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

EMRAS II
Reference Approaches for Biota Dose Assessment
Working Group 4
"Biota Modelling"
M I N U T E S

of the Fifth WG4 Meeting held at IAEA Headquarters, Vienna
24–28 January 2011
(during the Third EMRAS II Technical Meeting)

IAEA Scientific Secretary	Working Group Leader
Mr Sergey Fesenko *(SF)* Radioecologist, Chemistry Unit, NAEL International Atomic Energy Agency Laboratories A-2444 SEIBERSDORF AUSTRIA Tel: +43 (1) 2600-28247 Fax: +43 (1) 2600-28222 Email: S.Fesenko@iaea.org	Mr Nicholas A. Beresford *(NAB)* Radioecologist, Radioecology Group Centre for Ecology & Hydrology (CEH) Lancaster Environment Centre, LEC Building Library Avenue, Lancaster University LA1 4AP BAILRIGG, LANCASTER UNITED KINGDOM Tel: +44 (1524) 595-856 Fax: +44 (1524) 61536 Email: nab@ceh.ac.uk

Attending	
Name / Initials* / Email	**Organization / Country**
Mr Pål Andersson *(PA)* (pal.andersson@ssm.se)	Swedish Radiation Safety Authority (SSM), SWEDEN
Mrs Karine Beaugelin-Seiller *(KBS)* (karine.beaugelin@irsn.fr)	Institut de Radioprotection et de Sûreté Nucléaire (IRSN), FRANCE
Mr Andreas Bollhöfer *(AB)* (Andreas.Bollhoefer@environment.gov.au)	Environmental Research Institute of the Supervising Scientist, AUSTRALIA
Mr Marko Cerne *(MC)* (marko.cerne@ijs.si)	Jozef Stefan Institute (JSI), REPUBLIC OF SLOVENIA
Mr David Copplestone *(DC)* (david.copplestone@stir.ac.uk)	University of Stirling, UNITED KINGDOM
Mr Paul Dale *(PD)* (paul.dale@sepa.org.uk)	Scottish Environment Protection Agency (SEPA), UNITED KINGDOM
Mr Che Doering *(CD)* (Che.Doering@arpansa.gov.au)	Australian Radiation Protection & Nuclear Safety Agency (ARPANSA), AUSTRALIA
Mr Marc Fournier *(MF)* (marc.fournier@asn.fr)	Autorité de Sûreté Nucléaire (ASN), FRANCE
Mr Rudie Heling *(RH)* (heling@nrg.eu)	Nuclear Research & Consultancy Group (NRG), NETHERLANDS
Ms Brenda J. Howard *(BJH)* (bjho@ceh.ac.uk)	Centre for Ecology & Hydrology (CEH), UNITED KINGDOM
Ms Sunita Kamboj *(SK)* (skamboj@anl.gov / brijkamboj@yahoo.com)	Argonne National Laboratory (ANL), UNITED STATES OF AMERICA
Mr Isao Kawaguchi *(IK)* (kawag@nirs.go.jp)	National Institute of Radiological Sciences (NIRS), JAPAN

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

Attending	
Name / Initials* / Email	**Organization / Country**
Mr Dong-Kwon Keum *(DKK)* (dkkeum@kaeri.re.kr / dkkeum59@hanafos.com)	Korea Atomic Energy Research Institute (KAERI), REPUBLIC OF KOREA
Mr Steve Mihok *(SM)* (steve.mihok@cnsc-ccsn.gc.ca)	Canadian Nuclear Safety Commission (CNSC), CANADA
Ms Laura Newsome *(LN)* (laura.newsome@environment-agency.gov.uk)	The Environment Agency (EA), UNITED KINGDOM
Ms Tatiana G. Sazykina *(TGS)* (ecomod@obninsk.com)	Scientific & Production Association (SPA) "Typhoon", RUSSIAN FEDERATION
Ms Keiko Tagami *(KT)* (k_tagami@nirs.go.jp)	National Institute of Radiological Sciences (NIRS), JAPAN
Mr John Twining *(JT)* (jrt@ansto.gov.au / john.twining@ansto.gov.au)	Australian Nuclear Science & Technology Organisation (ANSTO), AUSTRALIA
Mr Shigeo Uchida *(SU)* (s_uchida@nirs.go.jp)	National Institute of Radiological Sciences (NIRS), JAPAN
Ms Hildegarde Vandenhove *(HV)* (hvandenh@sckcen.be)	Studiezentrum für Kernenergie (SCK/CEN), BELGIUM
Mr Jordi Vives i Batlle *(JVB)* (jvibatll@sckcen.be / jordi_vives_batlle@yahoo.co.uk)	Studiezentrum für Kernenergie (SCK/CEN), BELGIUM
Ms Christine Willrodt *(CW)* (cwillrodt@bfs.de)	Bundesamt für Strahlenschutz (BfS), GERMANY
♦ Mr Michael D. Wood *(MDW)* (m.wood@mmu.ac.uk)	Manchester Metropolitan University (MMU), UNITED KINGDOM

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

♦Unable to attend the meeting, participated via web-video link.

Beaverlodge Lake scenario

Ten organisations (SCK/CEN, CEH, EA, ANL, BARC (India), IRSN, SUJB (Czech Republic), CNSC, KAERI and JSI) had submitted results to the Beaverlodge Lake scenario. Participants had been provided with U-238 series radionuclide activity concentrations in water, bed sediment and 3 fish species for 15 sites in the Beaverlodge area; the availability of data varied between sites. The requested predictions were wholebody activity concentrations and absorbed dose rates for 3 fish species and 3 benthic invertebrate species. *SM* presented a provisional summary of the results on behalf of Richard Goulet (*RG*, CNSC); given the preliminary nature of the comparison this presentation will not be available on the WG4 webpage.

Participants had made a variety of assumptions to provide missing activity concentrations in water, sediment and wildlife species for input into their dose assessments (see the attached Agenda for details of all presentations mentioned in these Minutes). These included assumptions of secular equilibrium in media and wildlife and selection of wholebody concentration ratios (CR_{wo}) and distribution coefficient (k_d). Whilst these were largely reasonable based on available data, databases and published knowledge, they resulted in considerable variation between the predicted absorbed dose rates (up to *circa* 2-orders of magnitude).

LN had used the wildlife TRS values to predict the radionuclide activity concentrations in the fish for which data were provided in the scenario. Pb-210 and Ra-226 activity concentrations were generally predicted to within an order of magnitude, whilst Po-210 was generally under-predicted (typically by 2 orders of magnitude) and U-238 was generally over-predicted (typically by 1–3 orders of magnitude). *NAB* and *LN* had both observed that when used probabilistically, the ERICA Tool gave mean dose rate estimates approximately an order of magnitude greater than deterministic estimates if sediment activity concentrations were the only available inputs. Other participants had used the probabilistic tier of the ERICA Tool.

KBS presented estimated dose rates from U-235 series radionuclides assuming a U-235 activity concentration of 4.8% of that of U-238. The U-235 series radionuclides were estimated to contribute between 10–80% of the total dose rate depending on the assumption which had to be made for specific sites and organisms. *NAB* noted that similar results were obtained using the ERICA Tool with Ra-223 dominating the total dose rate.

As an aim of this scenario had been to provide a best achievable estimate of likely dose rates, WG4 members reconvened on Thursday afternoon in order to agree on an approach to estimating missing water, sediment and biota activity concentration to best estimate absorbed dose rates. The agreed approach applied to Hanson Bay can be found in Appendix I (below). The approach does not currently consider U-235 series radionuclides. During the course of discussions, *LN* presented an analysis of 'heavy metal' sediment concentrations, as specified within the scenario, against Canadian sediment quality standards. Many of the sites have concentrations of heavy metals in sediments at which occasional or frequent effects in benthic invertebrates may be expected.

Actions for Beaverlodge scenario

Action	Responsible	Due date
Discuss way forward for scenario with RG and SM	NAB	21/02/2011
Communicate back to the group with actions and timetable to progress scenario for discussion at summer 2011 meeting	NAB/RG	28/02/2011
Comment of 'best approach' (i.e. as presented in Appendix I)	All	21/02/2011
Draft text on U-235	KBS/NAB	June 2011

Little Forest Burial Ground (LFBG)

Seven organisations (SCK/CEN, CEH, ANL, KAERI, NRPA (Norway), MMU and JSI) had submitted results to the LFBG scenario; subsequent to the last (fourth) WG4 Meeting (held September 2010) participants had been able to check and revise submissions as appropriate. *JT* presented the results and led a discussion of potential reasons for variation in predicted activity concentrations and absorbed dose rates. The observations were generally supported by the statistical analyses conducted by *JVB*. Discussions during this session were recorded with the prior permission of all participants.

Participants were requested to provide *MJ/JT* (cc'ed to *NAB*) any suggestions for observed differences (especially with regard to their own results) and any amended results with 2 weeks. When providing this information please refer to Appendix II and the *Intercomparison of approaches – some key differences* slides of the ANSTO collation of results (circulated to scenario participants 31/01/2011). Note results are only to be amended if there is an actual error in reporting or calculation.

Mat Johansen (*MJ*, ANSTO) will prepare an initial draft manuscript for comment by the participants in April 2011.

An oral presentation on the LFBG scenario has been accepted for the International Conference on Radioecology and Environmental Radioactivity (ICRER 2011) being held in Hamilton, Ontario, Canada, 19–24 June 2011 (extended abstract due April 2011).

Actions for LFBG scenario

Action	Responsible	Due date
Circulate results and statistical analysis presentations to all participants	NAB	31/01/2011
Provided suggestions for observed differences to MJ/JT/NAB	All	11/02/2011
Correct any errors identified in submission	All	11/02/2011
Check results collation file (especially for echidna)	MJ	11/02/2011
Consider differences in the two allometric model results and provide noted to MJ	MW	18/02/2011
Circulate draft manuscript for discussion	MJ	15/04/2011

Dynamic Modelling

JVB presented a summary of the findings of the 13 responses which have been provided so far in reply to the questionnaire on the needs for models to be able to model the exposure of wildlife dynamically. The responses range from participants who were of the opinion that the current equilibrium models were fit for purpose, to those who suggested various needs for dynamic models (e.g., dose reconstruction after accidental releases, fluctuating releases to aquatic ecosystems). A number of models were available including those for human foodchains which have been/could be adapted for wildlife assessment. It was proposed to provide guidance on what is required to adapt (current) human food chain models for wildlife assessments. It was also suggested that the adaptation of appropriate available models for wildlife assessments could be an activity for the planned subsequent follow-up programme to EMRAS II.

Additional responses to the questionnaire are required and participants who have not completed it are requested to do so; it was also suggested that it be circulated to other interested parties, as appropriate. Responses are requested to be returned to *JVB* by the mid-March 2011. The questionnaire is available from: https://wiki.ceh.ac.uk/display/rpemain/IAEA.

Actions for dynamic modelling review

Action	Responsible	Due date
Request questionnaire be placed on IAEA EMRAS II webpages (*note subsequently sent to all of EMRA II mailing list by IAEA rather than on website*)	NAB	Done 28/01/2011
Return completed questionnaires to JVB	All as appropriate	15/03/2011

Estimating dose rates in heterogenous sediment profiles

KBS presented results from the EDEN model considering external dose rates to benthic organisms under conditions of heterogenous distribution of radionuclides in sediment profiles (based on data provided by CNSC for 2 sites in the Beaverlodge area). Dose rates were estimated for insect larvae at various depths in the sediment profile assuming a distribution of the contamination between the surface and 2 underlying layers (3 values); results were compared to homogenous average activity concentration in the sediment based on the whole sediment profile. A similar comparison was made for benthic fish on the sediment surface. If the organism was considered to be on the sediment surface the heterogeneous distribution scenario resulted in external dose rates *circa* 1–3 orders of magnitude higher than if a homogenous distribution was assumed. The other scenarios considered gave more comparable results for the homogenous and heterogeneous distributions. The importance of sediment profile assumptions in the overall assessment of dose will depend upon the contribution of external dose rate to the total absorbed dose.

Actions for sediment profile modelling

Action	Responsible	Due date
Liaise with Ali Hosseini (NRPA, Norway) with regard to providing comparative results using a different model	KBS	On-going
Estimate contribution of external dose to the total absorbed dose rate for different scenarios	KBS	For summer meeting

Wetlands scenario

PA presented the final draft of the wetland scenario which he has completed with help from *MDW*, Tammy Yankovich (*TY,* SRC) and *NAB*. The draft is based on an earlier version prepared by Karolina Stark (*KS*, Stockholm University) who is currently on maternity leave. The scenario utilises data for wetlands in the USA, Sweden and Canada. To ensure completion in the time left available to WG4, the scenario has been kept relatively simple.

A number of attendees expressed their interest in participating in the scenario. *PA* will be the contact point for this scenario and will take responsibility for initial collation of submitted results.

Actions for Wetland scenario

Action	Responsible	Due date
Provide revised text and reporting sheet to NAB after comments from KS, TY and MW	PA	04/02/2011
Circulate draft scenario and results sheet for comment	NAB	04/02/2011
Provide comments on the scenario and results sheet to PA	All	18/02/2011
Register interest in participating in scenario to PA (cc'ed NAB)	All	18/02/2011
Circulate finalised scenario and results sheet	PA, NAB	25/02/2011
Provide results and details of methodology used to PA (cc'ed to NAB)	All participating	30/04/2011
Prepare presentation based on results submitted for summer workshop.	PA	For summer meeting

Any other Business

The group's paper considering the dosimetry components of their models for an extended set of radionuclides is now available on-line: http://www.springerlink.com/content/fl5272767177x522/.

NAB noted that Carmell Mothersill (McMaster University) had offered facilities for the next interim WG4 meeting so that it could be held on dates either side of the ICRER 2011 Conference (19–24 June 2011).

Feedback from the Steering Committee Meeting (held 26 January 2011):

The IAEA will circulate requirements for reporting to WG leaders; once available *NAB* will forward to participants with responsibilities for areas of the WG's work programme (i.e. JVB, KBS, RG/SM, PA/KS, JT/MJ) with a suggested schedule.

NAB requested time in the January 2012 schedule for WG4 to meet.

Actions

Action	Responsible	Due date
Provide comments on draft minutes	All	14/02/2011
Please state preferences for summer workshop	All	28/02/2011
Circulate reporting format	NAB	ASAP

Next Meeting

The next (sixth) EMRAS II Working Group 4 meeting will be held at McMaster University, Hamilton, Ontario, Canada, 18–19 June 2011.

W G 4   M E E T I N G   A G E N D A

Monday, 24 January 2011 (WG4 did not meet in the afternoon, attendance at other WG Meetings)		
09:30–13:00	Opening Plenary Session	

Tuesday, 25 January 2011 (WG4 meeting jointly with WG6 morning		
09:30–12:30	Subtask Introduction: **Canadian Benthic Data Task**	Steve Mihok (CNSC, Canada) (Task Leader)
	LEL/SEL dose thresholds for benthos	Steve Mihok (with Graham Smith, Canada♦)
	Statistical Analyses	Claire Della Vedova (Magelis Company, France)
	Discussion of results, future, path forward	Steve Mihok / Tom Hinton, WG6L (IRSN, France)
12:30–13:30	*L U N C H B R E A K*	
13:30-17:30	**Beaverlodge Scenario:**	
	Short presentation of approach used	All scenario participants
	Approaches for ♣ERICA Assessment of LFBG and Beaverlodge Scenarios	Marko Cerne (JSI, Slovenia)
	Beaverlodge Lake Exercise 2, ♣SCK/CEN Assessment	Hildegard Vandenhove (SCK/CEN, Belgium)
	♣CEH application to Beaverlodge scenario	Nick Beresford
	Beaverlodge Scenario Approach using ♣RESRAD-BIOTA	Sunita Kamboj (ANL, USA)
	Beaverlodge Scenario (♣BARC)	A.K. Patra♦ (BARC, India)
	Beaverlodge Scenario (♣SUJB)	Jan Horyna♦ (SUJB, Czech Republic)
	♣K-BIOTA approach to Beaverlodge lake scenario	Dong-Kwon Keum (KAERI, Republic of Korea)
	Overview of results	Steve Mihok
	What do results mean?	
	♣U-235 series radionuclides – do they matter?	Karine Beaugelin-Seiller (IRSN, France) / Nick Besresford
	Way forward (including consideration of 'best approach assessment')	Lead: Steve Mihok / Nick Beresford

Wednesday, 26 January 2011		
09:00–10:30	Plenary Session	
10:30–11:00	*C O F F E E B R E A K*	
11:00–12:30	**Little Forest Burial Ground Scenario:**	
	♣LFBG Scenario overview	John Twining (ANSTO, Australia)
	♣LFBG Results	
	♣LFBG Statistical analyses	Jordi Vives i Batlle (SCK/CEN, Belgium)
	Discussion	John Twining
12:30–13:30	*L U N C H B R E A K*	
13:30–17:30	♣Heterogeneous media distribution	Karine Beaugelin-Seiller / Ali Hosseini♦ (NRPA, Norway)
	♣Dynamic modelling task – update and plans	Jordi Vives i Batlle
	♣Wetlands scenario (♣Instructions and ♣Report Sheet)	Pål Andersson (SSM, Sweden)
	Review of WG actions	Nick Beresford

Thursday, 27 January 2011 (WG4 did not meet during the day, attendance at other WG Meetings)	
~17:30	WG4 met after the close of the WG5 meeting in order to to agree 'best approach assessment' for Beaverlodge.

Friday, 28 January 2011	
09:00–13:00	Closing Plenary Session

♣ Indicates the name of the presentation given on the WG4 web page
(http://www-ns.iaea.org/projects/emras/emras2/working-groups/working-group-four.asp?s=8).

♦ Unable to attend the meeting.

Appendix I - *Suggested best estimate approach to assessing the Hanson Bay site within the Beaverlodge scenario.*

NOTE FOR INFORMATION ONLY – INSTRUCTIONS FOR THE BEAVERLODGE SCENARIO WILL BE MADE AVAILABLE FEBRUARY/MARCH 2011

Attempt to 'best approach' assessment for some U-sites

General rules (likely to be applicable to all sites)

Media data
Secular equilibrium for sediments - if broken chains then equilibrium with most appropriate member of the decay chain.

For water: for missing concentrations, use the mean K_d for that specific radionuclide over all sites. Sediment is the input source into these sites and therefore represents the most appropriate media for which to assume equilibrium between various chain members.

CR data
If there are activity concentration data for a similar species (e.g. large benthic fish vs small benthic fish vs large pelagic fish) then we take that value.

If no data at a given site, then take the average CR value for all species across all sites. The reviews of the CR values for the different types of fish for the radionuclides of interest in the draft wildlife TRS CR_{wo} tables, supports this assumption.

For invertebrates CR_{wo} values from the draft TRS have to be used:
For Pb: Pb-CR for molluscs: 6000
For Po: Po-CR for molluscs: 1.2E5
For Th: Th-CR value for fish for freshwater ecosystems justified by looking at the marine data: 670
For U: U-CR for molluscs: 560
For Ra: Ra-CR for molluscs: 2.4E5 (value has changed from version of database presented in Vienna Jan. 2011)

Hanson Bay

For sediments:
Po-210 and Pb-210 in equilibrium
U-238, Th-234, U-234, Th-230 in equilibrium

NOTE FOR INFORMATION ONLY – INSTRUCTIONS FOR THE BEAVERLODGE SCENARIO WILL BE MADE AVAILABLE FEBRUARY/MARCH 2011

Before looking at results - Refresher on Participant's approaches

Participant	Code	Vers'n	CR sources	CR distributions	Soil distrib'n	alpha, beta, gamma	Notes on run/numeric parameters
CEH Centre for Ecology & Hydrology, Lancaster, UK	ERICA	2009 update |v. 1.0	Wildlife Transfer Database (Dec 2010) except: Grass Co-60 (Tecdoc 1616) Yam (tuber, Tecdoc 1616)	Log N (when S. Dev was available in database) Or, Expon. (when S. Dev not available)	Log N	10, 3, 1	200 probability realizations
SCK-CEN Belgian Nuclear Research Centre, Mol, Belgium	ERICA		ERICA defaults except: Grass (Tecdoc 1616), and, Yam (Tecdoc 1616)	Log N (when S. Dev was available in database) Or, Expon. (when S. Dev not available)	Log N	10, 3, 1	Used ERICA Tier 3 default for E'worm and grass (RAPs), Used ERICA "new org" for all else. Progeny included if ½-life < 10d. Th-234 not included.
JSI Jozef Stefan Institute, Ljubljana, Slovenia	ERICA		ERICA defaults	ERICA default distributions Log N and Expon.]	Log N	10, 3, 1	
NRPA Norwegian Radiation Protection Authority, Oesteraas, Norway	FASTer-lite with ERICA, Eikos, and ECOLOGO		CRs from: ERICA Tool database. (soil-to-food only) Eikos and ECOLEGO (soil-to-org) DCCs generated using ERICA Tier 3 "Add Organism"	Log N			Steady- State Probabilistic (Eikos) for Co, Cs, and U where equilib reached quickly. Else, Dynamic (ECOLEGO) for 50% Organism lifespan.
KAERI Korea Atomic Energy Research Institute, Daejeon, Republic of Korea	K-Biota		ERICA defaults for grass, tree, e'worm, insect, bird TRS 364 for yam (potato) K-allometric for goanna, echidna, fox, wallaby	Log N, exponential		10, 3, 1	
ANL Argonne National Laboratory, IL, USA	RESRAD-Biota		RESRAD CR defaults Journal refs	Trunc. Log N, Bounded Log N, Exponential	Log N	20, 1, 1	1500 prob realizations Ext DCF cals, progeny w/<6mo ½ life in equilibrium. Int DCF calcs, progeny w/<100 ½ life in equilib.
Mike Wood/U. of Liverpool/ (Manchester?)	RESRAD-Biota		RESRAD CR recomm. (Grass-insect) K-allometric (Goanna-wallaby)	Not used	Not used	20, 1, 1	Half-life cut-off at 180 days.