

# IAEA

International Atomic Energy Agency

Atoms for Peace

# The new IAEA's programme on Environmental Modelling for Radiation Safety (EMRAS II): Historical context

## INTRODUCTION

The public exposure and environmental impact of releases of radionuclides from nuclear facilities should be assessed with the use of models. For such assessments the information on their reliability must be provided. Although, it has always been recognized that the site-specific information about physico-chemical forms of the radionuclides, their environmental speciation and transport, and the biokinetic behaviour may substantially improve the reliability of radiological assessments, the lack of data and experience of assessors, as well as the financial and technical limitations very often lead to the application of generic models and general parameter values. Furthermore, the assessor's assumptions about a critical group (representative person), exposure scenarios and pathways play an important role in radiological assessments.

The Swedish sponsored BIOMOVs programme, which started in 1985, was the first international exercise aimed at the testing and validation of environmental models and was a precursor of the International Atomic Energy Agency (IAEA) programmes. In the mid-1980s, the IAEA has initiated and sponsored the long-term series of programmes in the area of environmental modelling, assessments of public exposure and impact on the environment. This poster reviews the historical context of a new IAEA's EMRAS II programme, which will be started in 2009.

For more information visit:

<http://www-ns.iaea.org/projects/emras/emras2/default.htm>



## 1. IAEA VAMP Programme (1986-1995)

The acquisition of Chernobyl data sets justified in 1986 the establishment of an international programme aimed at collating data from different IAEA Member States and at co-ordinating work on new model testing studies. The possibilities for data acquisition and model testing in a "natural laboratory" were recognized at the Post-Accident Review Meeting, held in Vienna in August 1986. Following the recommendations of this meeting, the IAEA established a Co-ordinated Research Programme (CRP) on "Validation of Environmental Model Predictions" (acronym VAMP). VAMP was concerned with models and data relevant to the terrestrial, aquatic and urban environments. It did not deal with models for atmospheric transport, but, however, considered the interactions of aerosols in the surface air with terrestrial and aquatic surfaces. The principal objectives of the VAMP Co-ordinated Research Programme were:

- To facilitate the validation of assessment models for radionuclide transfer in the terrestrial, aquatic and urban environments. It is envisaged that this will be achieved by acquiring suitable sets of environmental data from the results of the national research and monitoring programmes established following the Chernobyl release.
- To guide, if necessary, environmental research and monitoring efforts to acquire data for the validation of models used to assess the most significant radiological exposure pathways.
- To produce a report or reports reviewing the current status of environmental assessment modelling, including a review of the improvements achieved as a result of post-Chernobyl validation efforts and identifying the principal remaining areas of uncertainty in models used for radiation dose assessments.
- To run "test scenarios" for model validations selected for their importance in relation to radiation dose assessments. In selecting scenarios and processes for model validations it is necessary to bear in mind that there should be a clearly demonstrable need to improve the reliability of predictions of radionuclide transfer in the pathways chosen.

VAMP therefore established four working groups on terrestrial, urban, aquatic and multiple pathway analysis. Since there was an obvious relationship between VAMP and the research of other international programmes (IUR: International Union of Radioecologists; BIOMOVs: Biospheric Model Validation Study), effort was made to guarantee the exchange of information and avoid possible overlap.

## 2. IAEA BIOMASS Programme (1996-2002)

The IAEA programme on Biosphere Modelling and Assessment (BIOMASS) was launched in Vienna in October 1996. The programme was concerned with developing and improving capabilities to predict the transfer of radionuclides in the environment. The programme had three themes:

**Theme 1: Radioactive Waste Disposal.** The objective was to develop the concept of a standard or reference biosphere for application to the assessment of the long-term safety of repositories for radioactive waste. Under the general heading of "Reference Biospheres", six Task Groups were established:

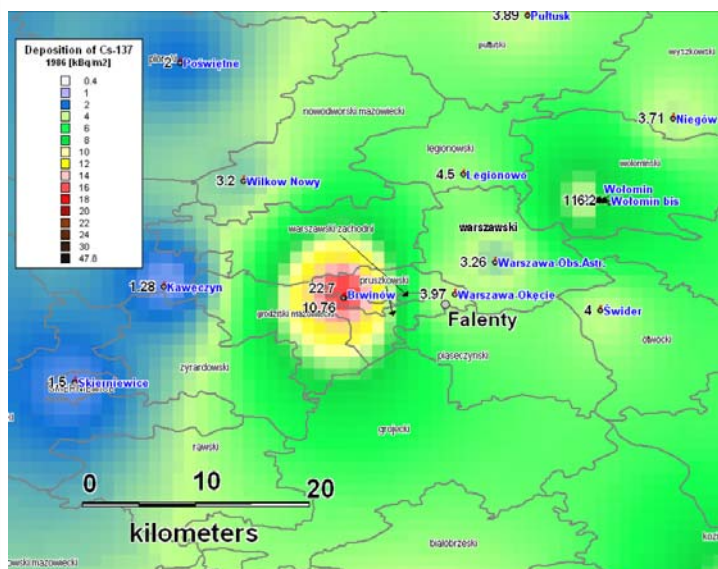
- Task Group 1: Principles for the Definition of Critical and Other Exposure Groups
- Task Group 2: Principles for the Application of Data to Assessment Models
- Task Group 3: Consideration of Alternative Assessment Contexts
- Task Group 4: Biosphere System Identification and Justification
- Task Group 5: Biosphere System Descriptions
- Task Group 6: Model Development

**Theme 2: Environmental Releases.** BIOMASS provided an international forum for activities aimed at increasing the confidence in methods and models for the assessment of radiation exposure related to environmental releases. Two Working Groups addressed issues concerned with the reconstruction of radiation doses received by people from past releases of radionuclides to the environment and the evaluation of the efficacy of remedial measures.

**Theme 3: Biosphere Processes.** The aim of this Theme was to improve capabilities for modelling the transfer of radionuclides in particular parts of the biosphere identified as being of potential radiological significance and where there were gaps in modelling approaches. This topic was explored using a range of methods including reviews of the literature, model inter-comparison exercises and, where possible, model testing against independent sources of data.

Three Working Groups were established to examine the modelling of: (1) long-term tritium dispersion in the environment; (2) radionuclide uptake by fruits; and (3) radionuclide migration and accumulation in forest ecosystems.

The results of VAMP and BIOMASS are published in the IAEA documents as well as in other open literature publications.



The <sup>137</sup>Cs deposition after the Chernobyl accident, which is used in the scenario "W" of the EMRAS Iodine Working Group for the model intercomparison exercise.

## 3. IAEA EMRAS Programme (2002-2007)

The IAEA's programme on Environmental Modelling for Radiation Safety (EMRAS) ran from 2002 to 2007. In common with the former VAMP and BIOMASS programmes EMRAS had the following general objectives:

- to improve models and modelling methods by model testing, comparison and other approaches;
- to develop international consensus, where appropriate, on environmental modelling philosophies, approaches, and parameter values;
- to develop methods for the assessment of radionuclide transfer in the biosphere in areas where they did not already exist;
- to provide an international focal point in the area of environmental assessment modelling for the exchange of information; and
- to respond to environmental assessment modelling needs expressed by other international groups.

It is noted that a special feature of the IAEA's modelling programmes in this area is the possibility of testing models using 'real environmental data'. In many other contexts, models cannot be tested in this way and can only be partly tested or compared. For this reason some priority has been given to model testing with real environmental data during previous programmes. The Themes and Working Groups within the EMRAS programme were as follows:

### Theme 1: Radioactive Release Assessment

- The revision of the IAEA Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Temperate Environments (TRS-364);
- model testing related to countermeasures applied to the intake of iodine-131 from the Chernobyl accident;
- testing of models for tritium and carbon-14 from routine and accidental releases;
- testing of models for predicting the behaviour of radionuclides in fresh water systems and coastal areas.

### Theme 2: Remediation Assessment

- Testing of models for the remediation of the urban environment; and
- modelling the transfer of radionuclides from naturally occurring radioactive material (NORM).

### Theme 3: Assessment Related to Protection of the Environment

- The review of data and testing of models for predicting the transfer of radionuclides to non-human biological species.

The draft results of EMRAS are available at the EMRAS web page <http://www-ns.iaea.org/projects/emras/default.htm> and will be published soon.

## 4. IAEA EMRAS II Programme (2009-2011)

The IAEA has decided to continue its series of programmes on the improvement and testing of environmental assessment models (BIOMOVs, BIOMOVs II, VAMP, BIOMASS and EMRAS) with a new programme starting in January 2009.

The EMRAS II programme proposal documents<sup>1</sup> outlines and summarizes the suggestions received on the nature and topics to be contained in the new programme and contains a provisional IAEA view on structure of the programme. The programme proposals have been developed following discussions during the IAEA Conference on Environmental Radioactivity in April 2007, the final EMRAS Combined Meeting in November 2007, the results of a Questionnaire sent out in December 2007 and a Consultants Meeting held in May 2008. The final structure of the EMRAS II programme will be elaborated during the first EMRAS II Technical Meeting, which will take place 19–23 January 2009. A common theme to the proposed programme will be the development of reference approaches:

### Working Group 1: Reference and Graded Approaches for Assessing the Impact of Radioactive Discharges

Analysis of available assessment schemes for regulatory purposes; development, validation and testing of the graded approach to the prospective assessments of public exposure and environmental impact at the design stage of nuclear facilities. Testing of the graded approach for demonstrating compliance at the operational stage of a facility. Formulation of the reference assessment schemes for common types of nuclear facilities and installations (e.g. laboratories, hospitals, uranium industry facilities, nuclear power plants, waste management facilities, waste disposal facilities, etc):

- Prospective assessments of radioactive discharges
- Prospective assessments of the long term impact of radioactive waste repositories
- Prospective assessments of the impact of NORM releases to the environment
- Assessments for demonstrating compliance
- International intercomparison exercise: Testing of models for discharge assessment
- Applicability of modelling and assessment in the regulatory approach to the protection of humans and biota

### Working Group 2: Reference Approaches for Assessing the Radiation Doses to Biota

The work of the EMRAS working group on biota model testing and data acquisition will be completed. It will include:

- New model comparison/testing scenarios
- Development of a handbook of transfer parameter values for application to biota
- Development of methods for determining protection quantities and levels for biota based on the existing data available on radiobiological effects
- As necessary, the working group will interact with other working groups and with international activities related to this subject, i.e. ICRP and EC.

### Working Group 3: Assessment after Emergency Situations

#### Urban situations

The potential for emergency situations in urban environments continues to exist. The uncertainties in predicting the dispersion and retention of radionuclides in these environments are significant. The EMRAS urban working group did not complete its work and has made proposals for further model comparison and testing, mainly in the context of evaluating the effectiveness of countermeasures.

#### Rural situations — environmental sensitivity

It is well known that the agricultural, and especially semi-natural, environments vary in their radioecological sensitivity to contamination in terms of the potential transfer of radionuclides to the human food chain. The countermeasures that have to be applied therefore also vary depending on soil, climate and freshwater conditions, land use, etc. both in the short and long term, following radioactive fallout.

#### Tritium accidents

For many countries tritium continues to be an issue, especially with regard to potential emergency releases, and for them maintaining a national radiological assessment competence is essential. The tasks of the working group would include: the (a) developing a standard conceptual dynamic model for tritium dose assessment for accidental releases to atmosphere and water bodies; and (b) carrying out model comparison and testing for tritium releases in various circumstances.

### Working Group 4: Integrated Assessment

One of the special features offered by international model testing programmes is to obtain access to unusual and unique environmental data sets and to test and compare assessment model predictions of transfer in real environments.

<sup>1</sup>See <http://www-ns.iaea.org/downloads/rw/projects/emras/emras-two/emras-2-programme-proposal.pdf>