EMRAS - Working Group on the Chernobyl ^{131}I releases: model validation and assessment of the countermeasure effectiveness

Summary Report of the First Working Group Meeting
IAEA, Vienna, 1 - 5 September 2003

1. INTRODUCTION

The Working Group on Iodine which has been established in the framework of the EMRAS programme continues some of the more traditional work of previous international programmes that were aimed at increasing confidence in methods and models for the assessment of radiation exposure related to the environmental releases. Such programmes are:VAMP (Validation of Model Predictions);

— BIOMOVS (BIOospheric Model Validation Study)

— BIOMOVS II

— BIOMASS (BIOsphere Modelling and ASSessment) completed in 2001

All these programmes were sponsored by the IAEA with the exception of BIOMOVS II, which was supported by organisations from Canada, Spain and Sweden.

2. OBJECTIVES

The main activity of the EMRAS Working Group on Iodine (IWG) will be to carry out environmental modelling exercises on radioiodine to test and compare model predictions with environmental data and to compare modelling approaches and model predictions among several assessors.

The most important areas on which the activities of the group will focus will be:

— Improvement of the accuracy of model predictions through the identification of the most important sources of bias and uncertainty;

— Implementation of new modelling procedures supported by current state of knowledge about processes and phenomena

The main objectives of the exercises to be carried out by the EMRAS Working Group on Iodine are:

— To evaluate the performance of the participating models in dose reconstruction exercises in cases when ^{137}Cs (^{129}I) tracer is used to estimate the deposition of ^{131}I;

— To assess the applicability of the models to countermeasure responseOther secondary objectives are to assess the uncertainties of the participating models, their limitations, and the input data required to run the model.

3. WORK DONE

The meeting of the EMRAS Working Group on Iodine was chaired by Dr Pawel Krajewski of the Central Laboratory for Radiological Protection (CLRP) of Warsaw (Poland). Mr T Cabianca of the IAEA's NSRW Division acted as Scientific Secretary of the Working Group. A list of the experts who participated at the meeting is provided in Annex I. Mr. O. Slávik, of VÚJE Trnava, Inc. only participated in the first day's discussion.

3.1. Preliminary work

Before the meeting a questionnaire had been sent to the people who had expressed an interest in participating to the work of the Iodine Working Group requesting information on the models which they intended to use in the project and on data sets which could be made available to all experts participating in the activites of the group. The purpose of the questionnaire was to identify potential participants to the Group.Ten responses were received with details of models and/or data sets. Mr. R. Yao of the China Institute for Radiation Protection (CIRP, People's Republic of China) and Mr V. Kashparov of the Ukrainian Institute of Agricultural Radiology (UIAR, Ukraine) returned completed questionnaires but did not participate to the meeting of the Working Group. In addition, Ms C Duffa (IRSN, France), Mr S Conney (FSA, UK) and Mr S Simon (NCI, USA) expressed their interests in participating to the activities of the group even though they had not complete the questionnaire. Details of experts who agreed to participate in the activities of the IWG are given in the Table I below.

No.	Participant Name	Country	Organization	Previous participation	Model
1	Mr. M. Ammann	Finland	Radiation & Nuclear Safety Authority (STUK)	None	Ecosys-87
2	Mr. S Conney	United Kingdom	Food Standard Agency	None	PRISM/SPADE
3	Ms. C. Duffa	France	Institut de Radioprotection et de Sûreté Nucléaire (IRSN)	None	ARGAL
4	Mr T Homma	Japan	Japan Atomic Energy Research Institute	BIOMASS	OSCAAR
5	Mr B Kanyár	Hungary	University of Veszprém Department of Radiochemistry	BIOMASS	TAM DYNAMIC
6	Mr P Krajewski	Poland	Central Laboratory for Radiological Protection	BIOMASS	CLRP
7	Ms T Nedveckaite	Lithuania	Institute of Physics	BIOMASS	LIETDOS-FILSTEG
8	Mr. S. Simon	United States of America	National Cancer Institute	None	NCI

3.2. Presentation/discussion of data sets proposed

All the data sets were presented and discussed during the meeting of the Working Group. The availability and suitability of the data to be used as scenarios were discussed. The scenarios presented and discussed are briefly summarised as follows:

— Scenarios based on the release of ^{131}I from the Chernobyl accident (these scenarios require the reconstruction of ^{131}I deposition using ^{137}Cs as a tracer):

  — TULA/PLAVSK Scenario, presented by Ms I Zvonova, Institute of Radiation Hygiene, Russia.

  — WARSAW Scenario, presented by Mr P Krajewski, Central Laboratory for Radiological Protection, Poland. Data available include concentrations of ^{131}I in air, vegetation, animal feed and milk, as well as thyroid burden, thyroid blocking, measured in the area near Warsaw in the weeks following the accident.

  - PRAGUE Scenario, presented by Ms I Malátová, National Radiation Protection Institute, Czech Republic. Data available include concentrations of ^{131}I in air, precipitation, vegetation, animal feed, water, milk, human thyroid measured in the area near Prague in the weeks following the accident. This scenario is the same as the VAMP's Central Bohemia Scenario.
  - LITHUANIA Scenario, presented by Ms T Nedveckaite, Institute of Physics, Lithuania. Data available include concentrations of ^{131}I in air, vegetation, animal feed and milk, measured in Lithuania in the weeks following the accident.

— Scenario based on the release of ^{131}I from other nuclear accident:

  - PAKS Scenario, presented by Mr B. Kanyár, University of Veszprém Department of Radiochemistry, Hungary. The scenario is based on the release of ^{131}I as a result of the nuclear accident at Nuclear Power Plant of Paks (10 April, 2003). Data available include source term of the release, radioiodine forms and deposition.

— Scenario based on the release of ^{129}I from other nuclear accident:

  - SELLAFIELD Scenario, presented by Mr S. Conney, Food Standards Agency, UK. The scenario is based on the releases of ^{129}I from the Sellafield nuclear complex during routine operation. Data available include activity concentrations in air, vegetation, soil and milk.

Details of two additional scenarios were also provided to the Working Group by Mr V. Kashparov of the Ukrainian Institute of Agricultural Radiology (UIAR), who was not at the meeting and were briefly described by the Chairman of the Iodine Working Group, Mr P Krajewski. The first scenario is based on experiments with cows involving ^{131}I (NaI solution); data available include activity concentrations in forage, milk and animal thyroid. The second scenario is based on a four-year study on soil to plant transfer of iodine (^{125}I) for various soil types.

Finally Mr S Simon of the National Cancer Institute, USA provided a presentation on a web-based calculator for estimating thyroid radiation dose and thyroid cancer from the fallout from the Nevada Test Site. The topic of the presentation is outside the scope of the activities of the Working Group but was of great interest to the participants.

4. WORK PLAN AND ACTIVITIES

The group agreed that the initial model validation and intercomparison exercises will be carried using the Tula/Plavsk scenario and the Warsaw scenario. Activities in 2004 will be focused on the Tula/Plavsk scenario. Calculations for the Warsaw scenario will be delayed until after the completion of the Group's work on the Tula/Plavsk scenario. Data to be used for the validation are those relevant to the Plavsk district. At a later stage calculation of endpoints might be extended to other districts of the Tula region.

4.1. The Tula/Plavsk scenario

A document describing in detail the Tula/Plavsk Scenario prepared by SENES was distributed at the meeting and discussed in detail. The advantages of this scenario include the high number of measurements of ^{131}I thyroid contents and an adequate data set of $^{131}I/^{137}Cs$ ratios in soil (based on measurements taken on 28 May 1986). The scenario presents a challenge because ^{131}I depositions have to be derived using ^{137}Cs as a tracer. The EMRAS exercise will

be used to validate ^{131}I thyroid burden for new born and less then 3month old babies. This represents a new topic as the modellers will have to develop and include in their models the - transfer of iodine from the mother's breast to milk

4.2. Input data for the Tula/Plavsk scenario

Input data on the Tula/Plavsk scenario were discussed in detail. The Group agreed that the calculations would be carried out using surface deposition of ^{131}I in the Plavsk region. These will be based on surface depositions of ^{137}Cs and measured ratios of activity concentrations in soil of ^{131}I to ^{137}Cs. The Group also agreed that a single value for the activity concentrations in soil, average of the measurements of activity concentrations taken in the region will be used. Depositions of ^{137}Cs are available for 18 collective farms in the region.

4.3. End points of the exercise

The Group agreed to carry out calculation of the following end points:

— Deposition density (or activity concentrations in soil) of ^{131}I at 19 milk farms situated at different locations in the Plavsk district;

— Time dependent activity concentrations of ^{131}I in milk for the period 27 April to 30 May 1986 at the same farms;

Thyroid burdens of ^{131}I – these will be calculated for both urban and rural populations of the district to be compared with thyroid burdens measured. Thyroid burdens to the urban population will be calculated for the town of Plavsk while those for the rural poulations will be calculated for a number of specified locations (probably 2 or 3) depending on the data set available. Thyroid burden will be calculated for the following age groups: newborn, 1-2 years, 3-7 years; 8-12 years; 13-17 years; >17 years. For urban population, thyroid burdens will be calculated for all age groups. It will be left to the participants to decide whether the thyroid burdens to be used in the exercise will be the value calculated for a specific age (for example the value for the 8-12 year is calculated at age 10) or the average of the values calculated for all the years. For the calculation of thyroid burdens for the rural area, Mr Krajewski and Mr Zvonova will analyse the data on measured thyroid burdens and decide for which settlement/collective farms and for which age groups the calculations will be carried out. Ms Zvonova will also indicate the number of measurements are available for urban and rural population and for each age group. It is assumed that milk consumed in Plavsk comes from equal contributions of all 18 collective farms of the district. Ms Zvonova agreed to search for information on milk production for the farms for 1986 in order to estimate possible contribution from single farms. The calculation of thyroid burdens for newborns are affected by considerations of the contribution of mother's milk to the diet. A final decision on this endpoint will be taken after revision of data on thyroid burdens to be used for the validation exercise. It was decided that assumptions on these contributions would be left to the participants as no information exists on this matter. Participants will have to provide calculated thyroid burdens for the period 29 April to 30 May, although measurements are available only for the period 15 May to 30 May. The additional data will be used for model intercomparison. In addition the participants can calculate committed doses to thyroid from ingestion, although this is not a requirement for the exercise. Thyroid burdens will be calculated only for ingestion of milk. The scenario developers (Mr Krajewski and Ms Zvonova) agreed to provide estimates of the contribution of inhalation to the thyroid burdens

measured in the population of the district of Plavsk. Participants to the exercise can, also estimate the contribution of inhalation to the total dose. This requires the reconstruction of ^{131}I air concentration from deposition.

4.4. Other scenarios

Another scenarion considered by the Group was the WARSAW Scenario. For this scenario the crucial points of the model validation exercise are the effectiveness of thyroid blocking and the inhomogeneous ^{131}I deposition. The end points considered for the exercise should be:

— Activity concentrations of ^{131}I in milk;

— ^{131}I thyroid burden for different age groups at two specified locations.

Information, which can be used to determine the effectiveness of the countermeasure include interviews on the administration of stable iodine solution, and information on the limitation of fresh milk consumption and the restriction of the use of pasture, although data on the latter two activities are somewhat uncertain.

5. FORTHCOMING ACTIVITIES/NEXT MEETING

The Working Group agreed the following work plan:

— Final version of the Plavsk Scenario will be prepared by 30 November 2003;

— Model predictions will calculated by the participants by 15 April 2004;

— Measurements data will be disclosed on 15 April 2004;

— The next meeting of the Iodine Working Group will be held at the IAEA in Vienna from 19 to 21 May 2004. The main purpose of the meeting will be to compare the model predictions. Participants to the meeting will also be asked to discuss and agree a methodology to evaluate the performance of the models.