IAEA
Atoms for Peace: The First Half Century
1957–2007

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International Atomic Energy Agency
Agence internationale de l'énergie atomique
Международное агентство по атомной энергии
Organismo Internacional de Energía Atómica

10th Meeting of the Urban Remediation Working Group
Environmental Modeling for Radiation Safety (EMRAS) Project

IAEA Headquarters, Vienna
5-9 November 2007

MINUTES

1. Background

The Urban Remediation Working Group (WG) of the EMRAS project held its eleventh meeting during the period 5-9 November 2007, at the IAEA headquarters in Vienna, in conjunction with the Fifth general meeting of the EMRAS project.

The Urban Remediation WG has the following overall objectives:

(1) to test and improve the capabilities of models to characterise the radiation environment, including external exposure rates and concentrations of radionuclides, in urban areas contaminated with dispersed radionuclides as a function of location and time following a contamination event;

(2) to use the results to estimate the doses to humans, including the identification of important exposure pathways; and

(3) to evaluate reductions of human exposures that could result from specific countermeasures or remediation efforts.

The goal of the WG is to develop the capabilities of models as tools for decision making to address long-term radiological concerns after an urban contamination event has occurred and to assist in identifying required remediation measures.

2. Scope and Objectives of the Meeting

The main objectives of the meeting were:

a) to present and review the most recent modelling results for the hypothetical scenario for deliberate radioactive contamination in an urban environment;

b) to present and review the most recent modelling results for the Pripyat scenario (Districts 1 and 4 of Pripyat in Ukraine);

c) to discuss the draft Working Group report (in particular the proposed lessons learned and conclusions) and to make plans for its completion;

d) to discuss plans for presentations/publications of the WG outcomes in addition to the Working Group report;

e) to discuss plans for continued work in the area of urban modelling, in the form of recommended activities for a Working Group in a follow-up to the EMRAS programme.

The meeting followed the agenda presented in Appendix A. It was chaired by K. Thiessen (USA) and was attended by seventeen experts from ten countries (see Appendix B).

3. Work Performed

3.1 Hypothetical Scenario

Preliminary modeling results for the hypothetical scenario from three participants (W. T. Hwang, South Korea; S. Kamboj, USA; and J. Tomás, Cuba) were presented and discussed in detail at the April 2007 meeting. At the November 2007 meeting, each of the participants had an opportunity to present revised results since the April 2007 meeting and to explain the revisions and the reasons for making them. Revisions to the models and modelling results included changes both to the conceptual models (due to improved understanding of the scenario being modelled) and to parameter values. These presentations were followed by a discussion of Section 4 of the draft Working Group report (prepared at a consultants meeting in October 2007), which deals with the hypothetical scenario and the modelling results for that scenario.

3.2 Pripyat Scenario

The most recent modelling results for the Pripyat scenario from three participants (T. Charnock, UK; W.T. Hwang, Republic of Korea; and J. Tomás, Cuba) were presented and discussed. In particular, revisions made since the April 2007 meeting were explained, including any changes made to the model or to parameter values. These presentations were followed by a discussion of Section 3 of the draft Working Group report (October 2007 version), which deals with the Pripyat scenario and the modelling results for that scenario. Section 3 includes a comparison of model predictions from four modellers (those named above and also V. Golikov, Russian Federation).

3.3 Completion of Working Group Report

All sections of the draft Working Group report were discussed with specific focus on the comparison of models and proposed lessons learned and conclusions for both scenarios. The WG also developed plans to complete the report before March 2008 (target publication date 2008). The October 2007 version of the report distributed at and just prior to the meeting is the most complete version to date, and this meeting was the primary opportunity for discussion of the report. Major sections on the results of the modelling exercises (Sections 3 and 4) were drafted at an October 2007 meeting of several Working Group participants (T. Charnock, UK; K. Andersson, Denmark; D. Trifunovic, Croatia; and B. Batandjieva, IAEA Scientific Secretary for the Urban WG). Section 5 of the report, “Conclusions and recommendations” was prepared based on discussions at the April 2007 meeting that were further elaborated at the October 2007 meeting. Further discussion of lessons learned, conclusions from the exercises, and recommendations for future work was held at this meeting, in conjunction with the review of Section 5. Remaining parts of the report include sections discussed at previous meetings (the introductory Section 1 and Section 2 on models and modelling approaches), as well as the annexes. The annexes include the full scenario descriptions for the two modelling exercises, descriptions and documentation of the models used in the two exercises, evaluations of model performance in the exercises, graphical and

tabular summaries of the model predictions, and supplementary information on remedial activities in Pripyat.

3.4 Plans for Additional Publications of the WG Outcomes

A paper describing the WG activities has been accepted for inclusion in the proceedings from the International Conference "Environmental Radioactivity – From Measurements and Assessment to Regulations", which was held in Vienna in April 2007. The proceedings will be published in a special issue of the *Journal of Applied Radiation and Isotopes.* In addition, the WG proposes to prepare two open-literature papers describing the results of the two modelling exercises. It was also proposed to consider presentation of the WG outcomes at the planned international workshop on Remediation of Legacy Facilities and Sites, 15-19 September 2008 in Moscow, Russian Federation.

3.5 Recommendations for Future Work in the Area of Urban Modelling

The Working Group assembled and discussed a number of suggestions and recommendations for further work in the area of urban modelling. From these recommendations an initial outline was prepared regarding the structure of the future WG and the exercises to be performed.

4. Outcomes of the Meeting

4.1 Hypothetical Scenario

- Three sets of model predictions for the hypothetical scenario have been submitted (W.T. Hwang, Republic of Korea; S. Kamboj, USA; J. Tomás, Cuba); preliminary sets of predictions were submitted in the spring of 2007 and discussed at the April 2007 WG meeting. Over the summer, the modellers submitted any revisions they wished, and the summer 2007 predictions form the primary basis for discussion of the modelling exercise. At the November 2007 meeting, all three modellers presented their results, and especially their revisions and the justification for their revisions. Comparisons of all three sets of predictions have been made, and explanations for the differences in predictions were discussed. The models vary in the surfaces considered to contribute to dose rates at specified locations and in how different surfaces are modeled.
- Comparisons of selected modelling results for the hypothetical scenario are shown in Figures 1-4 (in Appendix C of these minutes). These figures show the results submitted during the summer of 2007, including any revisions made to the preliminary predictions. Preliminary and revised results are compared in Figure 5 (Appendix C) for selected endpoints, to give examples of how modelling results changed since the preliminary predictions were submitted in the spring of 2007.
- For all models, relocation for 6 months reduced the predicted dose during the first year by 50-60%. However, its predicted impact on the cumulative dose over 20 years was only 5-16%, depending on the model (Figure 4). In contrast, a countermeasure involving permanent removal of contamination, such as removal of soil, reduced the predicted dose during the first year by 4-34%, depending on the model (Figure 4), but reduced the predicted cumulative dose over 20 years by as much as 40-80% in two of the models (about 10% in the third).

- The sections of the draft Urban WG report dealing with the hypothetical scenario (Section 4, Annex II) have been revised to reflect the final scenario description. In addition, comparisons of the model results have been added (Section 4 and Annex IV), together with a discussion of those results (Section 4). The discussion in Section 4 of the WG report is based primarily on the revised results (submitted during the summer of 2007), with some examples of how the revised results differed from preliminary results (submitted in the spring of 2007). Model descriptions and evaluations by the modellers of their modeling results (e.g., success, problems, any changes made, things that would be done differently next time, lessons learned) have been added to the WG report (Annex III).

4.2 Pripyat Scenario

- Four sets of results have been submitted for the Pripyat scenario (T. Charnock, UK; V. Golikov, Russian Federation; W.T. Hwang, Republic of Korea; J. Tomás, Cuba). Two of the modellers (Charnock and Hwang) submitted revised predictions during the summer of 2007; for Golikov and Tomás, the results are those submitted prior to the April 2007 meeting. All sets of results included the effects of various remediation efforts for District 4. The November 2007 meeting included an opportunity for presentation of any revisions made to the predictions and the justification for those revisions. Comparisons of all four sets of predictions have been made, and explanations for the differences in predictions were discussed. The models vary in the surfaces considered to contribute to dose rates at specified locations and in how different surfaces are modelled. There were also differences in treatment of the shorter-lived radionuclides (referring primarily to ^{95}Zr, ^{95}Nb, and ^{103}Ru).
- Comparisons of selected modelling results for the Pripyat scenario are shown in Figures 6-7 (in Appendix C of these minutes). These figures show the most recent results submitted for each model, including any revisions made to the preliminary predictions. Preliminary and revised results are for the contributions to dose rate of various isotopes are compared in Figure 8 (Appendix C) for one model.
- Due to the importance of the short-lived radionuclides in the Pripyat scenario, relocation for 6 months reduced the predicted cumulative dose over 20 years by as much as 70-85%, depending on the model and target individual (Figure 7). Cutting and removal of grass reduced the predicted cumulative dose over 20 years by 30-60% for the same models and target individuals (Figure 7). Clearly, for a situation in which short-lived radionuclides are present, relocation during the early period following the release is essential for reducing both short-term and long-term doses.
- The sections of the Urban WG report (October 2007 version) dealing with the Pripyat scenario (Section 3, Annex I) have been revised to reflect the revised scenario description. In addition, comparisons of the model results have been added (Section 3 and Annex IV), together with a discussion of those results (Section 3). The discussion in Section 3 of the WG report is based primarily on the most recent results for each modeller, with some examples of how revised results differed from preliminary results. Model descriptions and evaluations by the modellers of their modeling results (e.g., success, problems, any changes made, things that would be done differently next time, lessons learned) have been added to the WG report (Annex III).

4.3 Preparation of Urban WG Report

All sections of the WG report have now been drafted and discussed by the WG participants, with the exception of the summary section. Suggestions were made on the key aspects that need to be addressed in this section. The summary section will reflect the final version of the report and will form the basis of a summary of the WG's activities and findings that will be included in an IAEA booklet describing the whole EMRAS project. Based on discussions at the November 2007 meeting, plans have been made to revise and finish each section of the WG report. A final review version of the WG report will be distributed to WG participants in January 2008.

A small group of WG participants (expected to include K. Thiessen, USA; T. Charnock, UK; K. Andersson, Denmark; J.C. Kaiser, Germany; D. Trifunovic, Croatia; and B. Batandjieva, IAEA Scientific Secretary) plans to meet in February 2008 to incorporate all WG recommendations from the November 2007 meeting and to finish all remaining work on the report, after which the report will be submitted to the IAEA.

All EMRAS WG reports will be published in electronic form. The Urban WG's report is expected to include the main text and Annexes in PDF format, plus a variety of supporting materials in various formats, all on one CD. The EMRAS summary booklet is expected to contain a short summary of each WG's activities and findings, plus the CDs containing the full WG reports. Therefore it is expected that the Urban WG will submit proposed text for the EMRAS executive summary in 2008.

The schedule for completing the draft Working Group report is as follows:

31 December 2007	All comments, corrections, and revisions to be sent to Kathy and Borislava
31 January 2008	New version of the WG report to be distributed for review by WG participants (Kathy, Borislava)
18-22 February 2008	Meeting of small group of WG participants to finish the report, Croatia
March 2008	Complete report to be sent to the IAEA Summary of the Urban WG report to be sent to Gordon Linsley for inclusion in the EMRAS Executive Summary booklet

4.4 Plans for additional WG publications

In addition to the paper that will be published in a special issue of the *Journal of Applied Radiation and Isotopes*, two additional papers have been proposed, one describing each of the WG's modelling exercises. These papers will contain more detail about the models and modelling results than was possible for the conference paper. K. Thiessen will prepare draft papers based on the WG report, following its completion. These papers will be circulated to WG participants sometime in 2008, and appropriate journals will be selected for submission of the papers.

4.5 Recommendations for Future Work in the Area of Urban Modelling

The general conclusion of the WG is that more work on modelling urban contamination situations would be useful, and this can be achieved through a follow-up project of EMRAS. The primary interest is in modelling deliberate contamination or dispersal events, but accidental events are also of continued interest. During the EMRAS programme, the Working

Group concentrated on modelling situations after the initial contamination and dispersal event, in other words, the long-term contaminant transfer situation and the effects of various countermeasures. This emphasis should continue in a new programme. In addition, it would be helpful to consider modelling of initial atmospheric dispersion and deposition (e.g., from a deliberate contamination event) in an urban setting. For both types of modelling, it will be important to consider the needs of the relevant decision makers, so that the modelling exercises are geared towards providing the information that decision makers need and so that the capabilities and limitations of the models are understood by those who will use the information.

The current Urban Remediation Working Group suggests a two-part approach to the next program, involving one subgroup to model long-term situations and countermeasures (long-term subgroup) and a second subgroup to carry out a modelling exercise for atmospheric dispersion and deposition in an urban context (dispersion subgroup). The long-term subgroup would make use of the output from the dispersion subgroup's modelling exercise, to predict the long-term impact, with and without countermeasures, of the initial dispersion/deposition modelled by the dispersion subgroup. The WG identified a number of issues common to both subgroups that would be addressed in the exercises. In addition, while the dispersion subgroup is carrying out its modelling exercise, the long-term subgroup would look at some additional issues that do not require the dispersion/deposition results from the dispersion subgroup. A third area of emphasis, which could be a topic for a third subgroup, is the use of the modelling results in the decision making process for remediation. The proposed exercises to be developed and carried out by the next Working Group are outlined in Appendix D.

APPENDIX A

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International Atomic Energy Agency
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Urban Remediation Working Group
5th EMRAS Combined Meeting
IAEA Headquarters, Vienna, 5–9 November 2007

A G E N D A

Monday, 5 November 2007

08:30–09:30	***R E G I S T R A T I O N*** * **(Main Meeting Room C02-I)**	
09:30–12:30	**Plenary Session** (Main Meeting Room C02-I)	
12:30–13:30	*L U N C H B R E A K*	
13:30–17:30	**Working Group Meetings****	
	1. Welcome to Urban WG participants	Kathy Thiessen (USA)
	1.1. Adoption of the agenda	
	1.2. Objectives and expected outcomes of the meeting	
	2. *Current status of the Urban WG activities and plans for completion*	Kathy Thiessen (USA)
	3. Presentation and discussion of revised predictions since the April 2007 meeting (Pripyat Scenario)	T. Charnock (UK), W.T. Hwang (ROK), J. Tomás (CUB)
	4. Discussion of WG Report Section 3: Pripyat Scenario	All participants
17:30–19:30	***R E C E P T I O N*** *(HOSTED BY THE IAEA, C02 COFFEE BAR, JUST OUTSIDE THE MAIN MEETING ROOM)*	

* Please note that it is important that you report to **Meeting Room C02-I** to register on the first day of your attendance.

** Specific Working Group Meeting Rooms will be allocated before the lunch break on Monday, 5 November 2007 (Working Group Meeting Rooms ACV-U1-U-633-0, ACV-U1-U-636-0, ACV-U1-U-640-0, ACV-U1-U-642-0, A-7 (A0742), A0478, B1115 (+C02-I as necessary)).

Tuesday, 6 November 2007

08:30–09:00	***R E G I S T R A T I O N**** **(Main Meeting Room C02-I)**	
Morning	**Working Group Meetings****	
	5. Presentation and discussion of revised predictions since April 2007 meeting (Hypothetical Scenario)	S. Kamboj (USA), W.T. Hwang (ROK), J. Tomás (CUB)
	6. Discussion of WG Report (continued) Section 4: Hypothetical Scenario	All participants
Afternoon	**Working Group Meetings****	
	7. Discussion of lessons learned *8. Discussion of WG Report (continued)* Section 5: Conclusions and recommendations 9. *Discussion of future plans*	All participants

Wednesday, 7 November 2007

08:30–09:00	***R E G I S T R A T I O N**** **(Main Meeting Room C02-I)**	
9:00–12:30	**Plenary Session** (Main Meeting Room C02-I)	
13.30–17:00	**Working Group Meetings****	
	10. Discussion of the WG's publication plans *11. Discussion of WG Report (continued)* Section 1: Introduction Section 2: Modelling of contaminated urban environments Remaining parts of the report (Annexes, etc.)	All participants
16:00–17:00	**Meeting of the Steering Committee** (room to be specified)	

Thursday, 8 November 2007

09:00–14:00	**Working Group Meetings****	
	11. Discussion of WG Report (continued) 12. *Outstanding issues*	All participants
14:00–17:00	**Plenary Session** (Main Meeting Room C02-I)	

Friday, 9 November 2007

09:00–12:30	**Plenary Session and Close of Meeting** (Main Meeting Room C02-I)

APPENDIX B

LIST OF PARTICIPANTS

Experts	Country
G. Sdouz	Austria
J. Tomás Zerquera	Cuba
J. Horyna	Czech Republic
J. Hulka	Czech Republic
E. Navarro	France
J.C. Kaiser	Germany
M. Steiner	Germany
B. Batandjieva	IAEA
G.S. Choi	Republic of Korea
W.T. Hwang	Republic of Korea
E.H. Kim	Republic of Korea
A. Arkhipov	Ukraine
S. Gaschak	Ukraine
B. Zlobenko	Ukraine
T. Charnok	United Kingdom
S. Kamboj	USA
K. Thiessen	USA, Chairman

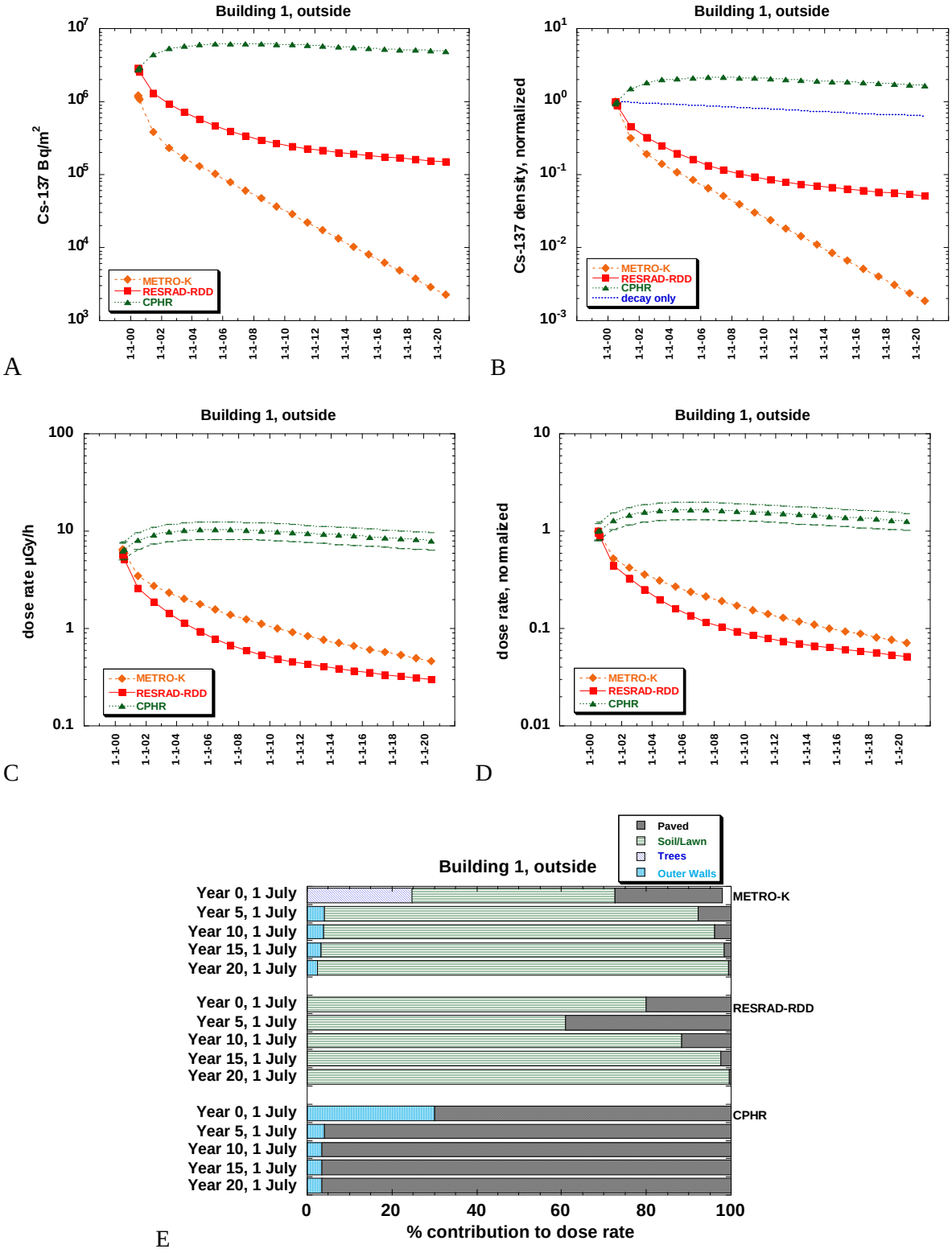

Fig. 1. Model predictions for contamination density and dose rate outside Building 1 in the hypothetical scenario. The top graphs show predicted contamination density (A) and predicted contamination density normalized for the initial value (B). The contamination density expected over time from radioactive decay is also shown in B. The middle graphs show the predicted dose rate (C) and predicted dose rate normalized for the initial value (D). The bottom graph (E) shows the predicted contributions to dose rate at selected times from various surfaces. Results include revisions submitted during the summer of 2007.

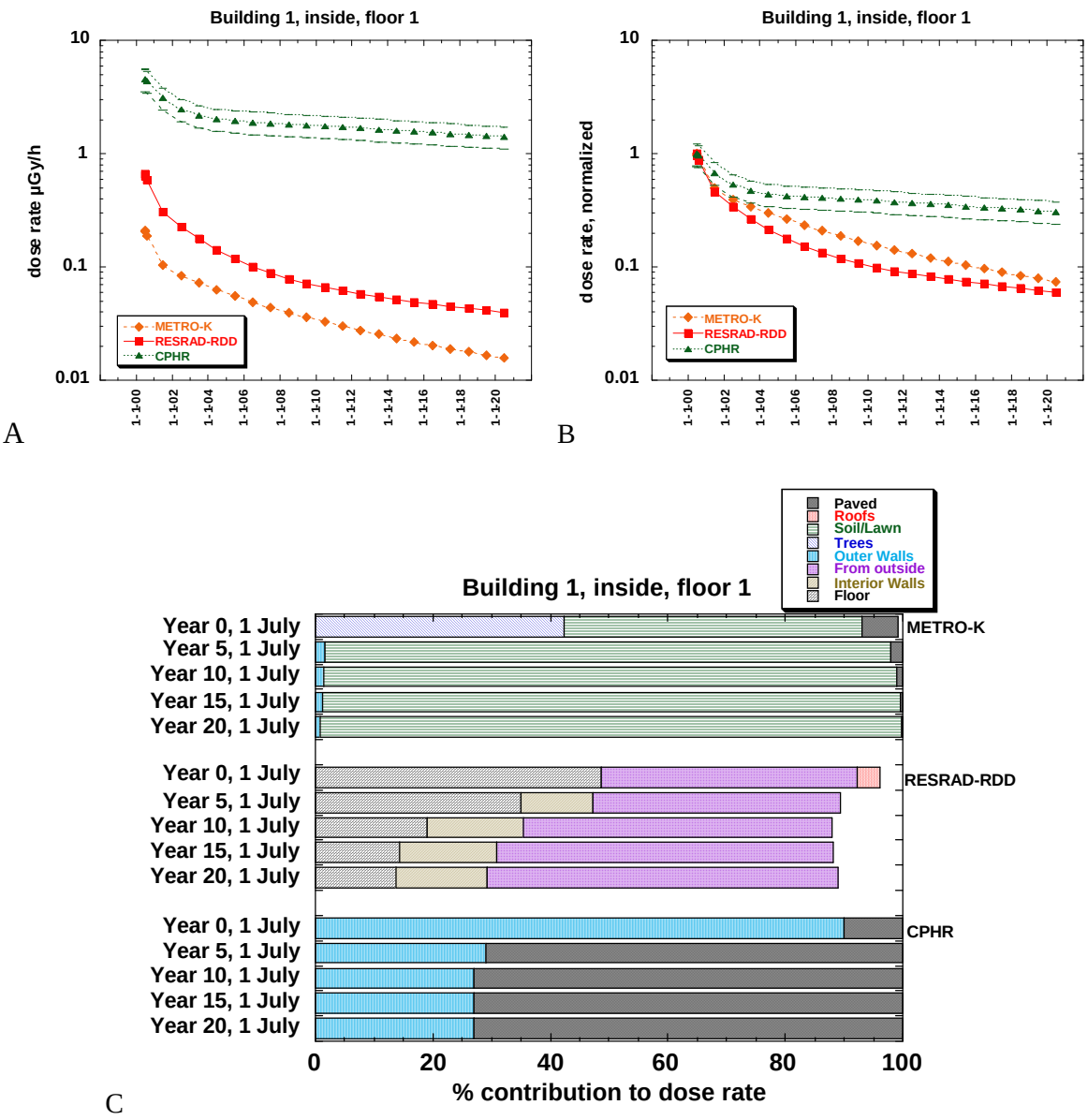

Fig. 2. Model predictions for dose rate inside Building 1 (ground floor) in the hypothetical scenario. The top graphs show the predicted dose rate (A) and predicted dose rate normalized for the initial value (B). The bottom graph (C) shows the predicted contributions to dose rate at selected times from various surfaces. Results include revisions submitted during the summer of 2007.

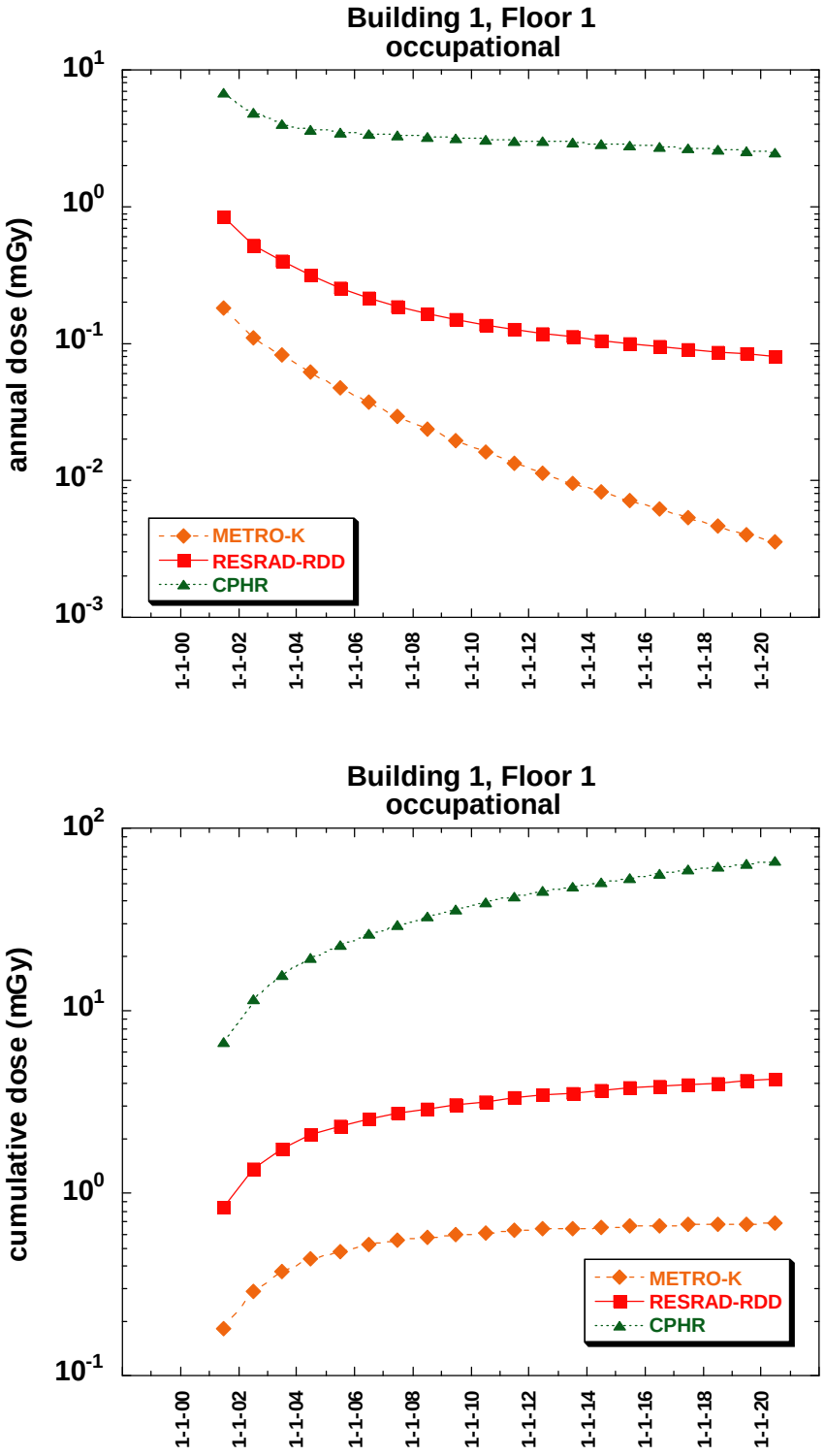

Fig. 3. Predicted annual (top) and cumulative (bottom) external radiation doses for occupational exposure on the ground floor of Building 1. Predicted doses are for the "no action" situation (no countermeasures). Results include revisions submitted during the summer of 2007.

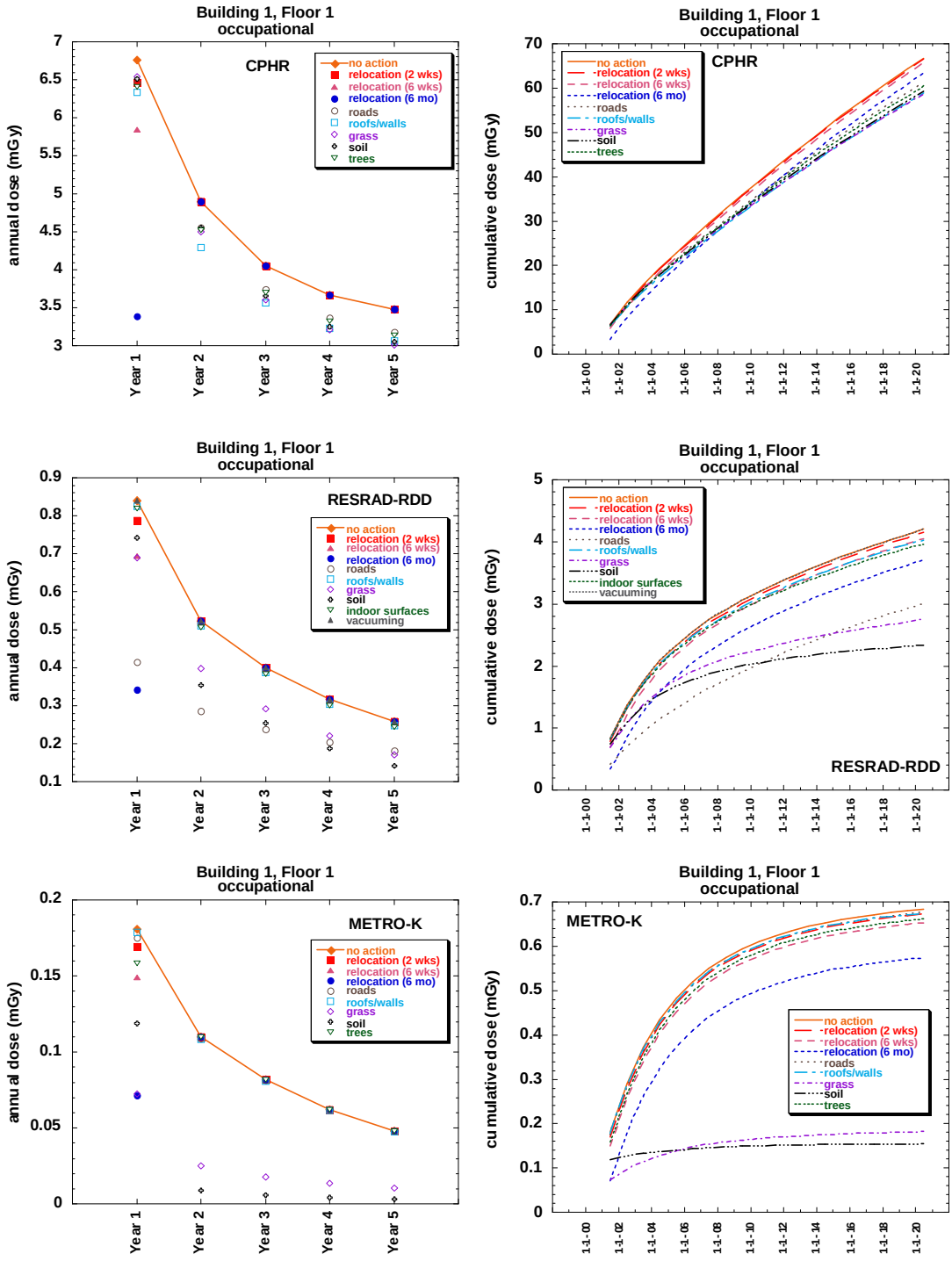

Fig. 4. Predicted annual (left) and cumulative (right) external radiation doses for occupational exposure on the ground floor of Building 1. Annual doses are shown for the first 5 years; cumulative doses are shown through year 20. The graphs show predicted doses for the "no action" situation (no countermeasures) and for selected countermeasures. Combinations of countermeasures were not addressed. Results include revisions during the summer of 2007.

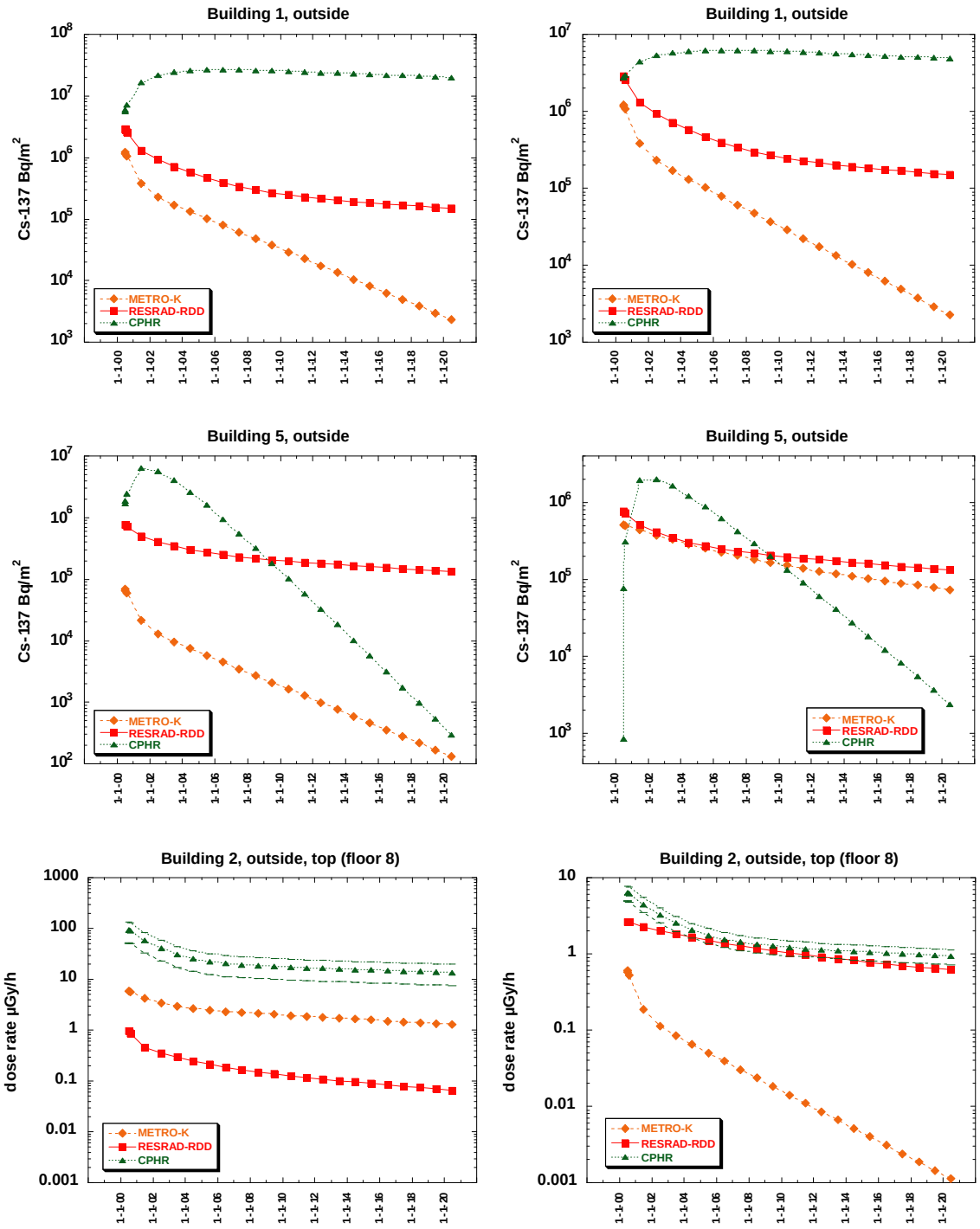

Fig. 5. Examples of preliminary (left) and revised (right) predictions for selected endpoints. The top and middle graphs show predicted contamination density outside Buildings 1 (top) and 5 (middle), with revised predictions from CPHR and METRO-K. The bottom graphs show predicted dose rate on the top of Building 8 (a parking garage), with revised predictions from all three models.

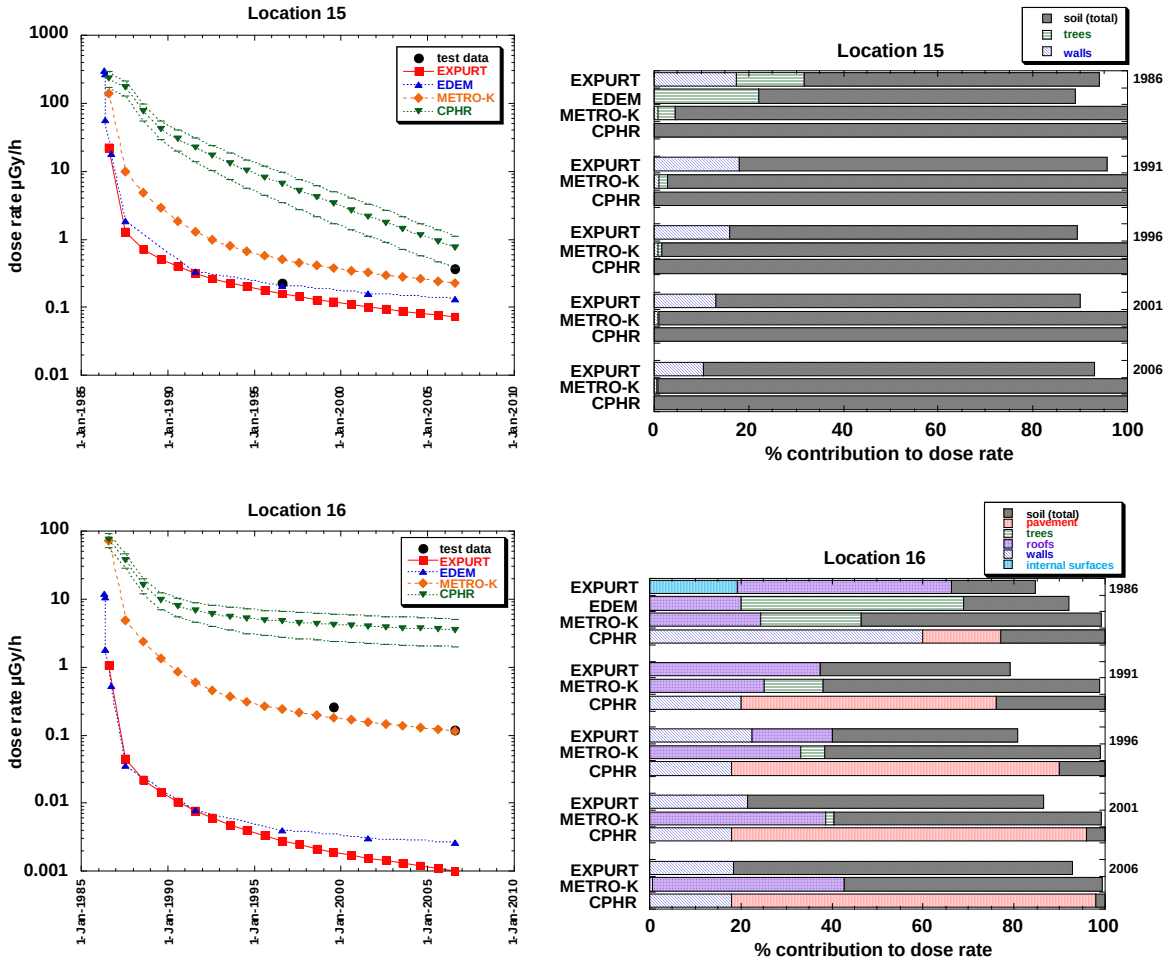

Fig. 6. Predicted dose rates (left) for Locations 15 (outdoors) and 16 (indoors) in District #4 of Pripyat. The graphs on the right show the predicted contributions to dose rate at selected times from various surfaces. Results shown are the most recent submitted by each participant (through the summer of 2007). Measured dose rates at the locations are also shown when available; the measurements have not been corrected for estimated background.

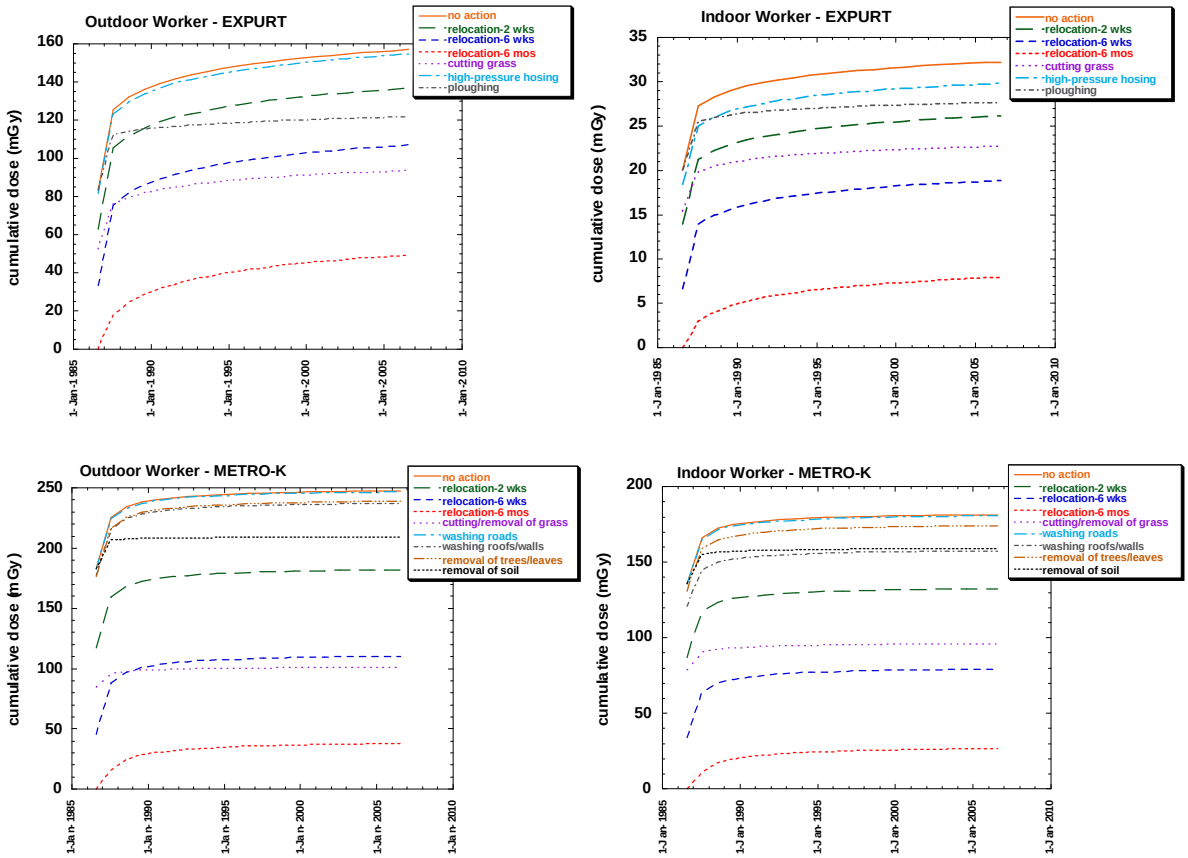

Fig. 7. Predicted cumulative doses for an outdoor worker (left) and an indoor worker (right) in District #4 of Pripyat, showing the "no action" situation (no countermeasures) and the effect of selected countermeasures. Results are shown for EXPURT (top) and METRO-K (bottom) and include revisions during the summer of 2007.

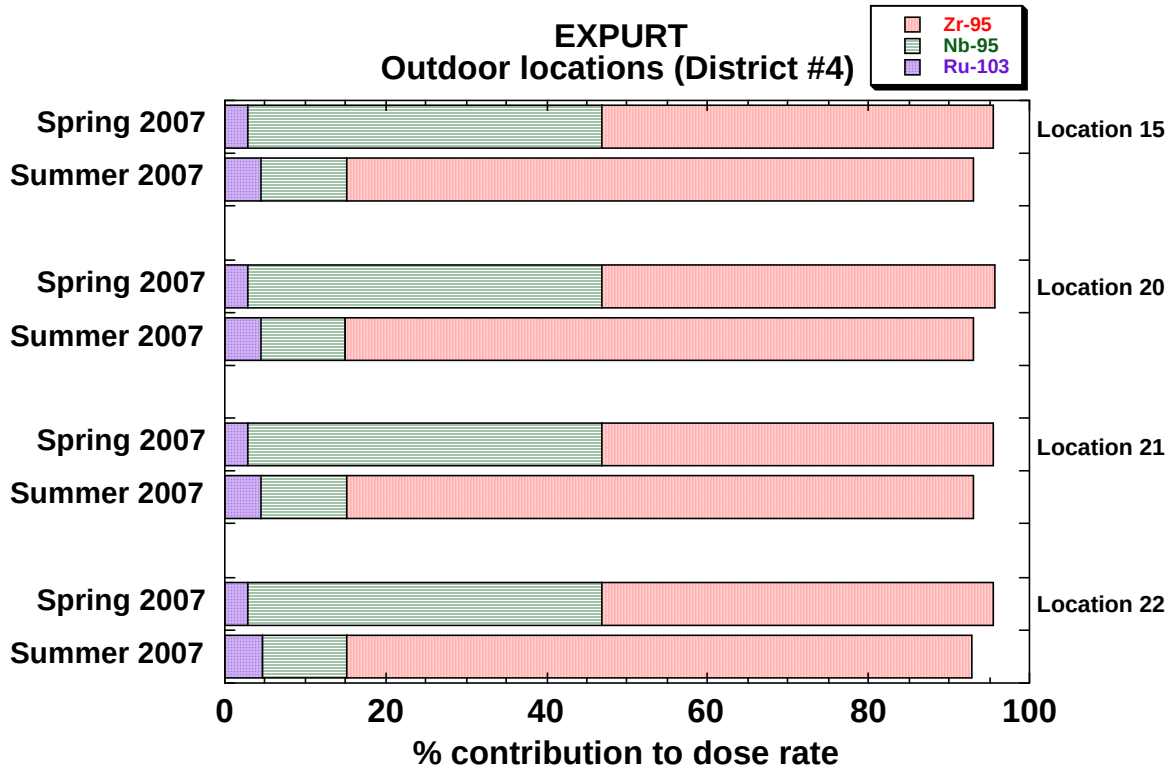

Fig. 8. For EXPURT, predicted contributions to dose rate on 1 August 1986 from the three most important radioisotopes for outdoor locations in District #4 of Pripyat, showing predictions of Spring 2007 and revised predictions of Summer 2007.

APPENDIX D

EMRAS Urban Remediation Working Group

Proposed Modelling Exercises for Continuation in a Follow-up to the EMRAS Programme

Based on Discussions 5-9 November 2007

The Urban Remediation Working Group of the EMRAS programme is agreed that more work on modelling urban contamination situations would be useful. The primary interest is in modelling deliberate contamination or dispersal events, but accidental events are also of continued interest. During the EMRAS programme, the Working Group concentrated on modelling situations after the initial contamination and dispersal event, in other words, the long-term contaminant transfer situation and the effects of various countermeasures. This emphasis should continue in a new programme. In addition, it would be helpful to consider modelling of initial atmospheric dispersion and deposition (e.g., from a deliberate contamination event) in an urban setting. For both types of modelling, it will be important to consider the needs of the relevant decision makers, so that the modelling exercises are geared towards providing the information that decision makers need and so that the capabilities and limitations of the models are understood by those who will use the information.

The Urban Remediation Working Group has identified a number of issues that are important to both types of modelling (initial dispersion/deposition and long-term situations). These issues include the type of release or dispersion event, various approaches to modelling a complex city, consideration of a variety of radionuclides, the effect of particle size assumptions, the effect of different kinds of deposition (wet, dry, mixed), the quantity and quality of input data, the consideration of additional exposure pathways (inhalation, inadvertent ingestion, deposition on skin) as well as external exposure, effects of seasonality and climate, and various location- or country-specific differences. Issues affecting primarily the modelling of initial atmospheric dispersion/deposition events include the need to compare complex and simple models for atmospheric dispersion in an urban environment, the use of data assimilation, and the availability of three-dimensional information about the city being modelled. Issues of importance primarily for modelling of long-term situations include the importance of sewer systems, modelling of various combinations of countermeasures, consideration of additional processes of contaminant transport (e.g., movement of contamination by automobile traffic, tracking of contamination into and within buildings), contamination events that do not involve atmospheric dispersion, consideration of the radioecological situation as well as the impact on people, and consideration of other aspects besides dose reduction for the general population (e.g., costs, waste generation and management, and doses to remediation workers).

The current Urban Remediation Working Group suggests a two-part approach to the next program, involving one subgroup to model long-term situations and countermeasures (long-term subgroup), and a second subgroup to carry out a modelling exercise for atmospheric dispersion and deposition in an urban context (dispersion subgroup). The long-term subgroup would make use of the output from the dispersion subgroup's modelling exercise, to predict the long-term impact, with and without countermeasures, of the initial dispersion/deposition modelled by the dispersion subgroup. In addition, while the dispersion subgroup is carrying out its modelling exercise, the long-term subgroup would look at some additional issues that do not require the dispersion/deposition results from the dispersion

subgroup. The proposed exercises to be developed and carried out by the next Working Group are outlined below.

D1. Atmospheric dispersion/deposition subgroup

Exercise 1: Comparison of simple and complex models for an event with radiological dispersal device

This exercise would involve an event similar to the one considered in the Urban Remediation Working Group's recent hypothetical scenario, namely an atmospheric release of radioactivity due to a "dirty bomb" (a conventional explosive associated with a radioactive source). The recent modelling exercise started with a simulated event with radiological dispersal deviceand modelled the long-term situation; this proposed new exercise would model the event itself. The purpose of the exercise is two-fold: (1) to compare modelling approaches and models for an initial dispersion event itself, and (2) to provide information (dispersion and deposition from a simulated event with radiological dispersal device) that would serve as input data for long-term modelling.

To produce the input information for the long-term modelling (Exercise 2), three approaches will be applied: 1) the output of a dispersion-deposition model will be used directly as input for the long-term models; 2) based on the results of the dispersion-deposition models, hypothetical measurements will be generated (i.e., simulating those expected from car-borne detectors) for use as input for the long-term models; and 3) by applying data assimilation methods, model results and (simulated) measurements will be combined for an optimal use of all available information, as would be done in case of an actual emergency.

Potential Endpoints:
Air concentrations and deposition of radioactivity
Exposures and doses (cloud immersion/inhalation/deposition on skin) from the event (for models with this capability)

Additional endpoints if possible:
Deposition by surface
Building infiltration and indoor concentrations of radioactivity
Distribution patterns of the particles
Effect of emergency countermeasures on the doses (sheltering in place vs. evacuation)

Variables to consider:
Different assumptions about particle size (defined sizes)
Wet and dry deposition
Season

Information needed:
Site with good information on buildings (dimensions, etc.) land use, and surfaces
Meteorological data for the site
Characteristics of the event with radiological dispersal device (e.g., type and amount of explosive)

The site should have flat terrain and a well-defined area (the area with detailed building information) with a radius of 3-4 km. For long-term modelling of the contaminated city, it will also be necessary to have information on land use and surface roughness for the larger

area. For incorporating data assimilation into the exercise, it will be necessary to invent a route through the city, simulating a route that would be used after an event for making measurements with a suitably equipped automobile. Note that it may be necessary to invent a city for the purpose of the exercise.

D2. Long-term transport/countermeasures subgroup

Exercise 2: Long-term effects of an event with radiological dispersal device

Exercise 2 is intended to make use of the output (modelling results) from Exercise 1 as input information for modelling the long-term effects of the event, including countermeasures. This exercise is designed to build on the recent hypothetical scenario by including additional issues or extensions of previously considered issues.

Inputs:
Air concentrations and deposition of radioactivity (output from dispersion modelling)
Countermeasures and dates of application

Additional inputs if possible (from dispersion modelling):
Deposition by surface
Building infiltration and indoor concentrations of radioactivity
Distribution patterns of the particles

Midpoints:
Air concentrations as a function of time (resuspension)
Contamination densities as a function of time
Dose rates as a function of time
Contributions from surfaces over time

Endpoints:
Inhalation exposures and doses
External exposures and doses
Ingestion exposures and doses
Effectiveness of various countermeasures and combinations of countermeasures
Quantities and activities of wastes produced
Input to sewer system

The exercise will consider radiation doses both for members of the public and for remediation workers. An important goal of the exercise is to evaluate how uncertainty in the initial dispersion/deposition results affects the outcome of the long-term modelling. For example, having a value for the deposition on walls (from the initial modelling) would remove an assumption (a partition factor) in the long-term modelling; how would that affect the results of the long-term modelling? The input of contamination to the sewer system will include input from both remedial activities and weathering (including snow), as well as from the initial event.

Long-term transport/countermeasures subgroup

Exercise 3: Additional issues

This exercise (or set of exercises) is intended to address other issues of concern with respect to long-term transport and countermeasures, in addition to the issues related ro radiological dispersal device. These exercises do not depend on the outcome of dispersion modelling (Exercise 1) and are intended to be carried out while the long-term subgroup waits for the results of Exercise 1. A number of possible issues (listed below) have been identified for consideration for these exercises; these will require further development as modelling exercises or as review papers, depending on the interests of the Working Group participants and the time available. It may be possible to make use of existing modelling scenarios for Slavutych (initial development during EMRAS, would require completion for the specific needs of this exercise) and for a resuspension exercise (from BIOMOVS II). As appropriate for each specific issue, internal doses (inhalation, inadvertent ingestion) as well as external exposure will be considered.

Resuspension
What resuspension factor(s) would be used to calculate indoor and outdoor air concentrations?
What approach(es) would be used to model countermeasures?

Contaminant movement in sewer systems
This could be addressed in terms of the contamination entering the sewer system or the contamination exiting the system.
What peak concentrations could result (e.g., from a heavy rainfall) and how significant are they?
What approach(es) would be used to model countermeasures?

Accidental spill
How far does contamination go, or how far is it tracked?
What are the effects of pedestrian traffic only? Automobile traffic only?
What approach(es) would be used to model countermeasures?

Contamination located in (or near or under) an urban area
This could involve legacy wastes, NORM wastes, or a situation such as Slavutych.
What approach(es) would be used to model countermeasures for these situations?

Prediction of secondary accumulation
What types or mechanisms of secondary accumulation should be considered?

Penetration of activity into different kinds of construction materials
How does this affect choice or cost of countermeasures?

Weathering in different parts of the world
What are the most important aspects of climate, weather, or surfaces that must be considered (generally or for specific locations)?

Environmental "self-clearing"
How do various radionuclides interact with various traditional and modern building materials over a long period of time?
How do various decontamination measures affect these interactions?