

NATIONAL DOSE ASSESSMENT WORKING GROUP

PAPER 9-03: FRAMEWORK FOR PROTECTION OF WILDLIFE AND THE ENVIRONMENT AGENCY APPROACH

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1 INTRODUCTION

The status of the ongoing EC FP6 funded project Environmental Risk from Ionising Contaminants: Assessment and management (ERICA) is described below. The Environment Agency is continuing to part-sponsor this project in order to update the current approach for undertaking Habitats and Bird Directives based assessments which was developed in 2001 and updated in 2003. The Environment Agency has been applying its assessment methodology to the high and medium priority sites and an update on the findings from this work will also be provided.

2 UPDATE ON THE ERICA PROJECT

The ERICA project has, as its principle objective, the following:

To provide and apply an integrated approach addressing scientific, managerial and societal issues surrounding the environmental effects of ionising contamination, at a community level, with emphasis on biota and ecosystems.

The final outcome of the project will be delivery of an integrated approach to the assessment, risk characterisation and (decision-making associated with) management of environmental risks of ionising radiation.

The project started in April 2004 and is due to deliver in March 2007. It is currently on target to achieve this. There are 15 participating organisations from seven European countries and, as part of a wider engagement in both the subject, requirements and assessment methods, there are over 50 participants of the 'End User Group' (EUG) who are stakeholders in the project.

The conceptual structure of the ERICA Integrated Approach that has gradually evolved (and is still evolving) is shown in Figure 1. The integrated approach acknowledges that assessments are rarely linear and that the process may involve several iterations within each stage of the assessment. The approach also recognises the need to involve other interested parties (stakeholders) in the decision-making and management process.

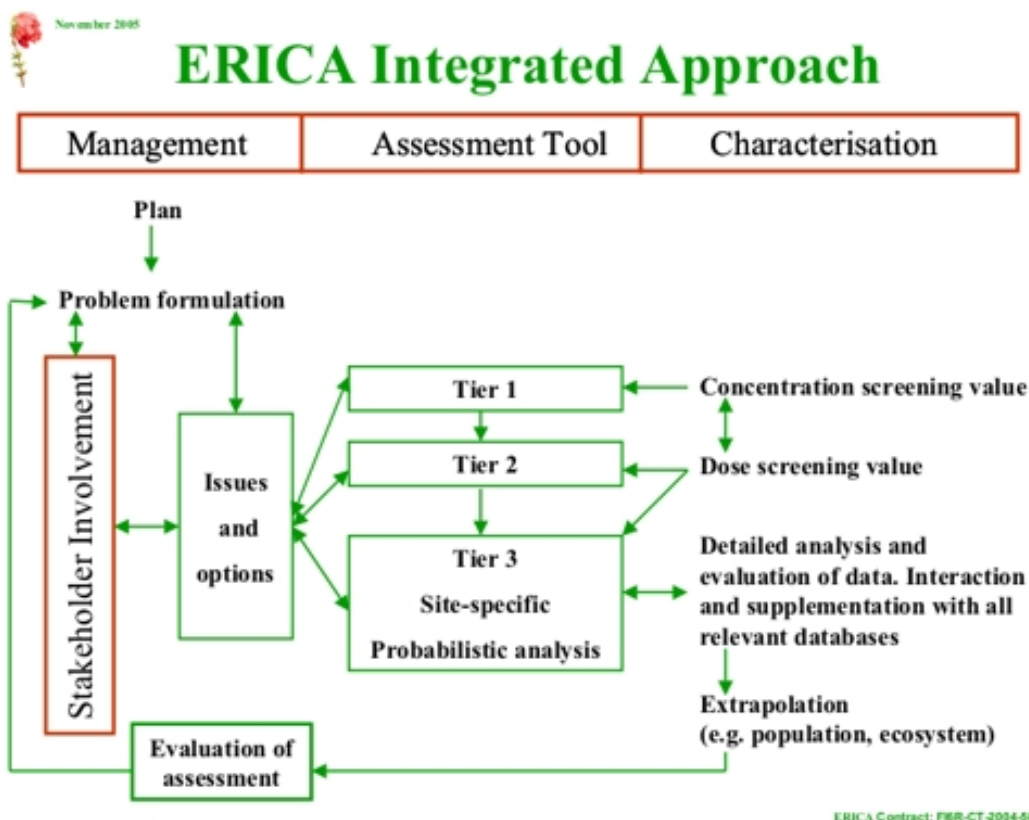


Figure 1 Working model of the ERICA Integrated Approach, depicting its three main features: the assessment tool, the methodology for risk characterisation and guidance to stakeholder involvement and decision-making (management).

The ERICA Integrated Approach is being developed through the interaction of five work packages (shown in Figure 2). Each work package is designed to undertake different but complementary tasks and the following section gives a brief indication of the tasks and a status report:

Work Package 1

Work package 1 is responsible for the development of the assessment tool (a software based tool to undertake calculations of doses to biota and an database which has compiled literature information on the biological effects of ionising radiation). There is some input into the assessment tool from WPs 2 and 3 along with the testing of the approach and tool by WP4.

A prototype of the ERICA assessment tool has been developed in Java and is based on a flexible, expandable structure which has a user-friendly interface and makes much use of 'wizards' to guide the assessor through each step in the assessment process. The assessment tool function reflects the tiered approach highlighted in Figure 1 and developed by WP2. This means that the first tier of the approach is a simple screening step which requires limited information (activity concentrations in the media (usually soil or water) of interest (depending on whether the assessor is working on a terrestrial or aquatic ecosystem). The second tier remains as a screening step but allows the user to refine the exposure pathway by allowing control over the choice of reference organisms, the ability to generate new reference organism geometries, to amend the parameters associated with the assessment (e.g. concentration ratios, occupancy factors, radiation weighting factors etc). Currently the code for these

two tiers has been fully implemented and is now being tested before release to a wider range of stakeholders.

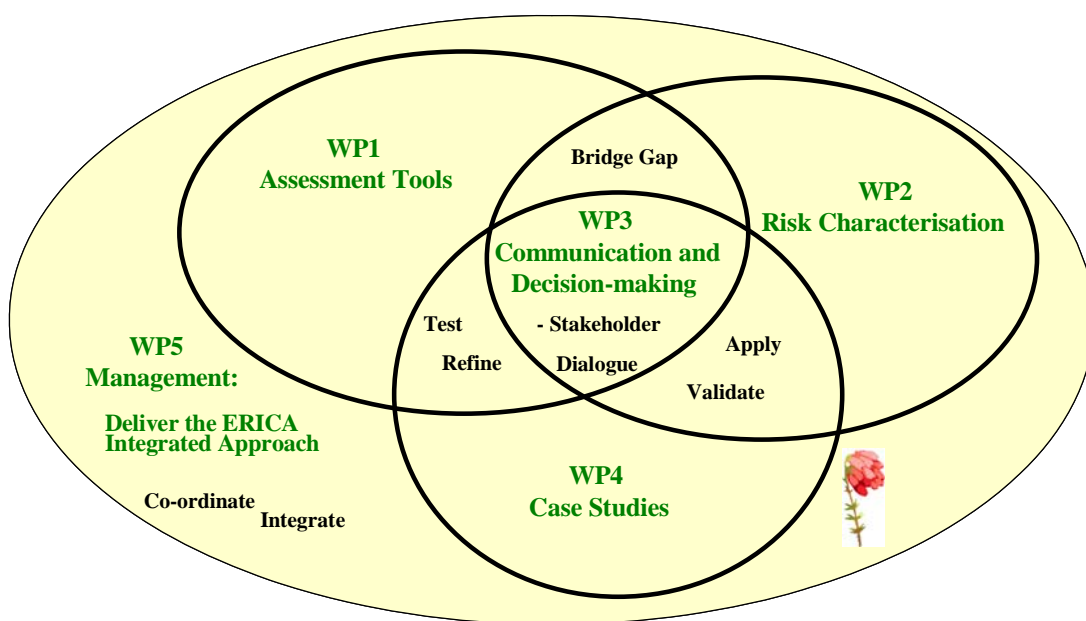


Figure 2 Work package description and interaction

Tier 3 will focus much more on the refinement of the effects component of the assessment and will allow the user to undertake probabilistic assessments and to include uncertainty and sensitivity analysis within the tool. The final description of tier 3 will be finalised by June and then implemented into the Java code by September. It is at Tier 3 that a direct link will be made between the assessment tool and the FREDERICA radiation effects database which is the other key tool development that has been worked on by WP1. FREDERICA is now available online and is a restructured version of the FRED database which was developed during the FASSET project. There are now additional searches available within FREDERICA (e.g. on authors, keywords, radionuclides, radiation types etc) along with new reference information which has been added to the database. This has focused on the inclusion of the effects data from another European FP5 funded project, Environmental Protection from Ionising Contaminants in the Arctic (EPIC, reference number ICA2-CT-2000-10032), which contains effects data from the Russian literature. All the original papers were also reviewed as part of a quality control exercise to a) check for missing or incorrect entries in the database and b) to score each paper for fitness for purpose within the context of the ERICA project. This scoring system basically applied a numeric value to the paper based on how well described the information contained within the paper was, the details of the statistical design of the experiment etc (based on the content of the paper). In other words it assessed the papers and how reproducible the information was likely to be. This addressed one of the criticisms of the FRED database in that no attempt to segregate the papers was made and the information was simply captured within the database but many of the experiments described in the literature were not specifically designed to answer questions on how the biological effects of exposure to ionising radiation could be used in the context of an assessment framework.

The final task of WP1 has been to fill the various databases that are required within the assessment tool (e.g. for concentration ratios, for dosimetric parameters etc) and to develop a software utility to allow the user to define their own geometries of interest. This work is ongoing but well advanced.

Work Package 2

WP2 is responsible for the provision of risk characterisation methodologies for ecologically meaningful estimates of risk. To achieve this, the WP has been responsible for the development of the tiered approach adopted within the project and the derivation of screening values/benchmark values to compare the outputs of the assessment tool with. Furthermore, this work package has undertaken experiments to look at particular extrapolation issues (external v internal exposure issues and individual to population level effects) using earthworms and Daphna in experimental systems.

The first task of this work package was to critically review available risk characterisation methodologies and from this was developed the interim method for the ERICA integrated Approach (described in Deliverable D4a). This interim tiered assessment approach described the proposed structure and provided some of the technical and scientific background to having a tiered approach but it did not consider in any great detail the numbers for use in the screening tiers or the interaction with stakeholders and the decision-making process.

The second task was then to apply a scientific approach using sound reasoning to solve a number of the main extrapolation issues by combining desk studies and experiments to establish a series of rules that might be applied to this problem. Experiments were conducted to evaluate how chronic external and internal irradiation might influence the effects data that is available and to explore the extrapolation from the effects on an individual to the population might be assessed using population modelling based on a series of vital traits such as reproduction, growth and survival (note these were on single species still and not microcosms looking at predator – prey interactions under the stress caused by exposure to ionising radiation).

The third task is a through evaluation of the effects data contained within the FREDERICA database and an evaluation of the different ways of exploring such data to provide benchmarks of effects. In this case different approaches have been adopted from the European Technical Guidance document (TGD) for chemical risk assessment and these methods have been applied to the data within the FREDERICA database. For example this has involved the application of safety factors to the effects data and to the generation of species sensitivity distribution curves. Both methods allow you to determine predicted no effect levels (called predicted no effects dose rates (PNEDR) in ERICA) and from this you can define screening level thresholds for the use in tiers 1 and 2. Advice and guidance on decision making at tier 3 is also being provided for the effects analysis component. Currently ERICA has proposed a screening dose rate value of $10 \mu\text{Gy h}^{-1}$.

Work Package 3

WP3 is responsible for the provision of managerial guidance together with stakeholder involvement to support the protection of the environment from ionising radiation frameworks. To do this WP3 has been engaged in dialogue with the End Users Group (EUG) to help to define the decision-making guidance which will form part of the integrated approach.

In order to achieve its objective, WP3 has/is running a series of workshops/seminars at which the members of the EUG have participated looking at particular problems in undertaking risk assessments. This has provided an input into the managerial/decision-making processes that need to be refined within the project in order to assist assessors through the provision of guidance on what to do next during the assessment.

The workshops include:

- **Assessment Framework And Scientific Knowledge Gaps**

Actual 'protection framework users' (e.g., UK, Sweden, USA...), legislation, monitoring, and knowledge gaps and choice of 'reference animals and plants'

➤ **Ionising Radiation And Other Contaminants**

Management and regulatory experience, other environmental stressors, multi-criteria analysis (including cost-benefit); 'bands of concern' and comparison with natural background

➤ **Ecological Risk Assessment: Criteria And Standards**

➤ **Decision-Making And Stakeholder Involvement**

Local stakeholder and public participation – choice and design of UK case study approach, experience with public participation and dialogue methodology; case study experience (Sweden, France, UK, etc...)

➤ **Scientific Uncertainties**

Dealing with uncertainties in practical management, precautionary approach, extrapolation issues, safety factors, other environmental stressors, existing legislation and ERA and EIA developments, assessment-management links

➤ **Consensus Conference On key issues for the ERICA project**

State-of-the-art on scientific, policy, management, decision-making and societal issues

➤ **Management, Compliance And Demonstration**

Web-consultation period, with a thematic meeting to address a number of specific issues

Each of these workshops generates a deliverable report from which the key learning points have been identified and fed into the ERICA project.

In addition to the workshops, WP3 is responsible for the maintenance of the project website, all communications to the end users and other interested parties.

Work Package 4

WP4 is responsible for testing the original FASSET outputs and then the ERICA tools and guidance against a series of case studies to ensure a) appropriateness of the information and tools being provided within the project and b) to ensure that the integrated approach works.

WP4's activities have been essentially in two parts, first right at the start of the project testing the FASSET assessment methodology and now towards the end of the project to test the ERICA integrated approach. Deliverable D9 contains the findings from the first phase of work, testing the FASSET approach. A number of scenarios were defined and data gathered to allow the testing of the approaches. The case study sites were: Sellafield, Loire River, North Sea oil and gas platforms, the Chernobyl exclusion zone and areas of enhanced natural radionuclides in the Komi Republic. The objectives of the case study applications are:

- To assess the applicability of the assessment frameworks;
- To compare predicted and observed activity concentrations in biota (and water/sediments for aquatic ecosystems);
- To identify data gaps and to feed these back into the ERICA project;
- To compare, where possible, observed radiation induced effects with estimated doses and predicted effects;

- To make recommendations to the ERICA project to guide developments of the ERICA approach.

Deliverable D9 provided information on the testing of the FASSET methodology and highlighted a number of issues not least related to the amount of documentation associated with the FASSET approach and the fact that the guidance does not always assist the user. These are key learning points taken on by the ERICA project which is now to produce a much more controlled amount of guidance for the user to follow during an assessment (the so called D-ERICA document that will now be delivered by WP5 – see below). A number of technical issues were also picked up by WP4 and these have been addressed within the ERICA project. WP4 have recently been involved in a short testing session on the ERICA assessment tool and the bugs identified in the software are now being addressed.

Work Package 5

WP5 is concerned with the overall management and delivery of the project. A key output from this WP will now be the D-ERICA document which aims to deliver the guidance for the ERICA Integrated Approach in a comprehensive, yet concise and user-friendly format with links to the underlying documents but only if the user is interested in pursuing particular issues. Therefore D-ERICA will serve as a practical handbook to the assessment, risk characterisation and management issues linked closely to the assessment software tools (including FREDERICA). In addition there will be a training workshop in February 2007 to disseminate the findings to the project and this will also be the responsibility of WP5.

Deliverables

There are a number of deliverables available from the project website and these include:

D1	Progress on the production of the web-based effects database: FREDERICA
D4a	Ecological risk characterisation: an interim method for the ERICA integrated approach
D4b	Overview of ecological risk characterisation methodologies
D5	Derivation of Predicted-No-Effect-Dose-Rate values for ecosystems (and their sub-organisational levels) exposed to radioactive substances
D5 Annex A	Guidelines for the design and statistical analysis of experiments on chronic effects of radioactive substances
D5 Annex B	Experiments on chronic exposure to radionuclides and induced biological effects on two invertebrates (earthworm and daphnid). Results and discussion.
D7a	First EUG event Part 1: Discussion of ERICA workplan First EUG event Part 2: Briefing notes on assessment frameworks and knowledge gaps
D7b	Briefing notes from the second thematic EUG event: Part 1: Ionising radiation and other contaminants Part 2: Contribution to Deliverable D4 on risk characterisation
D7c	Transcripts from the first generic EUG event. Ecological risk assessment and management

D7d	Transcript from the third thematic EUG event: decision-making and stakeholder involvement
D9	Application of FASSET framework at case study sites
	www.frederica.org

3 UPDATE ON THE ENVIRONMENT AGENCY HABITATS ASSESSMENTS FOR RAS

The Environment Agency is required to determine whether the discharges it permits could have an adverse effect on the integrity of Natura 2000 habitat sites. There are about 430 Natura 2000 in England and Wales, which include Special Areas of Conservation (SAC) and Special Protection Areas (SPA) (see Figure 3).

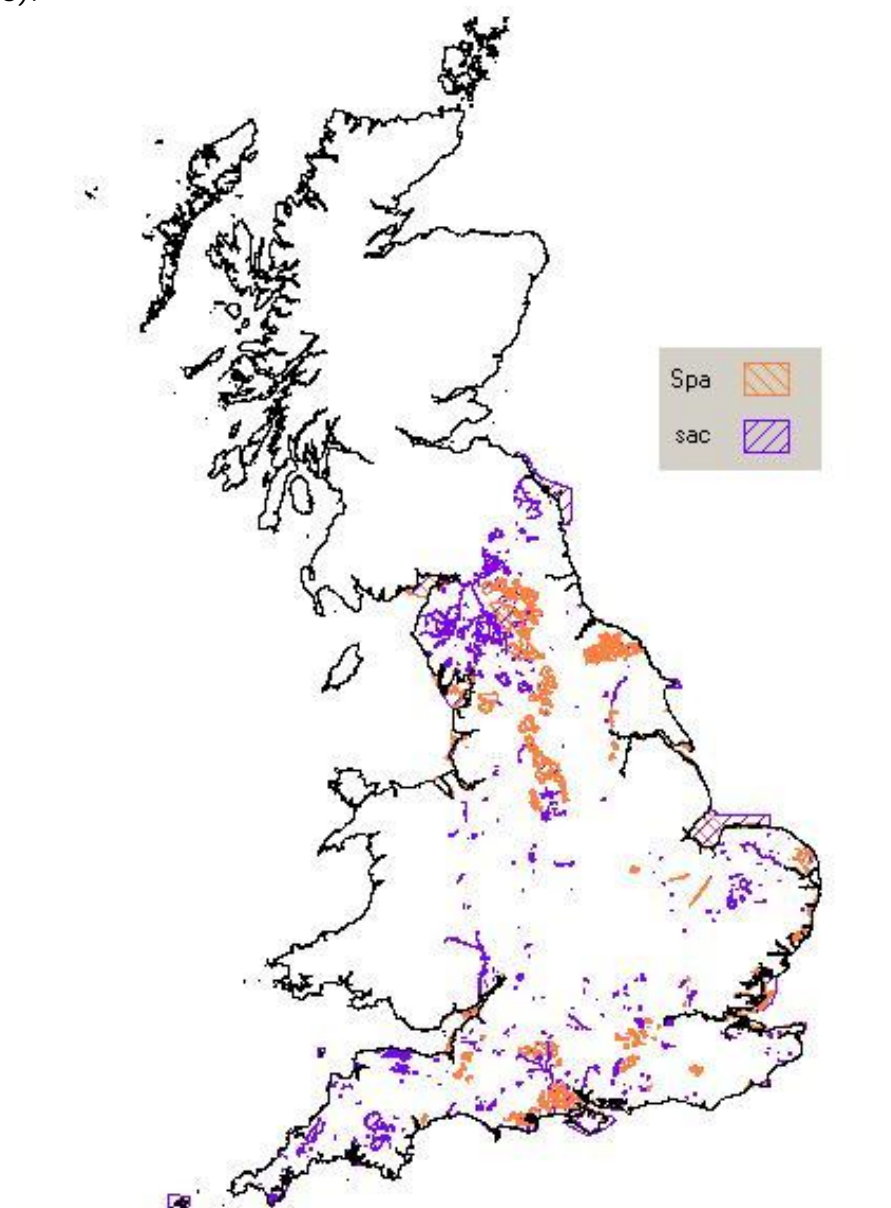


Figure 3 Natura 2000 Habitats sites

The impact of authorised discharges of radioactive substances on these Natura 2000 sites is being assessed as part of the overall Habitats project. Screening assessments have been made to identify those Natura 2000 sites which may be affected by permitted releases of pollutants and thus require a more detailed assessment (Stage 3 assessment). These screening assessments have been used to prioritise these detailed assessments (high, medium and low priority).

Detailed (Stage 3) assessments for 42 high and 135 medium priority Natura 2000 sites were completed by March 2004 and March 2006 respectively. Detailed assessments for 162 low priority sites do not need to be completed until March 2008.

A methodology has been developed for assessing the impact of releases of radioactive substances on Natura 2000 habitat sites based on Science project work for the Environment Agency [Ref 1]. Dose per unit release data have been derived for a range of reference organisms and species of particular importance at the Natura 2000 sites. These dose per unit release data have been calculated from dose per unit air, soil or water concentrations [Ref 1] and simple dispersion parameters for releases to air, freshwater or coastal waters. These dose per unit release rate data are multiplied by annual discharge limits to calculate the dose ($\mu\text{Gy/h}$) to each organism.

The doses to organisms are compared to a threshold of $40 \mu\text{Gy/h}$ which the Environment Agency agreed with English Nature would be used to decide whether a Natura 2000 site should go forward into Stage 4 of the Habitats project process. Stage 4 involves the potential variation of authorisation limits. Where doses are above this threshold, it cannot be concluded that there is no adverse effect on site integrity.

The Radioactive Substances Act 1993 (RSA 93) authorisations which can impact on each Natura 2000 site have been identified. For terrestrial Natura 2000 sites, these were RSA 93 authorisations for premises within 10 km of the Natura 2000 site. For freshwater Natura 2000 sites, these were discharges to sewer or direct to river which can flow in to the Natura sites. For coastal Natura 2000 sites, these were the discharges to sewer or river which may ultimately flow into the direct locality of the Natura site. Account has also been taken of more remote regional discharges which may be transported into a coastal Natura 2000 site, but where dispersion and hence dilution will be greater.

The combined impact of RSA 93 discharges has been assessed for the 177 high and medium priority Natura 2000 sites. Only, one Natura 2000 site has a dose to the worst affected organism greater than $40 \mu\text{Gy/h}$, this is the Ribble estuary with an assessed dose of $690 \mu\text{Gy/h}$. The majority of this dose arises from discharges of Th-234 and other alpha activity from the Westinghouse Springfields site.

The dispersion modelling used to derive the dose per unit release data is reasonably realistic for the Ribble estuary as the parameters used in this modelling were those for the Ribble estuary. The Th-234 dose per unit concentration data has cautious concentration factors. The other alpha activity is probably short-lived radionuclides, but there are currently no dose per unit concentration data available for short-lived alpha radionuclides, although outputs from ERICA will help to derive such data.

Springfields are due to cease processing uranium ore in April 2006 and their current RSA 93 authorisation already has lower limits which will come into effect from 2008. The Environment Agency has until March 2008 to determine whether these planned reductions are sufficient to ensure that the Ribble Estuary is protected from a habitats point of view or whether further action is required.

4 CONCLUSIONS

The ERICA project is ongoing and continues to be developed in terms of the assessment tool and the guidance documents that will be provided to help assessors with their application. The project is due to complete in March 2007 and it currently on target to do so. There are still two more EUG events along with a final training and dissemination meeting planned for February 2007 at which the ERICA integrated approach documents and tools will essentially be handed over to the end users.

The assessment tool is currently going through a round of testing to ensure that it a) functions correctly and b) to eliminate bugs from the programming. The tool will be applied to the case studies used to test the FASSET project outputs and this will, it is hoped, highlight any deficiencies in the approach/tool that can then be addressed by the project participants.

Once the project has delivered then the Environment Agency need to consider how best to implement the assessment tool within the current regime of Habitats assessments.

Full details of the ERICA project can be found on the following websites:

- ERICA project website: www.ERICA-project.org
- FREDERICA online database: www.frederica-online.org

The Environment Agency is progressing with assessments for Natura 2000 habitats sites. Assessments have been completed for 177 Natura 2000 sites and for all but one of these sites it has been concluded that there is no adverse effect on the integrity of the Natura site from authorised discharges of radioactive substances. The one exception is the Ribble Estuary and the Environment Agency is considering what action should be taken to ensure that this Natura site is protected from a habitats point of view.

5 REFERENCES

1. D Copplestone, M D Wood, S Bielby, S R Jones, J Vives and N A Beresford (2003) Habitats regulations for Stage 3 assessments: radioactive substances authorisations. Environment Agency R&D Technical Report P3-101/SP1a. ISBN: 1844321754.