

Work Plan for the IAEA EMRAS II Waste Disposal Working Group

1. Introduction and Objectives

The IAEA's BIOMASS programme completed extensive guidance on the development of reference biospheres in 2001 (IAEA, 2003). This included examples of how to develop reference biospheres in different assessment contexts. Since 2001, significant international projects have addressed some of the critical issues identified in IAEA (2003), notably the European projects:

- BIOCLIM (2004) which considered how to address climate change, and
- BIOMOSA (Olyslaegers et al, 2005) which considered the application of the BIOMASS methodology at specific sites, as compared to a generic methodology application.

Significant model inter-comparison exercises have been carried out under the BIOPROTA international collaboration, allowing peer review among operators and regulators of the science behind the biosphere modeling assumptions, as well as investigation of improved models for specific radionuclides, such as ¹³⁷Cs (Limer, 2008). More information on this work programme and its publications is available at www.bioprota.com

A further important international development is the setting up of a topical group on Radioactive Waste Management within the Asian Nuclear Safety Network, www.ansn.org. This group has developed a database for biosphere parameters relevant to climates in that region.

Yet another important development has been the update of IAEA's TRS-364 data advice.

Finally it is worth noting that the IAEA-BIOMASS-6 methodology has been taken into account in many major repository assessment projects, some of which have been site generic, e.g. ONDRAF/NIRAS (2001) and NWMO (Gierzewski P et al, 2004), and some of which are site specific, e.g. SR-CAN (SKB, 2006; KBS-3H Posiva Working report 2007-109 (Broed et al. 2007) and US DOE, (2008). These applications and variant approaches adopted in a wide variety of assessment contexts, as well as the international work referred to above, provide a substantial basis for review and updating of the usefulness of the IAEA-BIOMASS-6 methodology. This would be very timely given the 8 years since the methodology was developed.

The IAEA EMRAS II Waste Disposal Working Group (WG3) met first from 20 – 22 January 2009. That meeting identified some important and difficult areas which need to be addressed, notably:

- Environmental change, which can be climate driven but also includes related factors such as changes in landscape, and groundwater and sea levels, as well as changed land use by humans.
- Processes at the transition zone between the geosphere and the biosphere. A variety of potentially relevant geosphere-biosphere interfaces was identified, though it was recognised that the details will be site specific.
- Important migration and accumulation processes within the biosphere itself, which in many cases are radionuclide and/or site specific.

Noting these points and further information exchange in 2009, it was agreed that the WG3 objectives be updated to the following:

- To agree on approaches for developing reference biosphere models appropriate for assessments of exposures to humans in performance assessment studies of repositories for disposal of solid radioactive waste.
- To allow that the approaches should take into account changes of the exposure conditions as e.g. due to changes of the climate, the use of land, agricultural practices and changes in living habits.
- To derive a set of models that covers a wide range of environmental situations.

A WG3 meeting is planned to take place in the week beginning 4 October 2010, in Munich. The WG then plans to provide a draft document with recommendations (a **WG3 Recommendations Document**) to the IAEA addressing the WG objectives at the next EMRAS II Plenary Meeting in January 2011. Further work is anticipated in 2012 leading to a final WG3 Recommendations Document being completed for presentation at the beginning of 2012.

The plan agreed to meet these objectives is described below.

2. Methodological Steps and Sub-groups to Address Them

Annex A provides a line of investigation, i.e. methodological steps leading to the production of the WG3 Recommendations Document. Four sub-groups will investigate the issues taking into account different perspectives, as follows.

SG1 Analogue Approach

This SG will focus on the use of data for present day conditions at other sites with different climate and other characteristics which are considered as suitable analogues for future conditions at the site in question. It is proposed to start with static climatic conditions under the assumption of biospheres in equilibrium, then to consider the implications of transitions along prescribed trajectories (cool & warm; wet & dry). An interaction matrix approach may be used to explore the ecosystem relationships under environmental change. For more information contact: Christian Kiaser christian.kaiser@helmholtz-muenchen.de

SG2 Soil-Plant Processes

This WG will focus of the important features of the soil plant system. This was considered important because of the role of the foodchain in the most significant exposures for the most significant radionuclides, such as Cs-137 and I-129, as determined from previous assessments. Questions to be considered include:

- Which are the processes which will be affected by climate change in the soil plant system ?
- Which are the transfer processes affecting discretisation?
- Which are the processes which are affecting water balance?
- How can we integrate these processes in PA models?

The answers will be used to develop:

- Understanding climate impact on the Biosphere
- Understanding interactions between the vegetation, soils, land cover/land use and the climate system
- Identification of the different processes

- o Direct effects
- o Indirect effects
- o On Soil
- o On Vegetation
- o View of 'climate people' vs. view of PA biosphere modellers

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SG3 Dynamic analysis of future biosphere systems at specific sites

This SG will explore the use of system modelling of climate and landscape change to understand the possible future biosphere conditions at a site, on a site specific basis. The main steps are:

1. System description (general characteristics):
 - Overview based on available information from our site descriptions
 - Two sites, one in Finland (Posiva) and one in Sweden (SKB)
 - Finished by September 2010
2. Identify processes and parameters potentially affected by environmental change:
 - Sensitivity analysis of the model is used to identify the most important parameters
 - Use knowledge from climate modelling to identify parameters potentially affected by climate change
 - Finished by September 2010
3. Evaluate how these processes and parameters are represented in the model and how they can be changed
 - Evaluate whether the model consider the relevant features and processes
 - Result: a list of important processes, whether they are included in the model and suggested improvements of the model
 - To be done by the whole sub-group during next meeting (Oct. 2010)
4. Assess how changes in relevant processes and parameters affect model results
 - Use sensitivity analysis results
 - Possibly complementary simulations will be done, deterministic simulations of alternative setups
 - Planned for January 2011
5. Identify processes and parameters of general importance in the context of environmental change
 - Generalise from site specific to generic by comparisons with previous results and results from other WGs
 - Result: a non site-specific conceptual model with associated processes and parameters
 - To be done by the whole subgroup during next annual EMRAS II meeting (Jan. 2011)
6. Identify and describe characteristics that depend on the geosphere assessment
 - Features related to the radionuclide input that have impact on the surface system modelling, e.g. the well
 - Supporting calculations are used to evaluate effects of model discretisation and specific aspects of environmental change (SKB/Posiva)
 - Finished by September 2011

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SG4 Demonstrating compliance with protection objectives

This SG will explore common issues in compliance demonstration at the national level, taking into account international recommendations and protection objectives, as provided by ICRP and IAEA. In particular, consideration will be given as to how to environmental change affects the safety case for meeting radiation protection objectives. This will take into account the different stages of repository development.

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Integration and synthesis of the results from the sub-groups will be done at the October 2010 WG3 meeting and further definition of activities will be developed from that point.

Additional participation in the working is invited. Please contact:

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Annex A Steps in the Proposed Work Plan

Step 1. Process orientated consideration of critical factors that may have a major influence on dose to man

Here the idea is to identify the processes using our radio-ecological and assessment experience to identify important processes, based on existing work in BIOMASS, BIOMOSA, BIOPROTA, BIOMOSA and the national assessment projects which have been on-going, notably concerning

- climatic factors and climate change processes,
- geosphere-biosphere interface processes,
- geomorphological processes, and
- land use processes.

and then:

- determine whether these factors are of more universal nature or are they specific to a site, and
- consider whether models developed for one climate (e.g. temperate) are adequate to address the specific conditions of a changed climate

Step 2. Learning from Recent Assessments and Research

Study of how recent assessments and related research have addressed critical issues will provide practical examples of how issues have been addressed. Those assessments will have had specific contexts attached to them (as discussed in IAEA-BIOMASS-6, etc.), so it will be instructive to identify the assessment approaches used and to consider how they needed to be different in those different contexts, or whether in fact common solutions can be effective.

Participants may wish to propose particular assessments and research work for consideration.

Step 3. Quantitative analysis of alternative approaches

It is anticipated that the work in steps 1 and 2 will throw up potentially important questions which can be examined though applying alternative modeling approaches. Scenarios related to these questions can be constructed and different methods for their analysis applied or developed. Participants may already have such questions and proposals for their examination, as discussed in January 2009 in relation to the geosphere-biosphere interface, and these are certainly invited for consideration.

Step 4. Development of Contributions to Recommendations on Biosphere Assessment, Models and Data

The results from Steps 1 – 3 can be used to address questions such as:

- Are the basic steps in the IAEA-BIOMASS-6 methodology still relevant?
- What detailed improvements may be made in each step to support future biosphere assessments for repositories, relevant to:
 - specific ecosystems and their site specific data,
 - specific climate systems and climate changes,
 - specific geosphere-biosphere interfaces, in constant conditions and under environmental changes/transitions,
 - the selection and justification of model discretisation,
 - the assumptions for reference groups and food habits,
 - specific land use assumptions, and
 - specific regulatory requirements?