

# MINUTES OF THE 4<sup>TH</sup> WORKING GROUP MEETING

EMRAS Urban Remediation Working Group

*30 May - 1 June 2005, IAEA, Vienna*

## 1. INTRODUCTION

The overall objective of the Urban Remediation Working Group is to test and improve the capabilities of models to characterize 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, and then to use results of such predictions to estimate doses to humans, including an identification of important exposure pathways, and to evaluate reductions in external exposure rates, radionuclide concentrations, and doses to humans that are expected to result from specific countermeasures or remediation efforts. The goal 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 any needed remediation measures to be undertaken.

The primary objectives of the meeting of the Working Group held on 30 May to 1 June 2005 were twofold:

- (1) to define one or more scenarios that would be used to compare predictions of various models used by participants in the Working Group and to test those predictions against available data in an urban environment; and
- (2) to discuss the various approaches to modelling used by participants, with the aim of identifying model capabilities and data needs.

An agenda for the meeting is given in Attachment A. The meeting was chaired by Mr. David Kocher (USA) who represented the Working Group chair, Ms. Kathy Thiessen (USA). Including the chairman and the Scientific Secretary, Ms. Borislava Batandjieva, a total of fourteen experts participated in the meeting and a list of participants is given in Attachment B. Several of the participants were new to the Working Group.

The Working Group meeting began with a few introductory remarks from Mr. Mikhail Balonov (IAEA) and the IAEA Scientific Secretary to review the overall objectives of the Working Group, the role of the Working Group's activities in the EMRAS Program, and the importance of a final report to document the Working Group's activities and results. The Scientific Secretary particularly emphasized the importance of achieving goals in a timely manner and the need to focus on the two primary objectives of the meeting, as identified above.

## 2. WORK PERFORMED

In light of the importance of testing model predictions against data on radiological contamination in an urban environment, the working part of the meeting began with a presentation by Mr. Arkhipov (Ukraine), who reviewed the extensive sets of data on physical layout and radiological conditions in the town of Pripjat (Ukraine) that have been compiled. At its previous meeting on 8-11 November 2004, the Working Group had defined in general terms scenarios to be modelled in three towns that were contaminated after the Chernobyl accident, including Poleskoe and Slavutich, as well as Pripjat, and had identified available data and suggested modelling endpoints. Pripjat is particularly rich in data that can be used to test model predictions. The Working Group also heard a presentation from Mr. Zlobenko on the radiation environment in Poleskoe.

Mr. Arkhipov's presentation was helpful in emphasizing several important issues that must be considered in defining scenarios to be modelled. For example, does the Working Group wish to model Pripyat at the level of individual family dwellings, to model the variability of radiological conditions over a wider geographical area including the entire town, or to model average conditions over a geographical area; what endpoints should be modelled; and at what point in time should modelling begin and to what point in time should modelling be carried out? He indicated that at a suitable starting point in time would be about 3 to 4 months after the Chernobyl accident (i.e., August 1986), and that modelling could be carried out over a time frame of 10 or 20 years for comparisons with existing data or data that he and his colleagues could easily obtain at the present time.

At this point, it must be said that the Working Group was faced with a conundrum—namely, whether it would be better to discuss capabilities and data needs of existing models before attempting to define scenarios to be modelled, or whether it would be better to define scenarios first based on consideration of available data against which models can be tested. The approach of at least making a good start at specifying scenarios to be modelled before discussing modelling capabilities and data needs was taken, although some participants felt that this was not the better choice.

The Working Group then laid out a phased approach to defining scenarios to be modelled. Three different phases, denoted by Phase A, B, and C, were defined that increase in level of complexity and should allow evaluations of the importance of different factors that can affect how radiological conditions in contaminated urban environments evolve over time.

In *Phase A*, a scenario would be defined in which projections of radiological conditions would be made in a contaminated urban environment that remains undisturbed and in which there is no human habitation. The objective of Phase A would be to test the capabilities of models to predict the evolution over time of external exposure rates and concentrations of radionuclides in different compartments of an urban environment (e.g., grassy areas, roads, building roofs and walls) due only to natural processes. Data in Pripyat are particularly suitable for use in Phase A.

In *Phase B*, scenarios in Phase A would be expanded by introducing humans into a contaminated urban environment. Normal human activities could have an effect on how the radiation environment evolves over time, and introducing humans into the radiation environment is required when estimates of dose to humans are desired. Limited areas in Pripyat could be used to define a Phase B scenario, but consideration of radiological conditions in District 4 of Pripyat might be preferable, since that area has been inhabited for several years following the Chernobyl accident.

Finally, in *Phase C*, scenarios in Phase B would be expanded to consider the effects of various defined remediation efforts on the evolution of the radiation environment over time and reductions in doses to humans. The main purpose here would be to develop the capabilities of models to provide useful tools for decision making in regard to selecting remediation efforts or other countermeasures that could be used to reduce radiological impacts in contaminated urban areas over long time frames. The use of District 4 of Pripyat was considered a possibility for this phase.

The Working Group recognized that specifying in needed detail different scenarios in Phase A, B, and C and carrying out modelling in each of the three phases would be an ambitious undertaking. Modelling of radiological conditions in an urban environment can be complicated compared, for example, with the types of models that have been used to assess impacts on humans due to routine releases of radionuclides to the environment from nuclear facilities, and model development in this area is less mature. Nonetheless, the basic concept here is to proceed in manageable steps through the different phases and apply what is learned in each phase to defining scenarios and using models in the next phase.

Some participants also felt that it would be necessary to specify in great detail the initial radiological conditions to be assumed in modelling exercises if useful results that could be properly interpreted were to be obtained, and there was a more general concern by some that the capability of modelling

radiation environments in urban areas in detail might be lacking, which would increase the difficulty in performing meaningful tests of models. Some participants also were concerned that although extensive sets of data on the physical environment and radiological conditions in Pripyat had been assembled by participants from Ukraine, these data were not in a format that could be easily used with their models. As a consequence of all these concerns, there was much discussion about data needs and how to define scenarios that participants reasonably could model that would allow meaningful model intercomparisons as well as provide model results that could be compared with existing data on radiological conditions in Pripyat or one of the other towns.

As part of the discussion on data needs and scenario definition, the Working Group reviewed results of preliminary calculations in District #1 in Pripyat that had been performed by Mr. Tom Charnock (UK) and presented at the previous Working Group meeting on 8-11 November 2004. These calculations were useful in illustrating the kinds of simplifications and averaging of data that may be needed in modelling complex urban environments. The Working Group also recognized that a complete understanding of the calculations would require more information on assumptions used in modelling beyond what was provided in the record of a brief presentation.

Before making final decisions on defining a scenario or scenarios to be modelled, the Working Group undertook much needed and highly beneficial discussions on the capabilities of existing models of radioactive contamination in urban environments. Ms. Gallay (France) presented an overview of her work on assembling a list of references of studies of contamination in urban environments and applicable models. She presented a summary of existing models and their capabilities, and this prompted further discussion by modellers in the Working Group concerning what their models calculate and how they do the calculations. These discussions provided a basis, grounded in reality, for making decisions on scenarios to be modelled, data needs for modelling, and how available data in Pripyat and elsewhere could be used to test predictions of models. Discussions also indicated that there might be a need to review other literature, such as reports on complex suites of models to assess radiological consequences of reactor accidents, to determine if there are other approaches to modelling of urban environments that the Working Group is not aware of.

Following the discussions of modelling capabilities, the Working Group returned to the central issue of defining scenarios to be modelled. With a good understanding of available information, modelling capabilities, and data needs for modellers, the Working Group decided to proceed carefully through Phase A, B, and C, as discussed above, by considering first a single scenario that the various models were capable of addressing. The following decisions were reached:

- Modelling in Phase A would start with consideration of District #1 in Pripyat, which is one of the two locations in Pripyat that had been considered appropriate in the scenario development work at the previous Working Group Meeting.
- Specific locations in District #1 in Pripyat at which calculations should be performed were defined and agreed upon. As indicated by the diagram in Attachment C, nine locations in total were selected. The four outdoor locations (1, 2, 5, and 6) correspond to locations at which data on external exposure rates and concentrations of one or more radionuclides on the ground or in surface layers of soil exist in the Pripyat database and can be used for model testing. Locations 3 and 4 are indoors in schools, and are of interest in future modelling of doses to children. The remaining three locations (7, 8, and 9) are on the 1<sup>st</sup>, 3<sup>rd</sup>, and 5<sup>th</sup> floors of a 5-story apartment building. Data on external exposure rates at the indoor locations do not exist, but will be obtained by Mr. Arkhipov and colleagues to allow model testing at 20 years after the Chernobyl accident.
- All modellers should attempt to predict external exposure rates over time at each of the locations selected. This endpoint was accepted by the Working Group as a minimum requirement for testing and evaluating models, because exposure rates generally are used in characterizing radiation environments. In addition, modellers have the option of predicting levels of contamination for specific radionuclides at the specified outdoor locations.

- Model calculations should start at a time of about 3 to 4 months following the Chernobyl accident and would be carried forward for at least 10 years, and preferably 20 years to test model capabilities in indoor environments. Time series results should be presented, rather than results at a single point in time (e.g., 10 or 20 years).

Even though much progress was made in defining a specific scenario to be modelled, it became clear that it was still necessary to specify in detail the radiological conditions to be used as a starting point for the calculations, as noted previously. It was not possible for the Working Group to do this during the meeting. However, as discussed below, a plan was laid out for developing the needed information in a short period of time.

The central issues here involve (1) the complexity of the data base for Pripyat and the need to extract relevant data for the test exercise in readily useable form, (2) the possibility that several radionuclides were important at 3 to 4 months following the Chernobyl accident, which could cause difficulties with models that are designed to consider only a single radionuclide (Cs-137), and (3) the lack of data on external exposure rates or contamination levels in some environmental compartments of interest (e.g., roofs and walls of buildings), which could cause difficulties in interpreting comparisons of model predictions of external exposure rates with data in Pripyat if contamination in those compartments was a significant contributor to measured exposure rates and different modellers make different assumptions about levels in unmeasured compartments.

Upon request of the participants, the IAEA Scientific Secretary of the NORM Working Group within the EMRAS Program, Mr. Peter Waggitt, presented a briefing on that Working Group's activities. Since effects of remediation and intervention as well as dose to humans is a desired endpoint of calculations by both Working Groups, it would be useful for the Urban Remediation Working Group to be informed about activities of the NORM Working Group and issues that arise in their work. Mr. Horyna (Czech Republic), who is a member of both Working Groups, can provide such information. More information will be available at the EMRAS website.

Finally, B. Batandjueva presented a proposed outline of the contents of a Safety Report on the Working Group's activities; this outline is given in Attachment D. The importance of proper documentation of the work was emphasized, and the proposed outline provides a means by which various participants can determine how their contributions fit into the overall report.

### **3. PLANS FOR FUTURE WORK**

The last part of the meeting was devoted to a discussion of plans for future work. The future time frame was considered in two parts: (1) a near-term plan of action (up to next Working Group meeting from 21 to 25 November 2005) to permit interested participants to undertake modelling and obtain results in a timely manner on the basis of the defined scenario discussed above, (2) a longer-term plan for future Working Group meetings.

The main need over the short term is to finalize the agreed-upon scenario to be modelled, in particular to define the data to be used as the starting point for calculations. The plan of action is the following:

- The Scientific Secretary will contact Mr. Tom Charnock (UK), who provided preliminary calculations for Pripyat at the previous Working Group meeting, and all participants who were not able to attend the meeting, to inform them of the progress made during this meeting. The Secretary will need to ascertain his interest in helping to define details of the scenario to be modelled and in participating in future modelling activities of the Working Group.
- By 10 June 2005, all participants (modellers) should send to Mr. Charlie Yu (USA) a list of parameters that they require in order to perform calculations.

- Upon receipt of data requests from interested modellers, Mr. Yu will evaluate the information to make sure that the needs are clear and reasonably consistent, and he will then forward the requests to the Scientific Secretary and Working Group chair, Ms. Thiessen. The Scientific Secretary then will transmit the request for needed data to Mr. Arkhipov.
- By 24 June 2005, Mr. Arkhipov will provide to the Scientific Secretary and Working Group chair, with copies to all modellers who submitted data requests, the requested data in the desired format. The Working Group agreed that in the interest of proper documentation of results of model exercises, input data to be used should be compiled in the form of tables that can be provided in the final report. As indicated in previous discussions and as provided in Attachment C, the locations at which calculations are to be performed have already been defined and do not need further consideration.
- By 30 June 2005, the Working Group chair assisted by the Scientific Secretary will complete documentation of a full description of the scenario to be modelled and will transmit this documentation to interested modellers and all other participants in the Working Group. This document will include (1) a description of the scenario that was agreed to by participants at the Working Group meeting, as discussed above, (2) relevant portions of the draft document of October 2004, “Scenario Description for Development of the Radiological Situation in Three Different Towns of Ukraine, Contaminated As a Result of the Chernobyl Nuclear Accident”, and (3) the compiled data to be used as input to model calculations.
- By 1 September 2005, Working Group members will send to the Working Group chair and Scientific Secretary any suggestions or ideas for topics to be addressed at the next Working Group meeting in November. Of course, good suggestions are welcome at any time.
- By September 2005, Ms. Gallay will provide to the Scientific Secretary and Working Group chair documentation of her overview of modelling experiences and an updated list of references. This information should be in a form suitable for inclusion in the final report of the Working Group.
- By 17 October 2005, all modellers should submit their preliminary model results to the Working Group chair and Scientific Secretary for review and evaluation prior to the next EMRAS meeting on 21-25 November. This would allow sufficient time for the Working Group chair to seek additional information from modellers, if needed, to prepare a presentation on progress of the Working Group at a plenary session at the November meeting, and to prepare an agenda for a meeting of the Working Group at that time. Regarding breakout sessions of different Working Groups in the EMRAS Program at the November meeting, participants expressed a desire to minimize overlaps between meetings of the Urban Remediation, NORM, and Biota Dose Assessment Working Groups.

Over the longer time frame, the Working Group anticipates that it will meet again in May 2006. There was general interest in having a meeting in Slavutich to allow participants to view sites they are modelling (e.g., Pripyat).

## EMRAS Urban Remediation Working Group Meeting

30 May-1 June 2005, IAEA, Vienna  
*Room B0545, Vienna International Centre*

### Agenda

#### Monday 30 May

9:30-12:30

1. Introductions (Chairman-Mr. Kocher)  
(M. Balonov, IAEA)
2. Overview of meeting plans (Chairman-Mr. Kocher)
3. Discussion of modelling approaches (Ukrainian scenario) (All)

12:30-14:00 Lunch

14:00-17:30

4. Discussion of modelling approaches (continued) (All)
5. Discussion of documentation and information needs (All)  
Scenario description  
Model descriptions and results

#### Tuesday 31 May

9:00-12:30

6. Discussion of hypothetical scenarios (All)

12:30-14:00 Lunch

14:00-17:30

7. Discussion of hypothetical scenarios (continued) (All)

#### Wednesday 1 June

9:00-12:00

8. Discussion of other Working Group activities
9. Plans until Nov. 2005, future plans and outcomes
10. Discussion of any remaining issues
11. Close of meeting (Chairman-Mr. Kocher)

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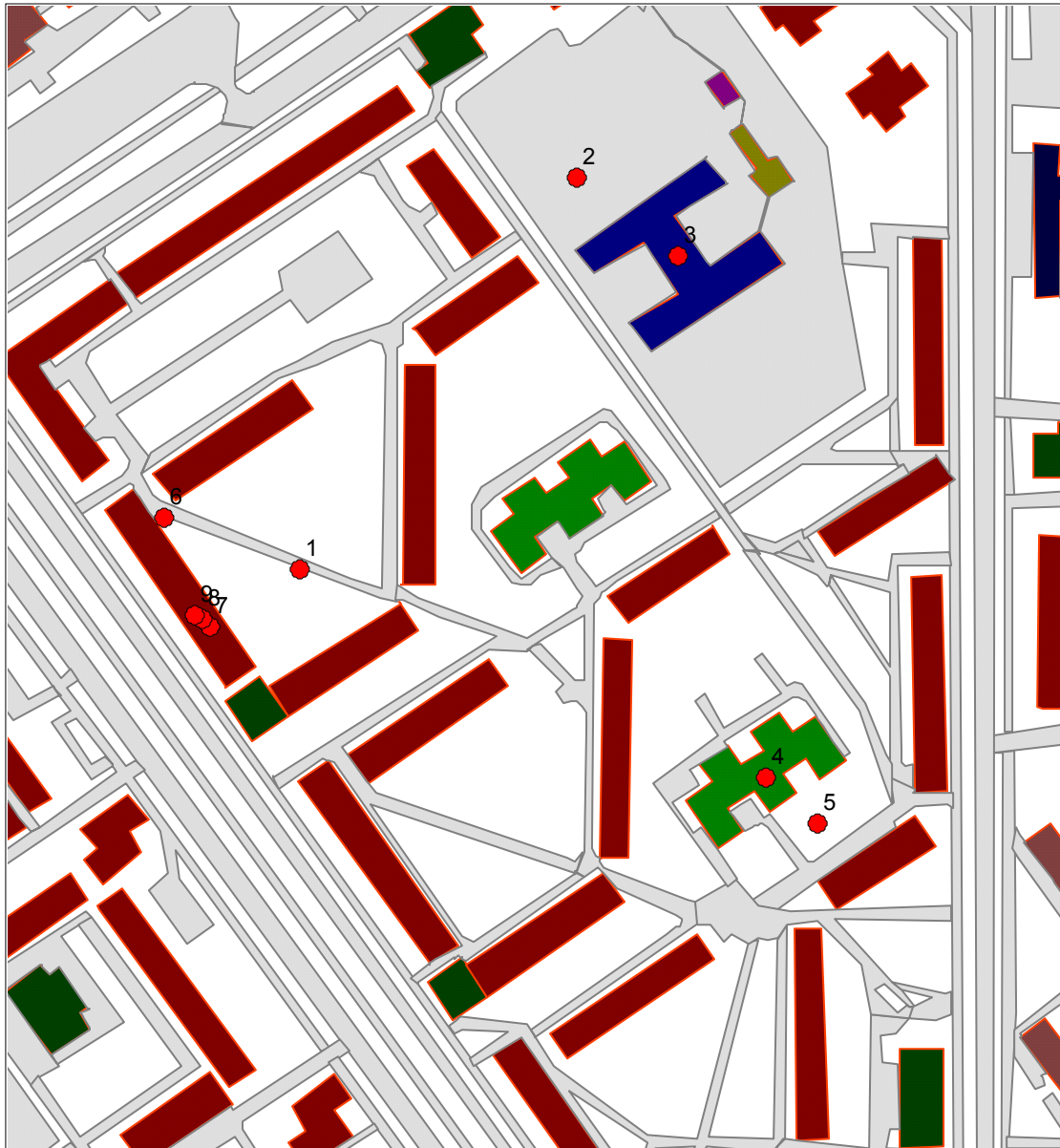
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MAP OF LOCATIONS IN PRIPYAT DISTRICT #1 TO BE MODELLED



**PROPOSED CONTENT OF THE URBAN WG DOCUMENT “ENVIRONMENTAL  
MODELING OF REMEDIATION OF URBAN CONTAMINATED AREAS**

1. INTRODUCTION

1.1. Background

1.2. Objectives

1.3. Scope

1.4. Structure

2. SCENARIOS

2.1. Overview and rationale

2.2. “No action” Scenario

District 1 of Pripyat city in Ukraine (Phase A)

2.3. Human inhabited contaminated urban areas

District 4 of Pripyat city in Ukraine (phase B)

2.4. Remediation actions

District 4 of Pripyat city in Ukraine (phase C)

3. MODELING

3.1. Overview of current stats of international experience

3.2. Description of models

3.2.1. Phase A

3.2.1. Phase B

3.2.2. Phase C

3.3. Results of intrercomparisons of models and results

3.2.1. Intercomparison of models

3.2.2. Comparison of results with data

4. CONCLUSIONS AND RECOMMENDATIONS

APPENDICES

REFERENCES

CONTRIBUTORS TO DRAFTING AND REVIEW OF THE DOCUMENT