

**The IAEA's Programme on  
Environmental Modelling for Radiation Safety  
(EMRAS II)**

**EMRAS II  
Reference Approaches for Human Dose Assessment  
Working Group 3  
Reference Models for "Waste disposal"**

**MINUTES**

**of the Fourth WG3 Meeting held at IAEA Headquarters, Vienna  
24–28 January 2011  
(during the Third EMRAS II Technical Meeting)**

IAEA Scientific Secretary	Working Group Leader
<p>Mr Gerhard Proehl (<i>GP</i>) Head, Assessment &amp; Management of Environmental Releases Unit, Waste &amp; Environmental Safety Section (Room B0765) Division of Radiation, Transport &amp; Waste Safety International Atomic Energy Agency (IAEA) Vienna International Centre PO Box 100 1400 VIENNA AUSTRIA Tel: +43 (1) 2600-22854 Fax: +43 (1) 26007-22692 Email: G.Proehl(x)iaea.org</p>	<p>Mr Tobias Lindborg (<i>TL</i>) Biosphere Safety Assessment Manager, Safety &amp; Analysis Swedish Nuclear Fuel &amp; Waste Management Company (SKB) Blekhölmstorget 30 Box 250 10 124 STOCKHOLM SWEDEN Tel: +46 (8) 459-8407 Fax: +46 (8) 661-5719 Email: tobias.lindborg(x)skb.se</p>

Attending	
Name / Initials* / Email	Organization / Country
Mr Talal Al Mahayni ( <i>TAM</i> ) (almahayni(x))yahoo.com)	Atomic Energy Commission of Syria (AECS), SYRIA (Currently residing: University of Nottingham, UNITED KINGDOM)
Mr Rodolfo Avila Moreno ( <i>RAM</i> ) (rodolfo.facilia(x))gmail.com / rodolfo(x)facilia.se)	Facilia AB, SWEDEN
Mr Sten Berglund ( <i>SB</i> ) (sten.berglund(x))skb.se)	Swedish Nuclear Fuel & Waste Management Company (SKB), SWEDEN
Mr Jacques Brulhet ( <i>JB</i> ) (jacques.brulhet(x))andra.fr)	ANDRA, Agence Nationale pour la Gestion des Déchets Radioactifs, FRANCE
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Mr Jan Christian Kaiser ( <i>JCK</i> ) (christian.kaiser(x))helmholtz-muenchen.de)	Helmholtz-Zentrum München GmbH, GERMANY
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Mr Sven Keesmann ( <i>SK</i> ) (sven.keesmann(x))nagra.ch)	National Cooperative for the Disposal of Radioactive Waste (NAGRA), SWITZERLAND
Mr Gerald Kirchner ( <i>GK</i> ) (gkirchner(x))bfs.de)	Bundesamt für Strahlenschutz (BfS), GERMANY
Mr Ryk Klos ( <i>RK</i> ) (ryk(x))blueyonder.co.uk)	Aleksandria Sciences, UNITED KINGDOM
Ms Katerina Kouts ( <i>KK</i> ) (kate.kouts(x))mail.ru / kouts.kate(x))gmail.com)	Republican Scientific-Practical Centre of Hygiene (RSPCH), BELARUS
Ms Maria Nordén ( <i>MN</i> ) (maria.norden(x))ssm.se)	Swedish Radiation Safety Authority (SSM), SWEDEN

\*Initials used to refer to participants within minutes and actions as appropriate.

<b>Attending</b>	
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Mr Geert Olyslaegers ( <b>GO</b> ) (golyslae(x)sckcen.be)	Studiezentrum für Kernenergie (SCK/CEN), BELGIUM
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## Objectives and content of the meeting

The objectives of the meeting were to present and discuss progress the work of the 4 subgroups (SG), and to develop a continuing work plan, leading to the production of a WG3 report.

**TL** began by presenting the progress in development of the WG3 report and the work to date in subgroups was presented by the respective SG leaders. Presentations from SGs were made and discussed, and the opportunity was taken to hear presentations of recent developments in national programmes, including some from newly participating organisations.

SG work was carried out, with the focus on providing material addressing the objectives of WG3 and the list of issues identified at the previous (third) WG3 meeting held in October 2010.

Finally, progress within the SGs was presented and discussed within the WG as a whole and plans prepared for work in 2011 and completing of the WG3 report.

## Presentations of progress in subgroups

### *SG1: Analogue approach*

**CS** and **CK** made a presentation on “Sensitivity Analysis of Parameters for a Reference Biosphere Model” providing substantial example results of how BDCFs can be different at different sites from Northern Europe to North Africa. He also presented tornado diagrams showing the more and less sensitive parameters in the model. Some discussion arose concerning the appropriateness of varying dose coefficients within the sensitivity analysis.<sup>1</sup>

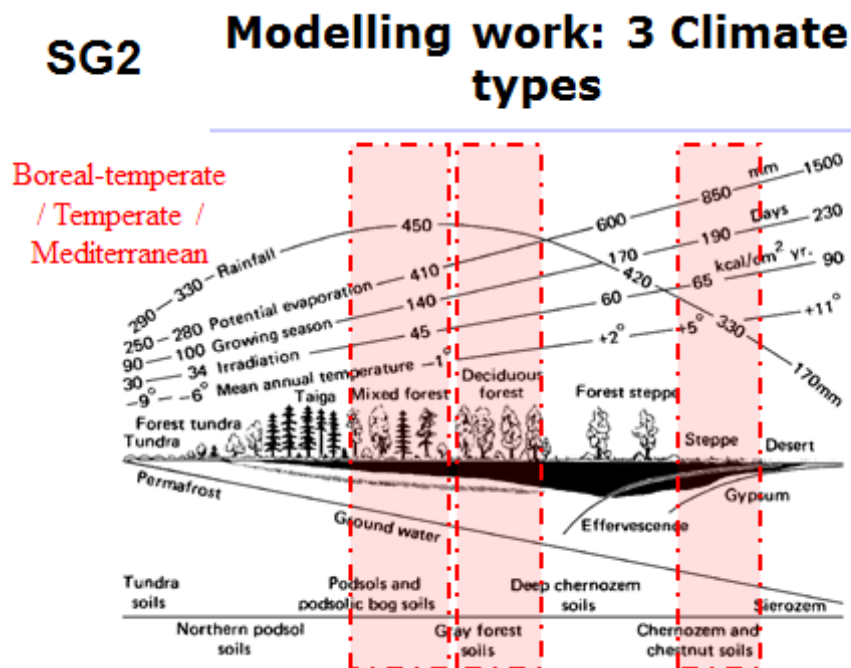
<sup>1</sup> Participants may be interested in the following quotation from the Report of the Committee Examining Radiation Risks of Internal Emitters, 2004, ISBN 0-85951-545-1, available from The National Radiological Protection Board (now the Radiation Protection Division of the Health Protection Agency, UK), viz: „Committee members agreed that insufficient attention has been paid in the past to uncertainties in dose and risk estimates for internal emitters. Reliable quantitative estimates of uncertainties in dose coefficients for a range of radionuclides are not yet available. Uncertainties in estimating equivalent dose, which combine the uncertainties in estimating both absorbed dose and RBE, are always likely to be significant, and probably vary in magnitude from around a factor of 2 or 3 above and below the central estimate in the most favourable cases (i.e. where good data are available) to well over a factor of ten in unfavourable ones (where they are not).”

NS made a presentation on “BDCF for Yucca Mountain and HMGU approaches: comparison of assessment and results”. A number of model and data similarities and differences were identified which could be investigated further to provide insight for the WG3 report. Initial draft material had been provided for inclusion in the WG report.

**SG 2: Soil-Plant Processes**

GO presented draft material for inclusion in the WG3 report on the influence of climate change on the soil plant system, addressing: the relevant physical, chemical and biological system processes: climate variables and their relation with parameters used in models. He also presented results of a specific model to estimate the water balance in the soil for different climates.

GO then presented some preliminary results for a common irrigation scenario about the effect of climate change on radionuclide concentrations in soil and wheat, applied to site descriptions for situations in Sweden and Germany. Similar consideration is due to be given to a Spanish site. The conditions for the three sites fall within the bands indicated in the following diagram:



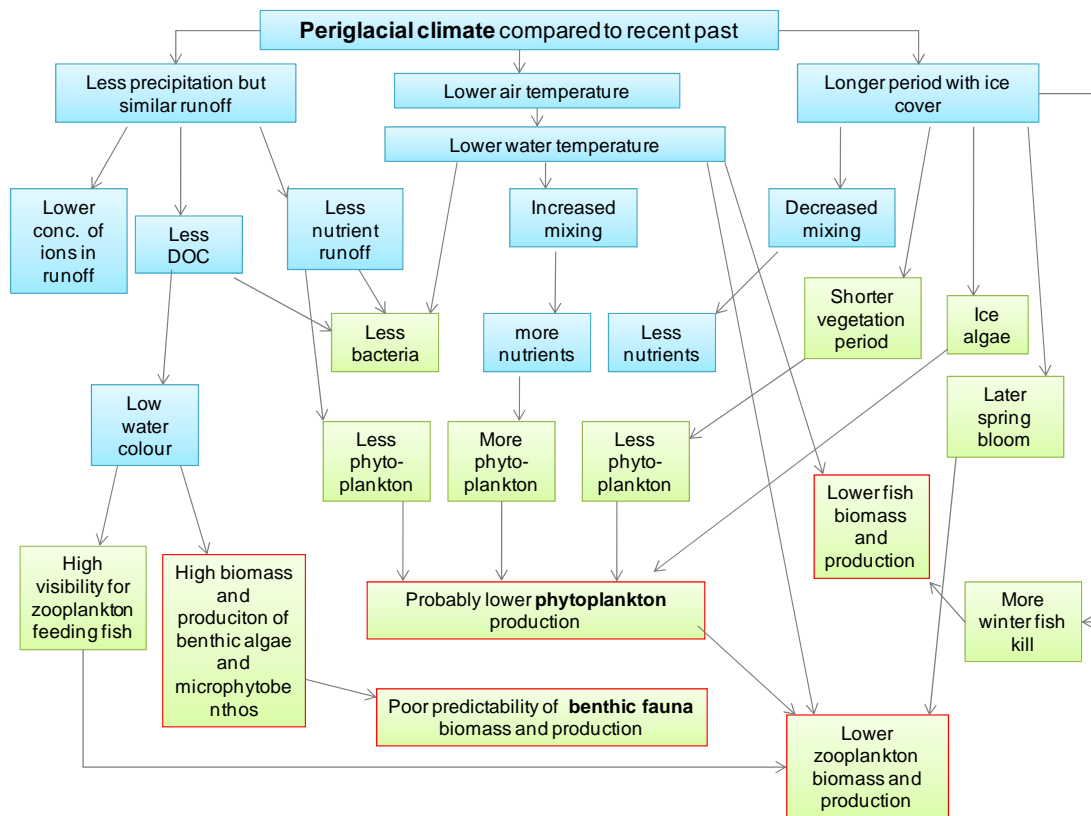
Four models are due to be applied to the scenario for the three sites, by CIEMAT, SCK/CEN, SSM and Nottingham University.

**SG3 : Dynamic treatment of environmental change**

Substantial report material has been prepared based largely on SKB experience, focussing on:

- System description of the Forsmark area;
- Identification of processes and parameters potentially affected by environmental change, e.g., as indicated in figure below for a colder climate;
- Identification of abiotic and biotic processes and parameters affected by climate change;
- Evaluation of processes and parameters through the use of interaction matrices; and
- Quantitative assessment of how changes in relevant processes and parameters affect model results.

Other inputs are also due to be taken into account from other assessment programmes, for example the POSIVA programme and the work presented below by JB.



#### SG 4: Demonstrating compliance with protection objectives

MN noted that substantial material was being collated on international and national:

- Fundamentals (F);
- Requirements (R); and
- Guides (G),

to identify how we are supposed to address environmental change in post closure safety assessment for waste repositories. The continuing work is to analyse further documentation on assessments and compliance reviews of assessments to determine:

- How these FRG have been taken into account;
- What general guidance can be derived from that experience; and
- What other guidance can be generated which is site type specific or needs to be specific for other reasons.

#### Other presentations and discussion

RA gave a presentation on modelling the evolution of landscapes from aquatic to terrestrial systems, as being applied by SKB. The stages considered include:

- Sea stage – the biosphere object is a sea basin which, as the landscape emerges from the sea, continuously reduces in size. The end of this stage is a bay with the threshold near the extreme low water level in the area;
- Transitional stage – the sea bay is isolated and transforms into a lake or a stream (aquatic object) surrounded by wetland (terrestrial), or directly into a wetland;
- Lake stage – the surrounding wetland expands into the lake, and aquatic sediments are gradually covered by a layer of peat;

- Terrestrial stage – the biosphere object has reached a mature state and no further natural succession occurs. For the majority of discharge areas, the end stage is a wetland that is drained by a small stream.

The selection of spatial and temporal discretization was raised during discussions.

**TL** provided further information on the Swedish Greenland Project. The project is providing analogue information for conditions which may pertain in future at the Forsmark site of interest to SKB, as well as the dynamics of surface and near-surface processes.

**RK** gave a presentation about recent work within the SSM approach modelling the soil-plant system, including example model results relevant to SG2 activities.

**GP** noted that results of the model are very difficult to evaluate, since the different uptake processes leading to a contamination of plants (interception, translocation, root uptake) are not addressed separately.

**UK** noted the Coop model for capillary rise, described in Gärdenäs et al. (2009), Tracey - a simulation model of trace element fluxes in soil-plant system for long-term assessment of a radioactive groundwater contamination. SKB TR-09-24. Svensk kärnbränslehantering AB. This is accessible at [www.skb.se](http://www.skb.se) under heading Publications.

**YT** presented information on the ANDRA biosphere site characterisation programme at Meuse/Haute Marne, and the use of a soil types analogy approach as applied to Meuse-Haute Marne reference biospheres. It was noted during discussions that some aspects of soil chemistry were relatively stable under climate change because of buffering by the sub-soil geology. The relative rate of soil evolution compared to climate change was raised as an issue by **RK**.

**JB** gave a presentation on geomorphology and landscapes in Meuse-Haute Marne reference biospheres. The approach used by ANDRA to justify the possible future biospheres in the Meuse/Haute Marne region, and determine their characteristics, is based on natural analogues mixed with dynamic modelling of changes (geomorphology and ecosystems) during the next the 1 My, at 1ky time scale, for the different possible climate scenarios that was defined in BIOCLIM Project.

**TAM** gave a presentation on the effects of parameter uncertainty on vertical distribution of iodine above the geosphere-biosphere interface. The combined experimental and modelling programme is intended to help resolve significant variation and uncertainty in the sorption of I-129 in different soil types.

**GK** noted that there are alternative methods for identifying key uncertainties, which show advantages and disadvantages according to the type of pdf they are applied to, e.g., normal, triangular, etc.

### **Integration and synthesis of subgroup activities**

It was confirmed to be the case that:

- WG3 is working towards one approach to developing reference futures which could apply to the whole PA not just biosphere, and the approach evolves as the repository development programme evolves from concept to site selection to licence application, construction then operation, then closure and decommissioning. The approach is based on scientific understanding, investigation and research, research level representation of systems and then abstractions for assessment models.
- It is helpful to retain the SG activities, as a matter of organisation and avoiding everybody trying to do everything at once. Different approaches are seen as complementary, for example, with different emphasis coming at different stages of repository development.
- WG3 aims to identify factors which constrain an assessment in terms of uncertainties. Output from the group could include a flowchart of the stages of “Constrained Conservative Reference Futures” development, possibly starting from the system identification and environmental change diagrams in IAEA-BIOMASS-6 (Figures A5 and A6), but building substantially to take account of stages in repository development.

- Much is made of the differences in results from different models, but it remains unclear what should be considered as a significant difference, or a significant uncertainty. The answer will be context dependent, but the general approach is to understand the differences/uncertainties scientifically (SGs 1–3), then consider if they are important in relation to demonstration of compliance with protection objectives (SG4).
- A part of this, it has to be acknowledged that there is little scientific basis for predicting human behaviour, so that the assessments have to be constrained by limiting the range of assumptions on this aspect.
- Nevertheless, WG3 can still do much to determine suitable approaches to addressing climate change in different circumstances, driven by the stage of repository development, the geological and geographic context of the site, and the particular regulatory requirements and other protection objectives applicable to the specific assessment being carried out.

## 5. Work plan for WG3 report preparation

Each SG has its own programme of actions, as given in the WG3 Work Plan (Version 2)<sup>2</sup> and as extended from the current meeting discussions.

Progress with development of the WG3 report will be made according to the following schedule:

- Draft minutes from January meeting to be provided for comment by 24 February (GS)
- Comments on draft minutes to GS for finalisation by 15 March and delivery to IAEA
- Further outline of WG3 report to be drafted (GS) based on current inputs to be distributed to participants by 31 March 2011;
- SGs provide further material from their activities by 31 May 2011 for inclusion in a first full draft report as well as contributions to the discussion of cross-cutting issues and draft conclusions;
- *TL* and *GS* prepare first full draft report for WG distribution by 30 June 2011, with request for comments, with emphasis on integration of the inputs, to be provided by 15 August 2011;
- *TL* and *GS* prepare second full draft report for WG distribution for WG distribution by 2 September 2011;
- 2 day WG meeting in week beginning 19 September for discussion of second draft WG report;
- Further third draft WG report for comment (*TL* and *GS*) for WG distribution by 31 October 2011;
- Comments to be provided 30 November 2011; and
- Final draft report 31 December 2011.

### Next meeting

The 2011 WG3 interim meeting was proposed to be hosted by NAGRA in Wettingen, Switzerland. *SK* has confirmed that NAGRA has kindly accepted this proposal, subject to official confirmation of arrangements through the IAEA.

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<sup>2</sup> Available for download from the WG3 web page <http://www-ns.iaea.org/projects/emras/emras2/working-groups/working-group-three.asp?s=8>

## WG3 MEETING AGENDA

### Monday, 24 January 2011

09:30–13:00	Opening Plenary Session	
13:00–14:00	<i>LUNCH BREAK</i>	
14:00–14:30	Welcome and overall review of progress	Tobias Lindborg, WGL (SKB, Sweden)
	Status of Interim Report	Graham Smith (UK)
14:30–15:30	Subgroup 1: Analogue Approach	Christian Staudt / Jan Christian Kaiser (HZ, Germany)
	Sensitivity analysis of BDCF pertaining to different reference biospheres	Natalia Semioschkina (HZ, Germany)
15:30–16:00	<i>COFFEE BREAK</i>	
16:00–16:30	Subgroup 2: Soil-Plant Processes	Geert Olyslaegers (SCK-CEN, Belgium) et al
16:30–17:00	Subgroup 3: Dynamic Analysis of Biosphere Systems	SKB, Sweden
17:00–17:30	Subgroup 4: Demonstrating Compliance with Protection Objectives	Maria Nordén (SSM, Sweden)

### Tuesday, 25 January 2011

09:00–13:00	Subgroup Work	All WG participants
13:00–14:00	<i>LUNCH BREAK</i>	
14:00–15:30	Presentations on topical issues:	
	Evolution from aquatic to Terrestrial Systems	Rodolfo Avila (Facilia AB, Sweden)
	The Swedish Greenland Project	Tobias Lindborg (SKB, Sweden)
	Advances at ANDRA on Biosphere Characterization	Jacques Brulhet (ANDRA, France)
15:30–16:00	<i>COFFEE BREAK</i>	
16:00–17:00	Subgroup Work	All WG participants

### Wednesday, 26 January 2011

09:00–10:30	Plenary Session	
10:30–11:00	<i>COFFEE BREAK</i>	
11:00–16:30	Subgroup Work	All WG participants

### Thursday, 27 January 2011

09:00–10:30	WG plenary to review progress in subgroups	All WG participants
10:30–11:00	<i>COFFEE BREAK</i>	
11:00 – 13:00	Discussion of integration of SG outputs, and develop draft plan for 2011	All WG participants
13:00–14:30	<i>LUNCH BREAK</i>	
14.30 – 15.30	Subgroup discussions on how to achieve plan and prepare inputs to Friday Plenary Session	All WG participants
16:00–16.30	<i>COFFEE BREAK</i>	
16:00 – 17.00	Confirm 2011 plan and prepare WG plenary presentation	All WG participants

### Friday, 28 January 2011

09:00–13:00	Closing Plenary Session	
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