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

EMRAS II
Reference Approaches for Biota Dose Assessment
Working Group 6
Biota "Dose Effects Modelling"
M I N U T E S

of the Fifth WG6 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 Tom Hinton *(TH)* IRSN/DEI/SECRE (Bâtiment 159) Institut de Radioprotection et de Sûreté Nucléaire (IRSN) Centre de Cadarache B.P. 3 13115 SAINT PAUL-LEZ-DURANCE, CEDEX FRANCE Tel: +33 (4) 4219-9532 Fax: +33 (4) 4219-9143 Email: thomas.hinton@irsn.fr

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 Nicholas A. Beresford *(NAB)* (nab@ceh.ac.uk)	Centre for Ecology & Hydrology (CEH), UNITED KINGDOM
Mr Marko Cerne *(MC)* (marko.cerne@ijs.si)	Jozef Stefan Institute, 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
Ms Claire Della Vedova *(CDV)* (claire.della-vedova@magelisgroup.com)	Magelis Company, FRANCE
Mr Marc Fournier *(MF)* (marc.fournier@asn.fr)	Autorité de Sûreté Nucléaire (ASN), FRANCE
Mr Samer Frederic-Amadeus Gaigl *(SFAG)* (S.F.Gaigl@iaea.org)	Consultant, NAEL, Terrestrial Environment Laboratory International Atomic Energy Agency Laboratories, AUSTRIA
Mrs Jacqueline Garnier-Laplace *(JGL)* (jacqueline.garnier-laplace@irsn.fr)	Institut de Radioprotection et de Sûreté Nucléaire (IRSN), FRANCE
Ms Brenda J. Howard *(BJH)* (bjho@ceh.ac.uk)	Centre for Ecology & Hydrology (CEH), UNITED KINGDOM

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

Attending	
Name / Initials* / Email	**Organization / Country**
Mr Isao Kawaguchi (**IK**) (kawag@nirs.go.jp)	National Institute of Radiological Sciences (NIRS), JAPAN
Mr Dong-Kwon Keum (**DKK**) (dkkeum@kaeri.re.kr)	Korea Atomic Energy Research Institute (KAERI), REPUBLIC OF KOREA
Mr Alexander I. Kryshev (**AIK**) (ecomod@obninsk.com)	Scientific & Production Association (SPA) "Typhoon", RUSSIAN FEDERATION
Mr Steve Mihok (**SM**) (steve.mihok@cnsc-ccsn.gc.ca)	Canadian Nuclear Safety Commission (CNSC), CANADA
Mr Luigi Monte (**LM**) (luigi.monte@casaccia.enea.it)	ENEA, CR Casaccia, ITALY
Ms Laura Newsome (**LN**) (laura.newsome@environment-agency.gov.uk)	The Environment Agency, UNITED KINGDOM
Ms Marcelle Phaneuf (**MPh**) (M.Phaneuf@iaea.org)	Chemistry Unit, Terrestrial Environment Laboratory, NAEL International Atomic Energy Agency Laboratories, AUSTRIA
Ms Maria Psaltaki (**MPs**) (ramps11@hotmail.com / n.markatos@ntua.gr)	National Technical University of Athens (NTUA), GREECE
Ms Almudena Real (**AR**) (almudena.real@ciemat.es)	CIEMAT, SPAIN
Ms Tatiana G. Sazykina (**TGS**) (ecomod@obninsk.com)	Scientific & Production Association (SPA) "Typhoon", RUSSIAN FEDERATION
Ms Synnöve Sundell-Bergman (**SSB**) (synnove.bergman@vattenfall.com)	Vattenfall Power Consultant AB, SWEDEN
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

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

Objectives

Working Group 6 "Biota Dose Effects Modelling" (WG6) is interested in understanding radiological impacts to the environment. To do so requires knowledge of exposure conditions, life history characteristics of the organisms exposed, estimation of absorbed dose, derivation of dose-response relationships, and the scientific establishment of dose (dose rate) screening levels that are believed to adequately protect the environment. Much high quality work has already been accomplished in this area by prior European efforts (ERICA and PROTECT), as well as on-going international work by the IUR and ICRP. Within the framework of the IAEA's EMRAS II Programme, WG6 will build on what has already been accomplished, and work closely with the IUR and ICRP as they pursue similar objectives. There are 5 subtasks in WG6. We anticipate completing our tasks within 2011. No midyear interim meeting is planned for all of WG6. The Population Modelling Task Group may, however, elect to meet mid-year (the time and place has not yet been decided).

Subtasks

1.   FREDERICA Database Task Group (Leader: Almudena Real (**AR**))

This subtask group has been actively searching the literature, finding appropriate biota effect data, performing QC analyses, and placing screened data within the FREDERCIA database. **AR** presented what are likely the final results of this subtask. During the EMRAS II Programme, 218 references have been added to the database, 66 of these represent the Russian language references. These Russian data (3006 entries) were presented to WG6 in electronic form by the Terrestrial Environment Laboratory (Seibersdorf) as the IAEA support to the project. 71 are potentially useful for developing dose-response relationships. The EMRAS II Programme has added key data to FREDERICA in the areas of field studies (as opposed to laboratory studies) and has enhanced the data in specific wildlife groups (i.e., plants, insects and invertebrates). These additions will be important to the Dose-response and Species Sensitivity Task Group as they attempt to expand on their analyses over what was done in PROTECT, prior to EMRAS II. The group also highlighted several global improvements that could be done in FREDERICA. These were welcomed by **DC**, manager of FREDERICA. **DC** also gave a brief presentation[1] on the need to update "look-up" tables within the ERICA Tool (ERICA Tool uses the FREDERICA database to conduct ecological risk analyses based on a tiered approach). **DC** highlighted the fact that this action needs to be considered independently from the ERICA tool, since the summary information could support any Environmental Risk Analysis, regardless of the tool used. The data derived within EMRAS II could be used to enhance these look-up tables. The task group will present their work during the International Conference on Radioecology and Environmental Radioactivity (ICRER 2011) in Hamilton, Canada, 19–24 June 2011.

2.   Dose-response and Species Sensitivity Task Group (Leader: Jacqueline Garnier-Laplace (**JGL**))

This group uses the data archived within the FREDERICA database to derive dose-response curves, and then derives species sensitivity distributions (SSD) in a transparent and robust manner, using methods accepted within the ecotoxicology discipline. The SSD curves are used to derive a screening level impact dose rate, below which assessors would not likely have to conduct additional analyses in order to prove that the impacts from the operations are not damaging to the environment. **JGL** summarized the group's efforts to date. SSDs conducted under the PROTECT framework used 31 references and involved 20 different species; the EMRAS II update now permits 60 references to be used containing 30 species. The new data permit SSDs to be estimated for groups of organisms that were not previously possible in PROTECT (i.e., for plants), and to substantially reduce the uncertainty of an SSD for invertebrates. PROTECT's mean SSD for invertebrates was 500 µGy/h with a 95% range of 55– 4450. The new data generated within the EMRAS II Programme lowered the mean SSD to 40 µGy/h and reduced the range of the 95% confidence interval (5–740), and include new marine species. The new SSD for a generic ecosystem did not differ substantially from that estimated within PROTECT (~10 µGy/h). Additionally, SSDs were calculated for the first time based on dose (µGy) rather than dose rate (µGy/h). Additional computations will occur over the next 6 months. Two summary papers are anticipated late in 2011; and the data will be presented at ICRER 2011 in Hamilton, Canada.

3.   Population Modelling and Alternative Methods Task Group (Leader: Tatiana Sazykina (**TGS**))

This task group is attempting to develop a simple, generic model that would allow life history characteristics (i.e., longevity, fecundity, age at first reproduction, etc.) of species to be considered when estimating effects to populations of organisms exposed to ionizing radiation. Since the last meeting, a benchmark scenario was developed and several individuals ran their models so that comparisons could be made. **TJS** introduced the benchmark scenario and then **JVB, TGS, AIK, LM and IK** presented their individual calculations. *TJS* then presented a synopsis of the results from all the models. Briefly, the scenario required estimating the reduction in population numbers of several animals that have widely different life history characteristics (e.g., mice; rabbit/hare; deer; dog/wolf, etc.). Each population started with 1000 members and was assumed to be in a stable state. Dose rates of 1, 10, 20, 30, 40 and 50 mGy/d were modelled for each population,

---

[1] Please see the Agenda appended to the end of these Minutes with regard to details of all presentations mentioned.

assuming 5 years of constant exposure, followed by 0 dose to examine the potential for recovery. The models agreed that a dose rate of 1 mGy/d did not impact populations of any of the species modelled. At 10 mGy/d mice and rabbit numbers decreased slightly (10–20%), while greater decreases occurred to the deer and wolf populations. The latter have much reduced fecundity rates compared to mice and rabbits. At 20 mGy/d wolf and deer populations were decreased to the point where recovery was not likely. The group will conduct additional analyses over the next 6 months, and consolidate their efforts into a generic model that will allow life history characteristics to be considered when evaluating impacts to various populations of animals.

4. *Canadian Benthic Data Set* (Leader: Steve Mihok (**SM**))

This portion of the WG6 meeting was held in conjunction with WG4, as they too are interested in using the same data set. **SM** gave a summary of the Canadian benthic data. The data have been derived from sediment cores and grab samples taken from lakes in Canada thought to be impacted from Uranium mining and milling. The data contain a complex mix of radioactive and stable contaminants, as well as species occurrence of benthic invertebrates. **SM** discussed how he has calculated the radiological dose to the invertebrates within his presentation. The dose calculations were complex because of the abundance of U-daughters and their contributions to internal dose from alpha emitting radioisotopes. Calculations based on the ERICA Tool indicate that Ra-226 dominates the dose, contributing about 35% of the total. **CDV** then presented her multivariate analyses of the Canadian data set. She compared a Principal Components Analysis to a Redundancy Analysis approach. Both approaches grouped the occurrence of contaminants with the occurrence of various benthic invertebrate species. Much discussion followed as the group considered the analyses. The group concluded that **CDV's** analyses could perhaps be expanded by considering the total dose combined from all radionuclides as one of the components in the multivariate analysis, rather than considering individual radioisotopes (presence or absence, with no dose). This analysis will be performed this summer and then a benthic expert will be consulted to see if the grouping by species provides any logic. Additionally, the absence of species, rather than their presence will be explored. A step-wise regression approach will also be attempted to increase data availability.

5. *Multiple Stressors Task Group* (Leader: Hildegarde Vandenhove (**HV**))

HV summarized this task group's efforts. The group has pursued the literature for multi-stressor data in which one of the stressors was radiation. Some 53 manuscripts were found and 38 passed a rigorous QC screening procedure similar to what is used in the FREDERICA data. A manuscript of the data review is being prepared with submission anticipated late in 2011.

HV mentioned the Mixture Toxicity Workshop (held 22–24 September 2010, Mol, Belgium) sponsored by SCK/CEN, IUR (4 grants @ 750 EUR each), and the Ministry of Economic Affaires. The Workshop was attended by 33 participants.

Because of the complexity and diversity of multi-stressor assessment methods, experimental approaches, and results, considerable time was spent discussing how best to complete this task group's work relative to the goals of the IAEA. It was decided that the final report would contain a review of approaches used in ecotoxicology for effects assessment in multiple stressor scenarios, and how best to transfer those methods to radiation protection. Some general guidance for conducting dose response experiments when multi-stressors are considered will also be included in the report. It was decided not to undertake MS experiments during the EMRAS II Programme.

W G 6   M E E T I N G   A G E N D A

Monday, 24 January 2011

09:30–13:00	Opening Plenary Session	
13:00–14:00	*L U N C H B R E A K*	
14:00–15:30	Working Group Introduction	Tom Hinton (WGL) IRSN, France
	Subtask Introduction: ♣Population Modeling; followed by: Description of the benchmark scenario on population effects of chronic irradiation, endpoints and input data	Tatiana Sazykina (TYPHOON, Russia) (Task Leader)
	Preliminary results of calculations (population model with ♣two age classes)	Jordi Vives i Batlle SCK-CEN (Belgium)
15:30–16:00	*C O F F E E B R E A K*	
16:00–17:30	Preliminary results of calculations (population model with ♣limiting resource)	Tatiana Sazykina
	Calculations of radiation effects to ♣animal populations using the EMRAS II benchmark scenario	Alexander Kryshev (TYPHOON, Russia)
	♣Preliminary results of calculations	Luigi Monte (ENEA, Italy)
	Generic Population Model for ♣Roe Deer	Isao Kawaguschi (NIRS, Japan)
	Discussion on the results, comparisons, improvements, path forward	Tatiana Sazykina / Tom Hinton

Tuesday, 25 January 2011 (WG6 met jointly with WG4 in the 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 / Graham Smith
	♣Statistical Analyses	Claire Della Vedova (Magelis Company, France)
	Discussion of results, future, path forward	Steve Mihok / Tom Hinton
12:30–14:00	*L U N C H B R E A K*	
14:00–14:30	Subtask: ♣FREDERICA Dose-Effect database	Alumdena Real (CIEMAT, Spain) (Task Leader)
14:30–15:00	Input to the FREDERICA Database (♣Russian information sources)	Sergey Fesenko (IAEA WG Scientific Secretary)
15:00–15:30	Subtask: ♣Species Sensitivity Distributions	Jacqueline Garnier-Laplace (IRSN, France) (Task Leader)
15:30–16:00	Subtask: ♣Multiple Stressors	Hildegarde Vandenhove (SCK-CEN, Belgium) (Task Leader)

Wednesday, 26 January 2011 (WG6 did not meet in the afternoon, attendance at other WG Meetings)

09:00–10:30	Plenary Session	
10:30–11:00	*C O F F E E B R E A K*	
11:00–12:00	WG6 wrap-up: Discussions, milestones, reports, path forward	Tom Hinton

Thursday, 27 January 2011 (WG6 did not meet, attendance at other WG Meetings)

Friday, 28 January 2011

09:00–13:00	Closing Plenary Session

♣ Indicates the name of the presentation given on the WG6 web page
(http://www-ns.iaea.org/projects/emras/emras2/working-groups/working-group-six.asp?s=8).