    - Wastes generated;
    - Impacts on climate.
- A preliminary assessment of the radiological impact of the PGRC on species other than humans;
- A preliminary assessment of the social and ethical impacts of the PGRC;
- An assessment of chemo-toxic impacts of the PGRC.

Some impacts cannot be assessed in the generic assessments, as they will depend on the site chosen. The following can not be evaluated until potential host sites are identified:

- Impacts on cultural heritage, including architectural and archaeological heritage, landscape;
- Impacts on population;
- Impacts on biodiversity, ecology and nature conservation;
- Impacts on landscape.

3.5 International collaboration

Nirex is involved in the CARL (Citizen-stakeholders [C], Agencies responsible for radioactive waste management [A], social science Research organisations [R] and Licensing and regulatory authorities [L]) project that is being funded by Belgium, Canada, Slovenia, Sweden and the UK. The work will be looking at the decision-making process relating to radioactive waste management and how social science issues affect it, and how it can be developed to enable greater stakeholder involvement, while meeting legislative requirements. It will look at how the SEA and EIA frameworks can be used to enable greater stakeholder involvement.

Nirex is continuing to be involved in the COWAM (COmmunity WAste Management) work programme that is being funded under the EC 6th Framework Programme. The work is looking at:

- Implementing local democracy and participatory assessment methods;
- Influence of local actors on the national decision-making process;
- Quality of decision-making processes;
- Long-term governance.

Nirex will also continue to be involved in the NEA Forum for Stakeholder Confidence and the discussions about process in that forum.

The findings and experience of this international collaboration are being fed into Nirex's ongoing programme of work.

4 CONCLUSION

Projects that will have an impact on the environment are subject to EC Directives on Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA). Both Directives have been implemented in UK legislation and are, we believe, applicable to the development of long-term radioactive waste management facilities.

The Directives are not prescriptive, they outline what has to be assessed, but not how. Nirex's approach to environmental assessments has been developed through dialogue with a range of stakeholders and by building on the lessons learned from UK and international experience. Nirex will continue to investigate best practice in this field and incorporate it into the decision-making process related to radioactive waste management. From reviewing the lessons learned from the past Nirex believes that the decision-making process must be robust, legitimate, open and transparent and we will continue to implement mechanisms to enable this.

Nirex will continue to work with stakeholders to identify their issues and concerns and enable them to make inputs into the development of the assessments. A range of

mechanisms will continue to be used to preview and review Nirex's approach to the assessments and enable stakeholders to make inputs. Nirex believes it is important that stakeholders' issues and concerns are adequately addressed in the assessments and will help to meet the requirements of the Environmental Assessment Directives and Aarhus Convention.

Nirex is undertaking wide-ranging work to demonstrate the Phased Geological Repository Concept is a safe, viable and environmentally sound option for the long-term management of radioactive waste. As part of this work, Nirex's assessments of the Phased Geological Repository Concept will be developed to evaluate environmental and social impacts more thoroughly. These assessments will develop over time as the programme moves from a generic concept, through site-related considerations under the SEA framework, to site-specific issues under the EIA framework.

The way in which the assessments are used will also change over time, as the UK moves from considering options through the different stages of implementation. The objective is to develop assessments that provide sufficient information, at an appropriate level of detail, at each stage to assist in consultation and decision making.

In developing its assessments, Nirex needs to keep up to date with international best practice in the field of environmental assessment, and with the guidance that is being developed. To achieve this Nirex will continue to be involved in the international fora that address this issue, and will work with colleagues in other countries to share knowledge and learn from their experiences.

The key areas where Nirex will be undertaking further work to develop its assessment in line with the requirements of the EC Directives are outlined in Table 1.

Table 1: Issues Associated with Environmental Assessments

Issue	Evaluation	Status
Using environmental assessment frameworks to structure decisions related to radioactive waste management and adhere to legal requirements	An open, transparent and inclusive decision-making process needs to be implemented in order to develop an acceptable solution to radioactive waste management. The EC Directives on environmental assessment provide a framework for doing this. The assessments will help to distinguish between waste management options.	Work will continue to be undertaken to understand developments in EC and UK legislation in the area of environmental assessments, to ensure that Nirex is adhering to all the requirements. See references [11, 14]. Best practice in decision making and adhering to the Environmental Assessment Directives is continually developing. Nirex is continuing to undertake work to identify best practice in this area to incorporate this into the approach it takes to its work. The aim is to ensure that each stage of the decision-making process involves a systematic and robust analysis of alternatives and builds public confidence and support. This work will continue throughout the development of the waste management solution for the UK. Work is being undertaken to investigate how best practice in sustainability appraisal and social impact assessment can be incorporated into Nirex's work. Nirex has also sponsored a PhD student to research how ethical issues can be integrated into the decision-making process relating to radioactive waste management.
Assessment of the non-radiological impacts of a waste management facility	This issue is relevant for all waste management options and will be used to discriminate between options.	A draft scoping report for a non-radiological environmental assessment of the Nirex PGRC has been written [24] and was discussed with a range of stakeholders at a workshop early in 2005 [25]. Work is being undertaken to provide a preliminary non-radiological assessment of the PGRC.
Assessment of the impacts of chemically toxic species on humans and the environment	This issue is relevant for all waste management options and will be used to discriminate between options.	Nirex is continuing to develop its assessments of these impacts to ensure that they will be adequate for the stage in the decision-making process, see Appendix A.

Issue	Evaluation	Status
Assessment of the impacts of a facility on non-human species	This issue is relevant for all waste management options and will be used to discriminate between options.	Nirex is continuing to develop its assessments of these impacts to ensure that they will be adequate for the stage in the decision-making process, see Appendix B.
Assessment of the social and ethical impacts of the facility	This issue is relevant for all waste management options and will be used to discriminate between options.	Preliminary assessments of the social and ethical impacts of waste management options including the PGRC are being developed. The assessments will continue to be developed to ensure that they will be adequate for the stage in the decision-making process, see Context Note 1.7.
Assessment of stakeholders' issues and concerns	This issue is relevant for all waste management options and will be used to discriminate between options.	Nirex has reviewed the dialogues it has undertaken to identify stakeholders' issues and concerns. Work is being undertaken to consider how these can be included in the next update of the Generic Documents. As further dialogues are undertaken more work will be required to ensure the assessments adequately address stakeholders' issues and concerns and are appropriate for the stage in the decision-making process, See Section 3.1.

APPENDIX A – ASSESSMENT OF THE IMPACTS OF CHEMICALLY TOXIC SPECIES

In addition to the radiological risk from radioactive waste, it is recognised that any future submissions by a waste management organisation to obtain permissions for a radioactive waste repository may require an assessment of risks associated with the chemically toxic species also present in the waste; additional details on the 2001 UK National Radioactive Waste Inventory and chemically toxic species present in it are given in [17, 18].

To date the Generic Transport Safety Assessment (GTSA) and Generic Operational Safety Assessment (GOSA) have not considered chemically toxic species. However, the Generic Post-Closure Performance Assessment (GPA) contains preliminary modelling undertaken to identify those chemically toxic materials in the waste inventory, or derived from the inventory, which may be of significance when compared to a 'screening concentration' based on established drinking water or similar standards for toxic materials - the approach in GPA 2003 [19] builds on that presented in GPA 2001 [39] (which utilises a report by AEA Technology [40]). However, it is appreciated that other approaches might exist and, regardless of the waste management option eventually chosen, a more complete understanding of the potential presence and behaviour of chemically toxic species will be required. Consequently, during the period September 2001 to January 2002 a report was produced for Nirex [41]; this report included a review of the GPA 2001 approach. The report also proposed a revised and more sophisticated screening and risk assessment methodology for non-radiological toxic species. Note that this was not incorporated in GPA 2003, which used the same approach in the chemical toxicity assessment as used in GPA 2001.

Future Work

It is desirable that future revisions / updates of the Generic Documents address the issue of chemically toxic species in the UK Radioactive Waste Inventory. This treatment may differ within the three generic safety and performance assessments, in recognition of, for example, differing applicable regulatory criteria. However, treatments across assessments must be as consistent as possible.

To this effect, in 2003, Nirex initiated a programme of Nirex activities intended to incorporate the treatment of chemically toxic species[4] present in the UK National Inventory into the GTSA, GOSA and GPA. The work built on a review of regulatory criteria affecting the treatment of chemically toxic species in the context of Nirex activities, and their treatment by other national and international organisations; guidance was sought regarding the appropriate treatment of chemically toxic species in revisions and updates to Nirex safety and performance assessments. A report [42] has been produced, and is available on the Nirex bibliography. Further work has been undertaken in FY04-05, on the basis of this report. The latest work, reported in reference [43] presents a methodology to address the chemical toxicological impact of radioactive wastes for generic transport and operational safety, and post-closure performance assessments, for the Nirex Phased Geological Repository Concept.

The provision of information on chemically toxic species to be disposed of, and the development of assessment methodologies for their appropriate treatment in Nirex safety and performance assessments, are iterative tasks. Once a sufficient level of

[4] Non-aqueous Phase Liquids (NAPLs) are here considered to be chemically toxic species.

understanding has been reached, Nirex will be able to decide upon the final form of assessment methodologies that are appropriate for the chemically toxic species present in the UK National Radioactive Waste Inventory.

Related Work

At the present time, reviews of the 2001 UK National Radioactive Waste Inventory have been undertaken, leading to the volumes and types of chemically toxic species and NAPLs present in the Inventory explicitly identified in reports [17,18]. However, it is recognised that the constituent materials and processes used to generate ILW/LLW are complex and there is a possibility that past and current assays of the waste streams have not identified all the chemically toxic species and NAPLs that might be present, or that might arise in the future, e.g. as a result of fire during the transport or the operational phase, or due to degradation and radiolysis during the post-closure phase. To address this issue, a separate project to the one detailed herein was initiated in 2003 and is currently being completed, which involves the identification of non-radiological chemically toxic species that are, or that may be, present in the UK Radioactive Waste Inventory, but which are not explicitly recognised as such. Results from that project, as well as input from the work outlined above, will feed into revisions / updates to the GTSA, GOSA and GPA for the identified chemically toxic groups of species.

APPENDIX B – ASSESSMENT OF THE RADIOLOGICAL IMPACT OF THE PHASED GEOLOGICAL REPOSITORY CONCEPT ON NON-HUMAN SPECIES

Introduction

In addition to the risk to humans from radioactive waste, it is recognised that any future submissions by a waste management organisation to obtain permissions for a radioactive waste repository will require an assessment of risks to non-human species (flora and fauna) associated with the radioactive waste, as outlined in the EC Directives.

To date the GTSA, GOSA and GPA have not considered an assessment of risks to non-human species (flora and fauna) associated with the radioactive waste. However, work undertaken in support of the GPA programme, but not reported in the GPA itself, does consider the radiological impact on the natural environment that could result from a deep geological repository for the UK's ILW and certain LLW [20, 21]. This work builds on review and modelling studies undertaken for Nirex by Westlakes Scientific Consulting (WSC); WSC subsequently undertook related experimental work for Nirex, although this programme of activities concluded in 2003. Reference [20] was originally designed to be incorporated in the 2004 update of the Generic Documents, prior to a change in the Nirex programme; it was not considered appropriate to include [20] in the GPA03 Update, given the remit of that update of the Generic Documents.

It is desirable that future revisions / updates of the Generic Documents note the issue of the assessment of the radiological impact of the Phased Geological Repository Concept on non-human species and, as appropriate, offer a treatment of it. This treatment may differ within the three generic safety and performance assessments, in recognition of, for example, differing applicable regulatory criteria. However, treatments across assessments must be as consistent as possible.

Nirex activities at present are investigating how to undertake an assessment of the radiological impact of the Phased Geological Repository Concept on non-human species. The work will build on a review of regulatory criteria undertaken as part of the GPA programme of work [44], work undertaken to date on incorporating non-human species in the GPA [20, 21], and the treatment of non-human species by other national and international organisations. Guidance will be sought from the regulators regarding the appropriate assessment of the radiological impact of the Phased Geological Repository Concept on non-human species in revisions and updates to Nirex safety and performance assessments.

The development of assessment methodologies for the appropriate treatment of non-human species in Nirex safety and performance assessments will be iterative tasks. Once a sufficient level of understanding has been reached, Nirex will be able to decide upon the final form of assessment methodologies that are appropriate for the assessment of the radiological impact of the Phased Geological Repository Concept on non-human species.

Related Work

For many years the radiological assessment of nuclear facilities has concentrated on impacts on humans. The view has been that a radiological protection system that afforded adequate protection to individual humans would also be adequate for other species. Recently, however, work has been done in certain countries (notably

Canada and Sweden) to examine radiological impacts on species other than humans. Also, the international waste management organisations have initiated work to provide a common framework for such assessments. The work of three international organisations is summarised below.

There are different views about the ability to assess the radiological impact of facilities on non-human species. The International Union of Radioecology [45] stated that there is not the scientific basis to arrive at an adequate radiation protection framework for non-human species. This may be contrary to the conclusions and recommendations ultimately reached by those involved in the international studies outlined below. This may mean that only qualitative assessments can be undertaken rather than quantitative.

ICRP Task Group on Protection of the Environment

The aim of this task group is to develop a radiological protection policy and establish a framework of environmental protection based on ethical-philosophical principles. The plan is to produce a document in time for key messages to be included in the new recommendations of the ICRP i.e. by 2003.

EC Framework for Assessment of Environmental Impact (FASSET)

The aim of this project is to produce a framework for the assessment of environmental impacts from ionising radiation. The work was completed at the end of 2003. It links together current knowledge about sources, exposure, dosimetry and environmental consequences for reference organisms and ecosystems. The framework will provide a system for linking together the release scenarios, exposure pathways, doses and effects to biota.

IAEA Safety Standard

IAEA has established a work programme to develop safety guidance on the protection of the environment from the effects of ionising radiation and held a second specialists meeting in Vienna in November 2001. Further meetings are planned to develop the guidance.

Summary and Recommendations

The overall aim of the work being carried out by the international organisations noted above seems to be to recommend a common set of criteria and reference methodologies for assessment of radiological effects on non-human species. This should help avert the situation where different countries and different organisations approach the problem in a different way. However, Nirex has already done some preliminary assessment work in this area, see Section 2.3. That work addressed how the radiological effects on the natural environment could be considered in a future post-closure performance assessment.

Nirex commissioned Westlakes Scientific Consulting to undertake a review of where international research and guidance on the assessment of radiological impacts on non-human species had progressed to and how Nirex could incorporate this into its work programme [22]. The paper concluded that this area of assessment will continue to become more important over time. However, there is still a lack of data available relating to non-human species and the impact of radiation exposure to them. Further research and work is being carried out under the EC 6th Framework programme (the ERICA project[5]) and by the ICRP UNSCEAR[6] and the IAEA [23]

[5] See www.erica-project.org for more details.

which will influence and guide developments in this field. Nirex will therefore continue to liaise with its sister organisations and keep up to date with developments in this field, so that it is able to undertake site specific assessments in the future. In the development of the next set of generic documents consideration will be given to how Nirex can assess the different stages of the PGRC on non-human species given the limited data that is currently available and the generic nature of the assessments being undertaken at this time.

[6] See www.icrp.org for more details.

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