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Progress Report, August 1993-January 1994:
Use of International Data Sets to Evaluate
and Validate Pathway Assessment Models
Applicable to Exposure and Dose Reconstruction
at DOE Facilities

Sheilah M. Hendrickson
Technical Editor

March 1, 1994

Lawrence
Livermore
National
Laboratory

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MASTER

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This work was funded by the U.S. Department of Energy. The portion of work performed by Lawrence Livermore National Laboratory is under the auspices of the U.S. Department of Energy under Contract No. W-7405-Eng-48.

For Additional Copies Contact

**Sheilah Hendrickson
Executive Director
Risk Sciences Center
(510) 424-6410
FAX (510) 424-6408**

PROGRESS REPORT
August 1993–January 1994

**USE OF INTERNATIONAL DATA SETS TO EVALUATE
AND VALIDATE PATHWAY ASSESSMENT MODELS
APPLICABLE TO EXPOSURE AND DOSE
RECONSTRUCTION AT DOE FACILITIES**

Subcontract to:

**Dr. F. Owen Hoffman
SENES Oak Ridge Inc.
Center for Risk Analysis
Oak Ridge, Tennessee 37830**

Subcontract No. B-218797

March 1, 1994

Technical Editor

**Sheilah M. Hendrickson
Executive Director
Risk Sciences Center
Health and Ecological Assessment Division
Physical Sciences Directorate
Lawrence Livermore National Laboratory
Livermore, California 94550**

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AUGUST 1993

- **Monthly Progress Report**
- **Foreign Trip Report**
F. Owen Hoffman and Stanley I. Auerbach
BIOMOVS Meeting, Vienna, Austria
VAMP Meeting, Vienna Austria

BACKGROUND

In April 1988, the US and the former-USSR signed a Memorandum of Cooperation (MOC) for Civilian Nuclear Reactor Safety; this MOC was a direct result of the accident at the Chernobyl Nuclear Power Plant Unit 4 and the following efforts by the two countries to implement a joint program to improve the safety of nuclear power plants and to understand the implications of environmental releases. A Joint Coordinating Committee for Civilian Nuclear Reactor Safety (JCCCNRS) was formed to implement the MOC. The JCCCNRS established many working groups; most of these were the responsibility of the Nuclear Regulatory Commission, as far as the US participation was concerned. The lone exception was Working Group 7 on Environmental Transport and Health Effects, for which the US participation was the responsibility of the US Department of Energy (DOE). The purpose of Working Group 7 was succinctly stated to be, "To develop jointly methods to project rapidly the health effects of any future nuclear reactor accident." To implement the work DOE then formed two subworking groups: 7.1 to address Environmental Transport and 7.2 to address Health Effects. Thus, the DOE-funded Chernobyl Studies Project began.

This project, "Use of International Data Sets to Evaluate and Validate Pathway Assessment Models Applicable to Exposure and Dose Reconstruction at DOE Facilities," grew out of several activities being conducted by the Principal Investigator Dr. F. Owen Hoffman. One activity was originally part of the Chernobyl Studies Project and began as Task 7.1D, "Internal Dose From Direct Contamination of Terrestrial Food Sources." The objective of Task 7.1D was to (1) establish a collaborative US-USSR effort to improve and validate our methods of forecasting doses and dose commitments from the direct contamination of food sources, and (2) perform experiments and validation studies to improve our ability to predict rapidly and accurately the long-term internal dose from the contamination of agricultural soil. The latter was to include the consideration of remedial measures to block contamination of food grown on contaminated soil.

At early times following an accident, the direct contamination of pasture and food stuffs, particularly leafy vegetation and grain, can be of great importance. This situation has been modeled extensively by scientists in the US, the former-USSR, and many other countries. However, models employed then to predict the deposition, retention and transport of radionuclides in terrestrial environments employed concepts and data bases that were more than a decade old. The extent to which these models have been tested with independent data sets was limited. The data gathered in the former-USSR (and elsewhere throughout the Northern Hemisphere) offered a unique opportunity to test model predictions of wet and dry deposition, agricultural foodchain bioaccumulation, and short- and long-term retention,

redistribution, and resuspension of radionuclides from a variety of natural and artificial surfaces.

The current objective of this project is to evaluate and validate pathway-assessment models applicable to exposure and dose reconstruction at DOE facilities through use of international data sets. This project incorporates the activity of Task 7.1D into a multinational effort to evaluate models and data used for the prediction of radionuclide transfer through agricultural and aquatic systems to humans. It also includes participation in two multinational studies, BIOMOVs (BIOSpheric MOdel Validation Study) with the Swedish National Institute for Radiation Protection and VAMP (VALidation of Model Predictions) with the International Atomic Energy Agency, that address testing the performance of models of radionuclide transport through foodchains.

In early Fiscal Year 1994, at the recommendation of DOE Headquarters with concurrence from the Working Group 7 Leader,* this project and any future work will be considered separately from the Chernobyl Studies Project. This is due to the nature and scope of this project being much broader than the original objective of Task 7.1D. Also, at the request of DOE Headquarters, the Working Group Leader will continue to provide oversight for this project. It is expected that the transfer of information from these international model-validation studies to dose-reconstruction activities being performed at DOE facilities will be facilitated by a separate project and that the essential activities of former Task 7.1D will be folded within the broader umbrella of the BIOMOVs and VAMP Projects.

As the DOE and other US organizations move further into environmental restoration and similar activities that require the use of models to predict risk or to determine cleanup criteria, the validity of such models becomes crucial. At the present time BIOMOVs and VAMP are the only model-validation studies that have significant stature, and it is strongly recommended that DOE aggressively support US participation in these validation studies.

NOTE: *During Fiscal Year 1993, the work being conducted under the auspices of Working Sub-Groups 7.1 and 7.2 was substantially changed, and many tasks were completed. Thus, the two sub-Groups were combined into a single Group 7.

BUDGET

EH Monthly Summary
International Data Sets: Summary of Financial Status
(1,000 Dollars)

Month Ending: January 1994

Budget Category: HA-01-17

Budget Category: HA-01-17			(1,000 Dollars)		Monthly Budget			Variance	
DOE Project Number	LLNL Project Number	Project Title	FY 1994 Budget*	FY 1994 Total Cost To Date**	Percent Spent	Remaining Balance	Linear Rate***		
93-ES-966 93-ES-1337	6288-13	Use of International Data Sets to Evaluate and Validate Pathway Assessment Models Applicable to Exposure and Dose Reconstruction at DOE Facilites	388.0	202.6	52%	185.4	73		
		Subcontract to: Owen Hoffman (SENES Oak Ridge Inc.) Lynn Anspaugh / Sheilah Hendrickson LLNL	315.0	166.0	53%	149.0	61		
TOTALS			388.0	202.6	52%	185.4	73		

* Includes FY 1993 carryover

** Includes commitments (Liens, Subcontract, IUTs, ICOs, etc.)

*** Amount in parenthesis () indicates total cost to date is under the cumulative linear spending rate

EH Monthly Detailed Summary
Use of International Data Sets: Summary of Financial Status
(1,000 Dollars)

Project: Use of International Data Sets to Evaluate and Validate Pathway Assessment
Models Applicable to Exposure and Dose Reconstruction at DOE Facilities
[Owen Hoffman—SENES Oak Ridge Inc.] (Lynn Anspaugh / Sheilah Hendrickson)

LLNL No: 6288-13
DOE No: 93-ES-966 and 93-ES-1337

Cost Item	Months												Year-to-Date
	1993 Oct	Nov	Dec	1994 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Salary/Benefits	53.6	7.2	10.0	10.7									81.5
Travel	8.1	4.7	0.1	0.6									13.5
Procurement and Expenses*	6.8	1.8	1.6	2.4									12.6
Technical Information Department	0.0	0.0	0.0	0.0									0.0
Facility/Service/Distributed Charges	37.7	5.5	7.2	8.0									58.4
LLNL Overhead+ / Taxes**	23.5	4.2	4.1	4.8									36.6
TOTAL	129.7	23.4	23.0	26.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	202.6
Liens/Preliens Subcontract \$315 K	208.8	189.6	170.7	149.0									
Budget Received \$388 K***	388.0	388.0	388.0	388.0	391.6								
Funds Available	258.3	234.9	211.9	185.4									
* Includes supplies; procurements; cost incurred from IUTs, ICOs, subcontracts ** General & Administrative (G&A) + LDRD; Division and Directorate Burdens, etc. *** \$391.6 K needed to administer subcontract. This is due to rate changes for LLNL Overhead and Taxes during FY 92–FY 94. Will transfer approximately \$3.6 K from Chernobyl Studies Project budget to cover additional cost.													

September 1993 costs included with October 1993 costs

3/9/94

PROGRESS REPORT
JANUARY 1994

SENE Oak Ridge Inc.
Center for Risk Analysis

February 15, 1993

Sheilah Hendrickson, L-453
University of California
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, California 94551

Re: Monthly Progress Report, Subcontract B218797

Dear Ms. Hendrickson:

Our monthly report for January 1-31, 1994, is enclosed. We have used the new format which you sent to us earlier this month, with one change. Rather than add a separate page addressing work plans for the coming month, we have added a subheading "Activities in Progress" to Section II., Current Project Status/Monthly Progress. We trust that this change will be acceptable.

Sincerely,

F. Owen Hoffman, Ph.D.
President and Director

cc: Virginia Henke, L-650
Barbara Brooks, DOE

EH-40 Monthly Report
January 1-31, 1994

Project Title: Use of International Data Sets to Evaluate and Validate Pathway Assessment Models Applicable to Exposure and Dose Reconstruction at DOE Facilities

DOE Project Number: 94-ES-966 **LLNL Project Number:** 6288-13
93-ES-1337

Principal Investigator: F. Owen Hoffman
M&O Contractor: Lawrence Livermore National Laboratory
(Lynn Anspaugh/Sheilah Hendrickson)

Contract to:
Subcontract B218797 with SENES Oak Ridge, Inc.

I. Project Objective

As stated in subcontract B218797, the purpose of this work is to evaluate and validate pathway assessment models applicable to exposure and dose reconstruction at Department of Energy facilities through use of international data sets.

II. Current Project Status/Monthly Progress

Administrative

Arrangements for the working group meetings of BIOMOVs II and VAMP, scheduled for March in Oak Ridge, are proceeding. The Post Chernobyl Data Working Group of BIOMOVs II will meet March 21-25, and the Multiple Pathways Assessment Working Group of IAEA/VAMP will meet March 28-31. Both meetings will take place at the Comfort Inn in Oak Ridge.

Invitations have been sent out to BIOMOVs II and IAEA/VAMP participants through the respective secretariats. An announcement has also been issued by SENES Oak Ridge to area scientists and other people who might find the meetings to be of interest. Public meetings are being planned to take advantage of the presence of scientists from the former Soviet Union. Announcement of the technical and public meetings will be made in area newspapers.

Funding and travel arrangements are nearly complete for participating scientists. SENES Oak Ridge, through this subcontract, is providing some or all of the travel and living expenses for Acad. R. Alexakhin, Dr. A. Konoplev, Dr. I. Kryshev, and Dr.

T. Sazykina of Obninsk, Russia; and Acad. B. Prister, Dr. E. Garger, and Dr. G. Laptev of Kiev, Ukraine. Dr. Kryshev and Dr. T. Sazykina will be staying on after the meetings for three weeks of collaborative work, including preparation of articles for submission to the open literature.

Technical accomplishments

Revision and editing was completed for Scenarios W, CP, and R of BIOMOVs II; revision included the addition of photographs to all three scenarios. Final copies were sent to the BIOMOVs II secretariat for copying and distribution to BIOMOVs II participants and other interested modelers.

Our part of the final report on IAEA/VAMP Scenario CB was completed. The main text, figures, and first appendix were sent back to the IAEA in December. The second appendix was received from the author in January, edited, and sent on to the IAEA. The report will be published by the IAEA.

Activities in progress

Comparison and evaluation of various U.S. models has been started, using the data from scenarios CB and S of IAEA/VAMP. Several models are being collected and installed on our computers, and the models and their documentation are being examined. Some initial sets of predictions using CB and S data have been run, to get acquainted with the workings of the models.

Most of the figures for IAEA/VAMP Scenario S have been completed. Final compilation and distribution is in progress. These figures will be used in the final report for Scenario S, which is scheduled for completion in November of 1994.

Completion of our revisions to the review paper on interception and retention for the Terrestrial Working Group of IAEA/VAMP is expected by the middle of March.

Scenarios I and H of IAEA/VAMP will be edited and revised prior to the working group meeting in March.

Several prospective open-literature publications are in progress, including an article summarizing experience to date with the use of Chernobyl data sets for model validation. We also plan to prepare the BIOMOVs II Post Chernobyl scenarios for publication in the open literature.

Travel--Not applicable this month.

III. Significant Problems/Issues/Concerns--Not applicable this month.

IV. Assistance Required of EH-40 Staff--Not applicable this month.

DECEMBER 1993

SENE Oak Ridge Inc.
Center for Risk Analysis

January 14, 1998 4

Sheilah Hendrickson, L-453
University of California
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, California 94551

Re: Monthly Progress Report, Subcontract B218797

Dear Ms. Hendrickson:

The highlights of the past month are as follows:

- (1) The Multiple Pathways Assessment Working Group of IAEA/VAMP was rescheduled for March 28-31, 1994, following the Post Chernobyl Data Working Group of BIOMOVs II, which will meet March 21-25, 1994. Both meetings will take place at the Comfort Inn in Oak Ridge. Hotel arrangements have been made, and preliminary information on both the meeting and the logistics has been sent to the coordinators at IAEA and BIOMOVs II.
- (2) Arrangements are in progress between SENE, IAEA, and BIOMOVs II for funding the attendance of key scientists for both Oak Ridge meetings; this includes several scientists from the former Soviet Union. Plans are underway between SENE and Oak Ridge National Laboratory for some of the Russian scientists to give guest lectures. We are also considering the possibility of holding public lectures during the weeks of the meetings.
- (3) We discussed projects related to both IAEA/VAMP and BIOMOVs II with Dr. Tatiana Sazykina of Obninsk, Russia, who visited the office December 16-17. The present goal for Scenario I of IAEA/VAMP is to finalize the scenario at the March meeting, following thorough editing and revision as needed. Dr. Sazykina brought photographs which will be added to Scenario CP of BIOMOVs II as an addendum to the present version of the scenario. The photographs will also be incorporated into the next version of the scenario to be released.

- (4) We have been revising Scenario R of BIOMOVs II for release in the near future. Target date for release of the scenario is February 1.
- (5) The availability of the three Post Chernobyl Data scenarios of BIOMOVs II has been announced in *Ecological Modelling*.
- (6) About half of the work has been completed on the new set of figures for IAEA/VAMP Scenario S. These figures incorporate revisions to the test data for several endpoints. The set of figures also includes revisions to the predictions made by some modelers.
- (7) We are initiating the comparison of various U.S. models using the data from scenarios CB and S of IAEA/VAMP. Different models or sections of models will be run using the same input data, and the resulting predictions will be compared with each other and with the test data (observations). We are presently collecting and examining the various models and their documentation.

Plans for the coming month are as follows:

- (1) Continued work as necessary on preparations for the Working Group Meetings to be held in Oak Ridge in March.
- (2) Completion of the new set of figures for IAEA/VAMP Scenario S. Approximately half of this work is already finished.
- (3) Final revision and editing of Scenarios W, CP, and R of BIOMOVs II, with all photographs and other background information, for release to modelers outside of current BIOMOVs II participants.
- (4) Continued work on the model comparison project, particularly getting the most important models running on our computers and choosing the pathways for primary attention.
- (5) Assistance as necessary with completion of the review paper on interception and retention for the Terrestrial Working Group of IAEA/VAMP.
- (6) Thorough revision and editing of Scenarios I and H before the March meeting of IAEA/VAMP.

- (7) Completion of our part of the final report on IAEA/VAMP Scenario CB.
We are waiting for a copy of the second appendix, describing the various models, to complete the editorial work on it.
- (8) Initial work on some prospective open-literature publications.

Sincerely,

F. Owen Hoffman, Ph.D.
President and Director

cc: Virginia Henke, L-650
Barbara Brooks, DOE

NOVEMBER 1993

SENE Oak Ridge Inc.

Center for Risk Analysis

December 15, 1993

Sheilah Hendrickson, L-453
University of California
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, California 94551

Re: Monthly Progress Report, Subcontract B218797

Dear Ms. Hendrickson:

The highlights of the past month are as follows:

- 1) Working Group Meetings have been scheduled for both BIOMOVs II and IAEA/VAMP. The Multiple Pathways Assessment Working Group of IAEA/VAMP will meet March 14-19, 1994, and the Post Chernobyl Data Working Group of BIOMOVs II will meet March 21-25, 1994. Both meetings will take place on the campus of Oak Ridge Associated Universities in Oak Ridge. Hotel arrangements have been initiated.
- 2) The availability of the three Post Chernobyl Data scenarios of BIOMOVs II has been announced in *Science of the Total Environment*, and *Health Physics*.
- 3) Most of the revisions for the final report on IAEA/VAMP Scenario CB have been completed. We have edited or revised the main text, several of the figures, and the first appendix, which describes the test data and observations.
- 4) We have prepared graphs of time-integrated concentrations of ^{137}Cs for several endpoints, normalized for total deposition, for comparison of the test data for Scenarios CB and S of IAEA/VAMP. We have written to the scientists in charge of the CB data requesting additional data for later time points, for further comparison with S.

- 5) We have prepared an addendum to the Scenario W description of BIOMOVs II, containing photographs and additional background material useful to potential modellers. This has been sent to the BIOMOVs II Secretariat for distribution.
- 6) We have received the test data for Scenario R of BIOMOVs II, and we are now in the process of revising this scenario for release.
- 7) We have sent requests to several scientists from the former Soviet Union, inviting them to contribute information to a review paper on interception and retention; this paper is now in the final stages of preparation prior to publication by the International Atomic Energy Agency.

Plans for the coming month are as follows:

- 1) Discussion of projects related to both IAEA/VAMP and BIOMOVs II with Dr. Tatiana Sazykina of Oboinsk, Russia, who will visit the office December 16-17. We expect to discuss the status of Scenario I for IAEA/VAMP and a target date for its release to modelers, as well as the final details (photographs, etc.) for the completion of Scenario CP for BIOMOVs II.
- 2) Finalization of Scenarios W, CP, and R of BIOMOVs II, with all photographs and other background information, for release to modelers outside of current BIOMOVs II participants. We plan to release these with a new version number, and without the "DRAFT" label.
- 3) Completion of our part of the final report on IAEA/VAMP Scenario CB. We are waiting for a copy of the second appendix, describing the various models, to complete the editorial work on it.
- 4) Completion of a new set of figures for IAEA/VAMP Scenario S.
- 5) Assistance as necessary with completion of the review paper on interception and retention for the Terrestrial Working Group of IAEA/VAMP.
- 6) Continued work as necessary on preparations for the Working Group Meetings to be held in Oak Ridge in March.

We wish you a very happy holiday season and our best for 1994.

Sincerely,

A handwritten signature in black ink, appearing to read "F. Owen Hoffman".

F. Owen Hoffman, Ph.D.
President and Director

cc: Virginia Henke, L-650

OCTOBER 1993

SENES Oak Ridge Inc.
Center for Risk Analysis

November 15, 1993

Sheilah Hendrickson, L-453
University of California
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, California 94551

Re: Monthly Progress Report, Subcontract B218797

Dear Ms. Hendrickson:

The highlights of the past month are as follows:

- 1) Completion of the foreign trip report for BIOMOVs II (September 27 - October 1) and IAEA/VAMP (October 4-8) by Dr. Hoffman and Dr. Thiessen.
- 2) Completion of most details necessary for the release of the Post-Chernobyl Scenarios for BIOMOVs II to interested modellers. Two of the three scenarios have been distributed in draft form to all BIOMOVs II participants. The availability of the three scenarios will be announced in several scientific journals, including *Ecological Modelling*, *Science of the Total Environment*, and *Agriculture, Ecosystems and Environment*.
- 3) Most of the revisions for the final report on IAEA/VAMP Scenario CB have been completed.

Plans for the coming month are as follows:

- 1) Determination of dates and places for the next Working Group Meetings for both BIOMOVs II and IAEA/VAMP.
- 2) Completion of final details necessary for the release of the Post-Chernobyl Scenarios to interested modellers outside of the present BIOMOVs II participants. Photographs are being collected and prepared for the

scenarios, and additional information (experimental details, author lists, and figure captions) is being obtained prior to finalization of the scenarios.

- 3) Completion of our part of the final report on IAEA/VAMP Scenario CB. The last figures are being revised, and we are expecting to receive some of the appendices for a final review.
- 4) Completion of a new set of figures for IAEA/VAMP Scenario S.

Sincerely,

A handwritten signature in black ink, appearing to read "F. Owen Hoffman", written over a horizontal line.

F. Owen Hoffman, Ph.D.
President and Director

cc: Virginia Henke, L-650

SEPTEMBER 1993

SENES Oak Ridge Inc.
Center for Risk Analysis

October 18, 1993

Sheilah Hendrickson, L-453
University of California
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, California 94551

Re: Monthly Progress Report, Subcontract B218797

Dear Ms. Hendrickson:

The highlights of the past month are as follows:

- 1) A trip to Vienna (for BIOMOVs II, September 27 - October 1) and Helsinki (for IAEA/VAMP, October 4-8) was taken by Dr. Hoffman and Dr. Thiessen.
- 2) For BIOMOVs II, the Post-Chernobyl Data Working Group chaired by Dr. Hoffman completed most of the work for three Post-Chernobyl scenarios; these will soon be distributed to interested modellers by the BIOMOVs II secretariat.
- 3) For IAEA/VAMP, the Multiple Pathways Working Group discussed the model predictions for Scenario S (Southern Finland), compared the predictions with the test data (observations and local estimates), and discussed reasons for misprediction. Comparisons were made of the results from Scenarios CB and S. Modellers have been asked for revised predictions where appropriate, and a draft report for Scenario S is in progress.

Plans were made for the completion of the final report on Scenario CB (Central Bohemia); the goal is to send the report for publication by November 15, 1993.

Two other scenarios under development were also discussed. Scenario H (Hanford) will be released for model predictions by the end of the year. A modified description for Scenario I (Iput River) is also expected by the end of the year.

- 4) Participation in both Working Groups by scientists from Russia and Ukraine, some of whom were funded for the trip by SENES Oak Ridge under this subcontract, was of immense value and importance to both modelling projects. The Post-Chernobyl scenarios of BIOMOVs II and Scenario I of IAEA/VAMP are made possible only by the efforts of these scientists in gathering and collating data from Chernobyl fallout and by their willingness to share their data with the scientific community.

Plans for the coming month are as follows:

- 1) Completion of the foreign trip report for BIOMOVs II (September 27 - October 1) and IAEA/VAMP (October 4-8) by Dr. Hoffman and Dr. Thiessen.
- 2) Determination of dates and places for the next Working Group Meetings for both BIOMOVs II and IAEA/VAMP.
- 3) Completion of details necessary for the release of the Post-Chernobyl Scenarios to interested modellers.
- 4) Completion of our part of the final report on IAEA/VAMP Scenario CB.
- 5) Completion of a new set of figures for IAEA/VAMP Scenario S.

Sincerely,

F. Owen Hoffman, Ph.D.
President and Director

cc: Virginia Henke, L-650

**SENES Oak Ridge
Center for Risk Analysis**

BIOMOVS II NEWSLETTER

BIOMOVS II, an international study managed by: The Atomic Energy Control Board of Canada; Atomic Energy of Canada Limited; Centro de Investigaciones Energéticas Medioambientales y Tecnológicas, Spain; Empresa Nacional de Residuos Radiactivos SA, Spain; and the Swedish Radiation Protection Institute.

BIOMOVS II 4TH WORKSHOP

This newsletter sets out the main points of progress arising from the 4th BIOMOVS II Workshop, held at the International Atomic Energy Agency, Vienna from 27 September - 1 October 1993. A progress report giving fuller details will be issued shortly. The next Workshop is scheduled for the autumn of 1994.

Summary Points from Workshop

55 Participants from 15 countries attended the fourth Workshop. Much of the week was devoted to evaluation of modelling results within the different Working Groups. Some very interesting proposals were made for further model testing, involving wider consideration of uncertainties and the use of experimental and field data in model testing. Progress in each Working Group is outlined below. Two invited plenary presentations were made at the Workshop: by Brenda Howard, Institute of Terrestrial Ecology (UK) on data for the transfer of radionuclides to ruminants; and by Eduard Hofer of the Gesellschaft für Anlagen und Reaktorsicherheit on new developments in uncertainty analysis. Summaries will appear in the next BIOMOVS II Progress Report along with fuller details of the overall BIOMOVS II programme.

Reference Biospheres *WG Leader:* *F Van Dorp, Nagra*

A draft document concerned with expected results and how to achieve them was discussed. Anyone with further comments should please pass them to Frits van Dorp or the Secretariat. This document is due to be issued as an Interim Report of the Group early in 1994.

A number of tasks were identified concerning the further development of the methodology and the

example application of the methodology. These two elements are proceeding in parallel and involve all participants.

Working Group meetings are tentatively planned in Switzerland, the first for the middle of January, and the second from 9-13 May, 1994. The latter meeting would be in combination with other Groups. Details will be distributed in due course.

Complementary Studies *WG Leader:* *R Klos, PSI*

Provisional results from several participants were reviewed. Some minor modifications to the scenario specification have now been distributed to participants along with a detailed schedule of actions. The key features are the finalisation of Phase 1 deterministic results, development of the evaluation of uncertainties, and extension calculations to other types of the release from the geosphere applied to the same site. A Working Group meeting is provisionally planned for 9 - 13 May, 1994, to be held jointly with the Reference Biospheres Group.

Uranium Mill Tailings *WG Leader:* *H Camus, IPSN*

A considerable number of deterministic results for the V1.07 scenario were collated prior to the meeting and the summary collation was reviewed. Further results

which were delivered at the meeting were also considered. Participants were asked to send any final V1.07 results to the Secretariat by October 31st, following which a new summary compilation will be produced. A draft Technical Report on V1.07 is planned for the early new year.

Discussions were held on development of a V2 Scenario, to include a realistic source term. D Acton (Beak) and A Aguero (IMA/CIEMAT) agreed to construct scenario descriptions with the source term based on information from the Rabbit Lake and Andujar sites respectively which would be fitted into a wider environment similar to that assumed for V1.07. Uncertainty estimates will be requested for a comparatively limited set of end points compared with V1.07. D Chambers (SENEC) agreed to provide proposals for parameter ranges for relevant parameters by the end of October, to enable distribution and review in November.

A Working Group Meeting is provisionally planned for early June 1994, in Madrid.

Uncertainties and Validation
WG Leader: T Kirchner,
Colorado State University

Model Complexity: Sub-group leader:
M Elert (Kemakta)

Results were presented by Mark Elert (Kemakta) for both a 3-box and a 7-box model, for an analytical advection-dispersion model and for a numeric hydrology and advection-dispersion model. Results were also submitted by Theo Zeevart (CEN/SCK), Glen Bird (AECL), and Alexei Konoplev (Institute of Experimental Meteorology, currently at Battelle NW). There were lengthy discussions concerning the reasons for differences in model predictions. Some of the discrepancies were found to be due to different interpretations of the scenario. Overall, the differences in radionuclide dispersion curves over the required timescale were due to how the various models treated hydrology and sorption processes.

Two sets of probabilistic calculations had been undertaken at the time of the 4th Workshop Meeting. Participants agreed on the additional parameters which should be varied and those parameters which should be correlated in order to perform uncertainty analyses. The extra information which will be required, mainly in relation to meteorological data, will be distributed by November 93. There was also a useful discussion concerning which additional processes to include in the calculations in order to assist model comparison. It was decided that bioturbation and chemical speciation would be modelled where models permitted the

inclusion of such processes.

**Guidelines for Quantitative Comparison
of Model Predictions:**

Sub-group leader:
M Scott (University of Glasgow)

Unfortunately Marian Scott was unable to attend the Workshop.

A further draft of the report is due to be available in October.

**Use of Lysimeter Data for Testing Models for
Upward Migration in Soil:**

Sub-group leader:
M Egan (AEA Technology)

An interesting proposal for testing models for upward migration of radionuclides in soil was provided by Mike Egan and distributed to participants. The objective is to compare model results with data derived from a series of lysimeter experiments carried out at Imperial College within the Nirex Safety Assessment Research Programme. The proposal provides a useful opportunity for Type A testing of models in an area identified in Phase 1 of BIOMOVs as requiring future work. Comments on the proposal are requested as soon as possible; further copies of the proposal are available from the Secretariat. It is hoped that a full draft case description can be made available by the end of the year.

**Effect of Modellers' Interpretation on
Model Uncertainties:**

Sub-group leader:
G Kirchner (University of Bremen)

Three scenarios and three codes for their evaluation were discussed with a view to examining the differences which can arise in model results as different assessment groups apply the same models. A draft description of the proposed study is due to be provided in November for distribution and comment, with a final version being distributed early in the new year.

Use of Natural Analogues Data

Sub-group leader:
U Bergstrom (Studsvik)

Ulla Bergstrom described work at the Aspö site in Sweden, on determining the distribution and behaviour of natural radionuclides and elements. Such information may provide a basis for testing models for long term contaminant migration from the ground into soils, water and the food chain. A draft task description is due for distribution and comment at the end of November.

Post-Chernobyl Data
WG leader: O Hoffman
SENES Oak Ridge

Three Type A scenarios were completed during the week and are now ready for distribution. Each scenario is described briefly below and copies may be obtained from the Secretariat.

Scenario W

This scenario concerns the wash-off of Sr-90 and Cs-137 from two experimental plots established in the vicinity of the Chernobyl Nuclear Power Plant (NPP). It offers an excellent opportunity to improve any model concerned with the movement of trace contaminants from terrestrial sources to water bodies. The particular objective is to take account of chemical speciation and the effects this has on the transfer of contamination from soil to water and the geochemical and geophysical processes which affect such transfer. The scenario will also provide an opportunity to calculate the attenuation and migration of contaminants in soil over different timescales, and also aid understanding of contaminant transport at the process level. Further phases are planned, to extend the calculations to account for wash-off on larger spatial scales than the two experimental plots.

Scenario CP

This scenario concerns the assessment of the radioactive contamination of the Chernobyl NPP Cooling Pond. The objective is to test models for radioactive contamination of aquatic ecosystems. The calculational endpoints will be considered in two stages. The first stage requires calculations for Cs-137 concentrations in different media for which measurements exist and against which model predictions can be tested. The second stage involves model-model comparisons for estimates of doses and risks.

Scenario R

This scenario considers the atmospheric resuspension of radionuclides in Ukrainian regions impacted by Chernobyl fallout. The scenario examines three different exposure situations. For the first situation, data are available for two locations within the highly contaminated 30 km zone where exposure to resuspended contaminated material will be dominated by local processes. The second situation involves information for the urban area of Kiev. Finally, data are available for a third location 40 - 60 km west of the reactor release point. Exposures at this location are influenced by both resuspension of locally-deposited radioactivity and the advection of material from upwind sources such as the heavily contaminated 30 km zone.

For all three sites, calculations of annual average and selected monthly averages of Cs-137 concentrations in air due to resuspension are requested.

Special Radionuclides
WG leader: P Barry

Tritium

Up until the time of the meeting, five sets of results had been received and collated. Another set of results were brought to the meeting and incorporated into the analyses and a further set are promised.

One important reason for differences between calculated results was found to be due to the way in which soil layers are modelled. However, it will be very difficult to sort out reasons for some of the other observed differences in predictions. It is hoped that a Type A scenario can be developed in order to enlighten the problem. Phil Davis (AECL) has agreed to investigate the possibility of obtaining a suitable data set for a Type A scenario. A draft report is due by the New Year. Before then, all modellers are requested to send in results and information concerning probabilistic calculations.

The WG plan to meet in Karlsruhe next spring to discuss final results, the draft report and, hopefully, a new scenario.

Carbon-14

Scenario V1.01 had been distributed earlier in the year following the compilation of a suitable set of Type A test data by Glen Bird (AECL). The objectives of the scenario are: to predict C-14 concentrations in water, sediment and biota in a lake following contaminant release directly into the lake; and to investigate the effects of more detailed biogeochemical information and model complexity on model predictions.

Two sets of results were submitted for discussion at the Workshop and three or four other participants have expressed the hope of undertaking calculations. As a result of discussions about the presented calculations, some minor alterations are currently being made to the scenario and V1.02 will be distributed by the end of October 93. Results are requested to be submitted to the Secretariat by mid March 1994.

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The Secretariat can now be contacted via E-Mail at BIOMOV5@intera.co.uk

General Information:

Further information about BIOMOV5 II and Working Group meetings can be obtained directly from the BIOMOV5 II Technical Secretariat, at Intera Environmental Division, Chiltern House, 45 Station Road, Henley-on-Thames, Oxfordshire, RG9 1AT, UK - Tel: +44 491 410474, Fax: +44 491 576916. Graham Smith, Barbara Watkins, Martine Greenhalgh or Richard Chalcraft would be happy to help you with any queries you may have and would welcome comments or contributions to the Newsletter.

Participants may be interested in the publication by the Nuclear Energy Agency of the report "PSACON Level 1B Intercomparison". This report documents model intercomparisons focussing on biosphere modelling aspects of disposal of solid radioactive waste, and is available from the Radiation Protection and Waste Management Division, NEA/OECD, Le Seine St-Germain, 12 Boulevard des Iles, 92130 Issy-les-Moulineaux, France.

Don't forget that to become an official participant in BIOMOV5 II, your organization should send a letter agreeing to participate according to the agreement described in the BIOMOV5 II proposal. Letters should be sent to Conny Haegg, the Steering Committee Secretary, at the Swedish Radiation Protection Institute, Box 60204, S-104 01 Stockholm, Sweden. There are no financial obligations to participating organisations other than to cover their own costs. The technical requirements are defined within the working groups and are agreed by a Co-ordinating Committee. The only other obligation is an acceptance that any of the BIOMOV5 II output might be openly published. In fact we would very much encourage this!

Summary Page of Foreign Trip Report

F. Owen Hoffman, Kathleen M. Thiessen, and Alexei V. Konoplev

SENES Oak Ridge, Inc.
Center for Risk Analysis
677 Emory Valley Road, Suite C
Oak Ridge, TN 37830
Telephone: (615) 483-6111
Fax: (615) 481-0060

Subcontract No. B218797

October 25, 1993

Date of Trip: 24 September - 9 October (FOH, KMT)
25 September - 2 October (AVK)

Trip Destination: International Atomic Energy Agency, Vienna, Austria, and Hotel Vaakuna, Helsinki, Finland.

Purpose of Trip: The purpose of this travel was to chair and participate in two meetings concerned with testing and improving models of radionuclide transfer in the environment.

Abstract

The first meeting was the BIOMOVs II 4th Workshop, at IAEA Headquarters, Vienna, Austria, with particular emphasis on sessions of the Post-Chernobyl Data Working Group. Chaired by FOH, the Working Group updated and completed the development of descriptions for three model validation scenarios based on data collected in Russia and Ukraine. The scenarios will permit testing of models for several different and important pathways of environmental contamination, including watershed runoff, aquatic ecosystems and foodchains, and resuspension of contaminated soil.

The second meeting was the Multiple Pathways Working Group Meeting of IAEA/VAMP, in Helsinki, Finland. The Working Group focused on the discussion of Scenario S (Southern Finland), particularly an analysis of the test data and of the predictions by a number of modellers. Efforts were also put into the final revision and completion of the report for Scenario CB, and into discussion and completion of two new scenario descriptions, Scenario I (Iput River, Russia) and Scenario H (Hanford, Washington, USA). FOH also gave an invited seminar at the Finnish Centre for Radiation and Nuclear Safety (STUK), entitled "A Risk-Based approach to the Evaluation of Multiple contaminants in Various Environmental Media."

FOREIGN TRIP REPORT

**F. Owen Hoffman
Kathleen M. Thiessen
Alexei V. Konoplev**

**SENES Oak Ridge, Inc.
Center for Risk Analysis
677 Emory Valley Road, Suite C
Oak Ridge, TN 37830**

The purpose of this travel was to chair and participate in two meetings concerned with testing and improving models of radionuclide transfer in the environment, in keeping with the provisions of Subcontract B218797. The intent was as follows:

(1) to attend (FOH, KMT, AVK) the BIOMOVs II 4th Workshop at IAEA Headquarters, Vienna, Austria, to participate in general discussions, plenary sessions, and coordinating committee meetings (FOH), and to chair (FOH) and participate in (KMT, AVK) the Post-Chernobyl Data Working Group Sessions of the BIOMOVs II 4th Workshop;

(2) to chair (FOH) and participate in (KMT) the Multiple Pathways Working Group Meeting of IAEA/VAMP, in Helsinki, Finland.

I. BIOMOVs II 4th Workshop (27 September - 1 October, 1993)

A. Post-Chernobyl Data Working Group

The Post-Chernobyl Data Working Group of BIOMOVs II, chaired by FOH, updated and completed the development of descriptions for three model validation scenarios. Two of these are presently being released in draft form, and the third is expected to follow soon, pending a few final details. All three scenarios are based on actual data collected in Russia and Ukraine; the scenarios will permit testing of models for several different and important pathways of environmental contamination.

Notices of the availability of these scenarios are presently being placed in appropriate journals; journals which have already agreed to publish these notices include *Ecological Modelling*, *Science of the Total Environment*, and *Agriculture, Ecosystems and Environment*.

(1) Scenario W: Wash-Off of ^{90}Sr and ^{137}Cs from Two Experimental Plots Established in the Vicinity of the Chernobyl Reactor.

This scenario offers an opportunity to test models for the movement of trace contaminants from terrestrial sources to water bodies, with particular emphasis on the effects of chemical speciation. Surface water runoff from contaminated land is one of the main processes responsible for the contamination of water bodies. Therefore it is very important to have a reliable model for prediction of the contamination of surface water by surface runoff. The Chernobyl accident has provided a unique opportunity to develop a data base suitable for testing the predictive capability of mathematical models to assess radionuclide wash-off into rivers and lakes from soils contaminated by the deposition of fuel particles.

The wash-off scenario will be developed in three phases. The first phase, which was completed at the Vienna meeting, examines the wash-off of ^{90}Sr and ^{137}Cs from two experimental plots established in the vicinity of the Chernobyl reactor. The second and third phases of the scenario development, to be presented at a later time, will extend the calculations to account for wash-off on larger spatial scales. Phase two will include the 37 watersheds, including the flood plain of the Pripyat River, which provide input to the Kiev reservoir; some of these watersheds were very highly contaminated by the Chernobyl accident. This provides an important opportunity to test our understanding of mechanisms of secondary contamination of water bodies. Phase three will include the migration of radionuclides for the whole Dneiper River basin, starting with the watershed processes and including consequent transport processes in the river itself.

AVK and FOH are the major developers of this scenario, on the basis of experiments carried out by scientists from the Institute of Experimental Meteorology, SPA "Typhoon," Obninsk, Russia, and the Ukrainian Hydrometeorological Institut, Kiev, Ukraine. AVK is a staff scientist with the Institute of Experimental Meteorology, SPA "Typhoon," Obninsk, Russia, presently spending a few months doing research at Battelle NW, Richland, Washington, USA. One of the other chief contributors to the scenario was also present for the Workshop; this was A.A. Bulgakov, also of Obninsk.

(2) Scenario CP: Assessment of the Consequences of the Radioactive Contamination of the Chernobyl NPP Cooling Pond.

The objective of Scenario CP is to test models for radioactive contamination of aquatic ecosystems, based on data from the Chernobyl Nuclear Power Plant cooling pond. The input data include characteristics of the cooling pond ecosystem and estimates of amounts of the ^{137}Cs in the Chernobyl

cooling pond (30 May 1986). The calculational endpoints of the scenario are in two stages. The first stage requires calculations for ^{137}Cs concentrations in different media for which measurements exist and against which model predictions can be tested. The second stage requires calculations for dose and risk estimates which can only be predicted, but not tested.

A cooling pond is a suitable model for studying the dynamic processes of radionuclide migration and accumulation in closed aquatic systems. Dynamic processes worthy of detailed investigation include (1) ^{137}Cs accumulation in different trophic levels, (2) the accumulation and removal of ^{137}Cs from fish flesh, and (3) the dependence on size of the accumulation of ^{137}Cs by various species of fish. In addition, the cooling pond has a unique temperature distribution structure.

FOH is one of the authors of the scenario. The rest of the developers and authors of the scenario include scientists from the Institute of Experimental Meteorology, SPA "Typhoon," Obninsk, Russia; the Institute of Evolution Morphology and Ecology of Animals, Russian Academy of Sciences, Moscow, Russia; the Chernobyl Ministry of Ukraine, Kiev, Ukraine; and the Institute of Nuclear Research, Ukrainian Academy of Sciences, Kiev, Ukraine. The chief contributor to the scenario, Dr. I. I. Kryshev, was present for the Workshop.

(3) Scenario R: Atmospheric Resuspension of Radionuclides in Ukrainian regions Impacted by Chernobyl Fallout.

Resuspension is the process by which surface deposits of radioactive particles are re-entrained into the air by mechanisms such as wind action and mechanical disturbances enhanced by human activity. Resuspension is generally not considered to be a significant pathway of human exposure to radioactive material during the time that the originating release is in progress. After the depositing release has stopped, however, resuspension may become a secondary source of airborne exposure. In addition, it may become a new source of exposure for persons who were not exposed to the original plume but who live downwind of the deposited material. As a result, the resuspension pathway must be considered when the long-term effects of radioactive releases to the environment are considered.

The resuspension of particulates deposited following the large, unintentional releases of radioactivity from Unit 4 of the Chernobyl Nuclear Power Station in 1986 has been studied extensively for the past 6 years. These data form the basis for this scenario. Resuspension of the material deposited by the Chernobyl event occurs as a result of the action of wind blowing across the

terrain and mechanical disturbances such as the movement of motor vehicles. The data in this scenario reflect the heterogeneity of exposure to resuspended material and permit the examination of three different exposure situations. This scenario provides an excellent opportunity to test models for assessing the long-term impact of future releases or past releases of radioactive material.

The primary developer of the scenario, Dr. E. Garger of the Institutes of Radioecology UAAS, Kiev, Ukraine, was a participant at the BIOMOVs II meeting.

B. Other activities of the BIOMOVs II Workshop.

The Post-Chernobyl Data Working Group was one of 6 Working Groups participating in the BIOMOVs II Workshop. The other working groups include Uranium Mill Tailings, Uncertainties and Validation, Reference Biospheres, Special Radionuclides (Tritium and Carbon-14), and Complementary Studies. Plenary sessions included presentations from all six working groups and discussion of the various activities. Two invited talks were given, one by Dr. Brenda Howard of the Institute of Terrestrial Ecology, Merlewood, UK, on "Use of Experimental Data in Radiological Assessments with Special Reference to Transfer to Animals," and one by Dr. Eduard Hofer of the Gesellschaft für Reaktorsicherheit, Garching, Germany, on "Developments in application of Uncertainty Analysis."

II. IAEA/VAMP Multiple Pathways Working Group (3-8 October, 1993)

The IAEA/VAMP Multiple Pathways Working Group was hosted in Helsinki, Finland, by Dr. Aino Rantavaara of the Finnish Centre for Radiation and Nuclear Safety (STUK). Dr. Shaheed Hossain was present on behalf of the IAEA. FOH is Chairman of the Multiple Pathways Working Group.

The Working Group focused on the discussion of Scenario S (Southern Finland), particularly the scenario test data and dose estimates, which were presented by staff members from STUK, and analysis of the predictions of various modellers as compared with the test data (observations), together with reasons for misprediction. Modellers were able to discuss the test data and dose estimates with the people who had determined them.

Examples of the results for the estimates of the total lifetime dose via all exposure pathways, the total dose via the food pathways, and the total dose from the inhalation of resuspended material in air are presented in Figure 1. The majority of models producing accurate estimates did so because of the

Fig. 1. Predicted and estimated values for Scenario S (Southern Finland) for lifetime doses to man: total, ingestion, and inhalation of resuspended material.

abundance of data on the behavior of Cs-137 in arctic and subarctic regions that were published prior to the Chernobyl accident.

One of the most interesting things to come out of the discussion was a comparison between the test data obtained for Scenario S and that for Scenario CB (Central Bohemia). When data normalized for deposition were compared, important regional differences were found, particularly with respect to the significance of different soil types. Figure 2 shows a comparison between the deposition-normalized data for CB and S for milk, beef, pork, and whole body Cs-137 concentrations in humans. Striking similarities in these results are evident for the first two to three years after the time of initial deposition, after which the Cs-137 concentrations in the food chains of CB decrease with time. This is thought to reflect the effect of the binding of Cs-137 by clay minerals in the root zone of CB soils. In southern Finland, the sandy soils are low in clay and the Cs-137 remains available for plant uptake, especially in areas where crops are produced from plowed fields. The relatively constant whole body concentrations of Cs-137 in southern Finland are also due to the important contributions of mushrooms, wild game, and fresh-water fish to the total diet.

Some effort was also put into the final revision and completion of the report for Scenario CB. The goal is submission by November 15 for publication by the IAEA.

Detailed presentations were given by representatives from Obninsk and St. Petersburg, Russia, for Scenario I (Iput River) and from Richland, Washington, USA, for Scenario H (Hanford). The Scenario H description is expected to be released for predictions by the end of the year; Scenario I will be released in 1994, following some modifications to the scenario description.

Highlights of the Working Group meeting included visits to many of the laboratories and research groups of STUK, and a banquet hosted by STUK for the Working Group participants.

The Working Group meeting ended at noon on Friday. Friday afternoon, FOH gave an invited seminar at STUK, entitled "A Risk-Based approach to the Evaluation of Multiple contaminants in Various Environmental Media."

Fig. 2. Comparison of test data for milk, pork, beef, and whole body concentrations in humans for Scenario CB (Central Bohemia) and Scenario S (Southern Finland). Data (in Bq/L or Bq/kg) were normalized for deposition by dividing by total deposition for the site (Bq/m^2).

Appendix A

Itinerary

Date	Activity	Contact
09/24-25/93	Depart Oak Ridge, Tennessee, USA and arrive in Vienna, Austria (FOH, KMT)	
09/25-26/93	Depart Pasco, Washington, USA and arrive in Vienna, Austria (AVK)	
09/26/93	Meeting of BIOMOVs II Working Group Leaders with BIOMOVs II Secretariat (FOH)	
09/27-10/01/93	BIOMOVs II 4th Workshop, International Atomic Energy Agency, Vienna (FOH, KMT, AVK)	S. Hossain
10/02-03/93	Weekend, travel to Helsinki, Finland (FOH, KMT), travel to USA (AVK)	
10/04-08/93	Meeting of VAMP Multiple Pathways Working Group, Hotel Vaakuna, Helsinki (FOH, KMT)	A. Raantavara
10/09/93	Return to Oak Ridge, Tennessee, USA (FOH, KMT)	

Appendix B

Agenda and List of Participants for BIOMOVs II 4th Workshop

BIOMOVS II 4th Workshop

**At the International Atomic Energy Agency,
Vienna International Centre (VIC),
Wagramerstrasse 5, PO Box 100, A-1400 Vienna**

27 September - 1st October 1993

Outline Agenda*

Monday 27 September

- 9.00 - 10.00 Registration
- 10.00 - 11.30 **PLENARY SESSION**
- Welcome and administrative announcements
- Status of BIOMOVS II
- Review of progress in each Working Group, and setting out of objectives for the work
- 11.30 - 12.30 Invited Presentation by Dr B Howard of the Institute of Terrestrial Ecology, Merlewood.
"Use of Experimental Data in Radiological Assessments with Special Reference to Transfer to Animals"
- 12.30 - 13.30 **LUNCH**
- 13.30 - 17.30 **WORKING GROUP SESSIONS**
- Uncertainties and Validation (Chair P. Davis, for T Kirchner)
Proposal on investigating "Effects of Modeller Interpretation on Uncertainty" by C Kirchner.
Proposal for "Use of Natural Analogues" by U Bergstrom.
Proposal for a "Type A Scenario for Upward Migration in Soil Based on Lysimeter Measurements" by M Egan, 15 minutes.
 - Post-Chernobyl Data Wash-off Scenario, A Konoplev.
- 17.30 Reception at the VIC hosted by the BIOMOVS II sponsors.

Tuesday 28 September

- 9.00 - 9.15 **PLENARY SESSION**
- Announcements, eg for Working Group Sessions
- 9.15 - 12.30 **WORKING GROUP SESSIONS**
- Post Chernobyl Data Cooling Pond Scenario, I Kryshev.
 - Uranium Mill Tailings
- 12.30 - 13.30 **LUNCH**
- 13.30 - 17.30 **WORKING GROUP SESSIONS**
- Reference Biospheres
 - Special Radionuclides, Tritium

Wednesday 29 September

- 9.00 - 9.30 PLENARY SESSION
Administrative announcements and brief reviews from Working Groups if appropriate
- 9.30 - 12.30 WORKING GROUP SESSIONS
- Reference Biospheres (cont.)
 - Uncertainties and Validation, Effects of Model Complexity
- 12.30 - 13.30 LUNCH
- 13.30 - 17.30 WORKING GROUP SESSIONS
- Post Chernobyl Data Resuspension Scenario, by F Garger.
 - Complementary Studies

Thursday 30 September

- 8.30 - 9.00 PLENARY SESSION
Administrative announcements and brief review from Working Groups if appropriate
- 9.00 - 10.00 Invited Presentation by Dr. E. Hofer of Gesellschaft für Reaktorsicherheit
"Developments in Application of Uncertainty Analysis"
- 10.00 - 12.30 WORKING GROUP SESSIONS
- Post Chernobyl Data (cont.)
 - Complementary Studies (cont.)
- 12.30 - 13.30 LUNCH
- 13.30 - 17.30 WORKING GROUP SESSIONS
- Uranium Mill Tailings
 - Special Radionuclides, C-14
- Social Evening

Friday 1st October

- 9.00 - 9.15 PLENARY SESSION
Administrative announcements
- 9.15 - 12.30 Presentations from Working Groups on Progress and Planned Actions, linked to discussion from floor, including discussion of links with other projects, publication of BIOMOVs work etc.
Closure of main Workshop
- 12.30 - 13.30 LUNCH
- 13.30 - 14.30 Coordinating Committee Meeting
- 15.30 - 17.30 Opportunity for Working Group Leaders and other active participants, the Secretariat and the Steering Committee to discuss detailed work programmes and to document arrangements.

BIOMOVs II
Provisional Attendees to the 4th
Workshop in Vienna
27 September - 1 October 1993

Name	Company Name	Country
Dan Acton		CANADA
Almudena Agüero	CIEMAT/IMA	SPAIN
Bulgakov Anatoly	Inst of Experimental Meteorology	RUSSIA
Rao Avadhanula	AECB	CANADA
Ian Barraclough	NRPB	UK
Runo Barndahl	SSI	SWEDEN
Peter Barry	Peter J S Barry	CANADA
Helmut Bauer		GERMANY
Yves Belot	CEA-IPSN	FRANCE
Ulla Bergström	Studsvik EcoSafe	SWEDEN
Glen Bird	AECL Research	CANADA
Henri Camus	CEA-IPSN	FRANCE
David Cancio	CIEMAT/IMA	SPAIN
Pedro Carboneras	ENRESA	SPAIN
Douglas Chambers	SENES Consultants Ltd	CANADA
Peter Coughtrey	L G Mouchel & Partners Ltd	UK
Jean Louis Daroussin	Cogema	FRANCE
Phillip Davis	AECL	CANADA
Constantin Dovlette	Romanian Inst of Env Res Eng	ROMANIA
Ove Edlund	Studsvik AB	SWEDEN
Mike Egan	AEA Technology	UK
Mark Elert	Kemakta Konsult AB	SWEDEN
Nándor Fülöp	NRIRR	HUNGARY
Dan Galeriu	Institute of Atomic Physics	CANADA
Evgenii Garger	Inst of Radioecology	UKRAINE
Helen Grogan	()	USA
Eduard Hanslik	T G Masaryk W R Inst	CZECH REPUBLIC
Eberhardt Henrich	BMGSK	AUSTRIA
Eduard Hofer	GRS	GERMANY
Owen Hoffman	SENES Oak Ridge	USA
Shaheed Hossain	IAEA	AUSTRIA
Brenda Howard	Institute of Terrestrial Ecology	UK
Gunnar Johansson	SSI	SWEDEN
Béla Kanyár	NRIRR	HUNGARY
Gerald Kirchner	University of Bremen	GERMANY
Viktor Kliment	Czech Ecological Inst	CZECH REPUBLIC
Richard Klos	PSI	SWITZERLAND
Alexei Konoplev	Battelle NW	USA
Branko Kontic	Jozef Stefan Institute	SLOVENIA
Ivan Kryshev	Inst of Exptl Meteorology	RUSSIA
Nikolajs Lucans	Ministry of Environment and Regional	REPUBLIC OF LATVIA
Charles W Miller	Centre for Disease Control	USA
Charles Murphy Jr	Savannah River Technology Center	USA

BIOMOVs II
Provisional Attendees to the 4th
Workshop in Vienna
27 September - 1 October 1993

Name	Company Name	Country
Sverker Nilsson	SKB	SWEDEN
Frank Pelz	WISMUT	GERMANY
B Prister	Ukrainian Academy of Agricultural	UKRAINE
Wolfgang Raskob	KFK	GERMANY
S Raviart	CEA-IPSN	FRANCE
Thomas Riesen	PSI	SWITZERLAND
Pascal Santucci	CEA-IPSN	FRANCE
Tatiana G Sazykina	Inst of Exptl Meteorology	RUSSIA
Graham Smith	Intera	UK
Denise Stammose	CEA-IPSN	FRANCE
Kathleen Thiessen	SENEs Oak Ridge	USA
Laszlo Toro	Inst Public Health & Med Res	ROMANIA
Carlos Torres	CIEMAT/IMA	SPAIN
Paul Uijt de Haag	RIVM	NETHERLANDS
C Valentin-Ranc	ANDRA - DESQ	FRANCE
Frits van Dorp	Nagra	SWITZERLAND
Barbara Watkins	Intera	UK
Kevin Weatherston		CANADA
David Webbe-Wood	MAFF	UK
Charley Yu	Argonne National Lab	USA
Theo Zeevaert	CEN/SCK	BELGIUM

Appendix C

Agenda and List of Participants for IAEA/VAMP Multiple Pathways Working Group Meeting

INTERNATIONAL ATOMIC ENERGY AGENCY

Tentative Programme for the VAMP-MP Working Group Meeting
4-8 October 1993, Hotel Vaakuna (Cabinet No. 5, 9th Floor), Helsinki, Finland

Time	Monday 4 October 1993	Tuesday 5 October 1993	Wednesday 6 October 1993	Thursday 7 October 1993	Friday 8 October 1993
09.00 - 10.40	09.00-09.30: Registration • Welcome and introduction • General information • Progress and development of the VAMP-MP WG (Hossain) • Lessons learnt from international model validation studies (Hoffman)	• Revised Scenario S predictions (contd.)	Technical Visit to STUK, Field Trip & Social Evening (see sep. prog.)	• Presentation of Scenario I (Kryshev/Balakov/Fesenko)	• Finalization of CB report • Future planning of S • Future tasks and work plan • Closure
10.40 - 11.00	Coffee break	Coffee break		Coffee break	Early lunch break
11.00 - 12.30	• Presentation and discussion of Scenario S observed data and dose estimates (STUK)	• Revised Scenario S predictions (contd.)		• Presentation of Scenario I (contd.) • Future planning of I	
12.30 - 14.00	Lunch break	Lunch break		Lunch break	Special Seminar in STUK on "A Risk Based approach to the Evaluation of Multiple Contaminants in Various Environmental Media" (Hoffman)
14.00 - 15.40	• Scenario S observed data and dose estimates (contd.)	• Analysis of Scenario S predictions vs. observation (Hoffman)		• Presentation of Scenario H (Kennedy) • Future planning of H	
15.40 - 16.00	Coffee break	Coffee break		Coffee break	
16.00 - 17.30	• Presentation of revised Scenario S predictions following individual evaluations (Participants)	• Scenario S predictions vs. observation (contd.)		• Working groups as necessary	

**VAMP-MP WORKING GROUP MEETING
4-8 OCTOBER 1993, HELSINKI, FINLAND**

LIST OF PARTICIPANTS

Belgium

**Theo Zeevaert
Nicolas Lewyckyj**

Canada

**Ring Peterson
Peter Barry**

Czech Republic

Irena Malatova

Finnland

**Vesa Suolanen
Hannu Arvela
Ritta Haenninen
Eila Kostainen
Arto Leppanen
Mikael Moring
Raimo Mustonen
Tua Rahola
Aino Rantavaara
Tapio Rytomaa
Ritva Saxen
Matti Suomela
Harri Toivonen
Antti Vuorinen**

Germany

Heinz Mueller

Hungary

Bela Kanyar

Poland

Pawel Krajewski

Russian Federation

**Ivan Kryshev
Tatiana Sazykina
Michael Balonov
Sergey Fesenko**

Sweden

Ulla Bergstroem

USA

**Owen Hoffman
Kathy Thiessen
Charley Yu
Bill Kennedy**

IAEA

Shaheed Hossain

Appendix D

Literature Acquired

Wash-Off of ^{90}Sr and ^{137}Cs from Two Experimental Plots Established in the Vicinity of the Chernobyl Reactor. Description of Scenario W. (Draft Version 1.02, October 1, 1993) A.V. Konoplev and F.O. Hoffman.

Assessment of the Consequences of the Radioactive Contamination of the Chernobyl NPP Cooling Pond. Description of the Scenario CP. (Draft Version 1.02, October 1, 1993) I.I. Kryshev, T.G. Sazykina, I.V. Dragolyubova, N.T. Borisova, I.N. Ryabov, O.I. Nasvit, V.K. Chumak, O.L. Zarubin, and F.O. Hoffman.

Atmospheric Resuspension of Radionuclides in Ukrainian regions Impacted by Chernobyl Fallout. Description of Scenario R. (Draft Version 1.01, October 1, 1993) E.K. Garger.

What's "New" in Uncertainty Analysis? E. Hofer. Presentation at the BIOMOVs II 4th Workshop.

Effects of Model Complexity on Uncertainty. Report from BIOMOVs II Working Group.

BIOMOVs II Glossary. Developed for the participants in the BIOMOVs II study. August 1993.

Evaluating the Reliability of Predictions Made Using Environmental Transfer Models. IAEA Safety Series 100 (1989).

Estimation of Consequences of Radioactive Contamination with Cs-137 in the Iput River Catchment Area. Description of test scenario I. Draft. I.I. Kryshev, I.V. Dragolyubova, A.I. Nikitin, T.G. Sazykina, R.M. Aleksakhin, S.V. Fesenko, N.I. Sanzharova, M.I. Balonov, F.O. Hoffman.

Description of Test Scenario H. Draft. B.A. Napier, W.E. Kennedy, Jr.

Multiple Pathways Assessment: Description of Scenario H. Presentation to IAEA/VAMP MP Working Group. B.A. Napier, W.E. Kennedy, Jr.

Uptake of Caesium-137 from Peat and Compost Mould by Vegetables in a Greenhouse Experiment. (1991) J. Malm, A. Rantavaara, A. Uusi-Rauva, and O. Paakkola. J. Environ. Radioactivity 14:123-133.

Sources of Radioactivity Data for Input Information and for Observed Values. Finnish Centre for Radiation and Nuclear Safety. Bibliography.

The Chernobyl Papers. Vol. 1: Doses to the Soviet Population and Early Health Effects Studies. Merwin, S.E., and Balonov, M.I., Eds. (ordering information only)

AUGUST 1993

SENE Oak Ridge Inc.
Center for Risk Analysis

September 14, 1993

Shellah Hendrickson, L-453
University of California
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, California 94551

Re: Monthly Progress Report, Subcontract B218797

Dear Ms. Hendrickson:

The highlights of the past month are as follows:

- 1) The subcontract was signed on August 27, 1993.
- 2) The travel report for the July trip to Vienna was submitted. This trip involved work on both BIOMOVs II and IAEA/VAMP by Dr. Hoffman and Dr. Auerbach.

Plans for the coming month are as follows:

- 1) A trip to Vienna (for BIOMOVs II, September 27 - October 1) and Helsinki (for IAEA/VAMP, October 4-8) is planned for Dr. Hoffman and Dr. Thiessen.
- 2) For BIOMOVs II, the Post-Chernobyl Data Working Group chaired by Dr. Hoffman expects to complete work on several Post-Chernobyl scenarios, so that they will be ready for use by modelers.

- 3) For IAEA/VAMP, the Multiple Pathways Working Group is in the process of completing the final report on Scenario CB (Central Bohemia) and most of work prior to the final report on Scenario S (Southern Finland). Other scenarios in progress will also be discussed.

Sincerely,

ph ~~S~~ F. Owen Hoffman, Ph.D.
President and Director

cc: Virginia Henke, L-650

Summary Page of the Foreign Trip Report

F. Owen Hoffman and Stanley I. Auerbach

**SENES Oak Ridge, Inc.
Center for Risk Analysis
677 Emory Valley Road, Suite C
Oak Ridge, Tennessee 37830
(615) 483-6111, Fax: (615) 481-0060**

Contract No. W-7405-Eng-48

July 28, 1993

Date of Trip: 27 June - 10 July, 1993

Trip Destination: International Atomic Energy Agency, Vienna, Austria

Purpose of Trip: The purpose of this travel was to chair and participate in two meetings that were concerned with testing and improving models of radionuclide transfer in the environment.

Abstract

The first meeting was the working group of BIOMOVs (BIOspheric Model Validation Study). As Chair of the program, F. Owen Hoffman (FOH) had organized 3 scenarios prepared by scientists of the former Soviet Union (FSU) based on contamination from the Chernobyl accident. These scenarios dealt with (1) runoff of Cs-137 and Sr-90 from plots within the 30km zone, (2) differentially contaminated zones of the Chernobyl cooling ponds and their potential impacts on biota and man; and the potential for resuspension of radionuclides, and (3) their impact on human populations in the Poleskoe settlement area. The scenarios and their potential use for modeling was the basis of discussion by the participants and resulted in agreement to go ahead with these scenarios as a basis for testing appropriate transport and dose assessment models utilizing scenario data.

The second meeting was VAMP (Validation of Assessment Model Predictions), which is a program of the IAEA for testing and improving models of radionuclide transfer in the terrestrial, aquatic, and urban environments using data from the Chernobyl accident fallout. This was the 5th Research Coordination Meeting and brought together 75 scientists from 27 countries. FOH serves as Chairman of the Multiple Pathways Working Group and Stanley I. Auerbach (SIA) was a member of the Terrestrial Working Group. This meeting is the beginning of the final year of this program. The Multiple Pathways Group reviewed the results of modeling of particular environmental scenarios developed during the past year for southern Finland and for the Iput River catchment basin in Russia. Analysis of predictions versus observations was the main thrust of the group. It was demonstrated by FOH that the model predictions which were most realistic were made by scientists who understood the local conditions represented in the test scenario. The worst results were performed by individuals with limited experience using software developed by a third party.

The Terrestrial Working Group reviewed the drafts of documents being developed for the VAMP Program. These included a handbook of element dependent transfer factors, a draft report on agricultural countermeasures to be taken after a nuclear accident and modeling of radionuclide behavior in forest ecosystems. SIA participated in these reviews drawing on his extensive research background and experience in these areas. The use of soil/water, sediment/water distribution coefficients (K_d 's) in modeling was reviewed in a joint session of terrestrial and aquatic scientists. The fact that a K_d is not a fixed value but depends on a variety of factors including soil or sediment chemistry, analytical techniques, etc., was brought out by all the speakers. Plans for the final year of VAMP include model testing of scenarios based on the Clinch River (Tennessee) and the Dnieper River (Ukraine) by several teams of modelers.

FOREIGN TRIP REPORT

F. Owen Hoffman & Stanley I. Auerbach

**SENES Oak Ridge, Inc.
Center for Risk Analysis
677 Emory Valley Road, Suite C
Oak Ridge, Tennessee 37830**

The purpose of this travel was twofold: (1) To chair [F. Owen Hoffman (FOH)] and participate [Stanley I. Auerbach (SIA)] in the Post-Chernobyl Data Working Group Meeting of the BIOMOVs (BIOspheric Model Validation Study) II Program (30 June - 2 July, 1993) at IAEA Headquarters, Vienna, Austria, and (2) To participate in (FOH and SIA) and chair portions of (FOH) the 5th Research Coordination Meeting of the VAMP (Validation of Assessment Model Predictions) which is a program of the IAEA for testing and improving biospheric models of radionuclide transfer in the terrestrial, urban, and aquatic environments using data from the Chernobyl fallout. Both meetings were held at IAEA Headquarters (5-9 July, 1993).

BIOMOVS II (30 JUNE - 2 JULY, 1993)

The meeting was opened by the Chairman (FOH) who briefly reviewed the history of BIOMOVS, which was started in 1985 to evaluate the strengths and weaknesses of mathematical models that were being used in radiological assessment of releases from a variety of nuclear and related radiological activities. The model evaluation effort received a major impetus from the Chernobyl accident in 1986, which provided a unique opportunity to organize efforts around specific sets of data pertaining to a variety of transport and ecosystem processes. FOH then outlined the goals and agenda for the working group meeting. Three scenarios had been prepared by FSU (Former Soviet Union) scientists. These were to be analyzed by the group for their suitability as test cases for modeling of radionuclide transport and behavior under in different environmental situations.

The first scenario "Washoff of Sr-90 and Cs-137 from Two Experimental Plots established in the Vicinity of the Chernobyl Reactor" was presented by Alexei V.

Konoplev of the Institute of Experimental Meteorology, Obninsk, Russia. This scenario was developed for the modeling of short-term processes during the first years after the accident. Surface runoff from contaminated land was one of the main processes responsible for the contamination of water bodies after the Chernobyl accident. A variety of surface hydrological processes (e.g., physical, chemical, and other related processes) play a role. Because of this complexity and the needs of the modelers, as brought out in the discussion, for detailed parameterization of critical steps in the transfer and movement of these radionuclides from the experimental plots, it was recommended by the Working Group that detailed data on soil conditions, fixation processes, rates, and other information related to the complex of soil/soil solution/radionuclide interactions be included in the scenario data base. In response to a question the Chairman (FOH) outlined the advantages and implications of this scenario for future assessments. In his view there were three: 1) Understanding the sequence of processes involved in the transfer of radionuclides from soil to water; 2) Understanding the attenuation and migration processes of radionuclides in soil; 3) Understanding the environmental behavior of radionuclides at the process level--an operation which requires a working relationship between experimentalists and modelers.

Konoplev then outlined his future plans for scaling up and working with the greater part of the Dneiper River Basin. This would be a phased approach beginning with an immediate 30 kilometer zone, which would include specific runoff sites. The next phase would be to expand the spatial area of modeling to a larger flood plain involving the Pripjat River, and eventually to the entire Dneiper River basin. All agreed that this was a major environmental modeling opportunity and the suggestion was made by several modelers (Peter Barry of Canada, Dan Galeriu of Romania) that notices of these available scenarios be published in a number of scientific journals (e.g., *Science*, *Nature*, *Journal of Radioactivity*, *Health Physics*, *Environmental Science & Technology*, etc.) emphasizing the availability of these scenarios for interested environmental modelers and encouraging their interest in participating in this international model testing exercise.

The second scenario (CP) was presented by Ivan Kryshev, assisted by Tatiana Sazykina, both from the Institute of Experimental Meteorology, SPA "Typhoon", Obninsk, Russia. The objective of this scenario is the testing of models for radioactive contamination of aquatic ecosystems based on data obtained from the

Chernobyl Reactor cooling pond. Kryshev presented an extensive set of data on fission product contamination levels in three separate areas of the cooling pond as well chemical characteristics, sediment levels, biomass of the key pond organisms, and radionuclide levels in fish. Data on 12 different radionuclides have been systematically collected by the Russians. In addition to the primary contamination that occurred as a result of the accident, there has been considerable secondary contamination resulting from runoff on the catchment area during rainfall and snow melt, washout of radionuclides from flooded parts of the flood plain, wind resuspension and deposition of radioactive aerosols, and direct discharge of radionuclides into the pond. As a result, there are opportunities for a number of types of modeling studies using this aquatic ecosystem and its subcomponent areas.

Because of the huge data base that has been collected, it was felt that there were several possible scenarios for model testing--physical movement, food chain pathways, sediment accumulation, and radiation effects and risk assessments on the contaminated fish populations. Graham Smith (England) pointed out that it may be more effective to focus on one radionuclide (Cs-137) rather than undertake a modeling exercise involving 12 different fission products. Hoffman discussed the importance of making dose estimates to fish if ecological risk assessments were to be undertaken. Ulf Tveten (Norway) argued that in order to model all the suggested possibilities in fish, detailed information and data on the distribution patterns of the fish populations throughout the year would be necessary. Following this discussion there was a prolonged debate, involving Auerbach, Hoffman, and Barry (Canada) and the two Russian scientists, on the pros and cons of attempting to model radiological impacts on fish populations. The Russians believed that they could model the impacts of radionuclides on fish population dynamics. Auerbach argued that after years of research, fisheries scientists cannot yet reliably predict the dynamics of fish populations over time irrespective of an insult or lack thereof. Barry argued that such an exercise could serve as a useful learning and test approach. General agreement was that the modeling exercise should emphasize simulation of the behavior of Cs-137 in these pond subsystems, simulation of accumulation of Cs-137 in the fish populations, and prediction of the effects of Cs-137 body burdens on fish.

The third scenario, also presented on Thursday, dealt with the deposition and potential resuspension of near field Chernobyl fallout in the Poleskoe region of the

Ukraine. This scenario was developed by Evgenie Garger of the Institute of Radioecology, Ukraine. This area of the Ukraine received some of the highest fallout levels from the accident ($>200 \text{ Ci/km}^2$). The small city of Poleskoe (population, 14,000) is primarily a farming community, and subsequent to the accident many people, especially children, were evacuated. Garger outlined some of the aspects of this scenario which make it valuable for a modeling exercise: (1) nearness of the area to the epicenter of the accident ($\sim 50 \text{ km}$); (2) high levels of soil contamination ($5\text{-}100 \text{ Ci/km}^2$); (3) spatial heterogeneity of the contamination which could favor the advection transport of radionuclides from areas of high contamination to areas of lower contamination. The data that have been collected by his institute since 1986 may provide input for testing and validation of 4 types of models: (1) Deposition and resuspension models of the radioactive fallout materials; (2) Models of vertical migration of Cs-137 in soils characteristic of this district of Ukraine; (3) Environmental transport models emphasizing soil-plant-animal food chains; and (4) Assessment of the doses to the human population of the Poleskoe settlement. Garger presented examples of the large data base that has been gathered, including extensive micrometeorological measurements pertinent to the resuspension and local transport issues.

The chairman (Hoffman) pointed out that since the accident, BIOMOVs has received new information on resuspension from scientists in Great Britain, Denmark, and other places in western Europe. A challenge is to ascertain the comparability of these data and their relation to the accidental releases at Chernobyl. FOH emphasized the importance of this scenario and its potential applicability to a wide array of radiation protection needs. This was also reinforced by Galeriu (Romania, Canada) citing the scenario's potential use for risk assessment modeling. FOH urged Garger and his coworkers to develop a near-final version of the scenario by late September. The group spent the rest of the time outlining specific data needs that should be included in a revised scenario, with particular emphasis on micrometeorological data relating to the questions being addressed.

The last day was devoted to review and discussion of the three action items. FOH outlined and discussed a series of questions and action items related to the resuspension scenario. He provided and outlined a key list of supplemental information items that would be needed to carry out the Ukrainian scenario. Hoffman established a small committee consisting of himself, Charles Miller (CDC,

Atlanta), and the Intera staff to provide quality control of the test data. Discussion on Scenario 1 (experimental plots) centered on the need to proceed with modeling effort for this scenario as soon as possible. The Russians were encouraged to start using E-mail for communication and transmission of data. The list of comments prepared by Intera staff on the Cooling Pond scenario was distributed and reviewed. A meeting to review the scenario results was tentatively scheduled for next Spring.

5TH IAEA/VAMP Research Coordinating Meeting (5-9 JULY,1993)

At the opening plenary session, VAMP General Chairman W. Templeton announced that this was to be the final phase of the program. All working groups should plan on completion of their activities by the end of 1994. Therefore, one purpose of this coordination meeting was to define final plans. At the plenary session on Friday, each Working Group was asked to report on what they expect to complete and what cannot be achieved by the end of 1994.

Each chairman then reviewed the status of activities of his particular working group. FOH, who is chairman of the Multiple Pathways Group outlined the current goals of his unit. The overarching goal is to use data sets that modelers have not seen before, with emphasis on the multiple pathways behavior of Cs-137 in Central Bohemia, Southern Finland, and the Iput River catchment basin, Russia. Additionally participants hope to model historic I-131 releases from the Hanford facilities, USA. Their work during the week would be to compare with the observed data.

The Terrestrial Working Group's initial effort was the review of a number of documents pertinent to the understanding and modeling of terrestrial pathways of radionuclide transfer or movement into human food chains. Martin Frissel of the Netherlands introduced a handbook of parameter values for the prediction of soil/plant transfer, especially for temperate environments. This project was initiated several years ago, prior to the Chernobyl accident, by the International Union of Radioecologists (UIR), (then under the leadership of the traveler SIA). At the time it was recognized that there was no central source of information on transfer values (soil-to-plant, plant-to-animal products, water-to-biota) that could be used by modelers or other applied radioecologists in assessing transfer of potentially hazardous radionuclides through food chains to man. Dr. M. Frissel undertook the

laborious task of assembling known data as well as establishing a research effort aimed at systematically determining such transfer coefficients for a variety of food plants in different geographic contexts. Considerable discussion took place following Dr. Frissel's introduction. The impression was gained that these experimentally derived transfer factors were to be used as universal constants. Subsequent discussion clarified that matter. Other questions were raised regarding statistics, etc. Nevertheless it was agreed that this document represented a unique compilation of data unavailable elsewhere and would be of great potential value to environmental modelers and those responsible for dose assessment in natural and semi-natural (agricultural) conditions.

Discussion of transfer in natural ecosystems raised a number of issues. Its particular importance is for the area of remedial action guidance. Because of the complexity and lack of knowledge of the operative processes it was suggested that such modeling of radionuclide transfers in totally natural systems should not take place until 2 years after a nuclear event (e.g., nuclear explosion).

The use of Distribution Coefficients (K_d 's) in modeling was the subject of a joint session of the terrestrial and aquatic working groups on Tuesday (6 July). Chaired by Lars Hakanson of Sweden, the groups heard Alexei Konoplev (Russia), a soil scientist, review the technical aspects of this parameter. Konoplev reminded the group that a K_d value is made up of a number of interacting processes—it is not a fixed value—although it can be treated as a constant when the chemical status of the components is known. Therefore one must calculate the K_d for each condition that is being investigated. By way of example he pointed out that in the case of the Chernobyl accident only 25% of the close-in Cs-137 was mobile whereas beyond the 30 km Zone, Cs-137 fallout was up to 100% mobile. This theme of K_d variability with respect to soil chemistry and similar factors was also voiced by the rest of the speakers, with examples drawn from studies in other environmental media.

The proposed report on agricultural countermeasures to be taken after a nuclear accident could not be reviewed in final form since the draft provided was still incomplete due to certain disagreements within the two Agencies responsible for its completion--FAO and IAEA. Nevertheless, a number of specific comments and suggestions for improvement were made by the WG which should be reflected in the final version of the report when it is released. This report was of particular

interest because our own National Commission on Radiation Protection (NCRP) is in the later stages of releasing a report on countermeasures for survival after a nuclear attack. I. Lihktarev (Ukraine) provided details of the I-131 contamination of the populations in his country. In addition to the usual measurements, scientists are analyzing trees to confirm the I-131 and C-14 in tree rings as a means of confirmation of the simultaneous release of those two radionuclides from the accident.

Analysis of predictions versus observations represented the main thrust of the Multiple Pathways Working Group. It was demonstrated by the Chairman (FOH) that the model predictions, which reflected a high degree of accuracy were those made by scientists who already had a detailed understanding of the actual conditions reflected in a particular test scenario and of the pathways and processes in that geographic area. The worst predictions were made by the most inexperienced scientists using generic computer codes that had limited capabilities of being modified for site-specific analysis. For the scenario using data sets from southern Finland, several modeling groups produced results that were within a factor of two for almost all test endpoints. The test endpoints included big and small game, mushrooms, berries, milk, beef, fish, and body burdens for children and adult males and females.

The terrestrial group heard a series of miscellaneous reports in its afternoon session on Thursday, 8 July. Forest ecosystem studies in the context of radionuclide contamination and subsequent transfer were the subject of reports by W.R. Schell (USA), F. Strebl (Austria) and O. Slavik (Slovak Republic). Joanne Brown of the NRPB (UK) described the intensive and extensive applied radioecological studies being carried out by the Board. These include soil lysimeter studies, uptake of radionuclides by major fruits, contamination of reclaimed, various grazing animal feeding studies, soil/plant uptake investigations, agricultural countermeasures after a nuclear accident, and a variety of modeling studies. Unlike the United States, the UK has a well organized logically planned program in applied radioecology that will provide a solid basis for countermeasures or remedial actions in the case of a nuclear accident.

The last day was devoted to reports of the working groups' plans for the final year of VAMP activities. In the aquatic arena, Haakanson outlined an ambitious program

of scenario/modeling projects. For lakes at least seven VAMP models will be prepared. These include an Italian (small, generic), Finnish, Swedish-Uppsala (small, mass balance), Swedish-Studsvik, Dutch, and a generic model based on fundamental processes and transfer rates. There are two riverine model scenarios: 1) Clinch River (USA)--a number of groups will prepare predictive models of dose based on scenarios prepared by Gordon Blaylock (USA/ORNL); 2) Dnieper (Ukraine)--several teams of modelers. The final report will encompass the work on these two river systems. The terrestrial group plans center around completing the several reports presently in draft form. All the working groups anticipate having one or more close-out meetings in late 1993 or early 1994.

General Comments

Several general items are worthy of note. First was the positive interactions of the scientists from the FSU. Not only did they engage in open technical dialogues amongst themselves but they also did not hesitate to contribute ideas, information, and details from their own experiences in dealing with contamination problems to the discussions when appropriate. They also demonstrated significant progress in the use of English. Two years ago few could speak any English. This time each FSU scientist gave his report or paper in English albeit with difficulty. When questioned about this phenomenon, all were found to be studying English in one way or another.

Applied radioecology and environmental health physics are thriving in Europe. Plans call for a doubling of the CEC budgets in this area during the next year (1993/1994), with considerable support for joint projects with the scientists from the FSU. The European scientists are well aware of their need to eventually understand ecosystem processes, and there is much enthusiasm among European modeling groups to become involved with scenarios requiring the development of newer and more sophisticated models that can predict with greater precision and accuracy the radionuclide transport or dose assessment to humans and other key organisms. This situation is in sharp contrast to the United States where applied and basic research in radioecology and environmental health physics (which used to be composed of multidisciplinary teams of scientists) has been reduced to the proliferation of computer software containing equations and data sets that are more than a decade old. We note that all European and Canadian models submitted for

testing in the IAEA/VAMP program were dynamic and took advantage of the most recent published data. The few models from the USA were based on equations of quasi-equilibrium typical of assessment codes built in the 1970's for determining compliance with NRC and EPA regulations for routine release conditions.

APPENDIX A

ITINERARY

<u>Date</u>	<u>Activity</u>	<u>Contact</u>
06/27/93	Depart Oak Ridge, Tennessee USA	
06/28/93	Arrive in Vienna, Austria	
06/29/93	Rest and Meeting Preparation	
06/30-07/02/93	BIOMOVs II Post-Chernobyl Data Working Group Meeting. International Atomic Energy Agency, Vienna.	S. Hossain
07/03-04/93	Weekend	
07/05-09/93	International Atomic Energy Agency, Vienna, Coordinated Research Program on Validation of Models for Radionuclide transfer in the Environment.	G. Linsley
07/10/93	Return to Oak Ridge, Tennessee U.S.A.	

APPENDIX B

AGENDA AND ATTENDANCE LIST FOR THE POST CHERNOBYL DATA WORKING GROUP MEETING

Auerbach

Intera Information Technologies
Chiltern House, 45 Station Road, Henley-on-Thames, Oxfordshire RG9 1AT, UK
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INTERA

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Fax Cover Page

Original to Follow Yes/No

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NB: This is only a partial list of recipients.

From Graham Smith and Barbara Watkins Our File No SSI/5.6
Date 22 June, 1993 Operator's Name Martine

Total Number of Pages Including Cover Page 5

If you do not receive all pages please telephone +44 491 410474 immediately.

Remarks **BIOMOVs II Post-Chernobyl Data WG**

Dear Colleague

Please find attached a provisional agenda and attendance list for the Post Chernobyl Data Working Group Meeting, IAEA, Vienna, 30 June - 2 July 1993.

We look forward to meeting you.

Yours sincerely

BIOMOVS II

Post-Chernobyl Data Working Group Meeting

30 June - 2 July 1993

Room A07, IAEA, Vienna

Provisional Agenda

Chairmen: Owen Hoffman, Alexei Konoplev, Ivan Kryshev, and Evgenii Garger

Day 1 - Wednesday 30 June

- 9:00 am** **Register.**
- 9:30** **Opening Remarks and General Introductions - Owen Hoffman.**
- Introduction of Participants.**
- Purpose, Goals and Agenda for Meeting.**
- 10:00** **(1) Scenario W, "Wash Off" of Sr-90 and Cs-137 from Two Experimental Plots Established in the Vicinity of the Chernobyl Reactor: (Watershed Runoff). - Alexei Konoplev**
- a. Current status of Scenario W.**
- 10:40** **COFFEE BREAK**
- 11:00** **b. State of data to be used for model testing.**
- 11:45** **c. Comments and reactions from modellers.**
- 12:30pm** **BREAK FOR LUNCH**
- 13:45** **d. Approaches for soliciting participation of modellers.**
- 14:30** **e. Consideration of a stand-alone scientific paper on the importance of runoff.**
- 15:10** **COFFEE BREAK**
- 15:30** **f. Future plans for Scenario W. (Discussion).**
- 16:00** **g. Concluding remarks and discussion.**
- 17:15** **ADJOURN**

Day 2 - Thursday 1 July

- 9:00am** **Opening Remarks-Goals and Objectives for Session - Owen Hoffman.**
- 9:15** **(2) Scenario CP "Assessment of the Consequences of the Radioactive Contamination of the Chernobyl NPP Cooling Pond" (Cooling Pond Scenario - Ivan Kryshev.**
- a. **Introductory comments and comments from Working Group.**
 - b. **Discussion of the status of the scenario.**
 - c. **Discussion on need for and selection of applicable models and modelling groups appropriate to this scenario.**
- 10:45** **COFFEE BREAK**
- 11:00** **d. Differentiation of models to correspond to the three levels of contamination of pond.**
- e. **Calculation of doses to biota and humans.**
- Data requirements, applicability of models, use of ecological risk analysis approaches, conventional hazard analysis versus risk assessment models for estimating human exposures.**
- f. **Alternatives to the scenario approach to model validation.**
 - g. **Concluding remarks and discussion.**
- 12:00pm** **BREAK FOR LUNCH**
- 13:15** **(3) Resuspension Scenario and Multiple Pathways Scenario for the Poleskoe Region - Evgenii Garger.**
- a. **Status of data for model testing.**
 - b. **Status of scenario development.**
- 15:10** **COFFEE BREAK**
- 15:30** **c. Consideration for individual papers in which authors try to relate their measurements and results with earlier work done elsewhere (Chamberlain, etc) in order to establish a basis for developing an appropriate simulation model.**
- 16:30** **d. Planning for future work on these scenarios.**
- 17:15** **ADJOURN**

Day 3 - Friday 2 July

9:00am	Opening Statement - Owen Hoffman.
9:15	Round table discussion on next steps; other scenarios, eg Pripjat Floodplain.
10:45	COFFEE BREAK
11:00	Head-on discussion of major problems.
12:30	BREAK FOR LUNCH
13:45	Future interactions of working group members.
15:00	COFFEE BREAK
15:15	Planning for next meeting. <ul style="list-style-type: none">a. What do we expect to accomplish.b. Who will do what.
16:30	Closing remarks.
15:15	ADJOURN

BIOMOVs II

Post-Chernobyl Data Working Group Meeting

IAEA, Vienna

30 June - 2 July 1993

Meeting Room A07

Provisional list of Attendees

list of attendees

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✓ R Barrdahl	SSI, Sweden
✓ A Kryshev	Inst of Experimental Meteorology, Russia
✓ Alexei Konoplev	Inst of Experimental Meteorology, Russia
✓ Tatiana Sazykina	Inst of Experimental Meteorology, Russia
✓ Evgenii Garger	Inst of Radioecology, Ukraine
Owen Hoffman	Series Oak Ridge, USA
✓ Stan Auerbach	Series Oak Ridge, USA
✓ Dan Galeriu	Institute of Atomic Physics, Romania/Canada
✓ Peter Barry	PJS Barry, Canada
✓ Ulf Tveten	Inst for Energiteknikk, Norway
✓ E Galan	CIEMAT/IMA, Spain
✓ Charles Miller	Centre for Disease Control, Atlanta, USA
Shaheed Hossain	IAEA, Vienna
✓ Graham Smith	Intera, England
✓ Barbara Watkins	Intera, England
✓ Tom Røisen	Switzerland

APPENDIX C

LIST OF PARTICIPANTS FOR THE VAMP MEETING

Department of Nuclear Energy and Safety
Division of Nuclear Fuel Cycle and Waste Management

Issue No. 3
1993-07-07

NOTIFICATION OF AN AGENCY-SPONSORED MEETING

Title of meeting: 5th RCM of the IAEA/CEC CRP on Validation of Models for Radionuclide Transfer in the Terrestrial, Urban and Aquatic Environments (VAMP)

Dates of meeting: 5-9 July 1993

Scientific Secretaries: Mr. G. Linsley, A2656 Ext.2666
Mr. S. Hossain, A2662 Ext.2668
Mr. M. J. Crick, A2736 Ext. 2729
Ms. K-L. Sjoebloom, A2661 Ext.2667

Secretary: Ms. Nerri Barrios, A2655, Ext. 2702

Conference Clerk: Mr. Dudley Pieries

Places of meeting: Conference Rm. I, 2nd Flr., C-Bldg., Ext.4611
Mtg. Rm. A1171, Ext. 1450
Mtg. Rm. IV, C07, Ext. 1341
Mtg. Rm. A27, Ext. 1391
Mtg. Rm. A0709, Ext. 1319

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APPENDIX D

LITERATURE ACQUIRED

LITERATURE ACQUIRED

Description of Scenario W: "Wash off of Sr-90 and Cs-137 from two Experimental Plots Established in the Vicinity of the Chernobyl Reactor." A. V. Konoplev.

Assessment of the Consequences of the Radioactive Contamination of the Chernobyl NPP Cooling Pond. I.I. Kryshev, F.O. Hoffman, T.T. Sazykina, et al.

Near Field Deposition of Chernobyl Radionuclides (s. Poleskoe). E. Garger, I. Lichtorev, and B. Prister.

Resuspension - (spatial-temporal scenario). E. Garger.

The Chernobyl Radioecological Lessons (in Russian). R.M. Alexsakhn.

Dose Burden for Domestic Animals in the Chernobyl zone (in Russian). R. M. Alexsakhn.

The Efficiency of Agricultural Countermeasures in the Chernobyl Zone - Russia (in Russian). R.M. Alexsakhn.

Handbook of parameter values for the prediction of radionuclide transfer in temperate environments. Martin Frissel (UIR).

The interception, initial and post-deposition retention by vegetation of dry and wet deposited radionuclides. G. Proehl and F.O. Hoffman.

Agricultural countermeasures following accidental release of radioactive materials into the environment (early draft).

Radionuclide contamination of natural ecosystems with emphasis on Forests. W.R. Schell, C. Myttenaere, and G. Shaw.

A field verification of some concentration ratios relating the radiological impacts

assessment of contaminated sites near NPP-Bohunice (Slovak Republic). O. Slavik.

Dose Assessment and Reconstruction in the areas of Russia Contaminated after the Chernobyl accident. I.I. Kryshev, K.P. Makhon, and T.G. Sazykina.

International Arctic Seas Assessment Project (IASAP). (1993-1996). K.L. Sjoebloom and Gordon Linsley.

Dose Reconstruction Studies at Selected Nuclear Weapons Facilities in the USA. C.W. Miller, J. M. Smith, and L.S. Denham.

Assessment of Potential Doses at the Maralinga and Emu Test Sites. S.M. Haywood and J.G. Smith.

Validation of multiple pathways assessment models using Chernobyl fallout data of Cs-137 in region Central Bohemia (CB) of Czech Republic-Scenario CB. Report of the first test exercise of the VAMP Multiple Pathways Assessment Working Group.

Environmental Modeling for the Hanford Environmental Dose Reconstruction Project. B.A. Napier, et al.

Dose Assessment Studies at Former Nuclear Weapons Test sites in Australia. G.A. Williams.

Model Uncertainties Linked to Uncertainties in Kd values. Lars Hakanson.

Modeling of resuspension, seasonality and losses during food processing. VAMP Terrestrial Working Group.

Transfer of Radionuclides by Terrestrial Food Products from Semi-Natural Ecosystems. B.J. Howard, et al. (VAMP Terrestrial Working Group).

Agricultural Countermeasures: Scientific Basis and Practice. Part II (Draft).

**DATE
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6/23/94

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