November 2, 1995

MEMORANDUM TO: John H. Austin, Chief
Performance Assessment and Hydrology Branch

THRU: Norman A. Eisenberg, Section Leader
Performance Assessment and Health Physics Section

FROM: Robert B. Neel, Systems Performance Analyst
Performance Assessment and Health Physics Section

SUBJECT: FOREIGN TRIP REPORT: SIXTH INTERNATIONAL WORKSHOP OF THE BIOSPHERIC MODEL VALIDATION STUDY (BIOMOVS II)

An abstract of my trip and a detailed trip report are attached. These documents present deliberations on the concepts of "Reference Biosphere" and "Critical Group" by the Reference Biosphere Work Group of BIOMOVS II. These concepts are of current interest to the Performance Assessment and Hydrology Branch because of the recent publication of "Technical Basis for Yucca Mountain Standards" in August 1995. The reports also document progress in development of an international biosphere methodology that may be applicable to Yucca Mountain, NV.

Attachments: As stated

cc: J. Taylor, EDO
C. Stoiber, OIP
C. Paperiello, NMSS
M. Knapp, NMSS
R. Brady, SEC/ADM
R. Meck, RES

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42 [redacted] 1995

TRIP REPORT ABSTRACT
OCTOBER 20, 1995

OFFICIAL TRAVELER: Robert B. Neel

TRAVEL TO: IAEA
Vienna, Austria

Begin on: 10/2/95
End on: 10/6/95

OFFICE: Nuclear Material Safety and Safeguards
Performance Assessment and Hydrology Branch
Division of Waste Management

MEETING TITLE AND/OR AFFILIATION:

Working Group of the Biospheric Model Validation Study, BIOMOVSII, the Reference Biospheres Work Group (RBWG)

ORGANIZED BY: Intera Information Technologies, United Kingdom

Robert Neel participated as an observer at the Sixth International Workshop of the Biospheric Model Validation Study (BIOMOVS II) conducted at Vienna International Center/IAEA, Vienna, Austria, from October 2-6, 1995. The primary reason for attending this conference was to exchange information with the members of the Reference Biosphere Working Group (RBWG) of BIOMOVS on two issues of current interest in the USA: "Reference Biospheres" and "Critical Groups."

Reference Biospheres

The RBWG continued work on the development of a biosphere methodology started in 1992 whose objective is to demonstrate that a specific biosphere model is fit for its intended regulatory purpose. J. Kessler, EPRI has hired Graham Smith, Intera, to apply the RBWG methodology in its present form to the proposed site for a geologic repository at Yucca Mountain. Graham's preliminary report is due to Kessler in December 1995, and Kessler has promised to send me a copy of the draft when it is available.

Critical Group

A questionnaire was sent to the limited number of members who participate in the RBWG to determine how these persons apply the concept of critical group in the context of the regulations peculiar to their country. Organizations in four countries participated in the survey: MAFF, United Kingdom; CIEMAT, Spain; NAGRA, Switzerland; and CEA-IPSN, France. In his summary of this survey, G. Smith of Intera Information Technologies indicates that the definitions of critical groups by regulatory bodies frequently appear to be inconsistent with their corresponding regulatory philosophies, and usually do not provide a basis for the determination of the size of the critical group.

Continuation of BIOMOVS

The final meeting of BIOMOVS II is scheduled for October 1996. A number of participants at the October 1995 meeting in Vienna proposed that this international exchange of ideas on the biosphere be continued in the future. IAEA would provide overall coordination of this group.

DETAILED TRIP REPORT OF:

Robert B. Neel, System Performance Analyst
Performance Assessment and Hydrology Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards

SUBJECT: Trip Report on a Working Group of BIOMOVS II, Reference Biospheres for Radioactive Waste Disposal

Robert Neel participated as an observer at the Sixth International Workshop of the Biospheric Model Validation Study (BIOMOVS II) conducted at Vienna International Center/IAEA, Vienna, Austria, from October 2-6, 1995. The primary reason for attending this conference was to exchange information with the members of the Reference Biosphere Working Group (RBWG) of BIOMOVS on two issues of current interest in the USA: "Reference Biospheres" and "Critical Groups." This interest became more intense following publication of a recent report, "Technical Basis for Yucca Mountain Standards," August 1995, by the National Academy of Sciences/National Research Council. In this report the NAS/NRC proposed a risk standard for this site and recommended that consideration be given to a "critically-exposed group" who can be assumed to reside and work in the context of a "reference biosphere" at Yucca Mountain during implementation of methods to estimate risk for comparison to the risk standard.

A list of participants at the meeting, which was organized by Intera Information Technologies Limited, UK, is appended to this report (Attach. 1).

Reference Biospheres Working Group (RBWG)

The RBWG continued work on the development of the "Reference Biosphere" methodology started in 1992. The concept of a "Reference Biosphere," which was originally envisioned as an indicator of likely possible "future states," is intended to be used as a benchmark for comparison of the relative performance of alternative disposal facility designs and locations. In this context, the RB methodology defines a systematic generic approach for the formation of an "audit trail" which should demonstrate that a biosphere model is fit for its intended purpose. The RBWG cautions that a Reference Biosphere, which is built around an assumed generic site, is not necessarily appropriate for the comparison of the results of a performance assessment against regulatory safety criteria for the biosphere at a specific site in a particular national context. However, the methodology can also be applied to a specific site (such as the potential site at Yucca Mountain, NV), when the features, events, and processes that impact the biosphere of that specific site are evaluated. The results of this evaluation may be compared to applicable regulatory standards for that site.

The methodology involves: Identification and definition of a structured list of biosphere features, events, and processes (FEPs); and an exploration of the many different ways that these FEPs may be combined into a conceptual model for the generic (or specific) biosphere. Following past practice, in March 1996 the RBWG is expected to send a copy of their draft report on this methodology to the NRC with an expectation of comments that will be due in April 1996. The final RBWG report, which is scheduled to be completed by June

1996, will be presented to the main body of BIOMOVS II participants in October 1996. For your information, a preliminary draft outline of the RBWG final report on this topic is appended as Attachment 2. I have fleshed out a number of sub-topics in this outline in the discussion that follows.

It is of great interest that J. Kessler, EPRI, has hired Graham Smith, Intera, to apply the RBWG methodology in its preliminary form to the proposed site for a geologic repository at Yucca Mountain. Graham's preliminary report is due to Kessler in December 1995, and to the RBWG in January 1996. Kessler has promised to send me a copy of the draft when it is available.

International Biosphere FEP List

Several versions of this list have evolved over the years, and recently CIEMAT has prepared an electronic format for these FEPs. These definitions of the FEPs were developed in order to permit a valid comparison of the conceptual models used in the computer codes of the various member countries, and thus to form a common basis for biosphere modelling. The most recent FEP list, which I have on a diskette in my office, contains definitions of FEPs that are abstracted from the descriptions submitted to the RBWG by the WG members. It will be revised again by the RBWG in a meeting in Baden, Germany, on November 21-21, 1995. The RBWG members consider the FEPs list as never complete, but in a state of constant development.

Various methods have been proposed to combine these FEPs into conceptual models for specific biospheres, but none have been generally accepted by the RBWG as yet. Several methods that were tested (including relational diagrams, the rock engineering system (RES) approach, and directed diagrams) in an attempt to identify all significant interactions of FEPs at specific disposal sites. The RBWG found this to be one of the most problematic parts of the overall model-building system. If you have further interest in these methods, I have documentation in my office that illustrates the application of the RES approach to a sample specific biosphere.

The Reference Biosphere Example

In order to illustrate the RB methodology, it was necessary that the RBWG develop a test case. The case adopted is concerned with an inland valley in Switzerland as the biosphere, and a self-sustaining agricultural community who live and work in the present-day climate as the critical group. Even though the conceptual model for this test case was not developed from the RBWG methodology, RBWG plans to use it to illustrate their methodology in the final report. For this reason, R. Klos, Chairman of the Complementary Studies Work Group, believes that in order to properly demonstrate the reference biospheres methodology, it must be applied to climates and sites other than that used in the Swiss test case. He expressed interest in a joint project with some organization in the USA for the application of the RBWG methodology to an arid site such as Yucca Mountain. The end result of this proposed activity would be a computer code, which reflects a site-specific conceptual model for this site, with an end-point of dose or risk. Klos indicated that he intends to correspond with me on this subject.

Critical Group

Attachment 3, a draft outline on the critical group that was prepared by J. Kessler, EPRI, chairman of a sub-group in the RBWG, will be a part of an appendix of the final report of the RBWG. Kessler indicated that the bulk of the discussion in the final report will center on sections 3 and 4 of the outline which are based on the results of a questionnaire sent to the limited number of members who participate in the RBWG. The objective of the survey was to determine how these persons apply the concept of critical group in the context of the regulations peculiar to their country. Organizations in four countries participated in the survey: MAFF, United Kingdom; CIEMAT, Spain; NAGRA, Switzerland; and CEA-IPSN, France. Most countries used ICRP guidance for their definition of the critical group, but their different interpretations of this guidance lead to widely different results in their performance assessments. I believe that the information in the survey should provide a good starting point for the definition of a critical group for Yucca Mountain, but since it will give only general guidance, the details of this site-specific biosphere will require additional definition by EPA and/or NRC.

In a summary of this survey, G. Smith of Intera Information Technologies indicates that the general approach by those who responded to the survey was to "...require some kind of assessment of the more likely highest exposure person(s) based on some set of human behavior assumptions associated with a homogeneous group located in time and place where the environmental concentrations are highest." Another common theme was that the definitions of critical groups by regulatory bodies frequently appear to be inconsistent with their corresponding regulatory philosophies, and usually do not provide a basis for the determination of the size of the critical group.

Kessler requested comments from the work group on his outline of the critical group section of the RBWG final report by the middle of November 1995. He will send the first draft report based on this outline to work group members in January 1996. He has also scheduled a working meeting to prepare the final BIOMOVS II report on the critical group during the week of April 22, 1995, in Palo Alto, California (just one week prior to the International High Level Waste Conference in Las Vegas, NV). The final report is due to BIOMOVS prior to the next work group meeting in late April 1996. NRC should receive copies of all these reports.

Continuation of BIOMOVS

The final meeting of BIOMOVS II is scheduled for October 1996. A number of participants at the October 1995 meeting in Vienna proposed that this international exchange of ideas on the biosphere be continued in the future. This group, which would be formed from the membership of IAEA, BIOMOVS, VAMP and the International Union of Radioecologists, would provide an international forum to promote exchanges of information, and also to test new concepts against international experts in biosphere modelling before presentation in a public forum. IAEA would provide overall coordination of this group, but the decisions on the establishment of projects to be explored by work groups would be determined by the Steering Committee whose members would also provide funds to the new organization. This is an opportunity for the NRC to take advantage

of the skills of experts from many countries on projects of their choice and to influence international policies on the biosphere. Some projects that might be explored in the new organization are identified on Attachment 4. Interested organizations are requested to contact IAEA by December 31, 1995.

ATTACHMENT 1

6th BIOMOVS II Workshop
Held at the IAEA, Vienna
2nd - 6th October 1995

LIST OF ATTENDEES

FULL NAME	ORGANISATION NAME
Almudena Aguero	CIEMAT/IMA
Iulian Apostoaie	SENES Oak Ridge Inc
Rao Avadhanula	AECB
Peter Barry	
Yves Belot	CEA-IPSN
David Bennett	Galson Sciences Ltd
Ulla Bergström	Studsvik EcoSafe
Glen Bird	AECL Research
Martin Broderick	UK Nirex Ltd
Anatolyi Bulgakov	Inst of Exptl Meteorology
Adrian Butler	Imperial College of Science, Technology & Medicine
Henri Camus	DAM/DQS
David Cancio	CIEMAT/IMA
Pedro Carboneras	ENRESA
Larry Chamney	AECB
Jining Chen	(C.A.R.E), Imperial College
Peter Coughtrey	L G Mouchel & Partners Ltd
Jean-Louis Daroussin	COGEMA
Philip Davis	AECL
Jeremy Dearlove	Westlakes Research Institute
Constantin Dovelette	Romanian Inst of Env Res Eng
Ove Edlund	Studsvik Eco &Safety AB
Mike Egan	AEA Technology
Mark Elert	Kemakta Konsult AB
Cecile Ferry	CEA-IPSN
Vitold Filistovic	Institute of Physics
Martin Frissel	IUR
Evgenii Garger	Inst of Radioecology
Martine Greenhalgh	Intera Information Technologies
Conny Haegg	SSI
Eberhardt Henrich	BMGSK
Owen Hoffman	SENES Oak Ridge Inc
Shaheed Hossain	IAEA

Duncan Jackson	Westlakes Research Institute
Gunnar Johansson	SSI
Béla Kanyár	University of Veszprem
John Kessler	Electric Power Research Institute
Gerald Kirchner	University of Bremen
Richard Klos	PSI
Branko Kontic	Jozef Stefan Institute
Ivan Kryshev	Inst of Exptl Meteorology
Alexander Kryshev	Moscow State University
Ralph Kulzer	GSF
Gordon Linsley	IAEA
Richard Little	Intera Information Technologies
Anna Mortimer	Intera Information Technologies
Robert Neel	US NRC
Sverker Nilsson	SKB
Frank Pelz	WISMUT
Paloma Pinedo	CIEMAT/IMA
A Prister	Ukrainian Academy of Agricultural Sciences
Wolfgang Raskob	FZKA
Cathy Read	L G Mouchel & Partners Ltd
Thomas Riesen	PSI
Pascal Santucci	CEA-IPSN
Tatiana Sazykina	Inst of Exptl Meteorology
Immaculada Simon	CIEMAT/IMA
Graham Smith	Intera Information Technologies
Tomoyuki Takahashi	JAERI
Kathy Thiessen	SENES Oak Ridge Inc
Brian Thompson	HMIP
John Titley	NRPB
Carlost Torres	IAEA
Paul Uijt de Haag	RIVM
Catherine Valentin-Ranc	ANDRA-DESQ
Frits van Dorp	NAGRA
Barbara Watkins	Intera Information Technologies
David Webbe-Wood	MAFF
Charley Yu	Argonne National Lab
Theo Zeevaert	SCK/CEN

DRAFT ATTACHMENT 2

BIOMOVS II Working Group on Reference Biospheres for Radioactive waste Disposal, Final Report, list of contents

Frits van Dorp
Nagra, Hardstrasse 73, CH-5430 Wettingen
Tel. xx41 56 437 11 11; Fax. xx41 56 437 12 07 (from 05.11.95)

Draft, 1995.09.13
Keywords: BIOMOVS; model; comparison; Reference Biospheres
Distribution (printed 95.09.26 15,15):

- potentially relevant

2.2.5 identification of relations between FEPs (the following methods provide also an additional check on "completeness")

- relational diagrams
- Rock Engineering System approach (details in Appendix)
- directed diagrams
- reversed method: see 2.2.7

2.2.6 scenario or conceptual model development

2.2.7 audit of FEPs against conceptual models

- adaptation or new conceptual models

2.2.8 mathematical representation and calculation code

2.2.9 identification of parameters

2.2.10 definition of parameter values (PDFs)

- boundary conditions
- attention: implicit FEPs

2.2.11 results ...

2.3 conclusions

3 INTERNATIONAL BIOSPHERE FEP-LIST — P. PINEDO

3.1 aim and objective

3.2 systematics

3.3 further developments

[A1 actual list in Appendix]

4 EXAMPLE of a REFERENCE BIOSPHERE — F. VAN DORP

4.1 rules and assumptions for its definition

- critical group definition = subsistence agricultural community
- semi-natural and natural environments should be included, but are not because the data have not yet been transformed into a database for assessments

4.2 description

[A2 detailed FEP-list (with comments why included and why not) in Appendix]

4.3 comparison with case of Working Group on Complementary Studies

5 CONCLUSIONS — P. COUGHTREY

5.1 what has been achieved and documented

5.2 achievements in experiences

5.3 how to apply the results/methodology/software

DRAFT ATTACHMENT 3

BIOMOVS II Reference Biospheres Critical Groups "Report" Outline

For discussion 2 - 6 October 1995

APPENDIX OF

The following outline is proposed for inclusion (suitably filled out) in the final BIOMOVS II Reference Biospheres technical report. Comments are welcome for discussion, especially in the WG session on Wednesday morning.

1. INTRODUCTION

- BIOMOVS Reference Biosphere's interest in critical groups.
- Critical Group definition must be properly linked to regulations and the regulatory philosophy.
- The members of the Reference Biospheres Working Grouphave lots of experience with critical/group.
- Purpose: 1) investigate different regulatory/guidance approaches to public health protection, and identify, (generally if need be) regulatory/guidance approaches to critical group definition that are consistent with the regulatory philosophy; [get into how much or little detail there is on critical group definition within regulations or regulatory guidance].

  2) investigate different approaches to implementing the regulations/guidance on critical groups. What's doable? What is left for interpretation? Problems in defining critical groups and how to overcome them.

  3) make recommendations on approaches to regulations and their interpretation that are consistent with the overall regulatory philosophy.

2. REGULATORY PHILOSOPHY AFFECTING THE CHOICE OF CRITICAL GROUPS

Introduction on prescriptive and non-prescriptive approaches, followed by 'illustrative' range of possibilitis, but with example text taken from real regulations/guidance:

A LIMIT — A. ~~Ultra conservative~~ cautious: Disposal constitutes an involuntary risk from a man-made source for which future generations will derive no benefit. Fear and distrust of anything to do with radiation lead to very strict regulation, ie beyond that associated with other risks.

GUIDANCE B Equitable (or moderate?): "Disposal constitutes a health risk to present and future generations just like many other risks society chooses to accept. Therefore, take no extraordinary measures to avoid or reduce. We will treat it like any other activity causing potential harm and regulate it to a level on a par with other risks society chooses to accept. In addition, the levels of 'acceptable' risk are generally accepted on a society-wide basis, rather than on specific considerations of usually ill-defined, higher risk subgroups."

AS BROADLY TOLERABLE

* $10^{-5} - 10^{-6}$ yr^{-1}

90-10% countries fall here

C Moderated,: ie, somewhere between A and B.

D Consistency with philosophy regulation of current day releases. (Where do we see D relative to A, B and C? Why should repository disposal be different?)

3. A SURVEY OF GUIDANCE AND REGULATIONS

A Provide a survey, but include the philosophy of the regulations, too. That is, set out what the protection objectives are (eg to provide same level of protection as today), how they are translated into quantitative and qualitative regulatory end-points and, where this is actually provided, set out the critical group regulations and guidance which applies to those end-points.

B Identify what's missing from the guidance/regulations on critical groups tand make suggestions for what's needed or could be useful.

C BIOMOVS II recommendations on regulatory approaches that are self-consistent (here and at the end).

4. SURVEY OF APPROACHES TO CRITICAL GROUP DEFINITION

A Provie a survey of what is actually done in assessments. Include an analysis of how well they follow regulations and guidance.

B Illustrate how/ternative but internally consistent approaches to critical group definition can result in drastically different results. Give specific examples here. However, also illustrate the point that the interpretation of the definitions in model construction and other unrelated aspects of the assessment model can also be crucial. Again, real examples.

C BIOMOVS-II recommendations on:

i approaches that are consistent with the various types of regulations;

ii the areas of interpretation that need to be clarified (to make calculational approaches comparable).

iii how to deal with legitimate alternative critical group definitions.

(in incubation stage)

5. CONCLUSIONS/RECOMMENDATIONS

A A wide range in regulatory philosophies gives rise to a wide range of approaches to critical groups.

B However, given a specific regulatory approach/philosophy, the choice of critical groups consistent with this approach/philosophy is more limited. (here's where we can start naming them).

C Problem of alternative, but legitimate and consistent interpretations of critical groups remains (or perhaps we'll show it can be minimized). Suggested approaches (same as 4 B iii).

ATTACHMENT 4

NOTE OF A MEETING TO DISCUSS IDEAS FOR CONTINUATION OF BIOMOVS II AND VAMP

Regina Hotel, Vienna, 26 October 1994

Introduction and Objective

The VAMP programme is due to be completed by the end of 1994. BIOMOVS II is due for completion by September 1996, with the technical programme being completed earlier in that year. These programmes provide a forum for international collaboration, peer review and debate in modelling and assessment concerning transfer of primarily radionuclides through the biosphere.

This meeting was held to identify potential ceas and technical areas for future collaboration. Those present were:

Rao Avadhanula, AECB
Runo Barrdahl, SSI
Larry Chamney, AECB
Phil Davis, AECL
Mike Egan, AEA Technology
Dan Galeriu, with AECL
Owen Hoffman, SENES Oak Ridge
Gunnar Johansson, SSI
Graham Smith, Intera
Carlos Torres, CIEMAT
Theo Zeevaert, SCK/CEN

Work Areas Identified

The following list arose and is presented uncritically.

1. Waste disposal (general, ie not only nuclear, not only solid waste)
    - Biosphere modelling for HLW (extension from BIOMOVS II)
    - Assessment of uranium mill tailings; new facilities and remediation
2. Environmental restoration
    - clean-up after nuclear power plant accident
    - use of data for model testing and validation
    - dose reconstruction in support of epidemiology studies
    - modelling to show that residual contamination levels are low enough, eg after nuclear reactor dismantling
    - 'East European/FSU' environmental restoration
3. Environmental risk assessment
    - in support of financial/investment/resource decisions
4. Modelling at the geosphere-biosphere interface to better determine the source term to the biosphere.

5. Follow on and completion of BIOMOVS II and VAMP activities

   - use of post-chernobyl data
   - tritium modelling /C14
   - assessments in urban environments
   - data for validation of quasi-equilibrium situation models (50 y continuous release)
   - changes in bioavailability
   - modelling of radioactive nobel gases
   - global circulation models/global environmental capacity given global nuclear programme.

6. Mixed hazardous waste

   - linking radioactive waste assessment and hazardous waste assessment through consideration of materials exhibiting both characteristics

   - development and application of consistent waste management assessment procedures for all types of waste

7. Non-human biota damage and ecosystem/environmental damage

8. Taking account of human intrusion/action in modelling the evolution of waste disposal systems (not the direct impact on the intruder, but the effects of the human actions in changing the system being modelled).

9. Answering the question, 'What do you do in the absence of data?'

10. Development of shallow land burial assessment

11. Comparative risk assessment, eg coal v nuclear waste management

12. Degradation of restoration barriers

13. Transport (in trains, and boats and planes, etc)

14. Showing that models are fit for purpose

Some observations made

It is valuable to retain a constructive mix of disciplines. However, this tends to lead to diffuse objectives.

There is a research interest which is different from an assessment interest.

Recognise the distinction between an international consensus on what you need and an international approach to getting it.

To proceed,

the ideas above could be supplemented,

screened against criterion of existing international projects,

screened against criterion of need for major programme relevance,

investigate administrative options.

G M Smith, 26 October 1994