1 of 1

PROGRESS REPORT
March-May 1994

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**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

June 1, 1994

Technical Editors

Lynn R. Anspaugh
Director

Sheilah M. Hendrickson
Executive Director

Risk Sciences Center
Health and Ecological Assessment Division
Environmental Programs Directorate
Lawrence Livermore National Laboratory
Livermore, California 94550

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For Additional Copies Contact

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

Table of Contents

BACKGROUND

BUDGET

EH Monthly Summary
EH Monthly Detailed Summary

PROGRESS REPORT

MARCH 1994

- **Monthly Progress Report**
- **BIOMOVs II Meeting
(BIOspheric MOdel Validation Study)
March 21–25, 1994**
 - Provisional Agenda**
 - List of Participants**
 - Newsletter No. 10 (draft)**
- **IAEA/VAMP Meeting
(International Atomic Energy Agency / VALidation of Model
Predictions)
March 28–31, 1994**
 - Tentative Programme**
 - List of Participants**
 - Newsletter (draft)**
 - Public Meeting Announcement
Guest Scientists to Speak on Radiation Accidents in the Former
Soviet Union**

Table of Contents (Continued)

APRIL 1994

- **Monthly Progress Report**
 - Table 1. Models involved in dose calculations for Central Bohemia (CB) scenario**
 - Table 2. Models involved in dose calculations for Southern Finland (S) scenario**
 - Figures** BEEF in CB region
BEEF in S region
PORK in CB region
PORK in S region
MILK in CB region
MILK in S region
- **BIOMOVs II Newsletter: No. 10, April 1994**

MAY 1994

- **Monthly Progress Report**
 - Figures** Effective Dose Equivalent for CB region
Effective Dose Equivalent for S region (1986)
Effective Dose Equivalent for S region (1986–1990)
- **VAMP-MP NEWSLETTER**
International Atomic Energy Agency, May 1994

BACKGROUND

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)

Budget Category: HA-01-17

Month Ending: May 1994

DOE Project Number	LLNL Project Number	Project Title	FY 1994 Budget*	FY 1994 Total Cost To Date**	Percent Spent	Remaining Balance	Variance 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 Facilities	391.6	350.6	90%	41.0	90
		Subcontract to: Owen Hoffman (SENES Oak Ridge Inc.)	315.0	273.9	87%	41.1	64
		Lynn Anspaugh / Sheilah Hendrickson LLNL					
TOTALS			391.6	350.6	90%	41.0	187

* 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			1994									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Salary/Benefits	53.6	7.2	10.0	10.7	10.5	19.4	9.9	8.2					129.5
Travel	8.1	4.7	0.1	0.6	0.0	0.0	4.0	3.0					20.5
Procurement and Expenses*	6.8	1.8	1.6	2.4	4.1	0.0	3.4	0.3					20.4
Technical Information Department	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2					0.5
Facility/Service/Distributed Charges	37.7	5.5	7.2	8.0	6.8	12.6	8.4	4.6					90.8
LLNL Overhead+ / Taxes**	-3.0	0.6	12.4	0.2	4.1	8.9	1.3	64.4					88.9
TOTAL	103.2	19.8	31.3	21.9	25.5	41.1	27.1	80.7	0.0	0.0	0.0	0.0	350.6
Liens/Preliens Subcontract \$315 K	208.9	189.8	171.0	149.3	130.0	83.0	57.3	41.1					273.9
Budget Received \$388 K***	388.0	388.0	388.0	388.0	391.6	391.6	391.6	391.6					
Funds Available	284.8	265.0	233.7	211.8	189.9	148.8	121.7	41.0					
* 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

7/14/94

MARCH 1994

EH-40 Monthly Report

March 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

The Post Chernobyl Data Working Group of BIOMOVs II met March 21-25, and the Multiple Pathways Assessment Working Group of IAEA/VAMP met March 28-31. Both meetings took place in Oak Ridge, with SENES Oak Ridge as host. Copies of the agendas and lists of participants are attached to this report.

SENES Oak Ridge, through this subcontract, provided some or all of the travel and living expenses for Dr. A. Konoplev, Dr. I. Kryshev, and Dr. T. Sazykina of Obninsk, Russia; Dr. M. Balonov of St. Petersburg, and Acad. B. Prister, Dr. E. Garger, Dr. G. Laptev, and Dr. G. Lyashenko of Kiev, Ukraine. Dr. Kryshev and Dr. Sazykina have stayed on after the meetings for three weeks of collaborative work as guests of SENES Oak Ridge under this subcontract.

The next meeting of the Multiple Pathways Assessment Working Group of IAEA/VAMP will take place June 20-24 in Helsinki. The next full Research Coordination Meeting of IAEA/VAMP will take place October 31-November 4 in

Vienna. BIOMOVs II will meet in full session just before that, October 24-28, also in Vienna.

Technical accomplishments

The two weeks of meetings were extremely productive for all concerned. Twenty-four scientists from eleven countries were present for one or both of the meetings, in addition to several members of our own staff. Countries represented include Russia, Ukraine, England, France, Canada, Romania, Hungary, Austria, Germany, Poland, and the United States. Many of the participants were able to attend both weeks, and by the end of the sessions the group was interacting freely on numerous topics. Although the information flow was significant in many technical areas, this interaction was especially important in view of current plans for future model testing work. Many of the scientists who had previously been involved in only one or the other of BIOMOVs II and VAMP were able to discuss together potential projects for the programs that will follow the present VAMP and BIOMOVs II programs.

Summaries of both meetings are given below. Further details are given in the draft newsletters from BIOMOVs II and VAMP, copies of which are attached to this report.

The Post Chernobyl Data Working Group of BIOMOVs II considered the three scenarios which had been distributed at or since the October workshop: Scenario CP (cooling pond), Scenario W (wash-off), and Scenario R (resuspension). Preliminary calculations were presented for all three scenarios, with several sets submitted for Scenario W. Questions which had arisen concerning the scenarios were brought up and addressed, and most were satisfactorily answered during the course of the week. This additional information will be incorporated into the scenarios before their release in final form. Present plans call for the revised scenarios to be distributed to interested modelers through BIOMOVs II. Modelers are being requested to submit their predictions by June 15, 1994, to allow time for evaluation of the predictions prior to the next BIOMOVs II meeting in October. The test data will be disclosed at the October meeting. Test data will be distributed on an individual basis to modelers upon receipt of their predictions, together with adequate documentation of the model and approach used to generate the predictions.

The scenario descriptions will also be edited for submission to the *Journal of Health Physics*, which has expressed interest in publishing them as a set. This will permit a

wider availability of the scenario descriptions over a longer period of time. Test data (observations) would be made available to modelers on an individual basis.

Expansions have been proposed to Scenarios CP and W which will increase the scope and potential utility of the scenarios. Stage 2 of Scenario CP will be incorporated into the next version of the document to be released, including the version to be submitted to the *Journal of Health Physics*. This section will include other radionuclides than Cs-137 and will extend the endpoints to other biota than fish. Estimates of risk to humans from hypothetical ingestion of contaminated fish will also be requested. The expansion of Scenario W is presently under development and will be issued at a later date. It will expand the wash-off scenario to an entire flood plain, allowing modelers to examine the mechanisms of secondary contamination of water bodies due to runoff from contaminated soil.

The Multiple Pathways Assessment Working Group of IAEA/VAMP discussed the four scenarios already in progress and two new ones which have been proposed. The IAEA has definite plans for a post-VAMP model testing exercise, and several of the working group's projects will extend into that exercise.

Scenario CB (Central Bohemia) and Scenario S (Southern Finland) are in their later stages now. The final report for CB is in press, and final revisions to the document are being made. Several sets of revised calculations were presented for Scenario S. Major discussion of S, together with a preliminary report, will be the focus of the next working group meeting in June.

The scenario description for the Iput River catchment basin of southern Russia (Scenario I) is nearly complete. A significant difference between Scenario I and Scenarios CB and S is that I takes into consideration detailed information on the protective measures that were applied following the Chernobyl accident. Questions which had arisen about details of the scenario were answered during the discussion. The revised version of the scenario will be presented at the fall Research Coordination Meeting of VAMP as a complete scenario description, ready for immediate use by participants in the post-VAMP exercises. Plans are also in progress for extension of the scenario to include additional radionuclides (including short-lived ones) and the consideration of doses to children.

The developers of Scenario H were not able to attend the working group meeting, and important questions about specific details have not yet been answered. The working group feels that the scenario is worth studying, provided that adequate information can be obtained from the developers. Completion of Scenario H will probably be a part of the post-VAMP exercises.

The two new scenarios proposed for development for the post-VAMP exercises are for the Polesskoe region of the Ukraine and the Techa River area in Russia. The Polesskoe scenario would include data on both Cs-137 and Sr-90 from the Chernobyl accident and would require consideration of the countermeasures used in the region. The Techa River scenario will be based on data from radioactive releases into the river during 1949-1956 and since. The scenario will consider an assessment of risk to humans, as well as past and present whole body concentrations and dose estimates.

SENES Oak Ridge hosted a public meeting on March 29, to take advantage of the presence of scientists from the former Soviet Union. Dr. Michail Balonov of the Institute for Radiation Hygiene, St. Petersburg, and Academician Boris Prister of the Ministry of Chernobyl Affairs, Kiev, gave presentations on their experiences following the Chernobyl accident and on the general situation in their countries with respect to contamination from accidental releases of radioactivity. Data on contamination levels and human dose estimates were presented, including information not widely known outside the former Soviet Union. In addition to these presentations, two videos provided by the IAEA were shown, one about the accident and subsequent cleanup activities at Chernobyl and one about similar activities following the Kyshtim accident. The audience included scientists and nonscientists from the Oak Ridge community, and lively question-and-answer times followed the presentations.

A number of invited presentations were given during both working group meetings. Speakers included Dr. Alexander Shlyakhter (Harvard University, "Uncertainty estimates in scientific models: lessons from trends in physical measurements, population and energy projections."), Dr. Steven Bartell (SENES Oak Ridge, "Perspectives on model validation" and a talk on challenges facing assessment modelers.), and Dr. Keith Eckerman and Dr. Richard Leggett (Oak Ridge National Laboratory, "New ICRP revisions"). Dr. Alexei Konoplev and Dr. Ivan Kryshev, both of Obninsk Russia, gave talks on their experiences with radiation accidents in the former Soviet Union, and Dr. Charley Yu (Argonne National Laboratory) gave a demonstration of RESRAD.

Activities in progress

Dr. I. Kryshev and Dr. T. Sazykina are spending time with us following the meetings. We are working with them on the completion of Scenario CP (including the addition of the second stage), the preparation of CP for submission to the *Journal*

of *Health Physics*, the completion of Scenario I, and the first draft of the Techa River scenario. Drs. Kryshev and Sazykina will also be giving some seminars during their stay in Oak Ridge. Also in progress are the final revisions to the Scenario CB report prior to its publication by the IAEA, and the preparation of Scenarios W and R for submission to the *Journal of Health Physics* together with Scenario CP.

Comparison and evaluation of various U.S. models is continuing, using the time-integrated data from scenarios CB and S of IAEA/VAMP. We are now able to compare several endpoints for a 5-year period for two geographical regions. So far we have run both sets of data with the NCRP model. We are currently using the AIRDOS-EPA model, the methodology described in IAEA Safety Series 57, and RESRAD V505, GENII, MEPAS, and PATHWAY..

Completion of our revisions to the review paper on interception and retention for the Terrestrial Working Group of IAEA/VAMP is in progress.

Work is in progress on a project to review the history of model validation in the ecological and environmental modeling literature. Steve Bartell of SENES Oak Ridge presented some of this material in his talks to the working group meetings.

Travel--Not applicable this month. Trip requests are being prepared for Dr. Hoffman and Dr. Thiessen to attend the next meeting of the Multiple Pathways Assessment Working Group of IAEA/VAMP. This meeting is scheduled for June 20-24 in Helsinki.

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

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

BIOMOVs II
Post Chernobyl Data Working Group Meeting
March 21-25, 1994
Oak Ridge, Tennessee

Provisional Agenda

Monday, March 21

9:00 - 9:30	Registration
9:30 - 10:30	Welcome
	Opening Remarks and General Introductions
	Introduction of Participants
	Purpose, Goals, and Agenda for Meeting
10:30 - 11:15	Invited Presentation by Dr. Alexander Shlyakhter, Harvard University
	"Statistics of past errors as a source of safety factors for current models"
11:15 - 12:00	Introduction of Scenario CP
12:00 - 1:30	Lunch
1:30 - 4:30	Discussion of calculations for Scenario CP-1

Tuesday, March 22

9:00 - 10:00	Invited Presentation by Dr. Steven Bartell, SENES Oak Ridge
	"Perspectives on Model Validation"
10:00 - 12:00	Discussion of the expansion of Scenario CP
	Discussion of the deadline for calculations for CP-1
12:00 - 1:30	Lunch
1:30 - 4:30	Introduction of Scenario R
6:30 - 10:00	Optional event: Department of Energy-sponsored public meeting on the environmental remediation activities going on in the Oak Ridge area

Wednesday, March 23

9:00 - 11:30 Discussion of Scenario R:
 Identification of points requiring clarification and/or
 additional information needs
 Identification of dates for initial and final calculations
 Finalization of Scenario R
11:30 Lunch
12:15 Leave for Tour of Oak Ridge National Laboratory
1:00 - 4:00 Work session: TBA

4:30 Leave for Social evening at the Cross-Eyed Cricket

Thursday, March 24

9:00 - 12:00 Review of Scenario W
 Discussion of calculations for Scenario W
 Identification of remaining points requiring clarification.
 Identify dates for final calculations
12:00 - 1:30 Lunch
1:30 - 4:30 Work session: Expansion of Scenario W

Friday, March 25

9:00 - 12:00 Discussion of future scenario possibilities using complete data
 sets involving human exposures in the Polesskoe region
 Discussion of publication of Scenarios CP, W, and R
 Decisions on action items for the working group
12:00 Lunch

Post Chernobyl Data WG Meeting
Oak Ridge, Tennessee, 21 - 25 March 1994
List of Participants

<u>Surname</u>	<u>Name/Company</u>	<u>Tel/Fax number</u> <u>Email/Telex</u>
Apostoaie	Mr. Iulian Apostoaie SENEs Oak Ridge, Inc. 677 Emory Valley Road, Suite C Oak Ridge, Tennessee 37830	t: (615) 483-6111 f: (615) 481-0060
Balonov	Dr. Michail Balonov Head of the Dept. of Radioecology Institute of Radiation Hygiene RSFSR Ministry of Public Health 8, Mira St. 197101, St. Petersburg Russia	t: 7-812-233-4843 f: 7-812-232-7025 7-812-314-3360 e: tlx:
Bartell	Dr. Steven Bartell SENEs Oak Ridge, Inc. 677 Emory Valley Road, Suite C Oak Ridge, Tennessee 37830	t: (615) 483-6111 f: (615) 481-0060 e: 73362.553@compuserve.com
Feng	Ms. Ying Feng SENEs Oak Ridge, Inc. 677 Emory Valley Road, Suite C Oak Ridge, Tennessee 37830 USA	t: (615) 483-6111 f: (615) 481-0060
Fields	Dr. David E. Fields Oak Ridge National Laboratory Oak Ridge, Tennessee 37831-6383 USA	t: 615 574 5435 f: 615 574 1778 e: FIELDSDE@ORNL.GOV DEF@ORNL.GOV
Galeriu	Dr. Dan Galeriu Institute of Atomic Physics Radioecology Laboratory, Romania c/o Environmental Research Branch Chalk River Laboratories AECL - Chalk River Ontario KOJ 1JO CANADA	t: +1 613 584-3311x1733 f: +1 613 584-1221 e: Dan.Galeriuqnve.crl.aecl.ca

Post Chernobyl Data WG Meeting
Oak Ridge, Tennessee, 21 - 25 March 1994

Garger	Dr. Evgenii Garger Institute of Radioecology UAAS 14 Tolstoy St Kiev 33 UKRAINE	t: +7 044 220 5313 f: +7 044 220 9346 e: tlx: 131 498 PTB SU -
Hammonds	Ms. Jana Hammonds SENES Oak Ridge, Inc. 677 Emory Valley Road, Suite C Oak Ridge, Tennessee 37830	t: (615) 483-6111 f: (615) 481-0060
Hoffman	Dr. F. Owen Hoffman SENES Oak Ridge, Inc. 677 Emory Valley Road, Suite C Oak Ridge, Tennessee 37830	t: (615) 483-6111 f: (615) 481-0060
Kanyár	Dr. Béla Kanyár National Research Institute for Radiobiology & Radiohygiene	t: +36-1-226-6531 f: +36 1 226 6531
Konoplev	Dr. Alexei Konoplev Institute of Experimental Meteorology 82 Lenin Street Obninsk, Kaluga Region 249020 RUSSIA	t: 08439 71896 f: +7 095 255 2225 e: typhoon@adonis.ias.msk.su typhoon%adonis@sovam.co tlx: 412633 INFOR SU
Kryshev	Dr. Ivan Kryshev Institute of Experimental Meteorology 82 Lenin Street Obninsk, Kaluga Region 249020 RUSSIA	t: Obninsk 7 12 89 f: +7 095 255 2225 e: typhoon@adonis.ias.msk.su typhoon%adonis@sovam.co tlx: 412633 INFOR SU
Laptev	Mr. Gennady Laptev Ukrainian Hydrometeorological Research Institute Nauka Av 37 252650 Kiev UKRAINE	t: 044-265-8680 f: +044 265 3355 e:

Post Chernobyl Data WG Meeting
Oak Ridge, Tennessee, 21 - 25 March 1994

Lyashenko	Mr. Gennady Lyashenko Cybernetics Center of Ukrainian Academy of Sciences Glushkov Av 42 252127 Kiev, UKRAINE	t: 044 266 6187 f: 044 266 5583 e: mark@dem.ipmms.kiev.va
Miller	Dr. Charles Miller Center for Disease Control and Prevention, MS-F35 4770 Buford Highway NE Atlanta, Georgia 30341-3274 USA	t: +1 404 488 7040 f: +1 404 488 7044 e:
Nair	Dr. Shyam Nair 305 Lawton Blvd Knoxville, Tennessee 37922 USA	t: 615/966-0161 f:
Prister	Prof Academician Boris Prister Ukrainian Academy of Agricultural Sciences 9 Suvorova Street 252010 Kiev UKRAINE	t: +7 044 296 3891 f: +7 044 226 3284 e: tlx: 131 498 PTB SU-
Santucci	Mr. Pascal Santucci CEA-IPSN CEN-FAR SERGD BP 6-92265 Fontenay-aux-Roses	t: +33 1 46 54 88 98 f: +33 1 46 54 71 35 e: Santucci@sofia.far.cea.fr
Sazykina	Dr. Tatiana G. Sazykina Institute of Experimental Meteorology 82 Lenin Street Obninsk, Kaluga Region 249020 RUSSIA	t: +7 08439 71289 f: +7 095 255 2225 e: typhoon@adonis.ias.msk.su typhoon@adonis.iasnet.com tlx: 412633 INFOR SU

Post Chernobyl Data WG Meeting
Oak Ridge, Tennessee, 21 - 25 March 1994

Shylakhter	Dr. Alex Shlyakhter 4 Greenway Court Apt. 4 Brookline, Massachusetts 02146	t: 617/232-3703 f:
Thiessen	Dr. Kathleen Thiessen SENES Oak Ridge, Inc. 677 Emory Valley Road, Suite C Oak Ridge, Tennessee 37830	t: (615) 483-6111 f: (615) 481-0060
Thompson	Dr. Patsy Thompson AECB Radiation & Env Protection Div Directorate of Analysis and Assess P.O. Box 1046, Station 'B' 280 Slater Ottawa K1P 5S9 CANADA	t: +1 613 947 3352 f: +1 613 995 5086 e: tlx: 053 3771
Watkins	Dr. Barbara Watkins Intera Chiltern House 45 Station Road Henley on Thames Oxon RG9 1AT UK	t: +44 491 410474 f: +44 491 576916 e: BIOMOVVS@intera.UK tlx:

NEWSLETTER No. 10 (draft)

ANNOUNCEMENT FOR VIENNA WORKSHOP 24-28 OCTOBER 1994

POST-CHERNOBYL DATA WORKING GROUP MEETING

WG leader: Owen Hoffman (SENES Oak Ridge)

A Post-Chernobyl Data Working Group meeting was held March 21-25, 1994, at Oak Ridge, Tennessee, U.S.A. The meeting was hosted by SENES Oak Ridge. Twenty-four participants from America, Russia, Ukraine, Hungary, Canada, Romania, France, China, and England had a most enjoyable and productive meeting. Working Group activities were interspersed with a number of very interesting invited presentations on approaches to model validation, plus a fascinating visit to the Oak Ridge National Laboratory and the historic Graphite Reactor.

The WG had three main objectives for the week. The first was to discuss the three scenarios which had been distributed following the 1993 Vienna Workshop. The second was to consider preliminary calculations which had been made for each of the scenarios and subsequently to make any required changes to the scenarios. The third objective was to discuss expansions of the scenarios to allow a second phase of calculations. All three scenarios provide an excellent opportunity to test radioecological models against extensive data sets which have been collated by our Ukrainian and Russian colleagues following the Chernobyl accident in 1986. The great interest which has been shown in these scenarios and the valuable data which have been collated is reflected in the large number of people, both from within the BIOMOVs community and new participants, who are actively engaged in undertaking model testing using the scenarios.

SCENARIO CP

Scenario CP (Version 1.03) has been developed to test models for radioactive contamination of aquatic ecosystems; it is based on data from the cooling pond of the Chernobyl Nuclear Power Plant (NPP). The cooling pond is a suitable model for studying the dynamic processes of radionuclide migration and accumulation in closed aquatic ecosystems. The dynamic processes which are investigated in detail include the accumulation of Cs-137 in different trophic levels; the bioaccumulation and loss of Cs-137 from fish flesh; and the dependence on size of different species of fish in the accumulation of Cs-137.

Three sets of preliminary results were presented during the WG meeting; several other sets of results are promised, as wide interest was expressed in the scenario. The first set of results was given by Ying Feng, a student from China currently studying in America. The calculations had been performed on the assumption that there had been a nuclear accident and that there was a need for a rapid assessment of the possible radiological consequences based on limited data and information, using a bounding analysis

approach. Dan Galeriu (currently with AECL, Canada) provided some early, preliminary calculations, but Dan is eager to develop his model further following the group discussions. A third set of results were received by e-mail from Rudie Heling (Kema Laboratories, Netherlands). Rudie had been uncertain whether the cooling pond circulation pumps had been in continuous use and so he had undertaken two sets of calculations - the first assumed the pumps had been turned on; the second assumed that the pumps were not in operation. A number of other questions were raised during the discussion, and the information will be included in an updated version of the scenario which will be distributed to all those with an interest in the work of the group.

Ivan Kryshev and Tatiana Sazykina presented some very interesting suggestions for the expansion of the scenario for a second phase of calculations and model testing. Stage 1 of the scenario had concentrated on the dynamics of the Chernobyl NPP cooling pond contamination with Cs-137 only. The objective of Stage 2 of the scenario is to model the effects of other radionuclides in the post-accident period of 1986 to 1990 and to extend the endpoints to other biota than just fish. In addition it is proposed that estimates of risk to human health from the consumption of contaminated fish are made. Modellers will have the opportunity to undertake a reconstruction of the dynamics of radionuclide concentrations in water, sediments and biota based on information of the total concentrations of different radionuclides which entered the cooling pond after the accident. This second phase will also provide the opportunity for model comparisons using the collated experimental data since this will be a Type B test.

SCENARIO R

This scenario examines the complex subject of the effects of resuspension of contaminated soils and dusts following the deposition of radionuclides after an accident. Scientists in the Ukraine have collated data for two locations within the 30-km zone, an urban area of Kiev, and a location 40 to 60 km west of the Chernobyl NPP. The objective of the scenario is not to study resuspension processes in detail. However, the scenario does provide an excellent opportunity to test models for assessing the long-term impact of future or past releases of radioactive materials and the contribution which resuspension would have on that assessment.

The WG meeting provided the first opportunity to discuss the scenario since its initial distribution. There was a very active debate over the need to include data for Pu since this radionuclide would cause an important health physics problem due to the inhalation of resuspended material. However, it was agreed that the purpose of the scenario is to help test and refine models which account for resuspension and therefore the emphasis should be on the best experimental data set that is available and this is for Cs-137.

Dan Galeriu gave a presentation on a possible approach to modelling resuspension, and Dr. Frank Gifford from ORNL was also present for part of the discussion to offer advice and comments. Only a few modifications will be made to the current version of the

scenario; these will be distributed as soon as possible and then calculations will be invited from all those who have expressed an interest in the process of resuspension.

SCENARIO W

This scenario 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, the effects that this has on the transfer of contamination from soil to water, and the geochemical and geophysical processes which affect such transfer. Although the present scenario deals with the contamination of water following the aerial deposition of radionuclides following the Chernobyl accident, the processes underlying the scenario may be adapted to many sources of contamination of surface and ground water and hence has wide appeal to many ecological situations. Overall, the scenario calculations will provide an evaluation of the movement of contaminants from soil to water, calculations for the attenuation and migration of contaminants in soil over different time scales, and increased understanding of contaminant transport at the process level.

The scenario calculations will be divided into at least two phases. The first phase will include estimations of the surface water runoff from two experimental plots located near to the Chernobyl NPP and the time-dependent surface water concentrations of Cs-137 and Sr-90 in the dissolved and suspended states. The expansion of the scenario for a second phase of calculations is discussed later.

Five sets of results were presented at the WG meeting and at least another four sets of calculations are promised. Presentations were made by Shyam Nair (Bechtel International, Tennessee), Béla Kanyár (NRIRR, Hungary) and Gennady Lyashenko (Cybernetics Center of UAS, Ukraine). Results were also received from Wolfgang Raskob (KfK, Germany) and Alex Popov (Computational Centre, SPA Typhoon, Obninsk). Unfortunately they could not attend the WG meeting and so their results were presented by the scenario author, Alexei Konoplev (SPA Typhoon, Obninsk). Dan Galeriu (currently with AECL) and three other colleagues from Russia and the Ukraine also intend to submit calculations. Differences in results were linked with the overall purposes of the models used. For example, some models were designed for radiological assessment purposes whilst others were mainly hydrological models. This led to differences in emphasis on the mechanisms and processes of importance and the level of complexity of the models for them. It was stated that such a complex process of radionuclide runoff needs to be addressed by complex models. However Owen Hoffman pointed out that one lesson learnt from the BIOMOVs I exercise was that more complicated models do not necessarily lead to more accurate model predictions. It will be interesting to compare the models used and the results obtained during this first phase of the scenario and to see how the predictions compare with the test data.

Gennady Laptev (Hydrometeorological Institute, Kiev) presented the proposed extension of the scenario for phase 2 which had been prepared by himself and Oleg

Voitsekhovitch (Hydrometeorological Institute, Kiev). This second phase of the scenario is in an advanced state of preparation and will provide a good opportunity to test the understanding of the mechanisms of the secondary contamination of water bodies with contaminants over different time and spatial scales.

The main hydrological processes which were responsible for the washoff of radionuclide contamination were snowmelting, rainstorms and the impact of flooding of the river flood plain due to ice jams. The first two process are considered in the phase 1 of the scenario. The third process is investigated in the second phase. As soon as this extension to the scenario is ready it will be distributed to all those who have expressed an interest in the WG.

TIME SCHEDULES

As mentioned above, there will be a few minor amendments to phase 1 of each of the three scenarios. The extra information will be distributed as soon as possible. Following this distribution, calculations are invited to be sent to The Secretariat no later than 15 JUNE 1994. This will allow analysis of results prior to the next Workshop in Vienna from the 24th to 28th October, 1994, when the first set of the test data will be released. However, if participants can send in their results earlier than this date then some of the test data can be released to individuals to allow continuation of calculations. This release of the test data would be on the understanding that it should be kept confidential until the October Workshop.

INVITED PRESENTATIONS

Owen Hoffman had arranged for two invited presentations to be given to the WG participants in connection with approaches to model validation. These are described briefly below.

1. Uncertainty estimates in scientific models: lessons from trends in physical measurements, population and energy projections. By: Alexander Shlyakhter (Harvard University).

Dr. Shlyakhter presented the results of a systematic analysis of actual vs. estimated uncertainty in scientific models. There is no single scale of uncertainty since there is a range from simple parametric uncertainty to crucial uncertainty of which model of several possibilities to choose. Uncertainty arises due to errors in model structure as well as uncertainty in model parameters. The latter is less important but easier to assess. The elicitation of expert judgments is often used, but often confidence in these is greater than should be. With environmental measurements and field data it is often hard to estimate actual errors in routinely collected data. Probabilities of large deviations from the true values are often parameterized by an exponential distribution with the slope determined by the data. Dr. Shlyakhter suggested that an alternative

parameterization by Levy stable distributions based on the fractal model for the distribution of errors could be used instead. A description of this approach and the application to a number of low probability/high consequence events was provided in the paper distributed by Dr. Shlyakhter. This paper could be made available through the Secretariat for anyone interested in the subject.

2. Perspectives on Model Validation. By: Steven Bartell (SENES Oak Ridge)

Steven Bartell started his talk with the provocative question as to whether there is such a thing as a valid model. The presentation considered some of the historical perspectives to addressing model validation, methods for model: data comparisons, and model-testing and decision-making issues. These considerations were illustrated with reference to a standard water column model (SWACOM) used by Steven Bartell.

As part of the historical perspective, it was said that the BIOMOVs Glossary defines validation as an adequate representation of the physical world, whilst verification is given as a demonstration of internal correctness. However, Steven Bartell pointed out that these definitions are the opposite of those given in the past by Caswell and also recently by Oreskes et al. in Science volume 263: 641-646 (1994).

Steps in the process of validation were considered to be:

- selection of validity criteria
- determination of appropriate error measures
- specification of minimum sample size
- collection of data and model results
- testing of data for significance and correlations
- computation of bias and testing for normality
- computation of model and data variance and testing
- use of appropriate statistical tests to assess validity

Steven Bartell pointed out that one can always falsify a model, and one cannot really validate a model. The real issue is "Is it a useful model?". But even that requires a definition of utility and adequacy! The ensuing discussion within the WG acknowledged the fact that criteria for usefulness on model validity has been intentionally kept outside of the model testing exercises. Different models and model users will have unique criteria for different types of assessment questions.

3. New ICRP Revisions. By: Keith Eckerman and Richard Leggett (ORNL)

Special presentations were given by Drs. Keith Eckerman and Richard Leggett (ORNL) that gave the WG participants insights into the new revisions of ICRP Publication No. 56; these revisions will reflect the recommendations given in ICRP 60. The revised publication is now in press. Problems with overestimating doses and risks for bone surface-seeking radionuclides, however, have been discovered and remain to be corrected. ICRP has formed a new subgroup to investigate the uncertainty and

reliability associated with the use of recommended internal dose coefficients. This new information provided the BIOMOVs II WG with unique information about the problems and approaches in the closely related fields of human metabolism and biokinetics.

INTERNATIONAL ATOMIC ENERGY AGENCY

Tentative Programme for the VAMP-MP Working Group Meeting
28-31 March 1994, Oak Ridge, Tennessee, USA

Time	Monday 28 March 1994	Tuesday 29 March 1994	Wednesday 30 March 1994	Thursday 31 March 1994
09.00 - 10.40	09.00-09.30: Registration • Welcome and introduction • General information • Progress and development of the VAMP-MP WG (<i>Hossain</i>)	• Discussion of Scenario I (contd.)	• Discussion of Scenario H (contd.)	• Working session as necessary
10.40 - 11.00	Coffee break	Coffee break	Coffee break	Coffee break
11.00 - 12.00	• Progress of the analysis of CB and S data (<i>Hoffman/Apostolaei</i>)	• Discussion of Scenario I (contd.)	• Discussion of Scenario H (contd.)	• Working session as necessary
12.00 - 13.30	Lunch break	Lunch break	Lunch break	Lunch break
13.30 - 15.10	• Discussion of revised Scenario S calculations • Discussion of Scenario I	• Discussion of Scenario H	• Finalization of Scenarios I and H • Future planning of I and H • Discussion of future scenario possibilities using human exposure data of the Pleskoe region	• Working session as necessary
15.10 - 15.30	Coffee break	Coffee break	Coffee break	Coffee break
15.30 - 17.00	• Discussion of Scenario I (contd.)	• Discussion of Scenario H (contd.)	• Discussion of plans for international projects after BIOMOVs II and VAMP • Discussion of preliminary conclusions based on data from CB and S • Closure	• Working session as necessary
19.30 - 21.30		Public meeting with guest scientists from Russia and Ukraine	Social evening	

VAMP Meeting
March 28-31, 1994

List of Participants

Mr. Iulian Apostoaei
SENEs Oak Ridge, Inc.
677 Emory Valley Road, Suite C
Oak Ridge, Tennessee 37830
FAX: (615) 481-0060
PHONE: (615) 483-6111
e-mail: 73304-3262@compuserve.com

Dr. Stanley I. Auerbach
SENEs Oak Ridge, Inc.
677 Emory Valley Road, Suite C
Oak Ridge, Tennessee 37830
FAX: (615) 481-0060
PHONE (615) 483-6111
e-mail: 73304-3262@compuserve.com

Dr. Michail Balonov
Institute of Radiation Hygiene
ul. Mira 8, St. Petersburg
Russian Federation
FAX: 7 (812)232-70-25 or 7(812)314-33-60
PHONE: 7(812)233-48-43

Ms. Ying Feng
SENEs Oak Ridge, Inc.
677 Emory Valley Road, Suite C
Oak Ridge, Tennessee 37830
FAX: (615) 481-0060
PHONE: (615) 483-6111
e-mail: 73304.3262@compuserve.com

Mr. David E. Fields
Health Sciences Research Division
Bldg. 7509
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831-6383
U.S.A.
FAX: (615) 574-1778
PHONE: (615) 574-5435
e-mail: Fieldsde@ornl.gov

Mr. Dan Galeriu
c/o Chalk River Nuclear Laboratories
Chalk River, Ontario K0J 1J0
Canada
FAX: (613) 584-1221
PHONE: (613) 586-3311 ext. 4733
e-mail: dan.galeriu@nve.crl.aecl.ca

Dr. E. Garger
Institute of Radioecology
UAAS
14 Tolstoy St.
Kiev 33
Ukraine
FAX: 7 (044) 220-93-46

Mr. Emmanuel Gnanapragosam
Argonne National Laboratory
Building 900
9700 South Cass Avenue
Argonne, IL 60439
U.S.A.
e-mail: kirthi@anl.gov

Ms. Jana Hammonds
SENEC Oak Ridge, Inc.
677 Emory Valley Road, Suite C
Oak Ridge, Tennessee 37830
U.S.A.
FAX: (615) 481-0060
PHONE: (615) 483-6111
e-mail: 73304.3262@compuserve.com

Ms. Sheilah Hendrickson, University of California
Lawrence Livermore National Laboratory
P.O. Box 808, L-453
Livermore, CA 94551
U.S.A.
FAX: (510) 424-6408
PHONE: (510) 424-6410
e-mail: hendrickson3@llnl.gov

Dr. F. Owen Hoffman
SENES Oak Ridge, Inc.
677 Emory Valley Road, Suite C
Oak Ridge, Tennessee 37830
U.S.A.
FAX: (615) 481-0060
PHONE: (615) 483-6111
e-mail: 73304.3262@compuserve.com

Mr. Shaheed Hossain
International Atomic Energy Agency
Wagramerstrasse 5
P.O. Box 100
Vienna, A-1400
Austria
FAX: 43-1234564
PHONE: 43-12360-2668

Mr. Béla Kanyár
National Research Institute for Radiobiology and Radiohygiene
Budapest 22, Anna u.5
P.O. Box 101
H-1775 Budapest
Hungary
FAX and PHONE: (36-1) 226 6531
e-mail: h5211kan@ella.hu

Mr. Alexei Konoplev
Institute of Experimental Meteorology
SPA "Typhoon"
Lenin Av. 82, Obninsk
Kaluga Region
Russian Federation
FAX: 7 (095) 255-22-25
PHONE: 7-08439-71896
TELEX: 412633 INFOR SU
e-mail: typhoon@adonis.iasnet.com

Mr. Pawel Krajewski
Central Laboratory for Radiological Protection
ul. Konwaliowa 7
03-194 Warsaw
Poland
FAX: (22) 111616

Dr. Ivan Kryshev and Tatiana Sazykina
Institute of Experimental Meteorology SPA "Typhoon"
82 Lenin Av.
Obninsk
Kaluga Region 249020
Russia
FAX: 7(095) 255-22-25
PHONE: 7(08439) 71289
TELEX: 412633 INFOR SU
e-mail: typhoon@adonis.iasnet.com

Dr. Gennady Laptev
Research Scientist
Ukrainian Hydrometeorological Research Institute
Nauka Av., 37
Kiev, 252028
Ukraine
FAX: 7(044) 265-1130
PHONE: 7(044) 519-9460
e-mail: voitsekh@voi.vedos.kiev.ua

Mr. Heinz Müller
GSF Institut für Strahlenschutz
Neuherberg, Postfach 1129
D-85758 Oberschleissheim
Germany
FAX: (49) 89 3187 3363
PHONE: (49) 89 3187 2283
e-mail: mueller@gretel.gsf.de

Academician Boris Prister
First Deputy Minister
Ministry of Chernobyl Affair
Suvorova St. 9
Kiev, Ukraine 252196
FAX: 7 (044) 290-42-55

Dr. Joseph Shinn
Health and Ecological Assessment Division
Lawrence Livermore National Laboratory
P.O. Box 808, L-453
Livermore, CA 94551-9900
FAX: (510) 423-6785
PHONE: (510) 422-6806
e-mail: shinn1@llnl.gov

Dr. Kathy Thiessen
SENES Oak Ridge, Inc.
677 Emory Valley Road, Suite C
Oak Ridge, Tennessee 37830
FAX: (615) 481-0060
PHONE: (615) 483-6111
e-mail: 73304.3262@compuserve.com

Mr. John Weeks
Labat-Anderson Inc.
575 Oak Ridge Turnpike
Oak Ridge, TN 37830
U.S.A.
TEL: (615) 481-0171
FAX: (615) 482-7364

Mr. Charley Yu
Argonne National Laboratory
Building 900
9700 South Cass Avenue
Argonne, IL 60439
U.S.A.
FAX: (708) 252-4624
PHONE: (708) 252-5589
e-mail: yuc@smtplink.eid.anl.gov

IAEA/VAMP

MULTIPLE PATHWAYS ASSESSMENT WORKING GROUP MEETING

WG leader: Owen Hoffman (SENES Oak Ridge)

A Multiple Pathways Assessment Working Group meeting was held March 28-31, 1994, in Oak Ridge, Tennessee, U.S.A. The meeting was hosted by SENES Oak Ridge. Twenty-four people participated, including scientists from the United States, Canada, Russia, Ukraine, Romania, Austria, Hungary, Poland, and Germany.

The working group focused on the status of and future plans for each of the model testing scenarios developed or being developed by the group: Central Bohemia, Southern Finland, Iput River, and Hanford. Two additional scenarios to be developed under the post-VAMP program were also discussed: the Techa River and the Poleskoe region.

One particular item of interest, first brought up at the October working group meeting in Helsinki, was the comparison of the test data from two regions, Central Bohemia and southern Finland. Comparison of the test data, normalized for total deposition, indicates that differences in the soil characteristics are critical for determining contaminant availability in the years following the accident. The Czech scientists who provided the test data for Central Bohemia have recently provided additional data, extending the set of available measurements to include an additional two years (1986-1991); this has allowed a better comparison of these data with the data from Finland.

A highlight of the meeting was a public session on the subject of radiation accidents in the former Soviet Union. Dr. Michail Balonov of Russia and Academician Boris Prister of Ukraine gave talks on their personal experiences with these accidents and told about the situations still facing their respective countries. Two films provided by the IAEA were shown during the meeting, one on Kyshtim and one on Chernobyl. A number of people from the community attended, both scientists and nonscientists, and there were lively periods of questions from audience members.

Several presentations were given during the technical meeting as well, including a talk on the challenges facing assessment modellers given by Dr. Steven Bartell of SENES Oak Ridge, as well as talks from two other Russian participants, Dr. Alexei Konoplev and Dr. Ivan Kryshev, concerning their experiences with Chernobyl and other radiation accidents. In addition, Dr. Charley Yu of Argonne National Laboratory gave a presentation of the newest version of the model RESRAD.

Status of Scenarios

CENTRAL BOHEMIA: The final report for Scenario CB is in press. A small work session was held to discuss some of the remaining details necessary to complete the report. Final revisions are in progress to the main text and to some figures. The report will be issued in final form as soon as possible.

SOUTHERN FINLAND: Several participants presented revised predictions for this scenario, based on the test data which were released following submission of participants' initial predictions in 1993. Major discussion of Scenario S, together with a preliminary draft of the report, will be the focus of the next working group meeting, presently scheduled for 20-24 June in Helsinki.

IPUT RIVER CATCHMENT BASIN: Scenario I is in the final stages of completion. A significant difference between Scenario I and the earlier Scenarios, CB and S, is that Scenario I takes into consideration detailed information on protective measures that were applied in the region following the accident. A number of questions were brought up concerning details that modellers felt were necessary to complete the scenario. Many of these were addressed during the session. A revised version of the scenario is now being completed for distribution. The present plan is to present the scenario at the fall RCM meeting as a complete scenario description, ready to be used for model predictions by participants in the post-VAMP model-testing exercises.

A proposal for the extension of the scenario was also heard. These plans call for the addition of predictions for doses to children and for the consideration of additional radionuclides, particularly the short-lived ones. This project would also be a part of the post-VAMP exercises.

HANFORD: No revisions have been made to Scenario H since the working group meeting, and no representative from the scenario's authors was in attendance. Several important questions remain which must be answered before the scenario can be used for making predictions. Further consideration of the scenario will wait until these questions can be adequately addressed. The scenario will be included in the post-VAMP exercises once the description is finalized.

POLESSKOE REGION: A proposal was made for a multiple pathways exercise to be developed for the Poleskoe region of Ukraine, based on data from the Chernobyl accident. This scenario would include description of the countermeasures applied following the accident, and would consider both Cs-137 and Sr-90. Soil profiles would be requested in addition to contaminant concentrations in foodstuffs, whole body concentrations, and dose estimates. This scenario will be developed as part of the post-VAMP exercises.

TECHA RIVER: A proposal was made for a model-testing exercise to be based on data from the radioactive releases into the Tcha River of Russia (1949-1956 and

current). This scenario will consider past and present whole body concentrations and dose estimates for humans, as well as an assessment of risk to humans from exposure to the contaminants released into the river. The first draft of the scenario description is in progress, and the scenario will be used during the post-VAMP exercises.

Guest Scientists To Speak On Radiation Accidents In The Former Soviet Union

Visiting scientists from Russia and Ukraine will be featured at a public meeting to be held Tuesday, March 29, at 7:30 p.m. at the Garden Plaza Hotel in Oak Ridge. The meeting is sponsored by SENES Oak Ridge, Inc., Center for Risk Analysis. The scientists will be in town as participants in two international meetings which SENES Oak Ridge is hosting under the auspices of the Swedish Radiation Protection Institute and the International Atomic Energy Agency. The invited speakers include several highly ranked individuals:

Academician Boris Prister, the Deputy Minister of Chernobyl Affairs for Ukraine;

Dr. Michail Balonov, Head of the Department of Radioecology of the Institute of Radiation Hygiene in St. Petersburg, Russia, and co-editor of *The Chernobyl Papers*;

Dr. Alexei Konoplev, Dr. Ivan Kryshev, and Dr. Tatiana Sazykina, all from the Institute of Experimental Meteorology, SPA "Typhoon," Obninsk (sister city of Oak Ridge); and

Dr. Evgenii Garger, Director of the Institute of Radioecology of the Ukrainian Agricultural Academy of Sciences in Kiev.

The meeting will include brief presentations from several of the guest scientists, during which they will describe their experiences with radiation accidents (especially Chernobyl) in the former Soviet Union and the consequences of these accidents. The individual presentations will be followed by a question-and-answer session during which members of the public may address their questions to some of Russia's and Ukraine's leading experts in radiation sciences.

APRIL 1994

EH-40 Monthly Report
April 1-30, 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

Trip requests have been submitted for Dr. Hoffman and Dr. Thiessen to attend the next meeting of the Multiple Pathways Assessment Working Group of IAEA/VAMP. This meeting is scheduled for June 20-24 in Helsinki. Participation forms and hotel reservation forms have been sent to the appropriate people in Vienna and Helsinki.

Technical accomplishments

(1) Dr. I. Kryshev and Dr. T. Sazykina spent three weeks with us following the March meetings. We worked with them on the completion of Scenario CP for BIOMOVs II (including the addition of a second stage, involving calculations of dose and risk assessment pertaining to the contamination of the Chernobyl cooling pond), the preparation of CP for submission to the *Journal of Health Physics*, the completion of Scenario I (Ipit River) for VAMP, and the first draft of the Techa

River scenario, also for VAMP. Altogether, their visit was a time of productive collaboration on several projects.

Scenario CP (both stages) has been sent to the BIOMOVs II secretariat for distribution. The condensed version of CP for *Health Physics* is essentially complete and ready to be joined with condensed versions of Scenarios R and W for submission to the journal. Scenario I has been sent to the IAEA secretariat for distribution to VAMP participants. This scenario will be a key project for the post-VAMP model testing exercises. The first draft of the Techa River Scenario (Scenario T) has been completed; this scenario, which is almost ready for initial distribution to VAMP participants, will also be a central part of the post-VAMP exercises. Scenario T is based on data from radioactive releases into the Techa River, in the Ural Region of Russia, during 1949-1956 and since. In addition, preliminary drafts were prepared for two manuscripts to be submitted to the open literature on the subject of radioactive contamination and risk assessment in the region of the Techa River and the Ural Mountains.

Drs. Kryshev and Sazykina also gave some seminars during their stay in Oak Ridge. These seminars included talks on environmental contamination and dose assessment in the areas of Russia exposed to radioactive hazards, given to the East Tennessee Chapter of the Health Physics Society and to a Nuclear Engineering class from the University of Tennessee, and a talk on ecological modeling given at SENES Oak Ridge to scientists from Oak Ridge National Laboratory.

(2) Our final revisions to the Scenario CB report prior to its publication by the IAEA have been completed and sent to the IAEA.

(3) Comparison and evaluation of various U.S. models is continuing, using the data from scenarios CB (Central Bohemia) and S (southern Finland) of IAEA/VAMP. So far, four models used in the U.S. have been run:

- NCRP screening model (NCRP Commentary No. 3)
- AIRDOS-EPA
- IAEA Safety Series 57 (SS-57)
- RESRAD

All of these models are quasi-steady state--that is, their equations are derived with the assumption that the radionuclide is in equilibrium in different environmental compartments. The first three models are designed to provide conservative estimates, or, in other words, not to underestimate. The RESRAD code, on the

other hand, was developed to produce a best estimate result. Tables 1 and 2 present information on the other models participating in the CB and S exercises.

Table 1. Models involved in dose calculations for CB scenario

Participant/MODEL	Country	Dynamic or quasi-steady state	Best estimate or Conservative estimate
Sohier/DOSDIM	Belgium	dynamic	best estimate
Peterson/CHERPAC	Canada	dynamic	best estimate
Hu/HUMOD	China	quasi-steady state	conservative estimate
Horyna/SCHRAADLO-T	Czech Republic	dynamic	best estimate
Kliment/ENCONAN	Czech Republic	dynamic	best estimate
Müller/ECOSYS-G	Germany	dynamic	best estimate
Kanyar/TERNIRBU	Hungary	dynamic	best estimate
Krajewski/CLRP	Poland	dynamic	best estimate
Galeriu/LINDOZ	Romania	dynamic	best estimate
Carrasco/PRYMA	Spain	dynamic	best estimate
Hinton/ECOSYS-S	Switzerland	dynamic	best estimate
Tarrant/SPADE-2	United Kingdom	dynamic	best estimate
Napier/GENII	USA	quasi-steady state	best estimate
Napier/HEDR	USA	quasi-steady state	conservative estimate

Table 2. Models involved in dose calculations for S scenario

Participant/MODEL	Country	Dynamic or quasi-steady state	Best estimate or Conservative estimate
Sohier/DOSDIM	Belgium	dynamic	best estimate
Peterson/CHERPAC	Canada	dynamic	best estimate
Horyna/SCHRAADLO-T	Czech Republic	dynamic	best estimate
Kanyar/TERNIRBU	Hungary	dynamic	best estimate
Krajewski/CLRP	Poland	dynamic	best estimate
Galeriu/LINDOZ	Romania	dynamic	best estimate
Yu/RESRAD	USA	quasi-steady state	best estimate
Sazykina/ECOMOD	Russia	dynamic	best estimate
Suolanen/DETRA	Finland	dynamic	best estimate
Bergström/ECOSAFE	Sweden	dynamic	best estimate
Attwood/FARMLAND	United Kingdom	dynamic	best estimate

The U.S. models we have used so far have very similar equations. The main difference between them is in the construction of the source term. For NCRP, AIRDOS-EPA, and SS-57, the source term is represented by the constant air concentration (Bq/m^3) in the area of interest. The radionuclide is deposited onto the soil and the plants and then is transported through the environmental pathways. Conversely, the source term for RESRAD is described as a uniformly contaminated zone below ground (Bq/kg dry soil) that is the starting point for all pathways. The source terms for the CB and S Scenarios are far more complex, but in either case the source term can be described as a contaminated cloud for 1986 and a soil reservoir for the next years.

This last approach does not fit any of the above-mentioned source terms for our models. In order to have the same input for all the models, we used the total

deposition as the starting point. The measured air concentration for the first year was used to calculate the doses due to inhalation and to cloud immersion. The amount deposited forms the soil reservoir for the next years. Obviously, the real system was not in an equilibrium situation. However, a first level of equilibrium was assumed for the first year and a second level for the next years. The first level of equilibrium consists of a constant air concentration and a constant soil contamination (surficial deposition for the NCRP, AIRDOS-EPA, and SS-57 models, and a 3-cm thickness of soil for the RESRAD model). The second level of equilibrium is based only on soil contamination (surficial deposition for NCRP, AIRDOS-EPA, and SS-57, and a 6-cm thickness of soil for RESRAD). These assumptions permit a provisional simulation of the dynamic aspect of the processes involved.

For our calculations, we have considered three endpoints which are intermediary steps in dose assessment. These endpoints are the concentrations of Cs-137 in milk, beef, and pork. The comparisons between our calculations and the predictions produced by the other models are depicted in the attached figures. The observed values (test data) are included as references. The names of the U.S. models are shown in each figure in bold, italic characters. For S scenario, RESRAD code was run also by the developer of the model, Dr. C. Yu of Argonne National Laboratory, as a participant in the exercise. His predictions are labeled RESRAD, while our predictions with this model are labeled RESRAD_A.

First of all, the graphs show the cumulative time-integrated concentrations for milk $[(\text{Bq} \cdot \text{month})/\text{L}]$ and for beef and pork $[(\text{Bq} \cdot \text{month})/\text{kg}]$. The integrated concentrations were preferred because the quasi-steady state models can produce only yearly averaged values. The integration was done separately for the first year because of the special assumptions that have been made for this particular year. The integration was also done for a longer period of time (3 years for CB and 5 years for S), where the integrated value has to contain the value for the first year, mentioned above. The expectation was that the steady-state models would produce better results for the longer period of time than for the first year, because for this case the

postulated equilibrium is more likely to be reached. However, this is not entirely true because the integrated values over 3 or 5 years are strongly influenced by the contribution of the first year.

Another characteristic of the steady-state models is that their predictions are directly proportional to the deposition for a certain set of parameters. For this reason, the integrated values were normalized to the total deposition (Bq/m^2). Most of the model users provided estimates of the total deposition which they used for their own predictions. Here the integrated values have been normalized to the predicted total deposition, in order to obtain only the influence of the model on the result. Analysis of the normalized graphs shows that the models have, more or less, the same transfer potential from the deposition to the endpoint. However, for CB region, the predictions are spread across a larger range. The reason for this spreading is the large difference between predicted total depositions among the models. For Scenario S, the participants had better information about deposition; therefore, their estimates of total deposition were very close to the observed value, and the spread of the predictions was almost the same as that in the normalized figures.

Some of the users of models did not provide an estimate of total deposition; in this case the normalization was done using the measured (observed) deposition. The models included in this category are DOSDIM and ECOSAFE.

It must be mentioned that the U.S. models do not make distinctions between beef and pork. Their predictions refer generally to a "meat" category. Even though the predictions are the same for pork and for beef, they are presented against the observations for each in order to see for which values the predictions are closer.

In all cases, the NCRP, AIRDOS-EPA, and SS-57 models overestimated by a factor between 2 and 20. This is not surprising, because these models were designed to not underestimate.

The RESRAD code was much closer to the observed values, producing a reasonable underestimation for milk and beef but giving an overestimation for pork (for the CB region). It can be inferred that RESRAD was designed for the pasture-milk-beef pathway, rather than for the pork pathway. Our predictions for S region are, however, comparable to the predictions produced by Dr. C. Yu, developer of the model.

For all the models we have run, no particular improvement can be seen between the prediction for the first year and predictions for longer periods of time. This is in agreement with the statement that the first year contribution dominates the contribution of the time-integrated concentration.

The uncertainty in the predictions estimated for the U.S. models is derived by propagation of the error associated with total deposition only. Additional uncertainty would be expected if the additional uncertainty in the model parameters were to be taken into account.

Activities in progress

Scenarios CP, W, and R are being prepared for submission as a set to the *Journal of Health Physics*. Scenario I will also be prepared for independent submission to this journal.

The Multiple Pathways Assessment Working Group of VAMP will meet in Helsinki in June. The meeting will focus on discussion of Scenario S, particularly the test data and modelers' revised predictions. Preparation of a draft report for S will be done at SENES Oak Ridge prior to the meeting; the report will be discussed and revised at the meeting.

Work is continuing on Scenario T for initial distribution to VAMP participants. Two manuscripts related to the Techa River and the Ural Region are being prepared for submission to the open literature.

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

The model intercomparison work will continue with examination of endpoints of dose (ingestion, inhalation, external or ground exposure, and total dose). The same four U.S. models (NCRP, AIRDOS-EPA, SS-57, and RESRAD) will be compared to models from various countries for predictions using the CB and S data sets. The next step will be to add more models, for instance MEPAS and PATHWAY. Uncertainty analyses will be extended to include other sources than just the error associated with the total deposition.

Travel--Not applicable this month. Trip requests have been submitted for Dr. Hoffman and Dr. Thiessen to attend the next meeting of the Multiple Pathways Assessment Working Group of IAEA/VAMP. This meeting is scheduled for June 20-24 in Helsinki.

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

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

BEEF in CB region

BEEF in S region

PORK in CB region

PORK in S region

MILK in CB region

MILK in S region

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.

5th BIOMOVS II VIENNA WORKSHOP 24-28 OCTOBER 1994

The dates for the 5th BIOMOVS II Workshop have been confirmed as 24 October - 28 October, 1994. The Workshop will take place at the International Atomic Energy Agency, Wagramerstrasse 5, PO Box 100, A-1400, Vienna. Further information will be provided nearer the meeting time.

POST-CHERNOBYL DATA WORKING GROUP MEETING WG leader: Owen Hoffman (SENES Oak Ridge)

A Post-Chernobyl Data Working Group meeting was held on 21st to 25th March 1994 at Oak Ridge, Tennessee, U.S.A. The meeting was hosted by SENES Oak Ridge. Twenty four participants from America, Russia, Ukraine, Hungary, Canada, Romania, France, China, and England had a most enjoyable and productive meeting. Working Group activities were interspersed with a number of very interesting invited presentations on the approach to model validation plus a fascinating visit to the Oak Ridge National Laboratory and the historic Graphite Reactor.

The WG had three main objectives for the week. The first was to discuss the three scenarios which had been distributed following the 1993 Vienna Workshop. The second was to consider preliminary calculations which had been made for each of the scenarios and subsequently to make any required changes to the scenarios. The third objective was to discuss expansions of the scenarios to allow a second phase of calculations. All three scenarios provide an excellent opportunity to test radioecological models against extensive data sets which have been collated by our Ukrainian and Russian colleagues following the Chernobyl accident in 1986. Great interest has been shown in these scenarios and the valuable data which have been collated, from within the existing BIOMOVS community and from a growing number of new inquirers.

Cooling Pond Scenario "CP"

Scenario CP (Version 1.03) has been developed to test models for radioactive contamination of aquatic ecosystems. It is based on data from the cooling pond of the Chernobyl Nuclear Power Plant (NPP). The cooling pond is a suitable model for studying the dynamic processes of radionuclide migration and accumulation in closed aquatic ecosystems. The dynamic processes which are investigated in detail

include: the accumulation of Cs-137 in different trophic levels; the bioaccumulation and loss of Cs-137 from fish flesh; and the dependence of accumulation on size of different species.

Three sets of preliminary results were presented during the WG meeting, although several other sets of results are promised as wide interest was expressed in the scenario. The first set of results were given by Ying Feng, a student from China currently studying in America. The calculations had been performed on the assumption that there had been a nuclear accident and that there was a need for a rapid assessment of the

possible radiological consequences based on limited data and information, and using a bounding analysis approach. Dan Galeriu (currently with AECL, Canada) provided some early, preliminary calculations but Dan is eager to develop his model further following the group discussions. A third set of results were received by e-mail from Rudie Heling (Kema Laboratories, Netherlands). Rudie had been uncertain whether the cooling pond circulation pumps had been in continuous use and so he had undertaken two sets of calculations - the first assuming the pumps had been turned on; the second assumed that the pumps were not in operation. A number of other questions were raised during the discussion and the information will be included in an updated version of the scenario which will be distributed to all those with an interest in the work of the group.

Ivan Kryshev and Tatiana Sazykina presented some very interesting suggestions for the expansion of the scenario for a second phase of calculations and model testing. Stage 1 of the scenario had concentrated on the dynamics of the Chernobyl NPP cooling pond contamination with Cs-137 only. The objective of Stage 2 of the scenario is to model the effects of other radionuclides in the post-accident period of 1986 to 1990 and to extend the endpoints to other biota than just fish. In addition it is proposed that estimates of risk to human health from the consumption of contaminated fish are made. Modellers will have the opportunity to undertake a reconstruction of the dynamics of radionuclide concentrations in water, sediments and biota based on information of the total concentrations of different radionuclides which entered the cooling pond after the accident. This second phase will also provide the opportunity for model comparisons using the collated experimental data since this will be a Type B test.

Resuspension Scenario 'R'

This scenario examines the complex subject of the effects of resuspension of contaminated soils and dusts following the deposition of radionuclides after an accident. Scientists in the Ukraine have collated data for two locations within the 30 km zone, an urban area of Kiev, and a location 40 to 60 km west of the Chernobyl NPP. The objective of the scenario is not to study resuspension processes in detail. However, the scenario does provide an excellent opportunity to test models for assessing the long-term impact of future or past releases of radioactive materials and the contribution which resuspension would have on that assessment.

The WG meeting provided the first opportunity to discuss the scenario since its initial distribution. There was a very active debate over the need to include data for Pu since this radionuclide could cause an important health physics problem due to the inhalation of resuspended material. However, it was agreed that the purpose of the scenario is to help test and refine models which account for resuspension and therefore the emphasis should be on the best experimental data set that is available and this is for Cs-137.

Dan Galeriu gave a presentation on a possible approach to modelling resuspension and Dr. Frank Gifford, from Oak Ridge (former head of the Atmospheric Diffusion and Turbulence Laboratory) was also present for part of the discussion to offer advice and comments. Only a few modifications will be made to the current version of the scenario and these will be distributed as soon as possible. Calculations will then be invited from all those who have expressed an interest in the process of resuspension.

Washoff Scenario 'W'

This scenario 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, the effects that this has on the transfer of contamination from soil to water, and the geochemical and geophysical processes which affect such transfer. Although the present scenario deals with the contamination of water following the aerial deposition of radionuclides following the Chernobyl accident, the processes underlying the scenario may be adapted to many sources of contamination of surface and ground water and hence has wide application to many ecological situations. Overall, the scenario calculations and results evaluation will provide an increased understanding of contaminant transport at the process level for the movement of contaminants from soil to surface water bodies over different time scales.

The scenario calculations will be divided into two phases. The first phase will include estimations of the surface water runoff from two experimental plots located near to the Chernobyl NPP and the time-dependent surface water concentrations of Cs-137 and Sr-90 in the dissolved and suspended states. The expansion of the scenario for a second phase of calculations is discussed later.

Five sets of results for phase one were presented at the WG meeting and at least another four sets of calculations are promised. Presentations were made by

Shyam Nair (Bechtel International, Tennessee), Bela Kanyar (NRIRR, Hungary) and Gennady Lyashenko (Institute of Cybernetics, Ukraine). Results were also received from Wolfgang Raskob (KfK) and Alex Popov (Computational Centre, SPA Typhoon, Obninsk). Unfortunately they could not attend the WG meeting and so their results were presented by Alexei Konoplev (SPA Typhoon, Obninsk). Dan Galeriu (currently with AECL) and three other colleagues from Russia and the Ukraine also intend to submit calculations. Differences in results were linked with the overall purpose of the models used. For example, some models were designed for radiological assessment purposes whilst others were mainly hydrological models. This led to differences in emphasis on the mechanisms and processes of importance and the level of complexity of the models for them. It was stated that such a complex process of radionuclide runoff needs to be addressed by complex models. However Owen Hoffman pointed out that one lesson learned from the BIOMOVs I exercise was that more complicated models do not necessarily lead to more accurate model predictions. It will be interesting to compare the models used and the results obtained during this first phase of the scenario and how the predictions compare with the test data.

Gennady Laptev (Hydrometeorological Institute, Kiev) presented the proposed extension of the scenario for phase 2 which he had prepared with Oleg Voitsekhoivitch (Ministry for Chernobyl Affairs, Ukraine).

The main hydrological processes which were responsible for the washoff of radionuclide contamination were snowmelting, rainstorms and the impact of flooding of the river floodplain due to ice jams. The first two processes are considered in the phase 1 of the scenario. The third process is investigated in the second phase. As soon as this extension to the scenario is ready it will be distributed to all those who have expressed an interest in the WG.

TIME SCHEDULES

As mentioned above, there will be a few minor amendments to phase 1 of each of the three scenarios. The extra information will be distributed as soon as possible. Following this distribution, calculations are invited to be sent to the Secretariat no later than **15 JUNE 1994**. This will allow analysis of results prior to the next Workshop in Vienna from the 24th to 28th October, 1994 when the first set of the test data will be released. However, if participants can send in their results earlier than this date then the test data will be released on a restricted basis to those individuals to

allow continuation of calculations. This release of the test data would be on the understanding that it should be kept confidential until the October Workshop.

INVITED PRESENTATIONS

Owen Hoffman had arranged for four invited presentations to be given to the WG participants in connection with approaches to model validation, neural network modelling and new information concerning ICRP publications. These are described briefly below.

1. **Uncertainty estimates in scientific models: lessons from trends in physical measurements, population and energy projections.** By: Alexander Shlyakhter (University of Harvard).

Dr. Shlyakhter presented the results of a systematic analysis of actual vs estimated uncertainty in scientific models. Uncertainty arises due to errors in model structure as well as uncertainty in model parameters. The latter is less important but easier to assess. The elicitation of expert judgements is often used but often, in Dr Shlyakhter's view, confidence in these is greater than it should be. With environmental measurements and field data it is often hard to estimate actual errors in routinely collected data. Probabilities of large deviations from the true values are often parameterized by an exponential distribution with the slope determined by the data. Dr. Shlyakhter suggested that an alternative parameterization based on a fractal model for the distribution of errors could be used instead. A description of this approach and the application to a number of low probability/high consequence events was provided in the paper distributed by Dr. Shlyakhter. (A I Shlyakhter. *Uncertainty Estimates in Scientific Models: Lessons from Trends in Physical Measurements, Population and Energy Projections*. To appear in: *Uncertainty Modelling and Analysis: Theory and Applications*. B M Ayyub and M M Gupta, eds., North Holland, 1994). This paper is available through the Secretariat for anyone interested in the subject.

2. **Approaches and Concepts for Testing Model Predictions.** By: Steven Bartell (SENES Oak Ridge)

Steven Bartell started his talk with the provocative question as to whether there is such a thing as a valid model. The presentation considered some of the historical perspectives to addressing model validation, methods for model: data comparisons, and model testing and decision making issues. These considerations were illustrated with reference to a

standard water column model (SWACOM).

As part of the historical perspective, it was noted that the BIOMOVs Glossary defines validation as an adequate representation of the physical world, whilst verification is given as a demonstration of internal correctness. However, Steven Bartell pointed out that these definitions are the opposite of those given by other authors in the past and also recently by Oreskes et al. in Science volume 263: 641-646 (1994). (Clearly this is a difficult problem. The BIOMOVs definition is consistent with usage in the UK National Radiological Protection Board's report on verification and validation, NRPB-R233, 1989; and with IAEA's TECDOC 264, 1982; and hence many others, eg C F Tsang, The Modelling Process and Model Validation, Groundwater Vol 29 No 6, 1991. It follows that it may be wise to restate your definition in each separate document.)

Steps in the process of validation were considered to be:

- selection of validity criteria,
- determination of appropriate error measures,
- specification of minimum sample size,
- collection of data and model results,
- testing of data for significance and correlations,
- computation of bias and testing for normality,
- computation of model and data variance and testing,
- use of appropriate statistical tests to assess validity

Steve Bartell pointed out that one can always falsify a model and one cannot really validate a model. The real issue is "Is it a useful model?". But even that requires a definition of utility and adequacy! The ensuing discussion within the WG acknowledged the fact that criteria for usefulness on model validity has been intentionally kept outside of the model testing exercises. This is because different models and model users will have unique criteria for different types of assessment questions.

3. Use of Neural Network Modelling. By: Iulian Apostoale (SENES Oak Ridge)

Iulian Apostoale explained the principles of neural network modelling and how the network could be 'trained'. He demonstrated the application of a neural network and compared the results with those obtained from a mathematical model and a known data set. He showed how neural networks could be of use in dose reconstruction but he also commented that they would be of much less use for predicting the consequences of a nuclear accident or for modelling routine releases. The presentation provoked a lively discussion.

4. New ICRP Revisions. By: Keith Eckerman and Richard Leggett (ORNL)

Special presentations were given by Drs. Keith Eckerman and Richard Leggett (ORNL) that gave the WG participants insights into the new ICRP revisions of Publication No. 56 that will reflect the recommendations in ICRP 60. This revised publication is now in press. Problems with overestimating doses and risks for bone surface seeking radionuclides, however, have been discovered and remain to be corrected. ICRP has formed a new subgroup to investigate the uncertainty and reliability associated with the use of recommended internal dose coefficients. This new information provided the BIOMOVs II WG with important information about the problems and approaches in the closely related fields of human metabolism and biokinetics.

GENERAL INFORMATION

Further information about BIOMOVs II and Working Group meetings can be obtained directly from the BIOMOVs 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, E-mail at BIOMOVs@intera.co.uk. Graham Smith, Barbara Watkins, Martine Greenhalgh or Richard Little would be happy to help you with any queries you may have and would welcome comments or contributions to the Newsletter.

Don't forget that to become an official participant in BIOMOVs II, your organization should send a letter agreeing to participate according to the agreement described in the BIOMOVs 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 BIOMOVs II output might be openly published. In fact we would very much encourage this!

A further newsletter in June will set out progress in other Working Groups, several of which are meeting in May.

MAY 1994

EH-40 Monthly Report
May 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

Dr. Hoffman and Dr. Thiessen will be attending the next meeting of the Multiple Pathways Assessment Working Group of IAEA/VAMP, scheduled for June 20-24 in Helsinki. Arrangements have been completed.

Technical accomplishments

- (1) Our revisions to the review paper on interception and retention for the Terrestrial Working Group of IAEA/VAMP were completed, and the paper has been returned to the IAEA.
- (2) Scenarios CP, W, and R have been prepared for submission as a set to the *Journal of Health Physics*. They will be sent to the journal following completion of a few remaining details.

(3) Supplementary material for Scenarios W and R was prepared and sent to the BIOMOVs II Secretariat for distribution. This included answers to questions which had arisen concerning the scenarios, as well as improved maps for Scenario R.

(4) Comparison and evaluation of various U.S. models is continuing with examination of the endpoints of dose. The analysis was performed using the data from scenarios CB and S of IAEA-VAMP, for the same four models considered before: NCRP screening model, AIRDOS-EPA, IAEA Safety-Series 57 (SS-57), and RESRAD (the models are described in more detail in the previous report).

The attached graphs present the calculations for the cloud inhalation dose, the ingestion dose, the ground exposure dose, and the total dose. While the cloud inhalation dose was calculated only for 1986, the other doses were reconstructed for longer periods of time. The authors of the scenarios provided estimates of the doses from local measurements obtained over a 3 year period for CB (Central Bohemia) and over 1 and 5 year periods, respectively, for S (Southern Finland); therefore, these calculations were done for similar periods.

The cloud inhalation dose due to Cs-137 was very small in both regions; its contribution to the total dose is negligible. However, this exposure pathway might be important in other circumstances, and it is interesting to see if the models perform well for it. All four U.S. models have close predictions for the inhalation dose because they use very similar equations. The RESRAD model (labeled RESRAD_A on the graphs) showed better results than AIRDOS-EPA, SS-57, and NCRP, because it was designed to give a best estimate and, therefore, its parameters are better adjusted. For CB region, RESRAD was very close to the estimated value, while the other three gave results right at the upper limit. For Southern Finland, all models overpredicted, despite the very large confidence limits for the estimated dose.

The dose due to ground contamination was highly overestimated by AIRDOS-EPA, SS-57, and NCRP. These three models do not include any sheltering factors, and the dose is calculated, for conservative reasons, assuming that 24 hours per day are spent outdoors. RESRAD, however, considers sheltering factors and indoors-outdoors time-sharing; this model performed better than the others, but the prediction is still outside the range of observed values. For ground exposure as well for cloud inhalation, AIRDOS-EPA, SS-57, and NCRP provided practically the same results for both CB and S regions. This demonstrates the similarity in the model structures for these particular exposure pathways.

The ingestion dose is determined by the concentration in milk and meats predicted by each model. RESRAD performed acceptably for CB region (only a slight underestimation), for which it accurately reproduced the time-integrated concentrations for milk and meat. In contrast, RESRAD underestimated the ingestion dose for S region by a factor of 3. This result comes from a previous underestimate for the milk and meat endpoints. The other three models showed a large overprediction for both scenarios. However, they provided values closer to the estimates for longer periods of time (dose accumulated over 5 years versus the first year's dose for S region). NCRP had the largest overestimate, while AIRDOS-EPA and SS-57 are very close together, due to the same mathematical description of the processes.

RESRAD gave excellent predictions of the total dose, but this result contains the compensatory effect of the underestimate for the ingestion dose and the overestimate for the ground exposure dose. This behavior can be seen in our calculations for both CB and S regions, as well as in the calculations provided by Dr. C. Yu (the model developer) for Southern Finland. AIRDOS-EPA, SS-57, and NCRP overestimated the total dose by a factor of 6-7 for Central Bohemia and by a factor of 3-4 for Southern Finland. Once again, the conservative character of these models is evident.

As a general comment, we need to stress that the uncertainty in our calculations comes only from the uncertainty in the total deposition, propagated through the model structure. The error bars for the U.S. models are drawn using dashed lines, in order to remind the reader of this issue. We would expect to obtain larger confidence limits if uncertainty related to other parameters were considered.

Activities in progress

Scenarios CP, W, and R of BIOMOVs II will be sent to the *Journal of Health Physics* following completion of a few remaining details. Scenario I will also be prepared for independent submission to this journal.

The Multiple Pathways Assessment Working Group of VAMP will meet in Helsinki in June. The meeting will focus on discussion of Scenario S, particularly the test data and modelers' revised predictions. Preparation of a draft report for S is being done at SENES Oak Ridge prior to the meeting; the report will be discussed and revised at the meeting.

Work is continuing on Scenario T for initial distribution to VAMP participants. Two manuscripts related to the Techa River and the Ural Region are being prepared for submission to the open literature.

The model intercomparison work will continue with additional models (MEPAS and PATHWAY), examining the endpoints previously evaluated for NCRP, AIRDOS-EPA, SS-57, and RESRAD, for the CB and S data sets.

Travel--Not applicable this month. Dr. Hoffman and Dr. Thiessen will be attending the next meeting of the Multiple Pathways Assessment Working Group of IAEA/VAMP, scheduled for June 20-24 in Helsinki.

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

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

Total Dose (1986 - 1988)

Cloud Inhalation Dose (1986)

Ingestion Dose (1986 - 1988)

Dose due Ground Exposure (1986 - 1988)

Effective Dose Equivalent for CB region

Total Dose (1986)

Ingestion Dose (1986)

Cloud Inhalation Dose (1986)

Dose due to Ground Exposure (1986)

Effective Dose Equivalent for S region

Ingestion dose (1986 - 1990)

Total Dose (1986 - 1990)

Dose due to Ground Exposure (1986 - 1990)

Effective Dose Equivalent for S region

VAMP-MP NEWSLETTER

International Atomic Energy Agency, May 1994

REPORT ON WORKING GROUP MEETING OAK RIDGE, 28-31 MARCH 1994

INTRODUCTION

A Working Group Meeting was held in Oak Ridge, USA during 28 to 31 March 1994 to finalize Scenarios I (Ipit River catchment area, Russian Federation) and H (Hanford, USA) as part of the VAMP Multiple Pathways Assessment Working Group programme. Altogether 24 experts from 8 countries attended the meeting. The Meeting was hosted by SENES Oak Ridge Inc. and was organized in Oak Ridge to facilitate an increased participation from US experts, and from Russian and Ukrainian experts who were attending a BIOMOVs II Working Group Meeting the preceding week.

A public meeting was organized on the evening of 29 March 1994 to facilitate interaction between members of the Oak Ridge public and visiting experts from Russian Federation and Ukraine. The visiting experts talked about the radiological accidents in the former Soviet Union, especially the Chernobyl nuclear reactor disaster in 1986, and consequences of these accidents. Mr. Michail Balonov of Russia and Mr. Boris Prister of Ukraine described their personal experiences in these accidents and gave accounts of the situations still facing their respective countries. In this connection, two related video films from the IAEA were shown.

THE MEETING AND ITS ACHIEVEMENTS

The Consultants' Meeting was opened by Mr. Owen Hoffman, Chairman of the VAMP Multiple Pathways Assessment Working Group, after the welcoming remarks by the Mayor of Oak Ridge, Mr. E. Nephew. Mr. Shaheed Hossain presented, as Scientific Secretary, the progress and development of the Working Group since the last Meeting of the Group in Helsinki, 4-8 October 1993. This was followed by an overview presentation of the Chairman on lessons learnt from international model validation studies. The Agenda of the Meeting contained the following main topics:

- Comparative analysis of Scenarios CB and S observed data
- Revised Scenario S predictions
- Discussion of Scenario I
- Discussion of Scenario H
- Proposals for future scenarios
- Special sessions
- Future tasks and work plan

COMPARATIVE ANALYSIS OF SCENARIOS CB AND S DATA

One particular item of interest, first brought up at the last Working Group Meeting in Helsinki, was the comparison of the test data from two regions, Central Bohemia (CB) and Southern Finland (S). Comparison of the test data, normalized for total deposition, indicates that differences in the soil characteristics are critical for determining contaminant availability in the years following the accident. The Czech scientists who provided the test data for CB have recently provided additional data, extending the set of available measurements to include an additional two years (1986-1991); this has allowed a better comparison of these data with the data for Scenario S.

REVISED SCENARIO S PREDICTIONS

Several participants presented revised predictions for Scenario S, based on the test data which were released following submission of participants' predictions in 1993. Discussion of the results of Scenario and the draft report will be the focus of the next Working Group Meeting, scheduled for 20 to 24 June 1994 in Helsinki.

SCENARIO I

Scenario I is in the final stages of completion. A significant difference between Scenario I and the earlier Scenarios, CB and S, is that Scenario I takes into consideration detailed information on protective measures that were applied in the region following the accident. A number of questions were brought up concerning details that modellers felt were necessary to complete the scenario. Many of these were addressed during the session. A revised version of the scenario is now being completed for distribution. The scenario will be presented at the final VAMP RCM as a complete scenario description, ready to be used for model predictions by participants in the post-VAMP model-testing exercises.

A proposal for the extension of the scenario was made to include further radionuclides, exposure of different age groups and risk assessments.

SCENARIO H

No revisions have been made to Scenario H since the last Working Group Meeting, and no representative from the scenario's authors was present in this meeting. Several important questions remain which must be answered before

the scenario can be used for making predictions. Comments to improve the scenario were collected from the participants for transmittal to the authors. Further consideration of the scenario will have to wait until these questions can be adequately addressed. The scenario will be included in the post-VAMP exercises once the description is finalized.

PROPOSALS FOR FUTURE SCENARIOS

Polesskoe region

A proposal was made for a multiple pathways exercise to be developed for the Polesskoe region of Ukraine, based on data from the Chernobyl accident. This scenario would include description of the countermeasures applied following the accident, and would consider both Cs-137 and Sr-90. Soil profiles would be requested in addition to contaminant concentrations in foodstuffs, whole body concentrations, and dose estimates. This scenario will be developed as part of the post-VAMP exercises.

Techa River

A proposal was made for a model-testing exercise to be based on data from the radioactive releases into the Techa River of Russia (1949-1956 and current). This scenario will consider past and present whole body concentrations and dose estimates for humans, as well as an assessment of risk to humans from exposure to the contaminants released into the river. The first draft of the scenario description is in progress, and the scenario will be used during the post-VAMP exercises.

SPECIAL SESSIONS

A talk on the challenges facing assessment modellers was given by Mr. Steven Bartell of SENES Oak Ridge. Two Russian scientists, Mr. Alexei Konoplev and Mr. Ivan Kryshev, described their experiences with Chernobyl and other radiation accidents. Finally, Mr. Charley Yu of Argonne National Laboratory gave a presentation of the newest version of the model RESRAD.

A small work session was held to discuss some of the remaining details necessary to complete the Scenario CB report. The concluding remarks of the report were finalized and final revisions are in progress on the main text and some figures. The report will be issued in final form in the near future.

FUTURE TASKS AND WORK PLAN

Discussions were held on the future tasks of the Working Group. It was decided that to bring the second test exercise of the Working Group, Scenario S, to proper conclusions, at least another meeting after the final VAMP RCM, scheduled for 31 October to 4 November 1994, will be necessary.

NEXT VAMP-MP WG MEETING HELSINKI, 20-24 JUNE 1994

The next Working Group Meeting will be held in Helsinki, Finland from 20 to 24 June 1994 to evaluate the predictions of model testing Scenario S (Southern Finland) by comparison with observed data and discuss the report on Scenario S. The Meeting will be hosted by the Finnish Centre for Radiation and Nuclear Safety (STUK) and will take place in STUK's new office building.

Detailed information on the meeting has been sent to the Working Group participants and can be obtained from:

SHAHEED HOSSAIN
Division of Nuclear Fuel Cycle
and Waste Management
International Atomic Energy Agency
Wagramerstrasse 5, P.O. Box 100
A-1400 Vienna
Austria
Tel: +43 (1) 2360 2668
Fax: +43 (1) 234564
EM: Hossain@nepol.iaea.or.at

and

AINO RANTAVAARA
Finnish Centre for Radiation and
Nuclear Safety
P.O. Box 14
Laippatie 4
FIN-00880 Helsinki
Finland
Tel: +358 (0) 75988436
Fax: +358 (0) 75988498
EM: aino.rantavaara@stuk.fi

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Silver Spring, Maryland 20910

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