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

EMRAS II
Reference Approaches for Human Dose Assessment
Working Group 2
Reference Approaches to Modelling for Management and Remediation at "NORM and Legacy Sites"

M I N U T E S

of the Sixth Meeting held at FANC Headquarters, Brussels, Belgium
4–7 October 2011

IAEA Scientific Secretary	Working Group Leader
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Attending	
Name / Initials* / Email	**Organization / Country**
Mr Daniel Salvador Cicerone ***(DSC)*** (cicerone@cnea.gov.ar)	Comision Nacional de Energia Atomica (CNEA), ARGENTINA
Mr Krzysztof Ciupek ***(KC)*** (ciupek@clor.waw.pl)	Central Laboratory for Radiological Protection (CLOR), POLAND
Mr Thierry Doursout ***(TD)*** (thierry.doursout@irsn.fr)	Institut de Radioprotection et de Sûreté Nucléaire (IRSN), FRANCE
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Mr Richard S. O'Brien ***(ROB)*** (richard.o'brien@arpansa.gov.au)	Australian Radiation Protection & Nuclear Safety Agency (ARPANSA), AUSTRALIA
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*Initials used to refer to participants within minutes and actions as appropriate.

Welcome and introduction

Mr Patrick Van Der Donckt, Director of FANC's Health and Environmental Department, welcomed the WG2 participants. Legacy and NORM sites in Belgium are an issue of strategic importance and there are several NORM industries of concern, especially in the phosphate industry. FANC expressed its pleasure in being given the opportunity to provide support to the EMRAS II Programme, and to share its experience and information on its best practices, noting that risk assessment is the core of good management options. It was noted that site visits to Olen, where Marie Curie worked, and Tessenderlo, a phosphate processing factory had been organized as part of the meeting. Mr Van Der Donckt wished the participants successful discussions and a nice stay in Brussels.

AL thanked FANC for hosting the meeting and for arranging the site visits. The Provisional Agenda was discussed and then adopted, after which ***SP*** went through the practical details.

Bellezane modelling

TD led the group and went through the input data used for running RESRAD-OFFSITE, i.e., two separate input files for the two scenarios: the current situation and the intrusion scenario.

For the distribution coefficients (cm^3/g) ***TD*** proposed the use of TRS 472 values for different soil types. SCK/CEN have recently updated their database on Kds within the frame of their work on near surface waste disposal, and recommend 500 cm^3/g for Ra, 140 cm^3/g for Pb and 30 cm^3/g for Po for sandy soil.

Soil to plant transfer factors: generic value for each radionuclide chosen according to the RESRAD four agricultural areas representing:

— Fruit, grain, non-leafy;
— Leafy vegetables;
— Pasture, silage; and
— Grain.

Discussions focussed on where to locate the well and the direction of water flow. A possible solution was to choose 100% flowing in the first direction and calculating the concentration in the well, then 100% flowing in the other direction and calculating the concentration in the well. This method should be used to assess the sensitivity of this parameter.

There is no unsaturated zone in Bellezane, for the saturated zone the group don't currently have site-specific values. Default values are therefore used and it was decided that the group would look for site-specific values for this part, e.g., from AREVA reports. The saturated zone in Bellezane is not isotropic, but RESRAD OFFSITE only allows one saturated zone.

For consumption values, there are some site-specific data determined for percentage local produce of the total.

In reality, the water system is under control and the monitoring programme has not shown values significantly over background values in fish. Only water at the discharge point shows elevated levels. When running the model with the currently available parameters, it overestimates the exposures since it was not possible to accurately describe the water system.

The modelled results need to be interpreted within the frame of the problem. They can't always be used directly.

Ideally, the group would need to look at both results from different models, and results within a model, when changing parameter values to determine what the crucial parameters are.

What would the group like to have in the report for the Bellezane modelling?

— Site description, scenarios, monitoring data and site-specific parameter data;
— A description of the challenges encountered when modelling a real site;
— How results could vary between models (at least RESRAD-OFFSITE and SATURN);
— Comparison of modelling results from several participants using RESRAD-OFFSITE;
— Comparison of the modelled activity concentrations with the monitored ones; and
— Carry out a sensitivity analysis for one or more models to show which parameters should have priority for site-specific data gathering.

To date ***SP*** and ***TD*** have modelled Bellezane with RESRAD-OFFSITE. ***DSC*** will do the same before Christmas. ♦Rodolfo Avila Moreno ***(RAM)*** and his group have carried out some modelling using SATURN, and will update the group in this regard soon.

The group suggested that ***CY*** could indicate what the most sensitive parameters are for Bellezane for the given scenarios:

— Water flow direction (conservative assumption: everything flows towards the well. If this still doesn't give elevated levels in the water, then this is not important).
— Kds are important;
— Atmospheric dispersion is not important since the prevailing wind direction is away from the village;
— Timeframe is important since there is initially a cover that will be eroded with time.

Gela modelling

ROB went through the available data and descriptions for Gela. A basic FEPs analysis was carried out for a scenario with an intact retaining wall and one with no retaining wall in place. The parameter values that were changed from the generic ones to the site-specific ones were listed. RESRAD-OFFSITE was used to model the development with time. The major features were represented in the model, even if it could not describe the retaining wall correctly. ***ROB*** tried to keep the model as simple as possible and as sophisticated as necessary. The modelled results seemed plausible noting that only Ra was modelled.

LS showed modelled results obtained using DOSDIM. There was no retaining wall, no cover and a house built 100m from the site. External irradiation is the most important pathway, followed by radon and drinking water for the first 4000 years. After that, drinking water (mostly Po) is the most important pathway. Even though the house is outside, the person spends quite some time on the site. ***LS*** has looked at the sum of all radionuclides.

The results from the two models showed comparable results when the timeframe was long enough. ***LS*** and ***ROB*** will discuss which timeframe and scenario to use and re-run the models for a subsequent model-model intercomparison.

Field visit Olen and Tessenderlo

Debriefing field visit Olen: Representatives from Umicore, FANC and OVAM attended in addition to EMRAS II WG2 participants.

Today Umicore is a materials research group that focuses on the recycling of precious metals, production of rechargeable batteries, solar panels and catalytic converters for cars. Historically, Olen was a Belgian mining and metals company which started in 1908. From 1921, ore containing Ra was mined in the Shinkolobwe mine in Katanga in the Belgian Kongo. 100 tons of ore with 0.11–0.18 ppm of Ra was sent to Olen in 1921 and the first pure Ra crystals were processed in December 1922. At that time the price was 70 000 $/g. Due to competition and a fall in prices towards the Second World

♦ of Facilia AB, Sweden was unable to attend due to other commitments.

War, the production at Olen declined and was completely stopped around 1970. During the period when Ra was produced, contaminated water was discharged to the river. The Ra production led to contamination of the site, the river, the river banks and the buildings themselves. The Ra facility was decommissioned by SCK/CEN in the early 1980.

Debriefing field visit Tessenderlo: Representatives from TC, FANC and OVAM in addition to EMRAS II WG2 participants.

The factory produces fertilizers, feed phosphate and other compounds for industrial use. The phosphate comes from a dedicated mine in Morocco.

Traditionally: Phosphate rock treated with sulphuric acid → phosphoric acid → mono calcium phosphate.

Tessenderlo uses HCl acid instead → less waste produced, but higher concentration of Ra.

CaF_2 produced in the waste (50%), contaminated with Ra, Cd, Ar, Pb, Hg. Currently around 11 Bq/g of Ra in the CaF_2 sludges, compared to 3 Bq/g before the 1990s (at that time, $BaCl_2$ was not added during the process).

Solid waste: 60 000 tons per year

Liquid waste after treatment: 20 Bq/l before the 1990s (no addition of $BaCl_2$), now 2 Bq/l (1000 m^3/h)

Today 6 legacy sites from 50 000 to 900 000 tons of waste.

Presentation from OVAM: TC must deal with both federal and regional authorities. Main problem: soil contamination. For organic compounds – propose bacterial remediation. There are also problems with salts and Ra, plus other heavy metals. The ground water in the first aquifer is impacted while a second aquifer underneath a layer of clay is not currently impacted.

A regional programme states that all contaminated sites must be remediated by 2036 and the polluter pays. The government has already collected money from all of the companies involved (remediation fund), but some additional funds still have to be paid by the companies concerned.

SCK/CEN found a correlation between gamma dose rates and Cd contamination. Aerial gamma spectrometry of the area was used to single out where the locations with highest contamination with Ra, Cd and other metals are. Contamination of the rivers and the bank sediments were also surveyed in this way.

TC have carried out a serious study to understand the processes and the impacts on the environment. A good working relationship between the operator and the regulators exists. TC is prepared to do whatever it takes so that they can continue their industrial activity in compliance with regulations and with public acceptance. The aim is to reach a level of 200–500 Bq/kg Ra in the sediments and soils after remediation. ***QW*** showed that this would correspond to 1–2 mSv/y according to IAEA general dose calculations based on soil contamination.

Final report – comments from participants

Comments were added into the draft report as track changes and a new version named "final report_ meeting version" will be distributed to all participants after the meeting through the IAEA/EMRAS II file sharing website (http://ns-files.iaea.org/fileshare/emras/default.asp?fd=347).

Plans for finalisation of report

Chapters on Bellezane and Gela modelling

Participants who will carry out the modelling of Bellezane: ***TD***, ***DSC***, ***KC ROB*** and ***SP***

TD will send the two input files to all of the other modellers as a starting point. When input values are changed, records should be kept of which ones and why they were changed. A division should be made between participants of the groups of parameters requiring change, so that each modeller is investigating a different aspect, e.g. pathway. ***CY*** can help in doing probabilistic sensitivity analysis. ***RAM***'s group will use SATURN. ***TD*** will also gather the results afterwards and compare the results.

For Gela: ***ROB*** and ***LS*** are to agree on scenario and parameter values and share them with the group. ***ROB*** will use RESRAD-OFFSITE and ***LS*** will use DOSDIM. Other participants might also be interested in trying once they've received the information from ***ROB*** and ***LS***. ***ROB*** will compile and compare the results.

Input to Chapters 3, 4, 9, 10

♦Malgorzata Sneve ***(MS)*** will take the lead in writing Chapter 3 on nuclear legacy sites. Chapter 4 on regulatory issues will instead go in as sub-chapters in Chapters 2 and 3, respectively.

Chapter 9 to be done as email discussion early in 2012. Chapter 10 was to be discussed during this meeting but was also to continue afterwards.

Timeline

— Send out scenario descriptions and parameter values: ASAP for Bellezane ***(TD)*** and Gela ***(ROB)*** so that participants can model these sites (all interested participants).

— Additions/comments/changes to Chapters 1–8 + Appendix: To be sent to ***AL*** by 31 December 2011. Any wishes for substantial changes MUST be sent before this deadline. (All participants).

— Next full draft deadline: 21 January 2012 ***(AL).***

— Deadline for comments on that draft: 21 February 2012. Specific comments on what text/figures/tables should be changed, input to Chapters 9 (Conclusion) and 10 (Further work) (All participants).

— Final report deadline: 21 March 2012 (***VK*** will check what the plans are from IAEA side) ***(AL)***.

"The necessity to include natural background"

JCMC presented some interesting thoughts for discussion of the topic of subtracting background in modelling of NORM. There is a large variation across the world on what is the natural background, which makes it even harder to subtract it, especially if you don't have measurements of the natural background at a specific place. In general, the group would be interested in considering the increment in dose due to a contamination, no matter the size of the background. For Rn this could be different since there is an absolute concentration level advised of 200 Bq/m^3. So perhaps Rn should be considered separately and have a target value of 200 Bq/m^3 for indoor concentrations no matter the source of Rn.

On the other hand, ICRP 103 states: "In protecting individuals from the harmful effects of ionising radiation, it is the control (in the sense of restriction) of radiation doses that is important, no matter what the source."

In the new European BSS for building materials, the equation for calculating acceptable concentrations of natural radionuclides in building materials includes a subtraction of the natural background outdoor. It is then possible to use either a European average or a country/region specific value.

♦ of NRPA, Norway was unable to attend due to other commitments.

If you are calculating only the impact from a source, the background would not make an impact on the calculations. It would, however, impact if you calculate the total dose received by a person.

Your considerations could be different if you are looking at controlling the polluter or if you are looking at limiting the total dose to a person.

Writing joint articles on model-model intercomparisons

Discussions showed that in addition to this, the group could write articles on testing GAMP on real sites and on the dilemma of including or not including natural background in modelling results.

Wishes for the follow-up Programme to EMRAS II

— Assessing the impact from operational sites to encourage them to operate in a better way in order to reduce the possibility of creating new legacy sites.

— Development of the capability to carry out probabilistic calculations;

— Development of rigorous methods of estimating uncertainties in model predictions and estimates;

— Modelling if NORM waste disposal in normal hazardous waste repositories is OK.

— Try to merge approaches/models for hazardous substances and radioactive substances (need to be risk based and not dose based).

— Model different remediation actions for real sites.

— Cross-fertilizing between groups, e.g., give other groups our real site data and ask them to model with their models.

UPDATE: Since this meeting was held it was announced that the follow-up programme to EMRAS II – "MODARIA" **MO**delling and **DA**ta for **R**adiological **I**mpact **A**ssessments) – will run for 4 years (2012–2015) and the first Technical Meeting will take place at IAEA headquarters in Vienna, 19–22 November 2012.

WG2 MEETING AGENDA		
Tuesday, 4 October 2011		
09:00–10:00	Welcome and introduction	Patrick Van Der Donckt & Stéphane Pepin, FANC (Belgium) Astrid Liland, WGL, NRPA (Norway)
10:00–12:00	Bellezane modelling (all, Thierry to take the lead)	Thierry Doursout, IRSN (France) Leading & All participants
12:00–13:30	***LUNCH BREAK***	
13:30–15:00	Bellezane (Continued)	All participants
15:00–15:30	***COFFEE BREAK***	
15:30–17:00	Gela modelling	Richard O'Brien, ARPANSA (Australia) Leading & All participants

Wednesday, 5 October 2011		
08:30 onwards	Field visit to Olen and Tessenderlo	All participants
	♣Overivew of the legacies of the former radium production in Olen – summary of radiological data	Astrid Liland
	♣Site visit EMRAS II working group & OVAM, UMICORE	
	♣NORM in TC – overview of the sites and of the radiological data	Daniel Cicerone, CNEA (Argentina)
	♣OVAM Overview of soil surveys and remediation	

Thursday, 6 October 2011		
09:00–09:30	♠Final Report – introduction	Astrid Liland
09:30–10:30	Comments on structure and contents	All participants
10:30–11:00	***COFFEE BREAK***	
11:00–11:30	Comments on Chapter 1	All participants
11:30–12:30	Comments on Chapter 2	
12:30–14:00	***LUNCH BREAK***	
14:00–14:30	Envisaged content for Chapters 3 and 4	All participants
14:30–15:30	Comments on Chapter 5	
15:30–16:00	***COFFEE BREAK***	
16:00–17:00	Comments Chapter 6	All participants

Friday, 7 October 2011		
09:00–10:00	Comments on Chapter 7	All participants
10:00–11:00	Comments on Appendix – Site description	
11:00–11:30	***COFFEE BREAK***	
11:30–12:30	Plans for finalisation of report: — Chapters on Bellezane and Gela modelling — Input for Chapters 3, 4, 9, 10 — Comments/changes to Chapters 1,2, 5, 6, 7, Appendix — Next full draft deadline — Deadline for comments on that draft — Final deadline	All participants
12:30–14:00	***LUNCH BREAK***	
14:00–14:45	"The necessity to include natural background" Considerations on ♣background subtraction in modelling: NORM	Juan Carlos Mora Canadas, CIEMAT (Spain)
14:45–15:15	Writing joint articles on model-model intercomparisons	All participants
15:15–16:00	Wishes for the follow-up programme to EMRAS II	
16:00	Meeting close	Astrid Liland

♣ Indicates the name of the presentation given on the WG2 web page (http://www-ns.iaea.org/projects/emras/emras2/working-groups/working-group-two.asp?s=8&l=63).
♠ The latest version of the WG2 draft report available for downloading from: http://ns-files.iaea.org/fileshare/emras/default.asp?fd=347.