

# NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Nuclear Waste  
148th Meeting

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Wednesday, February 25, 2004

Work Order No.: NRC-1331

Pages 1-168

NEAL R. GROSS AND CO., INC.  
Court Reporters and Transcribers  
1323 Rhode Island Avenue, N.W.  
Washington, D.C. 20005  
(202) 234-4433

TR08

**ACNW OFFICE COPY - RETAIN FOR  
THE LIFE OF THE COMMITTEE**

ORIGINAL

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

+ + + + +

148<sup>th</sup> ACNW MEETING

ADVISORY COMMITTEE ON NUCLEAR WASTE

+ + + + +

WEDNESDAY,

FEBRUARY 25, 2004

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear  
Regulatory Commission, Two White Flint North, Room  
T2B3, 11545 Rockville Pike, at 8:00 a.m., B. John  
Garrick, Chairman, presiding.

COMMITTEE MEMBERS:

B. JOHN GARRICK, Chairman

MICHAEL T. RYAN, Vice Chairman

JAMES CLARKE, Consultant

GEORGE M. HORNBERGER, Member

JOHN T. LARKINS, Executive Director, ACRS/ACNW

RUTH F. WEINER, Member

## 1 EXPERT PANEL:

2 DADE MOELLER, Keynote Speaker, Dade Moeller and  
3 Associates

4 JEFFREY DANIELS, Lawrence Livermore National  
5 Laboratory

6 KEITH ECKERMAN, Oak Ridge National Laboratory

7 DAVID KOCHER, SENES Oak Ridge, Inc.

8 MICHAEL THORNE, Mike Thorne and Associates (UK)

9 JOHN TILL, Risk Assessment Corporation

10

## 11 NRC STAFF:

12 HANS ARLT

13 JOHN BRADBURY

14 LATIF HAMDAR

15 BALER IBRAHIM

16 PHILIP JUSTUS

17 MATT KOZAK

18 TIM MCCARTIN

19 CHRIS MCKENNEY

20 TOM NICHOLSON

21 PHIL REED

22 A. CHRISTIANNE RIDGE

23 CHERYL TROTTIER

24 MITZI YOUNG

25

C-O-N-T-E-N-T-S

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

<u>AGENDA ITEM</u>	<u>PAGE</u>
Welcome by B. John Garrick	4
Introduction by Michael T. Ryan	5
Summary of day one by Dade Moeller	5
Open discussion	19
Presentation by Pat LaPlante	44
Presentation by Cheryl Trottier	75

P-R-O-C-E-E-D-I-N-G-S

8:01 a.m.

CHAIRMAN GARRICK: Good morning. The meeting will come to order. This is the second day of the 148<sup>th</sup> meeting of the Advisory Committee on Nuclear Waste. My name is John Garrick, Chairman of the ACNW. The other members of the committee present are Michael Ryan, George Hornberger, and Ruth Weiner. We also have a consultant with us today to the ACNW, Jim Clarke.

Today the committee will continue the working group on biosphere dose assessments for the proposed Yucca Mountain high level waste repository. Mike Lee is the designated federal official for today's initial session. This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act.

I don't think we have received any written comments or requests for time to make oral statements from members of the public regarding today's sessions. However, should anyone wish to address the committee, please make your wishes known to one of the committee staff. As usual, it's requested that you speak clearly so that we can understand you and that you announce your affiliation and representation. I think

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealgross.com](http://www.nealgross.com)

1 we'll just go directly to the chairman of the working  
2 group session and proceed, Mike.

3 VICE CHAIRMAN RYAN: Thank you, Mr.  
4 Chairman and good morning. Thanks again for a great  
5 day yesterday. I think we had some informative and  
6 thought provoking presentations. If you recall, we  
7 had a homework assignment at the end of the day to  
8 come in this morning and think about giving some  
9 summary ideas of what you heard yesterday recognizing  
10 we'll have several opportunities to discuss those  
11 ideas as the day proceeds.

12 So I just wanted to open with our panel  
13 chairman, Dade Moeller, and then ask him in turn to  
14 maybe have you summarize a few key comments from  
15 yesterday as we then go into our risk insights  
16 discussion and hear about research activities in this  
17 area. So Dade, thank you.

18 DR. MOELLER: Thank you, Mr. Chairman. To  
19 lead off, I have written down a summary of my own  
20 thoughts of what the highlights were from yesterday.  
21 The panel members or even the members of the committee  
22 may not agree. But I wanted to put them out of the  
23 table so that we can discuss them. Then, as Mike  
24 says, let's encourage all the panel members as well as  
25 committee members and others to contribute your own

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 additions to my list.

2 One of the first things that I heard was  
3 that there are two types of efforts in terms of doing  
4 dose calculations and dose estimates. You do dose  
5 estimates to evaluate compliance with the regulations.  
6 We also concluded, or at least I believe we concluded,  
7 that there are other calculations that you need to do  
8 which extend information and incorporate other aspects  
9 of the other calculation.

10 They are more for informational purposes,  
11 educational purposes for perhaps hopefully that these  
12 calculations will help members of the public better  
13 understand what's being done and so forth. I think  
14 that compliance calculations are - this isn't exactly  
15 true - but they are at least straightforward. We know  
16 what we need to do. The degree to which we can do it  
17 is always open to question.

18 But in terms of the second set, I put down  
19 some examples of what I heard yesterday. I would  
20 encourage the NRC to encourage the DOE to do dose  
21 calculations using all of the available sets that we  
22 discussed yesterday of sources of dose coefficients,  
23 in other words, do it using Title 10 Part 20, do it  
24 using Federal Guidance Report Number 11, do it using  
25 Federal Guidance Report Number 13. You might even

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 want to do it using NCRP Handbook 69. But that's open  
2 to question.

3 The second thing I believe would be very  
4 useful and it is good to have it written down so that  
5 you can distribute it when questions come up is to do  
6 dose calculations for different age groups. In other  
7 words, you do it for the adult for compliance but do  
8 it for a teenager and do it for an infant. We saw the  
9 curves yesterday in which one set of curves showed the  
10 dose estimates with time for Carbon 14.

11 Well, there were multiple questions about  
12 those dose estimates. So certainly I believe NRC  
13 should encourage DOE to reexamine those calculations.  
14 We have heard time and time again about the biosphere  
15 dose conversion factors. For many people, those are  
16 a black box. However, DOE and the NRC, both sets of  
17 staffs, have done multiple written reports in which  
18 they have explained the components of the BDCFs.

19 I believe that the NRC might encourage DOE  
20 to have available reports on that so that members of  
21 the public, if they ask, and even members of the  
22 technical community could read these reports and gain  
23 a better understanding of just how those are being  
24 done. Now, I want to add one other set of informative  
25 reports. This was not discussed yesterday. So I want

1 to clearly acknowledge that it's simply one of my  
2 suggestions.

3 We need a baseline report. Now, the  
4 information is available if you read the various  
5 environmental impact assessments, if you look at the  
6 technical basis document for the biosphere. You can  
7 find much of the information that is needed in what I  
8 would call a baseline report. To be sure everybody  
9 understands, here I have reference to conditions  
10 within the region that will eventually be impacted by  
11 the repository. In other words, what are the  
12 conditions there today?

13 How much iodine is there in the  
14 groundwater, technetium or plutonium or whatnot? You  
15 could say why? Well, as all of us know, the Nevada  
16 test site is next door. They have done many  
17 underground detonations. To me, it's very important  
18 to document all of this information. This includes  
19 natural background sources such as the uranium and  
20 radium and so forth.

21 You could say even if we find plutonium or  
22 neptunium or americium or et cetera in the ground  
23 water, say someone goes out and makes a measurement  
24 five minutes after the closure of the repository and  
25 they find some I-129. Well, the response and the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 almost logical response is that repository is leaking  
2 and here is some iodine.

3 If you have done a baseline survey, which  
4 has been done, as I say, I believe most all of the  
5 data that you need are available, have those data  
6 summarized in a document. That's what the condition  
7 was before any waste was even placed in the  
8 repository. That will be far better as a reference  
9 document at that time then to go out and say the fact  
10 that there's iodine there is not a problem because we  
11 can do forensic tests and do atomic ratios or isotopic  
12 ratios and forensically determine its source.

13 Well, fine. Well then good but it's much  
14 better to have a basic document. Now, you might ask  
15 who should do the compliance calculations? Well,  
16 certainly both the NRC and the DOE will be doing them.  
17 You might ask who should do these other extra  
18 informative calculations? I believe again that NRC  
19 should encourage DOE to do that.

20 The second item I have is the regulatory  
21 process. We heard and we were reminded that it  
22 consists of multiple steps. It permits factoring in  
23 new information along the way. DOE well understands  
24 this. Our science and technology panel was created to  
25 continue the research, to enrich the database even

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 after the license application is submitted.

2 Why? Because there will be many  
3 opportunities during that review period which  
4 legislatively is stated to be three years long, from  
5 2005 through 2007. Obviously the NRC staff will stay  
6 active throughout that period of time. But let's  
7 encourage people not to cease continuing to conduct  
8 studies to reduce uncertainties and so forth.

9 The third item I have is related to  
10 uncertainties. It ties in to what Dr. Till was  
11 commenting on. He was pointing out, and the panel  
12 obviously was not unanimous in that, but I'm unanimous  
13 on it, that there are two types. One is factors that  
14 have been fixed by the regulations.

15 You have to understand how Dr. Till is  
16 defining this. He said there are no uncertainties.  
17 He's meaning that in a strict sense. But what do  
18 these include? Well, the -- He or she drinks two  
19 liters of water per day. It's based on this  
20 withdrawal we heard of 3,000 acre feet per day. It's  
21 based on dose coefficients and at the moment Federal  
22 Guidance Report Number 11.

23 Now, the panel seemingly yesterday said we  
24 ought to encourage DOE to move to Federal Guidance  
25 Report Number 13. But in that sense, you don't argue

1 with the dose coefficients in the Federal Guidance  
2 Report because that is a decision that they are to be  
3 used.

4 Now, factors that must be measured and  
5 have a distribution of values include the obvious  
6 things as we're irrigating the crops and there will be  
7 uptake by the home gardens as well as the alfalfa and  
8 so forth, food for the cows. There's uptake and those  
9 uptake factors have uncertainties so we should  
10 certainly continue to try to refine those. It's a  
11 dynamic process as Dr. Kocher emphasized yesterday.

12 So that's one example. The biokinetics,  
13 there I think, and I hope that this is not incorrect,  
14 that one of the major uncertainties is the GI  
15 absorption track factor for plutonium or neptunium or  
16 americium. Then there's the dosimetry. That involves  
17 the distribution of the radionuclides within various  
18 body organs there, the types of radiation they emit,  
19 the energy of those radiations, how that energy  
20 deposits within the tissue and so forth.

21 So anything we can do along those lines,  
22 we, NRC and DOE should be moving ahead. The NRC  
23 should encourage DOE to prepare documents in which  
24 they express the conservatisms and the uncertainties,  
25 quantify them as best they can. What are some of the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1           uncertainties?

2                         Well, one to me is the solubility of  
3 plutonium. I know DOE has put a tremendous amount of  
4 effort into this. They have studied colloids. In  
5 fact, in the technical basis documents, there's a  
6 whole section on colloids and plutonium colloid. So  
7 they are making the effort. That needs to be put in  
8 a form so all of us can understand. The uptakes of  
9 the radionuclides, we have already talked about that.  
10 The Kds for the movement of the radionuclides in the  
11 soil, I gather that the Kds are one of the factors  
12 that play a major role in uncertainties.

13                         In a similar way, they should look at the  
14 conservatisms. I don't think I've seen in anybody's  
15 report, and someone will quickly correct me and please  
16 do because I'd like to read about it, the long  
17 effective half-lives of the alpha emitting neptunium,  
18 plutonium, and americium give you a factor of two  
19 conservatism in the dose estimates simply because of  
20 the committed dose concept.

21                         The acute versus chronic intake, the dose  
22 coefficients, and I believe Keith has agreed on this,  
23 are for acute. Not agreed, he knows. He can tell us.  
24 It's for me to agree with him. But they are based  
25 upon acute intakes. In other words, I take in the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 whole annual intake on January 1. That's not going to  
2 be the real world situation.

3 I think next we need to look at the fact  
4 that there are three sets of standards; the intrusion  
5 standard, the groundwater protection standard, and the  
6 individual protection standard. To me, it would be  
7 extremely helpful, and in fact Maryla Wasiolek  
8 yesterday pointed out at least one case where which of  
9 these - skip the intrusion standard - but for the  
10 groundwater protection standard and the individual  
11 protection standard, which one governs under what  
12 circumstance and for what radionuclide?

13 To me, that's very important. In fact, if  
14 you can do that, it helps people get a grasp of what's  
15 going on without being confused too much by the  
16 complexity of the regulations. What do I mean there?  
17 Several things. The groundwater protection standards,  
18 and please all of these statements will have  
19 qualifications. But I think in terms of technetium  
20 and iodine, the groundwater protection standards are  
21 it. That's it.

22 Now, it's the formula around that Dr.  
23 Kocher pointed out quite correctly. They have  
24 established secondary standards so it will be the  
25 picoCurie per liter limit in the two liters of

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 groundwater that you consume. But technetium and  
2 iodine are in my opinion just essentially totally  
3 controlled by the groundwater protection center.

4 Why do I say that? You can say there's an  
5 effective dose from technetium and iodine and it has  
6 to be considered in the individual protection  
7 standard. But the effective dose for technetium based  
8 upon FGR 11 is one-tenth of a millirem a year. Well,  
9 in 15 millirem, one-tenth is not much of a  
10 contribution. And for iodine it's two-tenths of a  
11 millirem per year.

12 Well, I say therefore the groundwater  
13 protection standard is controlling. Now, in a similar  
14 manner, the groundwater protection standard is  
15 controlling for radium 226 and 228 because I presume  
16 that the bulk of the radium 226 and 228 that's in the  
17 groundwater, which is now I think two or three  
18 picoCuries per liter. It's somewhere in that  
19 ballpark. In fact, they took one sample that I saw  
20 the exceeded the five picoCuries per liter. Then they  
21 resampled and it showed that that initial sample was  
22 not correct.

23 I say or suggest that radium 226 and 228  
24 are controlled by the groundwater protection standard  
25 because if they are naturally occurring, they do not

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 play any role in the individual protection standard  
2 because natural sources are exempt from the individual  
3 protection standard. Now, where does the individual  
4 protection standard play it's major role?

5 In my opinion, it's in neptunium,  
6 plutonium, and americium because the bounding limit  
7 under the groundwater protection standards for those  
8 nuclides is 15 picoCuries per liter. Well, 15  
9 picoCuries per liter permitted by the groundwater  
10 protection standards gives you from three to more than  
11 four times the 15 millirem a year limit. So  
12 therefore, for most cases, the individual protection  
13 standard will be governing.

14 Now, back to the secondary standards, Dr.  
15 Kocher is absolutely correct. They have been  
16 established by EPA. As I recall, it's 2,000  
17 picoCuries for Carbon 14. It's 900 for technetium.  
18 It's one picoCurie per liter for iodine 129. However,  
19 I tried all four sets of dose coefficients. I do not  
20 find four millirem per year consistently in any of  
21 them.

22 Let me give you the numbers. Again, I  
23 work alone so nobody checks my calculations. I  
24 acknowledge they need to be checked. But if you apply  
25 FGR 11 with those picoCurie per liter limits to two

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 liters of water per day for an adult, you get 3.1  
2 millirem for Carbon 14, 3.9 for technetium, and 6.7  
3 for iodine.

4 Now, I can understand the 6.7 for iodine  
5 because EPA doesn't want to say six-tenths or four-  
6 tenths of a picoCurie per liter. They want to say  
7 one. And that's fully understandable. But someone  
8 needs to look at those. Now, if we switch to FGR 13,  
9 I came out with 3.1 for Carbon 14 and 5.7 for I-129.  
10 I'm skipping technetium for the following reason.

11 When you shift to FGR 13, the organ with  
12 the highest dose is the lower large intestine. In  
13 that case, the dose to that organ, I don't know  
14 whether the lower large intestine is an organ or  
15 whether the colon is the organ. That needs to be  
16 clarified. In any event, it comes out almost ten  
17 picoCuries per liter.

18 Now, I'm winding down but I'm drifting  
19 into Never-Never land. My fifth item is  
20 considerations in terms of the groundwater. The  
21 groundwater is extremely hard, as we said yesterday,  
22 ranging from more than 200 to more than 1,100 parts  
23 per million total dissolved solids milligrams per  
24 liter. I have heard and have read the results of the  
25 food consumption survey.

1           There was nothing in there about water  
2 softeners. I realize the nature of the community and  
3 probably not a single soul has a water softener. But  
4 we are supposed to base our RMEI on the average member  
5 of the community and his or her dietary habits and  
6 living style. Well, there is a casino. There is a  
7 hotel. There is a country store, whatever you want to  
8 call it. I find it hard to believe that not one of  
9 those facilities would have anything in the way of a  
10 water treatment facility.

11           If they do, that's part of their living  
12 style. Again, it may only be a minor thing. But I  
13 would like to know about it. Is the water potable?  
14 It has from 1.6 to 2.3 parts per million of fluoride.  
15 One part per million of fluoride is ideal to prevent  
16 dental care or to assist in preventing them. I  
17 believe 2.3 will mop model your teeth if you consume  
18 it long enough. Well, I don't know the ramifications.  
19 But I ask, is the water potable?

20           Carrying on the earlier thing of  
21 informative calculations, we have read that the  
22 pumping permits, and I realize that's a permit only.  
23 They are not pumping as much as the permits allow.  
24 But at some time, and this is conjecture on my part,  
25 but certainly before the closure of the repository,

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 you could pump that aqua for dry.

2 Now then, they have to move to a new  
3 source. Whether it's practical to go 30 miles away  
4 and drill a new well and pipe it over, I don't know.  
5 But I would like to see DOE examine that. That would  
6 add to their credibility. It need not be done,  
7 insofar as I know, prior to submission of the license  
8 application. It's something that could be done  
9 afterwards.

10 The next to last, FGR 13, the panel pretty  
11 much said go for it. That would, in my opinion, be a  
12 tremendous step forward. My last point would be based  
13 upon my experience, and I was not involved in WIPP but  
14 Ruth Weiner was and others, after WIPP license was  
15 approved, I have been told personally by Wendell Weart  
16 that DOE disbanded its staff. Questions have come up  
17 time and time again since that facility started  
18 operation.

19 So my final urging, and it's a personal  
20 statement, is that for neither the NRC nor DOE to even  
21 think about disbanding their staffs until that  
22 repository is closed and even after. If it's  
23 approved, if it's filled and if it's closed, even  
24 after that, do not disband those staffs because you  
25 need the legacy of their knowledge, of your knowledge

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 about the facility as you move forward. I have taken  
2 up far more time than I intended. Keith, do you have  
3 comments, rebuttals, and additions?

4 DR. ECKERMAN: No, I think you hit all the  
5 points that I really had. I would view the compliance  
6 tool as a tool, as an instrument. I think you need to  
7 calibrate that instrument. That's these other  
8 satellite calculations that we have talked about. I  
9 think the compliance tool ought to use the latest  
10 Federal Guidance 13 dose coefficients which both the  
11 principal agencies have in the past endorsed people  
12 and allowed their use.

13 I would encourage the people that are  
14 responsible, if you don't have a copy of the ICRP CD,  
15 by all means, get this. We'll just have to calculate  
16 and use the ICRP 26 waiting factors that are in the  
17 regulations and recalculate what the effective dose  
18 equivalent is and use those coefficients. I'm still  
19 a little concerned about RMEI.

20 Is that definition being extended beyond  
21 what's really required by the law and whether that's  
22 done in a consistent manner? That's some detail that  
23 can be looked at later. But I think people should be  
24 very careful that they are not making some decisions  
25 in an inconsistent manner here as they treat RMEI. I

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 think that's basically reiterating most of what you  
2 had said in one way or another.

3 DR. MOELLER: Keith, let me ask you for my  
4 own education. Did you just say that the ICRP 26  
5 tissue waiting factors are in the law, in the  
6 regulations?

7 DR. ECKERMAN: This is the position the  
8 agencies have taken. They say that you can use the  
9 equivalent dose coefficients from the latest  
10 dosimetry. But they want you to use the waiting  
11 factors that are in part 20 and in the law. That's  
12 the interpretation I have gotten from people.

13 Because of the robustness, it really  
14 doesn't make a whole lot of difference. Numerically  
15 you will see the difference with iodine 129 depending  
16 on which set of factors you are using. That probably  
17 ought to be clarified with the agencies because that  
18 position I had heard some time ago.

19 VICE CHAIRMAN RYAN: And I think we heard  
20 that if a licensee asks for that explicitly, they can  
21 sure deal with it on an explicit request basis. But  
22 I guess I didn't hear that it's a policy per se.

23 DR. ECKERMAN: Yes.

24 VICE CHAIRMAN RYAN: So it would be your  
25 advice to qualify it.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 DR. ECKERMAN: It has to be qualified. By  
2 all means asked, don't take my position on it.

3 VICE CHAIRMAN RYAN: Thanks.

4 DR. MOELLER: Tim McCarten, are you in a  
5 position to comment? Would you please if you can?

6 DR. MCCARTIN: No, that's not my area.  
7 Chris might have some idea.

8 DR. MOELLER: All right.

9 MR. MCKENNEY: It is NRC policy that if a  
10 licensee asks, they can get an exemption from the  
11 definitions of part 20. Definitions in part 20  
12 unfortunately do have exactly the waiting factors  
13 listed in there. That is why there has to be a change  
14 to allow the new system.

15 DR. MOELLER: But they can request it.

16 MR. MCKENNEY: Yes, they can request it.

17 DR. MOELLER: Thank you. David Kocher.

18 DR. KOCHER: It would make no sense to me  
19 whatsoever to use the latest biokinetic models and  
20 calculate effective dose equivalent. That just flunks  
21 the laugh test. I would have to go look in my files.  
22 But the memo I remember seeing from NRC talked about  
23 you can use effective dose. I could be wrong about  
24 that.

25 Dade, also I was wrong yesterday about the

1 drinking water standard apparently. I'm told that  
2 there was a deal struck shall we say where the part  
3 197 just has the dose standard in there and it doesn't  
4 refer to the old MCLs. So you apparently are at  
5 liberty to use different --

6 DR. MOELLER: Concentrations.

7 DR. KOCHER: You can derive different MCLs  
8 from that based on newer biokinetic and dosimetric  
9 models. That apparently is the case so I was wrong.

10 DR. MOELLER: Tim McCartin.

11 DR. MCCARTIN: Could I just qualify that?  
12 I'm not aware of any deal that was struck. EPA chose  
13 to write the standard in that particular way that they  
14 do not explicitly point to the MCLs. There was no  
15 deal that I'm aware of in that regard. That was an  
16 EPA decision. The implication might have been that  
17 NRC had something to do with that.

18 DR. KOCHER: No, I think this is an  
19 internal EPA matter.

20 VICE CHAIRMAN RYAN: The decision was not  
21 to point to MCLs at the end of the day.

22 DR. KOCHER: Apparently that's so because  
23 part 197 doesn't refer to those explicitly. But  
24 that's something that a lawyer in consultation with  
25 EPA would have to fair it out. Congress, the Safe

1 Drinking Water Act amendments, may have something to  
2 say on the issue if somebody really examined what that  
3 means.

4 VICE CHAIRMAN RYAN: Tim had a comment.

5 DR. MCCARTIN: Yes, although the  
6 differences between applying those MCLs and applying  
7 the limits there are very small.

8 DR. KOCHER: Yes.

9 DR. MCCARTIN: It's not like there's a  
10 significant difference between the two.

11 DR. KOCHER: It's how many angels could  
12 dance on a head of a pin kind of thing.

13 DR. MOELLER: Dr. Till.

14 DR. TILL: I might just add a few things.  
15 My first point is that compliance with standards for  
16 public exposure is public business. I know that's why  
17 you are here and that's why these meetings are open.  
18 But in the same sense, this is as much a credibility  
19 building process as it is a calculational process.

20 I have always said this. I have been  
21 caught in the middle of it. I'm guilty myself as a  
22 scientist of thinking that we can do the greatest  
23 science, perfect calculations. But if you haven't  
24 brought those exposed along so that they understand  
25 what you did, then you are actually doomed to fail.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1                   Yesterday I heard several times  
2 opportunities for the Department of Energy or NRC or  
3 whoever is responsible to earn some credibility. The  
4 examples are the evaporators. Perhaps that would be  
5 something simple to do if it solves the problem.  
6 Visiting the dairy farm, if you have 5,000 cows out  
7 there, I would know everything about that dairy farm  
8 whether it plays directly or not. I would be able to  
9 answer that question.

10                   So I think it's important to keep in mind  
11 that this is really a credibility building process.  
12 I was very pleased to hear when this question came up  
13 about the survey. The first time it came up, we were  
14 told the survey was not done in Spanish. Finally, the  
15 record was laid straight. It was done in Spanish.  
16 That's crucial. So that's my first point.

17                   My second point is, and I mentioned this  
18 yesterday, about recommending that the Department of  
19 Energy use the best science available in going through  
20 this compliance process. I think that should be  
21 policy. I think it needs to be decided how you do it  
22 and how you implement policy. Just to make a  
23 statement is one thing. But how do you decide when  
24 there is new science and when you implement new  
25 science?

1           That's like the dose conversion factors.  
2           You can't pick and choose among the science.    You  
3           can't pick one dose conversion factor that makes your  
4           dose lower for plutonium inhalation and higher for  
5           plutonium ingestion.  We know that was the case in the  
6           last revision of the dose factors.  So some kind of a  
7           method that you are going to use the best science and  
8           here's how we're going to do it.

9           This is Keith's point.  I think this is a  
10          crucial issue about the RMEI.  I understand that  
11          requirements to stay within the law.  And that's  
12          important because that's the way the law is set up.  
13          But this is certainly not the traditional critical  
14          group concept.  I would certainly have, within these  
15          stylized calculations, in my back pocket what the  
16          critical group dose is as well just to be able to  
17          answer that question.

18          I assume we're going to come back and talk  
19          a little bit more today about this adult being the  
20          individual exposed.  I said yesterday I agree with  
21          that.  I want to talk a little bit more about it and  
22          explain why.  But I think that's going to raise some  
23          questions with regard to the public.  It came up  
24          yesterday about children being exposed.  That all  
25          needs to be taken into account.  There's a way to do

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 that. Maybe we can come back and discuss that some  
2 more today.

3 VICE CHAIRMAN RYAN: We'll have  
4 opportunities after the presentations to do that.

5 DR. TILL: Yes, I was very happy, Dade,  
6 with what you said about the uncertainties of some  
7 fixed and some not fixed. That's a little bit of a  
8 change in the way we have done business in the past.  
9 I recognize that. But the idea that the parameters  
10 that define an exposure scenario for an individual in  
11 the future in my view should be fixed.

12 Quite honestly, at the same time, I would  
13 make that calculation with the variability in those  
14 parameters and with a distribution. I think what you  
15 will find is there isn't much difference. But to me,  
16 like I said, it's a philosophical issue that's  
17 important to lay very clearly on the table.

18 Another point that I have a little bit of  
19 trouble with is this decoupling of the different  
20 elements of the TPA. What we're working on, what  
21 we're focusing on in this group are the biospheric  
22 dose conversion factors. And that's fine.

23 VICE CHAIRMAN RYAN: John, just to be  
24 clear, I think you mean the TSPA meaning the DOE  
25 calculations.

1 DR. TILL: Yes, I'm sorry.

2 VICE CHAIRMAN RYAN: Okay, I just wanted  
3 to be clear.

4 DR. TILL: I think what we're doing is  
5 fine. It's fine to look at this. But then you need  
6 to come back and look at the whole package together.  
7 What worries me some is this, and it goes back to  
8 credibility. I worry that this element of the  
9 calculation is de-emphasized so much because the  
10 uncertainty is so small and it plays such a small role  
11 overall in the overall compliance process that it's  
12 not given the attention it's due for the credibility  
13 issues.

14 Quite honestly, if I had to predict  
15 anything, I would say this is the element of the  
16 compliance calculation that will give you more trouble  
17 than anything in the long-term. It's because people  
18 understand. They understand what you are trying to  
19 do. They understand what people eat and what their  
20 lifestyle is. It will get challenged. So it's  
21 important that you come back and couple these together  
22 in the long-term. Those are my points. Thank you.

23 DR. MOELLER: Let me go back to Dave  
24 Kocher. I apologize, Dave, you were not through.  
25 Please continue.

1 DR. KOCHER: The bad news is I hadn't  
2 actually gotten started yet.

3 (Laughter.)

4 DR. KOCHER: I very much second John's  
5 concern about this decoupling business for a number of  
6 reasons. I think we all recognize we have a  
7 fundamental quandary here. The reason we're putting  
8 this stuff in the ground is because we think the  
9 geosphere and engineered barriers do good things for  
10 us. That's clearly where our greatest emphasis should  
11 be placed in assessing total system performance.

12 But the biosphere plays some part. If you  
13 are going to do it, you ought to try to do it  
14 reasonably well. I also think that there may well be  
15 some real couplings between the biosphere model and  
16 the geosphere model that simply are not accounted for  
17 in the present way of doing things. We learned  
18 yesterday that in modeling root uptake from soil by  
19 plants that there is a correlation accounted for  
20 between distribution coefficients  $K_d$  and root uptake  
21 factors  $B_v$ .

22 The same kind of correlation presumably  
23 applies to whatever distribution coefficient you  
24 assumed in your transport model to get to the well.  
25 There could well be some correlations. When you don't

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 account for these, you may under-represent the overall  
2 uncertainty in the system when you do stochastic  
3 modeling.

4 I don't think there are a large number of  
5 these couplings that would be significant. But it's  
6 probably worth some thought. I also agree with Dave's  
7 comment --

8 MEMBER HORNBERGER: Dave, can I? Just for  
9 clarification, when you talk about coupling of the  
10 transport system to plant uptake, you are suggesting  
11 there could be a feedback on the transport from  
12 uptake. I lost that.

13 DR. KOCHER: No, it could be that the  
14 appropriate value of a root uptake value is correlated  
15 with whatever Kd you assumed to transport the stuff to  
16 the well because it's known in its soils that for high  
17 Kd things, the root uptake factor is low. For low Kd  
18 things, the root uptake factor tends to be high.

19 So by not accounting for these  
20 correlations, you might under-represent uncertainty.  
21 If you just treat everything as independent, of  
22 course, if you have enough variables, your uncertainty  
23 shrinks to very little. I don't think it's a big  
24 deal. But it's worth thinking about have you cost  
25 yourself something by doing this complete decoupling

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 of the biosphere model from everything?

2 MEMBER HORNBERGER: From what consistency  
3 then correlation?

4 DR. THORNE: No, could I come in? I think  
5 it's a genuine correlation. What Dave is saying is  
6 that the mineralogy and texture of the soils is  
7 related to the mineralogy and texture of the  
8 underlying materials through which the radionuclides  
9 are passed. Unless you recognize that these are  
10 related materials, you won't build in the proper  
11 correlations between the Kd values that are  
12 appropriate to that material.

13 It's that underlying nature of the  
14 physical system which I think goes back to Dade's  
15 point that if you have a full site description report,  
16 you will recognize those mineralogical and textural  
17 relationships in the description. Then you will build  
18 them into the model subsequently.

19 MEMBER WEINER: Isn't this what the PA,  
20 performance assessment, in the general sense, does  
21 anyway, or are you suggesting something beyond what  
22 performance assessment does?

23 DR. KOCHER: What we have learned so far  
24 is that these kinds of correlations are not accounted  
25 for because the stochastic modeling of the part of the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 performance assessment that gets you to a  
2 concentration in a well is completely decoupled from  
3 whatever kind of stochastic uncertainty analysis you  
4 do for the biosphere component.

5 MEMBER WEINER: But the way the  
6 performance assessment works is that each distributed  
7 variable is sampled on. Yes, the samplings are  
8 independent. But you are certainly taking into  
9 account the uncertainties in both sets of variables.

10 DR. KOCHER: But the problem is this.

11 MEMBER WEINER: I'm just asking beyond  
12 that.

13 DR. KOCHER: In your geosphere model, if  
14 you by random sampling select a low value of  $K_d$  for  
15 your transport calculation and then you at random  
16 assume a low root uptake over here in the biosphere  
17 model, you have ignored that correlation completely.  
18 Let me give you a simple example. Suppose you have a  
19 bunch of film badge readings.

20 You make a bunch of readings on a film  
21 badge and you want to add them up to get the dose and  
22 you want to take into account uncertainty. If you  
23 treat the uncertainty in each film badge reading as a  
24 random thing, the more badge readings you have, the  
25 lower the uncertainty is going to get. But if there's

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 correlations, the uncertainty doesn't get as low. And  
2 you have the same potential problem here.

3 MEMBER WEINER: Yes, and I can see that.  
4 It seems to me that what you are suggesting, and I  
5 know we did this on the web and I haven't looked at  
6 the TSPA that closely, but there was an attempt to do  
7 stratified sampling, do latin hypercube (PH) sampling  
8 so that you at least sample more or less equally from  
9 the entire range. Now, you're suggesting something  
10 else. That's what I was trying to get to. You're  
11 suggesting that the performance assessment include  
12 positive correlations in addition to just the random  
13 sampling of uncertainty.

14 DR. KOCHER: I'm just suggesting that this  
15 is worth looking into to see if it matters. There  
16 could be others. I haven't really thought about this.  
17 Climate is a tricky business that I know nothing  
18 about. But it clearly affects both suites of  
19 models. Are there correlations in your  
20 climate change model that you are losing by treating  
21 climate as some kind of stochastic variable but treat  
22 them completely independently in the geosphere  
23 transport part and the biosphere part? Are you losing  
24 something by this total decoupling? I have no idea  
25 how important this is. But I'm just concerned that

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 something might be lost when you do this.

2 DR. MOELLER: Excuse me, David, I'm being  
3 nudged from my left that we need to move along. But  
4 go ahead and cover your other points. Perhaps we can  
5 do the discussion later today.

6 VICE CHAIRMAN RYAN: That would be great.

7 DR. MOELLER: But raise your points.

8 DR. KOCHER: Yes, I have some specific  
9 technical comments some of which I have transmitted to  
10 the DOE people already and probably should wait until  
11 later. It's about the modeling and parameters that  
12 they chose. I won't deal with that here.

13 DR. MOELLER: Okay, thank you. Jeff, why  
14 don't we move ahead then?

15 DR. DANIELS: My comments pretty much echo  
16 what you have had to say, Dade. I would only like to  
17 add that the extra informative calculations are an  
18 imperative. It's very important that we understand in  
19 a comparative sense what the age specific dose may be.  
20 People want to know. The other thing that I think is  
21 relevant here is there is a risk assessment  
22 performed. It doesn't stop exclusively with  
23 the dose calculations. It would be done with the  
24 appropriate dose conversion factors along the lines of  
25 Federal Guidance 13. While this is certainly in the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 extra informative calculations, it's what the public  
2 is not only asking for but is demanding.

3 Remember, we're talking here about a  
4 situation that is a prospective understanding. We're  
5 not talking about an epidemiologic study where people  
6 are being exposed and there is evidence of effect. We  
7 don't know what that effect might be. Unfortunately  
8 we have a model that says it's linear through zero and  
9 there's no threshold. At this point, that's the best  
10 we can do. It seems to be a conservative model for  
11 the purposes of analyses that are prospective.

12 So I think it's deficient not to advise  
13 the public what those numbers are. I think it's also  
14 important to recognize that because of the difficulty  
15 in comprehending the way MCLs are derived in the  
16 present based on the way they were derived in the  
17 past, there's an issue here that says risk may be the  
18 unifying thing. There's been arguments within the EPA  
19 about how the MCLs should be appropriately  
20 adjusted. The fact is that they won't be  
21 raised. But they could be lowered. The fact is that  
22 with all of that understanding taken into account,  
23 there's a great deal of confusion among the public  
24 about what might be considered right. But science  
25 moves forward. Thanks to Keith and the new

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 biokinetic modeling processes that exist, there's a  
2 better understanding of how that dose is converted.  
3 There's an understanding within the context of today's  
4 understanding of the risk what those numbers translate  
5 into. Ultimately the public wants to know.

6 The other points that I would like to make  
7 just in passing are I have to commend the process as  
8 it exists right now because we're here due to the fact  
9 that there is a defensibility and credibility to the  
10 documentation. In the past, it may have been a back  
11 of the envelope calculation that was done with a  
12 certain degree of conservatism that everybody said  
13 this is realistic or unrealistic in that case.

14 The compliance documents have now improved  
15 to the point where we can take into account a  
16 reasonably maximumly exposed individual. It's  
17 important to emphasize what that means. Maximumly  
18 exposed, this isn't just to say that it's going to be  
19 everyone in the population. It's to say that we're  
20 taking into account a certain degree of conservatism  
21 as Dr. Till has mentioned, and we fixed it at two  
22 liters a day for an adult.

23 Now, it's important to recognize within  
24 extra informative information what that is  
25 prospectively related to a child or a teenage. It's

1 also important to qualify the calculations to  
2 recognize that indeed the dose conversion factors  
3 assume, and you can correct me if I'm wrong, Keith,  
4 but that you are going to get the annual dose all at  
5 one time which is a little insincere but is  
6 conservative.

7 With regard to pathway exposure factors  
8 and uptake versus intake, I think the best that can be  
9 said right now in the process is that these things be  
10 documented well and that they be transparent in the  
11 way that the calculations are conveyed both to the  
12 public and to the regulatory agencies. Meetings like  
13 this continue in the licensing process so that all of  
14 the concerns, as you brought up, Dr. Kocher, are  
15 vented. That's the points I would like to make.

16 DR. MOELLER: Thank you. Mike.

17 DR. THORNE: You might feel that coming  
18 last I wouldn't have anything to say. But I have one  
19 or two extra points. Let me endorse or suggest a way  
20 forward on the RMEI. Obviously we are stuck with the  
21 RMEI. I think what I missed yesterday was a narrative  
22 that establishes the consistency between the RMEI and  
23 the biosphere model configuration and  
24 parameterization. That narrative would help us to see  
25 why the calculation was what it was.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 I think, just endorsing John's point, that  
2 I would like to see a supplementary calculation with  
3 a conventional critical group approach. There is a  
4 gut feeling that it doesn't make an enormous  
5 difference. But it would be nice to see that  
6 quantified. And I don't think that's too difficult to  
7 do.

8 Effectively, internationally there's a lot  
9 of discussion on the geosphere biosphere interface  
10 zone. It's recognized as a significant source of  
11 uncertainty. Effectively, it's regulated out here by  
12 the 3,000 acre feet rule. Again, if we're talking  
13 supplementary calculations, that's an obvious  
14 candidate for variant calculations to show the  
15 implications of that regulatory decision.

16 I would mention that's currently being  
17 addressed in the Bio-Prata (PH) project which I know  
18 the Yucca Mountain project people have an involvement  
19 in. So this is not going to be a new story to them.  
20 I think the detailed analysis for contributions by  
21 pathway was very welcome. Again, the words that come  
22 to mind here are a narrative is what I'm looking for  
23 there that describes why the results are what they are  
24 and how they could be different if I made different  
25 conceptual assumptions or different parametric

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 assumptions.

2 We talked about uncertainty and  
3 sensitivity analyses yesterday. I think I'd like to  
4 see an explicit recognition that both types of  
5 analysis are appropriate and that they are  
6 complimentary to each other in helping to explain the  
7 system. We sort of touched on specific activity  
8 models both on the iodine 129 and actually effectively  
9 on the Carbon 14 and fish issues.

10 I think that reveals to you that specific  
11 activity arguments can be useful. But they have to be  
12 used with considerable care and you have to decide  
13 what are the stable pools that are mixing with each  
14 other in the system? If you don't get that straight,  
15 you get the wrong answers.

16 Another big message I would send is Redox  
17 sensitivity. For things like iodine and technetium  
18 and a number of the actinides, chemical speciation and  
19 changes with oxidizing conditions are a major factor.  
20 I don't necessarily believe that those should be built  
21 in at the level of assessment models. But it's  
22 interesting when you look at the TSPA that the other  
23 parts of the model are underlay detail models which  
24 inform the actual assessment level model.

25 I don't see the same relationship between

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 the assessment level model in the biosphere and  
2 detailed process-based models to define and justify  
3 the parameterization and the conceptualization. I'm  
4 thinking of things like soil column-type models where  
5 you explicitly use Richard's equation where you  
6 consider the kinetics of the processes. The  
7 traceability from detailed process modeling is an area  
8 that could perhaps be useful.

9 FEP analysis we briefly mentioned. One  
10 thing that affects me about the FEP analysis is not  
11 surprisingly because it's based upon international  
12 experience the FEPs are described at a very high  
13 level. They are things like human lifestyle or  
14 inhalation which are nice motherhood words. But they  
15 don't actually give me a very big handle on how to  
16 build a real model.

17 But I think we saw very usefully that the  
18 interaction matrix approach is being applied. I think  
19 that gives you a very scrutable audit trail. I would  
20 draw attention to the ongoing work of the  
21 International Union of Radioecology in that area. I  
22 would very much encourage that there is talk between  
23 the DOE, the NRC and the IUR program in that area  
24 because I think that's where we'll develop much more  
25 structured modeling approaches.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 I am happy with the compartmental modeling  
2 approach. That's standard international practice, as  
3 I say, at the assessment level, though I think we need  
4 to underpin with process modeling. I am concerned  
5 also that spacial heterogeneities in the system are  
6 not represented in the model, that we treat the  
7 biosphere as if each of those compartments was a  
8 homogeneous system. We know that spacial in  
9 homogeneity in soil characteristics will exist.

10 I was a little concerned with the fact  
11 that when the activity has passed down through the  
12 soil zone, and this goes back to Dave's question on  
13 correlation and interactions, that the radioactivity  
14 disappears from the system. Now, if I take the NRC  
15 example where they irrigate for 15 years, 15 years  
16 will drive a soluble nuclide down in the soil.

17 But when you turn off the irrigation,  
18 there will be a net soil moisture deficit and  
19 effectively there will be an upward suction. The  
20 activity that moved down five or ten meters will move  
21 back up again. You have the problem there that you  
22 can build up a reservoir depth which is then recovered  
23 to the soil zone and is available for exposure again.  
24 It's that sort of interaction which is basically an  
25 understanding that the surface hydrology and its

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 coupling to transport that is the sort of thing that  
2 I see embedded in a process model.

3 I'm nearly there you will be glad to know.  
4 These are the highlights. One thing we didn't touch  
5 on yesterday is when I look at the underlying  
6 literature, I would commend the literature. I think  
7 the description of the new ERMYN model and the  
8 description of where do all the parameters come from  
9 is impeccably done. I can see where every number came  
10 from which of course allows me to ask more questions  
11 about them.

12 One of the things that strikes me there is  
13 that many of the value hues (PH) are derived from  
14 secondary reviews of the literature. This has a  
15 number of potential problems. Some of those reviews  
16 are very dated. One is that these is a Beas Review  
17 from 1984, an excellent review in its time but 20  
18 years old. Others are reviews that we use as a basis  
19 for other models.

20 Sometimes those reviews don't fully  
21 consider the full range of the primary literature.  
22 Sometimes, as in IAE technical report series 364, they  
23 are internally inconsistent. For example, animal  
24 transfer factors are sometimes considerably higher for  
25 goats than for cows for no reason from the underlying

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 primary literature and notwithstanding the fact that  
2 the goat is ten times as small as a cow. That just is  
3 logically wrong.

4 Sometimes the values are not applicable in  
5 the local context. The Carbon 14 fact for fish which  
6 is taking from IAE 364 is one example of that where it  
7 might be okay if you were in a contaminated ecosystem  
8 where everything was contaminated. But it's not okay  
9 when you are in a fish farm where just the water is  
10 contaminated.

11 There's a correlation to be mentioned.  
12 When you have several secondary reviewers, you often  
13 find that they point to exactly the same single  
14 primary literature source. You can't treat the  
15 numbers from the secondary reviewers as if they were  
16 independent variables for the purpose of determining  
17 a distribution.

18 I'm a bit surprised that the DOE has not  
19 at some point undertaken its own comprehensive review  
20 of the primary literature on transfer factors which  
21 would seem to me as a desk study a relatively limited  
22 cost operation and that you would get enormous  
23 benefits from it. And the international community,  
24 incidentally, would get enormous benefits from it.

25 Climate change, it is curious that there

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 is no recognition even of the possibility of  
2 greenhouse warm states and the potential new analog  
3 characteristics in the system. I'm not saying that  
4 DOE should definitively assume that greenhouse warming  
5 will occur. But it should at least be recognized as  
6 a possibility and calculations should be made I think  
7 for those alternative states. That's being addressed  
8 extensively internationally.

9 Finally, on dosimetry, I think I agree  
10 with everybody that use of good science implies use of  
11 the latest ICRP, biokinetic, and dosimetric models.  
12 We did have a discussion yesterday about where you  
13 should look at variability and uncertainty. I would  
14 suggest that possibly you might limit that to  
15 sensitivity studies for alternative values for aerosol  
16 solubility, alternative aerosol sizes, and alternative  
17 gastrointestinal absorption and leave the systemic  
18 bits of the model alone because that gets complicated  
19 because the systemic models are carefully tuned.

20 There's a lot of correlations between the  
21 internal parameters. If you get into that business,  
22 I think we should leave that to Keith if anyone is  
23 going to do it. That's what I have. Sorry, that was  
24 quite a shopping list.

25 DR. MOELLER: No, that was great.

1                   VICE CHAIRMAN RYAN: That was an excellent  
2 summary of where we have been so far today. I guess  
3 what I would suggest is that we turn our attention to  
4 our first speaker. We can certainly pick up all of  
5 these points as people think about them and digest  
6 them and hear these presentations. Then we'll come  
7 back for a full discussion and questions.

8                   So, our first speaker up is Mr. Pat  
9 LaPlante who is a senior research scientist from the  
10 Center for Nuclear Waste Regulatory Analyses. For  
11 those of you that did not recognize yesterday, we have  
12 staff from the center on the TV screen. I'm sure they  
13 can see us as well.

14                  MR. LAPLANTE: Hello. Can everybody hear  
15 me? My name is Pat LaPlante. I work for the Center  
16 for Nuclear Waste Regulatory Analyses, the technical  
17 support contractor for the NRC in the high level waste  
18 program. Today I'm going to discuss risk insights for  
19 biosphere modeling. I don't have a whole lot of time  
20 so I'm going to provide a general overview. We'll  
21 have time for questions, and we can get into some  
22 details if you would like.

23                  In general, I'm going to talk about how  
24 our reviews of DOE documents are risk-informed. I'm  
25 going to provide an overview of the biosphere risk

1 insights which will be consistent with what I  
2 presented yesterday. I'm going to discuss the  
3 agreements that came out of our DOE document reviews  
4 and how those were risk ranked or significance ranked,  
5 I should say, and discuss some of the effects of the  
6 risk insights on our current work plans.

7 As I mentioned yesterday, we have been  
8 conducting dose assessments for quite a while, since  
9 the early '90s. So leading into the DOE document  
10 reviews for the site recommendation, we already had a  
11 fair amount of understanding of the basic system  
12 processes. These were process level, modeling, and  
13 sensitivity studies that have been published in the  
14 past as well as an TSPA, total system performance  
15 assessment code development activity which has gone on  
16 since the early '90s to the present.

17 That's included continued refinement of  
18 the biosphere models and parameters including looking  
19 at intermediate results and doing confirmatory  
20 calculations, verification, and so forth. That whole  
21 activity has given us vast insights into how the  
22 models are operating. So when we did the DOE document  
23 review supporting the site recommendation report, we  
24 did focus our reviews on those areas that we knew were  
25 driving the calculations.

1                   This was based on a process level  
2 understanding because those were the tools that we had  
3 at the time. The risk insights initiative, in full  
4 swing, began after we had developed the comments on  
5 the DOE documents. During that time, we had enhanced  
6 our total system performance assessment code to allow  
7 sensitivity analyses at the total system level on the  
8 biosphere parameters because we had actually included  
9 the biosphere model completely into our total system  
10 performance assessment codes.

11                   So this allowed us the ability to  
12 understand how the individual biosphere parameters  
13 were affecting the total system performance rather  
14 than just the dose that was calculated within the  
15 biosphere as a separate process model. The risk  
16 insights initiative used this information to  
17 significance rank the agreements we had already made  
18 with DOE that they would provide information to  
19 resolve our comments.

20                   The risk insights essentially provided a  
21 context to help us resolve the agreements. How much  
22 information do we need on certain topics if they are  
23 either important or not so important in the total  
24 system calculation? In general, our technical work  
25 over the years has been directed towards important

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 topics with large uncertainties. Obviously we're not  
2 spending a lot of time focusing on the drinking water  
3 consumption rate or that type of idea.

4 This slide provides just a basic overview  
5 of our risk insights for the biosphere modeling. This  
6 is consistent with what I presented yesterday. I've  
7 broken it down into insights related to the  
8 groundwater release, biosphere pathways, and those  
9 related to igneous activity release. In general, for  
10 the groundwater release pathways, we're seeing about  
11 50 percent of the dose due to drinking water and about  
12 40 percent due to crop consumption. Again, this is  
13 for key radionuclides that are driving the  
14 calculation.

15 The key parameters that we have determined  
16 in the process level sensitivity studies include  
17 distribution coefficients, plant transfer factors,  
18 crop interception which is deposition of material on  
19 the crop surface. In general in the crop  
20 contamination models, you get a certain amount that's  
21 deposited directly on the surface and a certain amount  
22 that comes up through the roots. That's what gets you  
23 your crop ingestion dose.

24 The uncertainty in the groundwater  
25 biosphere calculations is low relative to other

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1       abstractions. This influences the overall importance  
2       of the groundwater release biosphere pathways and the  
3       total system calculation.

4                 For the igneous activity release scenario,  
5       as I said yesterday, inhalation pathway dominates.  
6       That's fairly clear. Key parameters include mass  
7       loading and some of the exposure duration parameters.  
8       Mass loading is sort of a lumped parameter that  
9       includes a number of processes. Of course any of  
10      those processes that are driving the mass loading  
11      could also be important.

12                VICE CHAIRMAN RYAN: Excuse me. Because  
13      of the problem with the slides, he needs a four  
14      minute, everybody keep their place break. I hate to  
15      interrupt you. But that way, folks will be able to  
16      see your slides.

17                MR. LAPLANTE: Okay, sure.

18                VICE CHAIRMAN RYAN: So let's just take a  
19      quick break right in place.

20                (Pause.)

21                MEMBER HORNBERGER: One thing I'd like to  
22      know is that we keep using very qualitative terms;  
23      low, high, medium, et cetera.

24                MR. LAPLANTE: When I say "low," I mean  
25      relative to other abstractions.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1                   MEMBER HORNBERGER:   Relative to other  
2                   abstractions.

3                   MR. LAPLANTE:       The one I presented  
4                   yesterday gave you in a quantitative idea the level of  
5                   uncertainty that we're propagating just in the  
6                   biosphere calculations. Within our calculations, it's  
7                   within an order of magnitude that's slightly less than  
8                   that. DOE, as you heard, have more elements in their  
9                   model such as swamp coolers and slightly more involved  
10                  climate fluctuations and so forth.

11                  They are propagating slightly more now.  
12                  They used to be propagating less than we were. Now,  
13                  with the new model, they are within about an order of  
14                  magnitude. But if you consider that, some of these  
15                  other abstractions, waste package corrosion or  
16                  whatever, have many orders of magnitude of variation.  
17                  So as those are causing the dose to flop around, the  
18                  biosphere is just in the background noise.

19                  So that's the conceptualization at a high  
20                  level of how the uncertainty in the biosphere relates  
21                  to the total system uncertainty. You've seen those  
22                  horsehair diagrams, the TPA output. The variation is  
23                  quite large from the total system.

24                  CHAIRMAN GARRICK: Question, depending how  
25                  you do in your uncertainty analysis, the sensitivity

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 analysis is a subset of that.

2 MR. LAPLANTE: Right.

3 CHAIRMAN GARRICK: It's very easy to pull  
4 out. If you have a PDF that's an accumulation of a  
5 lot of contributions, it's very easy to pull out the  
6 PDFs that make that up and display very graphically  
7 the sensitivity as well as the uncertainty.

8 DR. THORNE: Could I just comment on that?  
9 I think we are in danger of missing something there.  
10 We're in danger of thinking that all uncertainty is  
11 parameter value uncertainty. To my mind, the bigger  
12 issue in the biosphere is conceptual model. Have we  
13 got the structure right?

14 CHAIRMAN GARRICK: Yes, sure.

15 DR. THORNE: You don't get at that by  
16 doing a Monte Carlo simulation. You do that by  
17 brainstorming alternative conceptual models and  
18 running them through the system.

19 DR. ECKERMAN: Right, exactly.

20 MR. LAPLANTE: Right, although I think you  
21 might agree that this biosphere is not extremely  
22 complex compared to some biospheres. It's an arid  
23 environment. There aren't a large variety of  
24 activities. The rule constrains some of the aspects  
25 of the conceptual model in a way. Also, given what

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 DOE presented yesterday, it's a little bit more of a  
2 mathematical model.

3 When they ran a bunch of different  
4 biosphere models, they get the same results. I know  
5 a conceptual model might draw you to slightly  
6 different biomathematical models. I understand when  
7 you get into the details you can come up with all  
8 kinds of different conceptual models.

9 But I think our models are maybe a level  
10 above that that consider most of what we would expect  
11 to be occurring in the biosphere. I don't see a lot  
12 of alternative conceptual models that are missing. If  
13 you know of one, we're certainly open to hearing  
14 suggestions of what conceptual models are being  
15 missed.

16 DR. THORNE: I think we're talking across  
17 purposes in a sense. The conceptual model I had as an  
18 example was the one I gave earlier where the  
19 radionuclide moved to depths, is accumulated in  
20 reservoir depths, and then because of changes of  
21 either human irrigation or environmental conditions,  
22 that reservoir becomes available. Now, that actually  
23 falls outside the scope of the standard biosphere  
24 models which typically operate top of the soil down  
25 into about the base of the subsoil but don't operate

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 to 15, 20, 30 meters of depth. It's that wider  
2 conceptualization that raises the issues in my mind.

3 MR. LAPLANTE: Is that type of process  
4 really what you would expect, or is this more  
5 speculative?

6 DR. ECKERMAN: No, letting the agriculture  
7 land rest under heavy irrigation is often done. You  
8 irrigate a field for a period of time especially  
9 because the solids build up. Then you let that track  
10 of land rest, not be in an agriculture practice, and  
11 then come back and irrigate later.

12 MR. LAPLANTE: Right, I understand that.

13 DR. ECKERMAN: So there's a rotation like  
14 how you rotate crops.

15 MR. LAPLANTE: But I mean the upwelling.

16 DR. ECKERMAN: The upwelling could occur  
17 during those periods.

18 CHAIRMAN GARRICK: Certainly when I talk  
19 about uncertainty I'm thinking both aleatory and  
20 epistemic uncertainties. I'm not thinking of just  
21 information uncertainties. You can convolute both  
22 into the same distributions. You can disassemble the  
23 information in such a way to display the relative  
24 contributions of both types of uncertainty. And you  
25 can decompose it into the sensitivity component as

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 well if you do it from the ground up with a  
2 comprehensive uncertainty model.

3 MR. LAPLANTE: Isn't the iodine and  
4 technetium fairly mobile in terms of wouldn't that  
5 continue to wash through?

6 DR. THORNE: Technetium is only mobile in  
7 oxidizing conditions. It's essentially completely  
8 immobile in reducing conditions. Those are the  
9 conditions that exist below the phreatic surface. So  
10 if you have created a water table at depth, then  
11 technetium will essentially be stuck where the Redox  
12 potential is less than minus 100 millirems or  
13 possibility even a bit higher.

14 With iodine, iodine tends to be immobile  
15 in oxidizing conditions with high organic content in  
16 the system. So if you have an organic layer and the  
17 iodine hits it, then it will tend to stop. So it  
18 depends on the chemistry.

19 MR. LAPLANTE: But would there be an  
20 organic layer?

21 DR. THORNE: Well, that's part of site  
22 characterization.

23 MR. LAPLANTE: Yes, okay. Moving forward,  
24 for igneous activity, I think I already went through  
25 that. So I think we're on the next slide. In the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 next few slides, I'm going to go through the  
2 agreements that were established that DOE would  
3 resolve certain comments that we asked on the site  
4 recommendation report.

5 I have separated these up into those  
6 related to mostly or are more applicable to the  
7 groundwater release biosphere pathways. Then after  
8 that, I'll discuss some related to the igneous  
9 activity release biosphere calculations. The  
10 biosphere groundwater pathway modeling agreement  
11 topics are generally ranked low significance. If  
12 anyone is interested in seeing the detailed  
13 descriptions or paraphrasing of the agreements, I have  
14 included these on backup slides number 10 and 11.

15 I'm summarizing them in these view graphs.  
16 But you can keep them handy. If you are interested in  
17 looking at them, you can. The low significance,  
18 again, is related to the low variability in the  
19 biosphere. When we made the comments, we did  
20 emphasize those parameters that were found to be  
21 important in the biosphere process modeling decoupled  
22 from the total system calculation.

23 These included soil partition  
24 coefficients, Kds for soil leaching calculations,  
25 plant transfer factors, the crop interception. We

1 also had some comments on the sampling approach. To  
2 some degree this related to what Dr. Kocher was  
3 mentioning about the decoupling. They had decoupled  
4 their biosphere sampling from the total system  
5 sampling. We were asking them to tell us whether that  
6 was biasing the results or not.

7 That was maybe less of a numerical  
8 importance issue as more of just a how are you doing  
9 it. So in general with these risk insights, the  
10 effect on our biosphere plans were that we really  
11 don't have any plans to do major technical work in  
12 this area. I think things are in pretty good shape.  
13 DOE subsequently has improved their documentation, as  
14 was noted.

15 They have gone actually quite far in  
16 documenting everything. You can identify every  
17 parameter that they are using in their modeling. So  
18 that resolved these core agreements that we had on the  
19 SR. Of course, we will continue to monitor as the  
20 documents come in whether they are changing anything  
21 and so forth. But we're not really conducting much  
22 additional work in that area.

23 This is just to provide an example of the  
24 type of technical information we used to supplement  
25 our risk insights when we were focusing on these

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealgross.com](http://www.nealgross.com)

1 particular specific agreement issues. I've chosen the  
2 plant transfer parameter as an example. We did have  
3 an agreement on that. We're asking DOE I believe to  
4 justify the site relevance of their plant transfer  
5 factor choices.

6 So to get an idea, numerically how is this  
7 factor affecting our total system performance  
8 assessment results, in addition to what we have known  
9 from previous analyses, we did a simple perturbation  
10 analysis where we perturbed the parameter that's  
11 normally sampled at the high and low ends of the  
12 range. We can see from here at the 10,000 years it  
13 can increase from the base case, totally stochastic,  
14 total system calculation about a factor of 3.7.

15 That's a fairly extreme perturbation  
16 because normally you would want to look at does the  
17 distribution of that parameter shift to a higher  
18 level? This is actually going to the end of where the  
19 point value would be. So the conclusion here would be  
20 not very significant increase in risk, low risk  
21 significance or low significance ranking.

22 Doing a similar look at the igneous  
23 activity-related biosphere agreements, the igneous  
24 activity biosphere agreement topics have more varied  
25 significance rankings. Those related to mass loading

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 and inhalation of ash were ranked high or medium.  
2 Those that were ranked low were related more to  
3 documentation and bases for certain parameters or  
4 modeling assumptions.

5 The inhalation pathway and mass loading,  
6 as I have already mentioned before, is highly  
7 significant. Our total system calculations, I've  
8 already mentioned that so next slide.

9 DR. KOCHER: This is because this scenario  
10 basically bypasses the geosphere.

11 MR. LAPLANTE: Yes, pretty much, release  
12 of the inventory directly into the air from a volcanic  
13 intrusion. You don't wait for the decay of things  
14 like americium 241. Okay, next slide. So the effect  
15 of these risk insights on our biosphere plans are  
16 ongoing model development and risk analyses. So we're  
17 continuing to dig into this area because it is  
18 affecting the total system results.

19 This work includes refinement of the  
20 inhalation models. We discussed a little bit  
21 yesterday about looking into the particle size  
22 assumptions and better integrating the transport and  
23 mass loading models, getting a better understanding of  
24 the duration of the mass loading over time and how  
25 remobilization of ash after its been deposited might

1 affect that mass loading over time as well as the  
2 magnitude of the value. Again, this is ongoing work  
3 so we continue to look at it. I know DOE is  
4 continuing to look at their approach as well.

5 So in summary, the use of risk insights is  
6 integral to planning and conducting staff work. Risk  
7 informing is an iterative process. It's a learning  
8 process. We obviously continue to iterate our  
9 calculations and assessments. As I said yesterday,  
10 what we knew five years ago was more focused on the  
11 process modeling. Within the biosphere, what's  
12 important to that calculation? Now, with enhanced  
13 capabilities, we can look how is the biosphere  
14 affecting the total system results?

15 I guess the walk away with message would  
16 be inhalation of volcanic ash is highly significant.  
17 So we have additional work ongoing. The remainder of  
18 the biosphere calculations are much less significant  
19 to total system performance. Therefore, we don't have  
20 any addition work planned other than to monitor what  
21 DOE is doing. Of course, eventually we'll be  
22 reviewing their license application. That's it.

23 VICE CHAIRMAN RYAN: Thank you very much.  
24 Let me pick up on a point that Michael Thorne made  
25 earlier. That is that the risk significant issue

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 identified which is inhalation of volcanic ash I  
2 imagine would be particularly sensitive to those three  
3 issues of solubility, particle size, and other  
4 parameters that would pretty dramatically shift the  
5 inhaled quantity.

6 MR. LAPLANTE: Yes.

7 VICE CHAIRMAN RYAN: Again, I concur with  
8 the idea, and we touched on it yesterday, of we're  
9 really talking about the intake, not the uptake. Let  
10 me define that again. The intake is what I breathe  
11 in. The uptake is once we get to the blood and we  
12 take it forward into organs and calculate those. I  
13 concur fully that Dr. Eckerman has a handle on that  
14 for us all. We probably don't need to challenge that  
15 nearly as much as we need to think about accurately  
16 assessing that intake and the ramifications of the  
17 variation of that intake.

18 MR. LAPLANTE: Right, yes, we would agree  
19 with that.

20 VICE CHAIRMAN RYAN: Any questions or  
21 comments? David.

22 DR. KOCHER: I guess I wanted to accept  
23 your challenge about alternative conceptual models.  
24 I'm pretty sure that a first order biokinetic model  
25 for soil erosion is not right. I'm almost sure that

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 a first order biokinetic model for retention and  
2 surface soil going downward is not right either.

3 MR. LAPLANTE: Right.

4 VICE CHAIRMAN RYAN: I'll ask the  
5 question. What is?

6 MR. LAPLANTE: I would just say I think  
7 it's recognized in the technical community that those  
8 models are very simplistic models. In general, if you  
9 talk to geochemists, they really don't like the Kd  
10 approach because it's a vast simplification of a very  
11 complex geochemical system. Yet, the dilemma is once  
12 you go further into the details, you're dealing at the  
13 atomic level with complex geochemical processes. It  
14 ends up becoming a very long, drawn out project.

15 So I accept the comment. I think we do  
16 need to take a look at how alternative models might  
17 impact those processes. But we also have to be  
18 sensitive to the fact that we can't spend a whole lot  
19 of time and resources if it's not going to impact the  
20 overall results. There might be some way to more  
21 simply bound the effect.

22 VICE CHAIRMAN RYAN: Michael.

23 DR. THORNE: Perhaps it's just worth  
24 looking at what's being done in one or two other  
25 programs. The one I know about is the MACCS program

1 where we are, for example, at the Imperial College  
2 using a 3-D transport equation for soil based on the  
3 richness equation to get the flow in the system and  
4 then admittedly using an equilibrium Kd in that  
5 model. Then we're using a  
6 biogeochemical model based on the SUTRA system but  
7 with the add on flow and transport component. So in  
8 a way, our soils are looking more like what you  
9 actually do in process modeling in the geosphere  
10 because the processes are actually quite the same.

11 MR. LAPLANTE: Have you compared those  
12 models with the simpler models just as a matter of  
13 interest?

14 DR. THORNE: We compared the earlier 1-D  
15 version, the SPW-1 and SLT-1 models. Those were  
16 studied in BIOMASS-2 in the validation exercise  
17 against the lacimeter (PH) experiment. We've also  
18 compared the data for effects like ground freezing  
19 which we observed in our lacimeter (PH). So we looked  
20 at things like validation of the model against solude  
21 (PH) exclusion and solude (PH) recovery in freezing.  
22 So in as far as we can validate those models, we have  
23 done so.

24 The other one that we use, going back to  
25 the point that I was making earlier, is the SHETRAN

1 surface water catch model which basically covers the  
2 surface hydrology and subsurface hydrogeological  
3 regime in a spatially distributed sense down to about  
4 50 to 80 meters because that's the interesting zone.  
5 I don't want to go into the details. But there are  
6 programs where more physically-based models are being  
7 deployed to underpin the assessment models.

8 In fact, when I go back, I'm having a  
9 discussion with SKB who will be using a similar suite  
10 of models, a mixture of possibly SHETRAN, Darcy Tools-  
11 type models to explore these near surface processes.  
12 But I think if you think near surface processes rather  
13 than biosphere, you have a better flavor for what the  
14 issues are.

15 MR. LAPLANTE: One thing to keep in mind  
16 before Chris goes is for the igneous activity  
17 calculations, I don't believe leaching is a  
18 predominant factor in our modeling results because  
19 most of those radionuclides, like americium and  
20 plutonium, that are driving the dose are staying  
21 pretty much in the ash blanket. Now, for the  
22 groundwater pathways, we're mostly talking about  
23 technetium, iodine, and uptunium (PH).

24 I know this could change if you change the  
25 models. But the drinking water pathways is 50 percent

1 of that dose. So the question would be, how much  
2 could you alter that other 50 percent of the dose  
3 which is from the rest of the biosphere by  
4 implementing a different soil model? That's the key  
5 question. If it's going to be just a small amount,  
6 then it obviously might not be worth it to spend a lot  
7 of effort in that area.

8 We have a very large program with a lot of  
9 uncertainty and other total system models that are  
10 going to be more important for the total system  
11 results and understanding repository behavior. Do you  
12 want to divert resources from focusing on waste  
13 package corrosion to get into detailed three  
14 dimensional soil modeling? That's how we have to  
15 weigh the decisions on how deep to go and use risk  
16 insights and make those decisions. Chris, you wanted  
17 to add something.

18 MR. MCKENNEY: I just wanted a point of  
19 clarification. Those lacimeter (PH) studies and other  
20 ones that I know of were all for below ground sources.  
21 They were not for irrigation sources above. The  
22 BIOMASS-2 were all lacimeter (PH) studies where the  
23 source was added below the ground and the roots pulled  
24 the water up the soil column which is a different  
25 phenomena than what we experience with the over-

1 watering. They are there, but whether it's actually  
2 an applicable analog would be a question.

3 DR. THORNE: Yes, I'll come back now. I'm  
4 not saying that those are an accurate analog. What  
5 I'm saying is that the type of structural model may be  
6 useful in this context. It's interesting. The  
7 experiments are now being jointly sponsored by ANDRA  
8 because ANDRA is interested in the irrigation pathway.  
9 So the extension of those experiments is now to the  
10 irrigation pathway as well as the upwelling pathway.

11 VICE CHAIRMAN RYAN: Thank you. Any other  
12 questions from others? Yes, Ruth.

13 MEMBER WEINER: Since your inhalation for  
14 the volcanic intrusion has a high significance, what  
15 kind of work are you doing to bound the uncertainty in  
16 particle size in order to look at particle size  
17 distribution?

18 MR. LAPLANTE: Well, we are currently  
19 looking into the transport models. We're looking at  
20 alternative transport models. As part of that, they  
21 are looking into particle size assumptions that are  
22 inherent to those models in the mass loading. All the  
23 work is infused with particle size considerations.  
24 The work is ongoing. Tim might be able to add more  
25 technical detail to it or perhaps some of our staff in

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 San Antonio.

2 But like I said before, the key  
3 uncertainty is we're dealing with volcanic ash. It's  
4 fairly fine particles. There isn't a lot of data on  
5 volcanic ash. We've collected some on volcanic ash in  
6 Nicaragua. There is spotty information here and  
7 there. But I think you have to look to analogs and so  
8 forth. Tim.

9 VICE CHAIRMAN RYAN: Pat, maybe we could  
10 defer to Keith Eckerman for a question. Most of the  
11 action in occupational exposure circumstances are  
12 below 20 microns. Probably somewhere around a micron  
13 is not a bad number to think about for a lot of  
14 occupational sites. Could you give us some insight as  
15 to what's happening between say 10 and 100 microns of  
16 what we really know? I know the ICRP has a model to  
17 extend to larger particle sizes. What do you think of  
18 that? What advice could you give us on that point?

19 DR. ECKERMAN: Well, the ICRP model, as  
20 you just said, has a complete deposition model that's  
21 run out to particles as large as 100 microns. You  
22 have to consider the inhalability and how the  
23 individual is actually coupled with the windspeed. It  
24 gets complicated.

25 VICE CHAIRMAN RYAN: Well, let me just

1 shape that a little bit more.

2 DR. ECKERMAN: Let me just go back. In  
3 occupational, through the years, like in Federal  
4 Guidance 11, we used a one micron assumption with  
5 regard to the particle size. Now, in publication 68  
6 which is the ICRP document for the worker using the  
7 newer model, we've gone to five microns as more  
8 typical of the kind of aerosols that are encountered  
9 in the work place.

10 Now, for the general public, assuming that  
11 normal releases from facilities have gone through a  
12 processing system and through filters and so forth, we  
13 retain the default size as one micron. The data for  
14 sizes out to AMEDS (PH) all the way from aerosols that  
15 you have to characterize by their thermodynamic  
16 properties rather than their particle size, density,  
17 so from atomic sizes almost up to ten microns, our  
18 dose coefficients appear on that ICRP CD to cover that  
19 range.

20 It's difficult to get much to go beyond  
21 much an AMED (PH) of ten microns with the current  
22 information that's available. But for these studies  
23 dealing with volcanic ash, the inhalation model that  
24 you really should be using is of course not the old  
25 one of Federal Guidance 11 but you should be using the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 newer model because it's responsive to those issues.  
2 I'm sure that's the case.

3 MR. LAPLANTE: Right, we're using or we're  
4 currently looking into doing calculations with the  
5 newer models to provide a better idea of how much  
6 overestimation there is in using the previous models  
7 because the newer models are more refined.

8 DR. ECKERMAN: Now, I think on the Mt. St.  
9 Helens event, even the folks at North West Laboratory,  
10 there was a lot of effort to collect particle size  
11 information and so forth. That was a different kind  
12 of --

13 MR. LAPLANTE: Yes, it was a different  
14 kind of eruption. It's also arrange a lot in that  
15 part of Washington State. I know there's air of  
16 regions in Spokane. But it's not the best analog.

17 DR. ECKERMAN: Right, I agree it's not the  
18 best.

19 MR. LAPLANTE: There have been discussions  
20 between the NRC and DOE on that topic as well.

21 VICE CHAIRMAN RYAN: Could you expand just  
22 a bit, Keith? You said you have to couple the  
23 individual at the exposure with windspeed, direction,  
24 and so forth. Gravitational settling obviously  
25 becomes much more important as the particle size get

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 bigger and things leave air streams more quickly  
2 rather than stay in them.

3 So what advice would you give in terms of  
4 trying to create a range of scenarios? This is for  
5 material that's been deposited and resuspended. So  
6 that's really where we're starting. We're not looking  
7 at the volcanic ash plume coming by. We're looking at  
8 a redeposition and then the inhalation. What would  
9 you do there?

10 DR. ECKERMAN: Well, first, it would be  
11 useful to look at the information you have on particle  
12 size in mass loading situations. What's going to be  
13 resuspended, as you said, are going to be the fines.  
14 With lack of any better information, I think I would  
15 start by assuming that those may well be on the order  
16 of five micron AMAD (PH) size.

17 MR. LAPLANTE: Right, I think our  
18 understanding, and someone can correct me if I'm  
19 wrong, but the resuspendable particles generally are  
20 below the hundred micron range.

21 DR. ECKERMAN: Yes.

22 MR. LAPLANTE: That bounds the problem  
23 there. Inhalables, I think less than ten or deep into  
24 the lungs. So in between that ten and 100 there's --

25 DR. ECKERMAN: You must have data on what

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 the density of that material would be. I don't happen  
2 to have that in the back of my mind. That's the first  
3 thing of course you want to look at is what's the  
4 physical density of the material?

5 MR. LAPLANTE: Right.

6 DR. ECKERMAN: That information I'm sure  
7 is available to you.

8 DR. THORNE: It must be about two grams  
9 per --

10 DR. ECKERMAN: And I would expect that  
11 it's an order of a couple of grams.

12 MEMBER WEINER: The question I had is do  
13 you have any idea of what fraction of what is  
14 entrained in the ash plume would be in that particle  
15 size range? That's what I meant by particle size  
16 distribution really. How much? Because that's the  
17 critical thing.

18 MR. LAPLANTE: What fraction of spent  
19 fuel, is that what you are asking?

20 MEMBER WEINER: Yes, what fraction of what  
21 is entrained in the igneous upwelling, if you will, is  
22 of the particle size that can be resuspended?

23 MR. LAPLANTE: Right.

24 MEMBER WEINER: Has a micron AMED (PH) of  
25 about one or two grams per cubic centimeter density.

1 MR. LAPLANTE: Well, that again I think  
2 takes it back to the original source term release  
3 calculations. We're looking at the whole calculation.  
4 There's no analog really for a volcano erupting  
5 underneath a repository. So there's inherently some  
6 assumptions about particle sizes and so forth.  
7 Generally, we're doing that conservatively. Tim would  
8 like to say something.

9 DR. MCCARTIN: Yes, currently mass loading  
10 is one of those parameters that has a lot of processes  
11 in it. As Pat indicated, we are in the process of  
12 trying to better quantify the uncertainties in all of  
13 the assumptions and try to lay that out in a  
14 systematic way what the assumptions are and better  
15 understand ourselves what is the impact on the dose  
16 estimate? As Pat appropriately mentioned before,  
17 where do we want to focus the studies and the  
18 interest?

19 VICE CHAIRMAN RYAN: I think in our  
20 questions, Pat, we've covered the gamut from source to  
21 transport deposition to resuspension to inhalation.  
22 So there's a lot of ground covered there. Some of the  
23 things carry through and some of them are unique.  
24 Solubility is another one obviously that's a driver.  
25 If you assume Y class or W class or under the new

1 categories and so forth, you come up with big changes  
2 in numbers. I think you are on the right track. But  
3 I didn't want to miss the opportunity to pick Keith's  
4 brain while we're all here.

5 MR. LAPLANTE: Right.

6 VICE CHAIRMAN RYAN: Mike. Oh, I'm sorry,  
7 go ahead.

8 DR. DANIELS: Do I understand correctly?  
9 Are you actually making a coupled model here? You are  
10 not uncoupling the BDCF process from the TSPA in this  
11 particular case.

12 MR. LAPLANTE: Yes, that's correct. The  
13 calculation mathematically is not uncoupled. For the  
14 sake of implementing the calculation in our total  
15 system performance assessment code, we do run the  
16 GENII code with a unit concentration to start with.  
17 Then the resulting dose is multiplied by the  
18 concentration. That whole calculation is integrated  
19 into the total system realization by realization  
20 calculation approach.

21 So we're not doing the biosphere modeling  
22 outside our total system model and then sampling those  
23 results like what DOE is doing. We made a conscious  
24 decision that we thought it would be better to have  
25 that calculation integrated with the total system

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 parameter sampling and so forth so we could assess  
2 sensitivities of individual biosphere parameters on  
3 the total system results.

4 DR. DANIELS: Can you then also at least  
5 qualitatively add these relationships that Dr. Kocher  
6 was putting out? Can you somehow see if there are --

7 MR. LAPLANTE: You mean coupling the  
8 biosphere with the saturated zone transport, like the  
9 Kd issue that he was talking about.

10 DR. DANIELS: Exactly, is that possible?

11 MR. LAPLANTE: I was listening to that  
12 discussion. We have the capability to coordinate  
13 parameters in our TPA code. I believe we can  
14 correlate any of them that we want to. We don't stop  
15 the thinking if we don't explicitly correlate certain  
16 parameters. We obviously thought about the issue of  
17 G (PH).

18 Our hydrologists are making assumptions  
19 about the chemistry of the material as it transports  
20 through the groundwater. How does that impact the  
21 chemistry of the material as it enters the biosphere?  
22 Again, once you get into geochemistry, things become  
23 very complicated very quickly. In the case of the  
24 groundwater scenario, once that contaminated  
25 groundwater comes out of that sprinkler and is sprayed

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 through the air and it contacts the soil, there's all  
2 kinds of potential transformations that can take place  
3 chemically.

4 So consulting with our geochemists, we  
5 couldn't come up with a very clean association.  
6 There's also the soil properties themselves that are  
7 not the same as the properties in the groundwater path  
8 geochemically. So they can be considered as separate  
9 systems.

10 MEMBER CLARKE: Excuse me, the decoupling  
11 issue is a good issue. But I think this might be a  
12 bad example because it makes sense to me to have one  
13 set of Kds for deep transport then another set of Kds  
14 for the near surface soils.

15 MR. LAPLANTE: Right, we tried.

16 MEMBER CLARKE: I'm not sure.

17 MR. LAPLANTE: We tried in our modeling  
18 process. I don't just put on the blinders on and say  
19 I'm just focusing on the biosphere. We're constantly  
20 interacting with our other abstraction modelers. If  
21 there is something that they're doing that's  
22 influencing something that I'm doing, we make that  
23 integration and discuss what the potential  
24 ramifications are.

25 There aren't a lot like Dr. Kocher said.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 We haven't come up with a lot of these types of  
2 interfaces. But there are some that come to mind and  
3 that was one of them. There is chemistry assumptions.  
4 How does that affect what we're doing in the  
5 biosphere? The particle size issue obviously, we have  
6 looked into that. The air transport modeler is --

7 VICE CHAIRMAN RYAN: And we appreciate  
8 that's a work in progress so we'll hear more about  
9 that later. I think we're at a point where we need to  
10 press on to our next speaker if we may and come back  
11 to any other questions on this issue.

12 DR. THORNE: Mine is just a quick one on  
13 volcanic ash.

14 VICE CHAIRMAN RYAN: Please, yes.

15 DR. THORNE: The one thing that we missed  
16 was the discussion of solubility. Radionuclides will  
17 be incorporated in the ash if that event occurs. I  
18 wondered whether any consideration had been given to  
19 dissolution studies in simulated lung fluid for  
20 volcanic ash because I think that might lower the  
21 range of uncertainty very rapidly on the solubility  
22 issue?

23 MR. LAPLANTE: Sounds like a good idea.

24 VICE CHAIRMAN RYAN: Great idea. But  
25 where do we get the analog?

1 DR. THORNE: I'm suggesting you do it on  
2 natural ash and look at staple trace elements in  
3 natural ash leached out into lung fluid.

4 VICE CHAIRMAN RYAN: It's a possibility.  
5 But again, you have the same is that a valid question  
6 to at least wrestle through? Our next presentation is  
7 from Ms. Cheryl Trottier, the branch chief of the  
8 Radiation Protection Environmental Risk and Waste  
9 Management Office of Nuclear Regulatory Research.  
10 Good morning.

11 MR. TROTTIER: Good morning. I know the  
12 request was for a perspective from us. What I was  
13 hoping to do today was give you a little bit of  
14 information, especially for the working group who  
15 probably has no idea what we do in the Office of  
16 Research at least to support Yucca Mountain, to give  
17 you a little idea of what our research program is  
18 like.

19 Basically within this branch, you can tell  
20 by the name, we have a variety of disciplines. We  
21 look at health effects, research, radiation  
22 protection, methodologies, et cetera, and also issues  
23 related to ways mostly involving dosimetry transport  
24 issues like that. Basically what we do is generic  
25 research. What that means is we don't directly

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 support Yucca Mountain.

2 We do research at least in this area of  
3 the environmental issues mostly for decommissioning  
4 sites. But because a lot of these topics, and a lot  
5 of the topics you are talking about at the meeting,  
6 involve other kinds of agency decisions, that kind of  
7 research is very effective for multiple situations;  
8 waste disposal or decommissioning.

9 At least actually at the advice of this  
10 committee, we developed a research plan which I'll  
11 advertise a little bit. This is the published version  
12 of it. It's actually on the NRC website. Because we  
13 had a very small program. We were always told how do  
14 you know you're doing the right research and you need  
15 to have some disciplined process.

16 So several years ago, we did develop a  
17 research plan. We had a lot of stakeholder  
18 involvement. We eventually had it peer reviewed. As  
19 a result of all of this activity, we then prioritized  
20 our research projects. Again, it's only in this area  
21 which I will call, even though a lot of staff disagree  
22 with this title, radionuclide transport in the  
23 environment. It's not just transport. It's the whole  
24 issue of environmental contamination.

25 So what I tried to focus on for this

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 particular session is that work that deals with  
2 biosphere modeling. A lot of work we do does address  
3 transport. I think you're going to have a separate  
4 session. We can come and speak to you then about some  
5 of our activities in that area.

6 In fact, prior to the research plan, we  
7 really hadn't done anything in this area, at least not  
8 in the time frame that I have been with this group.  
9 The work we're doing is with PNNL. It was recently  
10 initiated actually September 2002. So this is very  
11 new work. We have set up certain objectives that  
12 we're trying to address.

13 One of those is we have observed that a  
14 lot of the models have parameters that either have  
15 uncertainty, the data is very old. The idea was that  
16 we would try to do an assessment of those parameters  
17 and see where we might be able to inform the modeling  
18 by attempting to address some of these uncertainty  
19 issues. As I said, our overall budget is very small.  
20 As you can guess, this is an enormous project.

21 So we began with a literature survey. Out  
22 of that literature survey, that helped us to then  
23 narrow down the field of things that we were going to  
24 look at. This list is basically those lists of  
25 activities that we hope we can address in the next two

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 years. This is basically a four year project,  
2 hopefully, to be completed in four years.

3 We're going to focus on a few parameters  
4 that we think we can have some hope of getting  
5 accomplished in a fairly short amount of time. The  
6 one area on the animal product transfer coefficients,  
7 that may be more difficult. When we get to the next  
8 slide, I'll talk a little bit about that. We have  
9 already begun the process of looking at soil. That  
10 will take up a fair amount of time over the next year  
11 or two.

12 One of the things that we're really trying  
13 to do here is work with the international community.  
14 I know several of you have talked about that. There  
15 are a lot of studies ongoing. The principal  
16 investigator for this project has been working with  
17 those who are involved in that. We're hoping actually  
18 to be able to make use of some of the studies that are  
19 going on in the former Soviet Union as a database of  
20 trying to inform these parameter studies.

21 As a result of the literature review,  
22 these are radionuclides that we decided to focus on  
23 for this effort. As you can tell from the topics that  
24 you are talking about, they are in fact radionuclides  
25 that are important in this assessment of the Yucca

1 Mountain impact. The plants that we're proposing to  
2 look at are as listed up there.

3 You can see a note next to the trees under  
4 discussion. We're still in the process of discussing  
5 with PNNL their feasibility of looking into these  
6 larger crops. The time frame is an issue when you  
7 have larger crops. So we haven't firmed up the  
8 research plan for looking at the trees.

9 The same with animals. In the area of the  
10 large animals, there's a lot of work going on right  
11 now with cows. So we will be looking into that.  
12 Again, the small animals would be handled within the  
13 U.S. So that's again an issue that's under  
14 discussion.

15 For now, the sampling locations have been  
16 settled as being in the State of Washington which I  
17 believe is actually near the Hanford site. In Nevada,  
18 it is the Amargosa Valley. South Carolina, I forget  
19 the town, but it is near the Barnwell site. The  
20 concept was to pick sites with different degrees of  
21 being arid and semi-arid, et cetera, not to pick all  
22 from the same type. It would be nice to add a couple  
23 more. But I don't know whether we're going to be able  
24 to do that.

25 VICE CHAIRMAN RYAN: Just a quick question

1 if I may.

2 MR. TROTTIER: Sure.

3 VICE CHAIRMAN RYAN: We've heard a lot  
4 about americium in our working group in the last  
5 couple of days. Was that off the list for a reason?  
6 Or is it bracketed by what you have there?

7 MR. TROTTIER: That's a good question.  
8 I'm going to ask Phil Reed who is the project manager.

9 VICE CHAIRMAN RYAN: Thank you.

10 MR. REED: Yes, Phil Reed. We had  
11 actually considered both the americium 241 and the  
12 other long-lived isotope. But our focus here was  
13 strictly on the groundwater irrigation pathway and not  
14 in the volcanic scenario so we did not put it on our  
15 top five priority. We actually have it in our top  
16 six.

17 VICE CHAIRMAN RYAN: Okay.

18 MR. REED: If funding does become  
19 available and if we switch to the volcanic scenario,  
20 we will certainly look at americium 241.

21 MR. TROTTIER: Just as an opportunity to  
22 remind you, again, our research is generic. So  
23 obviously igneous activity is not a research topic for  
24 us. I guess we can move to the next slide. As I  
25 said, we have so far to this point published a

1 literature review. This is the literature review. It  
2 is available on the NRC website.

3 Now, we have probably a few copies still  
4 available. In our new electronic age, everybody wants  
5 to look at everything on the web. It's much easier to  
6 look at a book as a book. So it has a lot of  
7 information in it. I really think the lab did a very  
8 good job for this first step. As I said, this is very  
9 early in the process. So unfortunately, I don't have  
10 a lot of results to give you.

11 I would like to turn to slide nine please.  
12 I don't want you to take any great stock in these  
13 particular numbers because the QA on them is not 100  
14 percent at this point. But the project manager did  
15 this simply as a way to illustrate part of the issues  
16 here. These are default values apparently in use for  
17 various codes. As you can see, they are all over the  
18 place.

19 And that is an issue. You do want to have  
20 some understanding as to what causes these to be  
21 different. Hopefully when we get done with this work  
22 we will be able to have a better understanding of what  
23 values we should be using for these transfer factors.  
24 The next slide is very similar. The first one is  
25 technetium. The second one is iodine. I realize the

1 numbers are very small for those in the back.

2 This is not a log scale. The other one  
3 was a log scale. So these numbers are not as far  
4 apart as they appear to be when you look at them in  
5 this bar chart style. Nonetheless, it does show that  
6 there is still a lot of variation among the codes that  
7 are in use today. With that, I think I'll quit.

8 VICE CHAIRMAN RYAN: Cheryl, just a quick  
9 question. I'm reminded of Dr. Thorne's comment about  
10 the context of a model and making sure that you go  
11 back to the fundamentals and the literature which you  
12 have done. Could you react to his observation there?  
13 Do you think that's on track and you are on track with  
14 it?

15 MR. TROTTIER: Well, yes, I agree. I  
16 think you have to look at the fundamental.

17 VICE CHAIRMAN RYAN: Thank you. Other  
18 questions? David.

19 DR. KOCHER: I'll probably be completely  
20 wrong again. Technetium, based on a very weak memory,  
21 has been confounded by issues of potted plant studies  
22 versus field studies. Help me, Michael. The potted  
23 plant studies are now viewed to have limited  
24 reliability. Those are the ones that give these  
25 humongous values.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 DR. THORNE: Right, yes.

2 DR. KOCHER: So maybe at a minimum when  
3 you do literature reviews like this, if you haven't  
4 already identified how the study was done and that  
5 kind of dichotomy, it might be really helpful.

6 MR. TROTTIER: Right, I remember that  
7 issue being there, yes.

8 DR. KOCHER: I think technetium is a  
9 problem in a lot of these codes.

10 VICE CHAIRMAN RYAN: Ruth.

11 MEMBER WEINER: I look at your two slides  
12 and I zero in on the codes I know something about and  
13 forget the others. I know for example in MACCS2 there  
14 were really only two or three radionuclides for which  
15 the ingestion pathway was modeled and everything else  
16 was done by analogy. So I would encourage you, if you  
17 are in the process of recommending a model, to look  
18 very carefully at what they actually did to get those  
19 numbers.

20 MR. TROTTIER: Right, in fact, MACCS does  
21 fall within my branch also. MACCS is undergoing major  
22 revision at this point. It needs to be improved a  
23 lot. That's one factor.

24 DR. MOELLER: What is the name of the  
25 project leader at PNNL?

1 MR. TROTTIER: Bruce Napier.

2 DR. MOELLER: Thank you.

3 MR. TROTTIER: That's on one of the back  
4 up slides.

5 DR. THORNE: Can I come back and take up  
6 Dave's point? There is this difference between the  
7 potted plant. I believe already the principal  
8 investigator on this study has been in discussion with  
9 my colleague George Shaw at Imperial College.

10 MR. TROTTIER: Yes.

11 DR. THORNE: We've conducted over about  
12 the last 10 years comparisons between lacimeter (PH)  
13 and column studies. We got to the stage at least for  
14 chlorine, iodine, and to some extent technetium of  
15 being able to relate the parameter values of the  
16 models at the lacimeter (PH) scale and at the column  
17 scale.

18 But you can't simply assume that the  
19 transfer factor of one is the other. You need to go  
20 through some sort of modeling exercise to see which  
21 parameters are changed in a pot bound experiment  
22 relative to a lacimeter (PH) experience because the  
23 hydrology changes and the root density profile  
24 changes. It's those sorts of things that affect the  
25 uptake.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 DR. KOCHER: There have been limited field  
2 studies for technetium.

3 MR. TROTTIER: Right, I understand that.

4 VICE CHAIRMAN RYAN: Cheryl, you mentioned  
5 studies in Russia. Could you expand a little bit on  
6 what you are bringing from those studies?

7 MR. TROTTIER: I'm going to have Phil do  
8 that because you might get half of my brain working  
9 and half not working.

10 VICE CHAIRMAN RYAN: Okay.

11 MR. REED: Phil Reed again. These are  
12 some studies that we're discussing through DOE with  
13 their agreement with the former Soviet Union  
14 countries. Apparently they have a lot of contaminated  
15 soils and contaminated lands where the United States  
16 does not. We would be interested in using those  
17 particular actual lands and field studies to use for  
18 our particular studies.

19 Also the fact that the cost is now  
20 becoming more involved and it's almost getting  
21 prohibited to do some of these animal studies  
22 particularly with some of the radionuclides that we're  
23 interested in. So we have talked with DOE about the  
24 possibility of using their, I forget what their state  
25 department agreement is with the former Soviet Union

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 countries, to make that data available to us and in  
2 the process do some coordinated field studies that so  
3 far have been pretty difficult to do in the United  
4 States.

5 VICE CHAIRMAN RYAN: Thank you. That's  
6 interesting. Other questions or comments?

7 DR. THORNE: One last one on arid zones.  
8 I think one of the things that we saw when we were  
9 looking at Chlorine 36 is a very strong correlation on  
10 plant uptake with soil moisture stress. Basically  
11 there was much greater uptake in arid conditions than  
12 there was in temperate conditions. I think this is a  
13 caution about applicability of the general literature  
14 to the arid zone region.

15 MR. TROTTIER: Right, yes.

16 DR. THORNE: But it's also an indication  
17 which I know you are aware of in formulating these  
18 experiments. I would strongly suggest that  
19 hydrological monitoring of the system is pretty  
20 fundamental to any new studies which is interesting  
21 because the bulk of the literature over the last 50 of  
22 60 years, when you go to the papers, you will be hard-  
23 pressed to find any information at all on the  
24 hydrological status of either the lacimetry (PH)  
25 studies or of the pot studies. That is a real

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 problem.

2 VICE CHAIRMAN RYAN: Thank you.

3 MR. TROTTIER: Good point.

4 VICE CHAIRMAN RYAN: We are at a break  
5 point in the schedule. We are scheduled for a 15  
6 minute break. Cheryl, thank you very much.

7 MR. TROTTIER: All right, thank you very  
8 much.

9 VICE CHAIRMAN RYAN: We appreciate it. It  
10 sounds like interesting work ahead. We will reconvene  
11 at 10:25 a.m. please. Off the record.

12 (Whereupon, the foregoing matter went off  
13 the record at 10:06 a.m. and went back on  
14 the record at 10:24 a.m.)

15 VICE CHAIRMAN RYAN: If we could come to  
16 order, please.

17 We have an additional speaker this  
18 morning, Matthew Kozak from Monitor Scientific, and  
19 his co-authors are Graham Smith and John Kessler from  
20 EPRI, Graham Smith being from Enviros.

21 So, Matt?

22 MR. KOZAK: Thanks, Mike.

23 I appreciate the opportunity to come and  
24 speak to you today. I'm here representing the EPRI  
25 team that conducts performance assessments on Yucca

1 Mountain independently from DOE or NRC. And you  
2 should know that EPRI has been conducting and is  
3 maintaining the capability of conducting independent  
4 performance assessments for 14 years on Yucca  
5 Mountain.

6 And my purpose here today is, first, to  
7 bring you up to date on what EPRI has done in the past  
8 and is doing now in the area of biosphere. It's been  
9 a very active program. And then I'm going to make a  
10 few off-the-cuff remarks about some of the things that  
11 I've been hearing said here at this meeting, if I may.

12 And so before I begin, I would like to  
13 explain the mishmash of organizations you see up  
14 there. EPRI is the organization that is sponsoring  
15 the TSPA work. Over the past year, Monitor Scientific  
16 has taken over the prime responsibility for the TSPA  
17 itself. And one of our subcontractors is Enviros out  
18 of the UK, and the principal investigator there is  
19 Graham Smith.

20 So, in fact, I'm really presenting a lot  
21 of the material that is Graham's work, but it was  
22 cheaper for me to come than for him to come over. Or,  
23 actually, he wanted to come, but he couldn't.

24 So I want to make it clear that this is  
25 primarily other people's work, but it's integrated in

1 the TSPA.

2 Could I have the next one, please?

3 And, really, the main thing that I'd like  
4 to do is to get across the idea that it has been a  
5 very active program, and that there are a lot of  
6 publications that we produced on this subject of  
7 biosphere. We started in about 1996, or 1995 was when  
8 the work actually originated -- and the first  
9 publications coming out in '96 -- and a lot of the  
10 early work on trying to establish critical groups, and  
11 so forth.

12 This is back in the days when the National  
13 Academy report first came out, and so there were a lot  
14 of people trying to figure out what to make of this.  
15 And EPRI really had a pretty strong role in helping to  
16 identify key concepts that maybe should be considered  
17 coming out of the NAS report. Next one, please.

18 At the same time that we were developing  
19 sort of an independent capability of doing biosphere,  
20 EPRI has been going along producing a large number of  
21 TSPAs over the year, about one every two years -- an  
22 update to the TSPA. And since '96, the biosphere has  
23 been an integral part of the EPRI TSPA.

24 And here are the four most recent that  
25 actually incorporate something about biosphere.

1 Previous to that they were Part 191-type analyses, and  
2 so there wasn't any emphasis on biosphere.

3 And for those of you who are following the  
4 EPRI program, you should know that we have just  
5 completed the most recent TSPA analysis. It's in  
6 press. It went to publication in December, and so it  
7 should be out on the street shortly. And that  
8 particular report contains a significant update to the  
9 EPRI biosphere portion.

10 In addition to sort of the things that we  
11 tend to see in the States, the EPRI program has been  
12 an active participant in these international programs,  
13 BIOMOV5 and then BIOMASS. And, really, one of the key  
14 areas particularly early on was, again, looking at  
15 some of these things on how to define critical groups  
16 and the segue into the RMEI, and so forth, and a lot  
17 of the discussions that went on related to that.

18 But the group that dealt with a lot of  
19 those issues was actually chaired by John Kessler from  
20 EPRI, and so some of these other reports that are --  
21 that have been published by the IAEA from the BIOMASS  
22 program had a strong contribution for the EPRI program  
23 as well.

24 Here is sort of a sampling of additional  
25 publications that you may or may not be aware of.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 These are sort of more recent publications to the  
2 original ones that -- there was a large spate back in  
3 '96, and more recently Graham and his co-workers have  
4 been publishing again on a number of issues related to  
5 Yucca Mountain.

6 So just to summarize, it is a very active  
7 program. I would urge you to take a look at some of  
8 the publications. They're good publications. There's  
9 a lot of good information in them. It is entirely  
10 independent from the DOE/NRC world, and so it provides  
11 an independent viewpoint on a lot of technical issues.

12 We've done a lot of work on trying to  
13 incorporate international developments into our  
14 program. In fact, I've had to argue frequently with  
15 Graham that he really does have to go back and use  
16 Federal Guidance Report 11 instead of more recent  
17 dosimetry, but that's a whole different matter. If  
18 you go to the EPRI TSPAs, you'll see how we've  
19 integrated that into -- into our TSPAs.

20 And beginning my segue into my comments on  
21 what I've heard here, we've been using deterministic  
22 biosphere dose conversion factors as a stand-alone  
23 calculation at the end of the TSPA. And in the coming  
24 year, we're planning on starting to work into doing  
25 some Monte Carlo sensitivity analysis on the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 parameters associated with that.

2 And as an independent group, we have come  
3 up with the conclusion, based on analysis, that we can  
4 use this approach, that the dynamics of the system are  
5 such that the response of the biosphere is much more  
6 rapid than the response of the geosphere. And that's  
7 one part of the argument that suggests that you can  
8 use this approach.

9 Another part is the decoupling of the  
10 geosphere parameters, such as the Kd approach that  
11 Dave was talking about earlier, from surface soil --  
12 Kd's that are used in agricultural soils or properties  
13 that are in agricultural soils, as opposed to the  
14 alluvium, the deep alluvium. There is not any  
15 particular reason to couple those.

16 And so we've come up with this independent  
17 -- independently from the DOE/NRC kind of approach.  
18 Modeling the dynamics of the system, we've been able  
19 to demonstrate that, at least based on our  
20 understanding of the system, that this is -- this is  
21 an appropriate approach to use.

22 The second point I wanted to mention in  
23 the discussions that we've heard here is -- we heard  
24 a little bit about Greenhouse gas warming effect and  
25 how it plays a role in the TSPA. And you should be

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 aware that EPRI, in the past, has had explicitly  
2 Greenhouse gas warming kinds of scenarios in their  
3 TSPA, and were aware that DOE and NRC have considered  
4 this also.

5 And up until about two years ago, it was  
6 an active part of the EPRI program, and then at that  
7 point we stopped looking at it, because it didn't  
8 matter. We found that it had inconsequential effects  
9 on the total system performance. And so while we  
10 understand that these things are out there and that  
11 this is a potential effect, that it no longer shows up  
12 as an explicit part of our TSPA.

13 The second thing that I wanted to address,  
14 which may end up being more controversial than the  
15 other things I've said, is we've had a lot of  
16 discussion about these ancillary analyses that we  
17 would do on the side, because people want to see them.

18 And I think we want to be careful about  
19 this, because we are on a licensing path. And there  
20 are uncertainties that are associated with making that  
21 regulatory decision, and I think there are separate  
22 uncertainties that are associated with scientific  
23 evidence.

24 And it's sort of this argument that we had  
25 yesterday that we may have scientific uncertainties,

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 and they could be substantial, but if the  
2 uncertainties are all down at extremely low dose  
3 levels, we don't care from a licensing perspective.  
4 And I think we need to keep that clearly in mind.

5 We don't want to start sending DOE  
6 marching orders that they need to start doing all  
7 kinds of scientific studies, if it's going to affect  
8 the licensing path. I mean, I think that's a very  
9 important point that we need to keep clearly in mind.  
10 Which are the uncertainties associated with the  
11 regulatory process, which I'll call regulatory  
12 uncertainties?

13 Those have a different flavor from the  
14 scientific uncertainties. There can be a lot of  
15 scientific uncertainties, but they may not affect the  
16 regulatory decision. And so I think we need to really  
17 keep that clearly in mind.

18 And that's all the comments I wanted to  
19 make. I'll keep it short and sweet. Be glad to take  
20 any questions.

21 VICE CHAIRMAN RYAN: Thank you, Matt.

22 Any questions? John?

23 DR. TILL: Yes. I'm just curious about  
24 this Greenhouse effect. If you have looked at that,  
25 is that published in the literature, so then --

1 MR. KOZAK: Yes.

2 DR. TILL: It is? So then this can be  
3 dismissed as an issue.

4 MR. KOZAK: Well, I think this -- this  
5 crept into the argument as -- as another one of these  
6 scientific things that people want to see that you've  
7 considered it. I think if you look at the full body  
8 of literature, if you look at the DOE FEP analysis,  
9 for instance, they may ultimately -- at the end of the  
10 day in their TSPA, they say, "We can use paleo  
11 climate."

12 But if you look at their FEP analysis, I  
13 think you'll find that, yes, they recognize that the  
14 Greenhouse effect occurs. They've done studies of it,  
15 and they've essentially dismissed it. And that's  
16 essentially what we've done. And to a large extent  
17 it's based on the properties of the Yucca Mountain  
18 system and how it would behave under the Greenhouse  
19 situation. There's a slightly elevated rainfall, but  
20 it's not -- it's not a drastic effect. It's not like  
21 a coastal site where you have rises in the sea level,  
22 falls in the -- falling sea level.

23 DR. TILL: Well, that doesn't exactly  
24 answer the question. I mean --

25 MR. KOZAK: Yes.

1 DR. TILL: -- Michael had raised it as an  
2 issue, and at least the question -- I guess he said he  
3 was surprised this had not been included in the DOE  
4 analysis.

5 MR. KOZAK: Right.

6 DR. TILL: Okay? So, I mean, if indeed it  
7 has been considered --

8 MR. KOZAK: Yes.

9 DR. TILL: -- and considered carefully,  
10 the way you get it off the table is make sure that  
11 it's clearly documented somewhere --

12 MR. KOZAK: Yes.

13 DR. TILL: -- in the literature.

14 MR. KOZAK: Yes.

15 DR. TILL: The answer, you're saying, is  
16 that it is. And it is --

17 MR. KOZAK: I believe it is, yes. That  
18 would be my response is, yes, I believe it is well  
19 documented that that does not have a significant  
20 effect on the system.

21 VICE CHAIRMAN RYAN: Do you have some  
22 specific references, Matt, that you could maybe point  
23 us to? I don't want to try and pick your memory while  
24 you stand there, but if you could think about --

25 MR. KOZAK: Well, I can speak to the EPRI

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 documentation.

2 VICE CHAIRMAN RYAN: Yes, that's what I'm  
3 asking.

4 MR. KOZAK: Yes. In the EPRI  
5 documentation, the '96 and the '98 versions of the  
6 TSPA, although it could be as late as the 2002 TSPA --  
7 I know within that range is when we decided to stop  
8 spending significant effort on it, because our results  
9 showed that there was no real effect.

10 VICE CHAIRMAN RYAN: And these are on the  
11 list that you've given us.

12 MR. KOZAK: Yes.

13 VICE CHAIRMAN RYAN: Okay.

14 MR. KOZAK: Yes. Those would be the TSPA  
15 documents that are on there.

16 VICE CHAIRMAN RYAN: Okay. I just want  
17 to --

18 MR. KOZAK: Yes.

19 VICE CHAIRMAN RYAN: -- be clear about  
20 where it was.

21 Dave?

22 DR. KOCHER: I want to understand your  
23 comment about the dynamics of the biosphere system.  
24 I gather what you're driving at there is you -- that  
25 you think equilibrium-type models are appropriate. Or

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 do you have in mind a certain time scale that's short  
2 when you think about things like that?

3 MR. KOZAK: Yes. When we derived the  
4 biosphere dose conversion factors, we used a dynamic  
5 model and reach an approach to steady-state. I won't  
6 say it's equilibrium or -- what was the word  
7 yesterday? Saturation. It's a steady-state -- it  
8 reaches a steady-state. And when it reaches, you can  
9 model it out until it -- you can do the calculation,  
10 the dynamics, until it reaches some approach to that  
11 steady-state, and then you say, "I'm done."

12 And you look at how long that takes, and  
13 it's not that long in the analyses that we've done.  
14 It's not -- it's not thousands of years. It's not --  
15 and if you look at the rate of change of the plumes  
16 coming from Yucca Mountain, if you remember the ones  
17 on the TSPA SR yesterday, that rapid rise that  
18 everyone was talking about, that's on a log scale out  
19 in the hundred thousand to million decades.

20 That's actually a very slow rise, and so  
21 it's basically a stationary -- you can think of it as  
22 a series of stationary steady-states that the  
23 biosphere has a chance to respond to.

24 DR. KOCHER: And I assume that the time to  
25 steady-state or some approximation of it is pretty

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 much driven by how you model retention in soil?

2 MR. KOZAK: Yes. Yes, the surface soil  
3 compartment is what drives the approach to steady-  
4 state. That's correct.

5 DR. KOCHER: So you would think order of  
6 a few thousand years and less is -- is basically  
7 nothing on the time scale we're talking about here?

8 MR. KOZAK: I think a few thousand years  
9 -- I don't think we've seen anything that's a few  
10 thousand years.

11 DR. KOCHER: And it's all in the  
12 assumptions, of course.

13 MR. KOZAK: Yes.. On the order of a  
14 thousand years would almost be constant concentration  
15 on these scales.

16 DR. KOCHER: Okay. Great. Thank you.

17 MEMBER WEINER: Since you mentioned the  
18 cumulative distribution functions, the TSPA results  
19 that Dr. Swift showed yesterday --

20 MR. KOZAK: Yes.

21 MEMBER WEINER: -- do you have -- could  
22 you point out for me any significantly different  
23 results that your independent TSPA showed? Or just  
24 summarize them qualitatively?

25 MR. KOZAK: Yes. Our results show

1 something quite similar. The results that we just  
2 came out with, our most recent ones which I can speak  
3 to, since I was most intimately involved with those,  
4 show a very similar type of behavior. The exact  
5 numbers may be slightly different, but the key points  
6 are that it's well below the regulatory limit in --  
7 within the regulatory time period, and it doesn't rise  
8 to incredibly high numbers after that.

9 I mean, if you looked at those TSPA SR  
10 numbers yesterday, keep in mind that the highest peak,  
11 way out at a million years, is below the public dose  
12 limit. It was below 100 millirems. So it's not --  
13 they're not astronomical doses, even though on that  
14 scale it looked like they were going way up. They're  
15 not -- they're not really high.

16 MEMBER WEINER: I'm more interested --

17 MR. KOZAK: And we find something quite  
18 similar.

19 MEMBER WEINER: Oh, you have that --

20 MR. KOZAK: Yes.

21 MEMBER WEINER: Are there any input  
22 parameters where you differ markedly from DOE? I'm  
23 interested in the -- since yours is an independent  
24 TSPA, independent of both DOE and NRC --

25 MR. KOZAK: Yes.

1 MEMBER WEINER: -- I'm really interested  
2 in what -- if you could highlight the differences.

3 MR. KOZAK: Okay.

4 MEMBER WEINER: And not so much, you know,  
5 that it's a low dose or a high dose, but just --

6 MR. KOZAK: Sure.

7 MEMBER WEINER: -- what the differences  
8 are.

9 MR. KOZAK: We are a considerably smaller  
10 program than DOE or NRC.

11 MEMBER WEINER: Yes.

12 MR. KOZAK: And as a result, we rely  
13 fairly heavily on their breakdown of the raw  
14 information. Based on that, we come up with an  
15 independent evaluation of whether or not that's  
16 reasonable or if their are conceptual models represent  
17 what we consider to be the best available science kind  
18 of approach, and then we come up with an independent  
19 approach.

20 So if we immediately go to parameters,  
21 we've got to be careful, because our models are  
22 different. We've got a totally different modeling  
23 structure. And within that, then there's also  
24 independent estimates of the parameters.

25 And so what we do is we have people on

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 subcontract who are really high-level people. We have  
2 Ed Sudicky from University of Waterloo doing the  
3 groundwater modeling; Frank Schwartz from Ohio State  
4 doing some of the data interpretation for the  
5 groundwater hydrology. So these are very well-known  
6 top-level people. Graham Smith is well-known for his  
7 biosphere work.

8 And so we rely on those people to come up  
9 with -- by evaluating the information that both DOE  
10 and NRC come up with -- to come up with their own  
11 independent ideas. But primarily where we focus our  
12 attention is in the assumptions and the modeling to  
13 come up with independent models rather than focusing  
14 so much on the parameters. We do that, too, but  
15 that's probably not the crux of the difference between  
16 them.

17 So it's a hard question to answer is what  
18 I'm talking a long way around about is -- is we really  
19 have taken a totally different approach and come up  
20 with somewhat similar results, rather similar results  
21 I would say.

22 MEMBER WEINER: I guess what I was trying  
23 to get at was -- and maybe you can't answer the  
24 question that simply -- is some significant  
25 difference, either in model or in parameters or in

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 results somewhere, what -- are there any significant  
2 differences? And what are they?

3 MR. KOZAK: In the realm of the biosphere,  
4 there are -- I can't give you specifics off the top of  
5 my head. I'm sorry.

6 CHAIRMAN GARRICK: What do you see as the  
7 primary purpose of the EPRI TSPA? I know it's  
8 independent and --

9 MR. KOZAK: Yes.

10 CHAIRMAN GARRICK: -- and I know industry  
11 needs to have --

12 MR. KOZAK: Yes.

13 CHAIRMAN GARRICK: -- access to their own  
14 resources for getting an essence of what's going on.  
15 But what do you see as the primary purpose of this  
16 TSPA?

17 MR. KOZAK: I think it serves as a good  
18 in-depth review of both programs to make sure that --

19 CHAIRMAN GARRICK: How is it used in that  
20 context? What do you --

21 MR. KOZAK: Well, I mean, we publish our  
22 work and go to conferences, and so forth. And if a  
23 significantly different conceptual model -- for  
24 instance, let's say for some of the things we're  
25 talking about here -- significantly different

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 conceptual model for inhalation, for instance, I don't  
2 think we do, but that's an example.

3 If we were to have that, we'd go and  
4 present it, and we would try to get it on the table --  
5 get it out and published, and the information out  
6 there soon enough so that it could be taken on by DOE,  
7 that they would get the benefit of our independent  
8 viewpoint. They could take it on if they felt they  
9 needed to, or that NRC would be able to take it on as  
10 they saw fit.

11 So that's really the role that we play is  
12 to be able to provide information as an independent  
13 evaluator of the system that might be useful to the  
14 regulatory process.

15 CHAIRMAN GARRICK: Now, you've been doing  
16 this for a long time. Do you -- can you point to  
17 areas where you think you've influenced --

18 MR. KOZAK: Oh, yes.

19 CHAIRMAN GARRICK: -- the DOE and the NRC  
20 models?

21 MR. KOZAK: Definitely. EPRI, in a number  
22 of cases that I could point to, started putting some  
23 of these things out first, and sort of drew  
24 interaction matrices. We were the first person --  
25 we're the first group to produce an interaction matrix

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 for parts of the Yucca Mountain system, for instance,  
2 and that was one of the things that we saw here. That  
3 was back '96, I think.

4 So that's one approach that we brought  
5 from the international community and published it.  
6 Whether or not it was actually seeing our work that  
7 influenced DOE to start producing interaction  
8 matrices, or whether it was their participation in  
9 international programs, I can't say.

10 But there are a number of things along  
11 those lines. We've done different types of source  
12 term modeling, which is outside of the realm of this.  
13 But in our TSPA, our source term modeling has been  
14 significantly different from either NRC or DOE, and  
15 has led to some changes in the DOE modeling.

16 CHAIRMAN GARRICK: Yes. Now, just one  
17 final comment. I don't like decoupled models unless  
18 what's been decoupled doesn't make any difference.

19 MR. KOZAK: Right.

20 CHAIRMAN GARRICK: What's your comment  
21 about that, about your biosphere -- how coupled is  
22 your biosphere model to the geosphere model?

23 MR. KOZAK: In terms of intimate coupling  
24 that you need to have information from one compartment  
25 that's used in the next, there's very little. But the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 point is is that we've gone through -- about it in a  
2 justified manner. We've said, "We recognize that  
3 these couplings can occur, and so we want to look at  
4 the dynamics of the system to justify that we can  
5 decouple them."

6 My belief is that probably even though we  
7 haven't seen that necessarily in this meeting, my  
8 belief is probably that DOE has done that, too.

9 CHAIRMAN GARRICK: Yes. Okay. Thank you.

10 VICE CHAIRMAN RYAN: Michael.

11 DR. THORNE: Could I ask a question of  
12 clarification? On the Greenhouse modeling, you  
13 mentioned that the precipitation was slightly  
14 increased in the Greenhouse --

15 MR. KOZAK: Yes.

16 DR. THORNE: How was the increase in  
17 precipitation quantified or limited for those  
18 calculations?

19 MR. KOZAK: I'm going back a couple of  
20 years, and I hesitate to misspeak. We had -- we had  
21 a professor of climatology on our team at the time who  
22 was going through the data and the modeling that were  
23 available at the time to come up with an independent  
24 estimate.

25 That independent estimate was consistent

1 with the types of effects that both DOE and NRC have  
2 seen from the Greenhouse gas effects in their  
3 interpretations of the data and modeling as well.

4 DR. THORNE: Okay. The reason I ask, for  
5 other people, is that GCM-type modeling, both  
6 transient and point-estimate type, or point-in-time  
7 estimate, have moved on a lot in the last sort of five  
8 or six years. But one of the things I'm struck with  
9 continuously is that while there is some broad  
10 agreement on temperature change in those models, the  
11 projections of precipitation change, even for areas  
12 like Northern Europe where it's rather constrained --

13 MR. KOZAK: Yes.

14 DR. THORNE: -- are quite often very  
15 variable. And one of the problems that I see with the  
16 Greenhouse gas business is that you may get a  
17 reasonably constrained envelope for the temperature  
18 changes from modeling exercises, but you don't get  
19 such a reasonably constrained envelope for the  
20 precipitation changes from those modeling exercises.  
21 And if you're in a non-analog situation, it's very  
22 difficult to use past data to constrain the  
23 precipitation regime.

24 MR. KOZAK: Yes. Although to some extent  
25 -- I was going to say to some extent there is -- some

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 of the information that I'm aware of, in terms of the  
2 paleo record, the correlations of CO2 records in  
3 icepacks to rainfall in arid regions, and so forth, I  
4 think is one of the significant bases. So you can  
5 draw a correlation between Greenhouse gases in the  
6 environment at a particular time and the paleo climate  
7 at that time.

8 So I think that there are -- and I'm  
9 stepping out of my -- my realm of particular expertise  
10 here, but I know that that's one of the threads of  
11 evidence that has been used.

12 DR. THORNE: Yes. And I think that's a  
13 legitimate argument, but I think you have to recognize  
14 that those CO2 levels are pre-Quaternary. So they're  
15 more than 1.6 million years ago. In fact, often quite  
16 a lot older.

17 MR. KOZAK: Yes.

18 DR. THORNE: And that a lot of other  
19 elements of the climate system, like the rise of the  
20 Tibetan Plateau, the drift of Antarctica, have also  
21 occurred over that period. So I'm -- the world was  
22 different then, and I'd be very cautious about using  
23 those as a strong thread of argument, though I think  
24 it -- basically, in this business we're looking for  
25 every bit of argument that we can get.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MR. KOZAK: Yes, absolutely.

2 VICE CHAIRMAN RYAN: We have a response  
3 here.

4 DR. SWIFT: Peter Swift, Bechtel SAIC and  
5 Sandia Labs. The Department of Energy has not  
6 attempted to use general circulation models directly  
7 to do forward modeling of climate for Yucca Mountain.  
8 The Department made a decision there that -- this  
9 would have been many years ago, but uncertainty in  
10 forward-looking climate models was just going to be  
11 very great and was not going to provide a credible  
12 basis for going forward.

13 Instead, we chose to look at paleo climate  
14 data -- a broad range of possible sources of  
15 information -- available sources of information about  
16 past climates in the region, and then to model --  
17 conceptually model, not numerically model, forward  
18 climates with an assumption that future climates would  
19 repeat those of the past.

20 We're well aware that anthropogenic change  
21 may disrupt that assumption. It may create  
22 anthropogenic changes that would lead to future  
23 climate changes that do not follow patterns of the  
24 past.

25 With respect to the magnitude of those

1 changes, changes in -- there certainly is uncertainty  
2 about future precipitation and temperature. So we  
3 have uncertainty bands on our future states, so we  
4 have a -- and on the present state, too, for that  
5 matter. But the monsoonal climate comes in drier and  
6 wetter versions. So, too, is our glacial transition  
7 climate, and so, too, for that matter is our future  
8 flow glacial climate.

9 Those enter the geosphere modeling system  
10 through changes in the amount of infiltration entering  
11 the unsaturated zone. So we have low infiltration  
12 states and high infiltration states, and intermediate  
13 ones, for each of our future climate conditions.

14 So it's our belief that the uncertainty  
15 associated with anthropogenic changes in precipitation  
16 will still fall within the range of basically wet and  
17 dry infiltration states that we have for our future  
18 climate states.

19 Now, can we prove that? No, that -- this  
20 is a conceptual statement. We believe that the  
21 anthropogenic effects will not take us out of the  
22 range of uncertainty already included in our models.

23 There has been quite a lot of  
24 consideration given to that. That's the best I can do  
25 for an answer.

1 MR. KOZAK: Yes, that's -- thank you.

2 VICE CHAIRMAN RYAN: Any last questions?

3 Yes.

4 MEMBER CLARKE: Just a follow up to Ruth's  
5 question that came out in response to another question  
6 -- that you're handling the source term a little  
7 differently. How about transport in unsaturated zone,  
8 VADOS zone --

9 MR. KOZAK: Yes.

10 MEMBER CLARKE: -- saturated zone,  
11 dimensionality -- any major differences in the two  
12 models that we're hearing --

13 MR. KOZAK: The short answer is yes, there  
14 are differences in all those aspects. I guess to  
15 borrow Dave's comment, we don't want to get up in the  
16 weeds on things that are outside of the biosphere.  
17 But my understanding is that other people from our  
18 group will be addressing the ACNW in future meetings,  
19 and certainly at that point -- in fact, I think Frank  
20 Schwartz is supposed to be talking at one of the  
21 upcoming ones. And he would certainly be the one to  
22 address a lot of the conceptual model stuff on the  
23 geosphere.

24 MEMBER CLARKE: Thank you.

25 MR. KOZAK: He's outstanding.

1 VICE CHAIRMAN RYAN: Thank you. Oh, yes.  
2 I'm sorry. Dade?

3 DR. MOELLER: I don't know if it would be  
4 proper, but could we ask Dr. Swift or Dr. Wasiolek  
5 what impact the EPRI work has had on DOE?

6 VICE CHAIRMAN RYAN: Sure. Please be my  
7 guest.

8 DR. WASIOLEK: Basically, what is going on  
9 here is that Graham Smith, who is the primary author  
10 or one of the primary authors of biosphere models for  
11 the EPRI work, is very heavily involved in what's  
12 going on in the European community in all programs  
13 that are international programs that are -- like most  
14 currently completed BIOMASS program, and there are  
15 several programs that are going on now, like BIOPROTA  
16 or BIOCLIM, and there is a whole variety of programs  
17 that looks at various aspects of biosphere modeling.

18 And we are familiar with the programs. We  
19 are familiar with BIOMASS and biosphere model  
20 developed for BIOMASS or in -- in this effort is one  
21 of the models that we compare our model with in the  
22 model validation. So we just take the very same model  
23 that was used for EPRI, and not because it was used  
24 for -- in the EPRI evaluation, but because it is the  
25 most current European model, which just happened to be

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 used by EPRI.

2 So it's a sort of coincidental correlation  
3 here, I would say, plus we are -- we are not on the  
4 uninhabited island. We've participated in  
5 international effort. We've participated in BIOPROTA.  
6 I am a task leader on one of the BIOPROTA -- I mean,  
7 Mike contributes very heavily to -- I mean, he is one  
8 of our primary contributors, and we really appreciate  
9 this, because we are getting input from the whole  
10 international community.

11 I am a member of IUR, and so we're just  
12 trying to stay on top with the current development of  
13 biosphere models, and so does EPRI. So this is where  
14 the -- where the commonalities come in place, and not  
15 because of the association with particular  
16 institutions. It's just the -- that we are all trying  
17 to stay abreast with the current development in the  
18 discipline.

19 DR. MOELLER: Thank you. I'm glad I  
20 asked.

21 (Laughter.)

22 This is a terrific answer.

23 VICE CHAIRMAN RYAN: Thank you. Any other  
24 last questions? We've had a request for a couple of  
25 additional speakers during this time, so -- Steve

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 Frishman I think wanted to speak. Yes?

2 MR. FRISHMAN: I just wanted to sort of  
3 follow up the presentation before you have your  
4 further extended discussion by pointing out that I  
5 think it's important to sort of go back to before the  
6 beginning of this whole discussion. And if you have  
7 it handy, look at page 8 of Peter Swift's first  
8 presentation yesterday. It's the false color IR  
9 photograph of the region.

10 The discussion for the last day and a half  
11 has, to not coin a phrase, been in the box. Now, the  
12 system doesn't end at the end of the blue flow paths  
13 shown on this map or on this photo. So if you go sort  
14 of back to basics, when you're talking about  
15 contaminants being released into the environment, very  
16 quickly you get to questions of what are the -- what  
17 is the fate of those contaminants?

18 And this discussion, as has the biosphere  
19 model, both used by DOE and NRC, doesn't ask that  
20 question. Well, we're in a situation where we know in  
21 general terms the fate of those radionuclides that are  
22 transported out of the repository, and that fate is  
23 that they come back to the biosphere, just outside of  
24 this box if they're not captured by a well.

25 And we know that we are in a closed basin.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 We know the bottom of that basin, the bottom of the  
2 gradient, which is Franklin Lake Playa, which is an  
3 area south of the box, and just the very beginnings of  
4 the white area due south of the box on the photograph.  
5 This is an area that is an evaporative lake. When  
6 there's a lot of water in the system from heavy rains,  
7 it's a lake. It flooded one time this summer and  
8 washed out a road across it.

9 Now, it's dry most of the time. It  
10 generates a lot of dust. The water is -- when it's  
11 not a lake, the water is very close to the surface.  
12 If you try to walk across it, you sink in the mud, if  
13 you break through the salt crust on the surface. So  
14 it's an integral part of the system, and it is the --  
15 the primary sink under current climate conditions for  
16 the radionuclides escaping from Yucca Mountain.

17 Now, what happens if we have different  
18 climate conditions? The extreme that we know of is  
19 one that, at least according to the modelers, fits --  
20 is bounded by the -- that the climate model that's  
21 used, and the extreme representation are spring  
22 deposits right at the foot of Yucca Mountain.

23 Those spring deposits right now are on the  
24 order of 100 meters above the water table, and the age  
25 on those spring deposits, the youngest that I know if,

1 is on the order of between 8,500 and 9,000 years. So  
2 we have -- we have one extreme which is we're very  
3 near the edge or very near that extreme, which is the  
4 dry condition right now, and we know where the sink  
5 is.

6 And we have another at least extreme from  
7 the record, which is a water table 100 meters higher  
8 and springs flowing out, so, therefore, Amargosa  
9 Valley being essentially a large area of standing  
10 water, and water that the water table is constantly  
11 feeding.

12 Well, the biosphere model takes only the  
13 current condition of pumping. And I think that it's  
14 not out of the question that we have to, at this  
15 point, say that the biosphere model is limited and  
16 actually artificially truncated, both in space and  
17 time, because it doesn't deal with the -- the sink of  
18 those radionuclides that are right now thrown out if  
19 they get below the root zone.

20 They not only, under current conditions,  
21 probably do come back up, but they also are in a  
22 condition to where they can, with a little bit more  
23 moisture, however you break that balance, they can go  
24 back down to the water table and be redeposited out in  
25 the Franklin Lake Playa area, picked up by the wind,

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 and moved right back into that same biosphere where  
2 you're trying to do your measurements.

3 So I think when you talk about conceptual  
4 model, the conceptual model is an incomplete  
5 conceptual model at this point, not -- not necessarily  
6 wrong but I think clearly incomplete. And it also  
7 does not take into consideration the -- even the  
8 10,000-year time period, where it's possible that we  
9 would not get a very rapid rise in the water table to  
10 the point of springs at the location that we see this  
11 one near the foot of Yucca Mountain.

12 But there are also indications of other  
13 small spring deposits farther out in Amargosa Valley  
14 at a lower elevation. So I think it's -- it's fine to  
15 discuss the biosphere under the current condition, but  
16 it has to be looked at under other conditions as well.

17 And I guess I've sort of not always,  
18 because it hasn't gone on always, but I've been  
19 concerned about the regulatory framework and how it is  
20 applied into this system, because the regulatory  
21 framework sort of makes you do it wrong. And in this  
22 case, it makes you take everything out of the well,  
23 and it's I think in part because the EPA rule sort of  
24 drives you to the current human condition, and the  
25 current human condition is that you're going to take

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 the water out of the well.

2 But if you're looking for realism, the  
3 realism is that not all of the water goes up the well  
4 as the regulation requires, but whatever doesn't --  
5 whatever radionuclides don't go up the well come out  
6 in Franklin Lake Playa to be broadly dispersed in the  
7 environment.

8 So this brings to at least one more point  
9 that needs to be made -- and the Europeans are much  
10 more conscious of it than the people in this country  
11 -- and that's that when you're talking biosphere  
12 you're not only talking dose to humans, you're talking  
13 about radionuclides in the environment.

14 And that's also apparently left out of  
15 this whole discussion, whereas in Europe it's becoming  
16 more and more common to be brought into the  
17 discussion. And the regulation I think is negligent  
18 in that area, at least on EPA's side, and it's -- some  
19 people maybe as cynical as I figure we'll get another  
20 bite at the EPA rule pretty soon. And I think that's  
21 one area that we're going to be exploring, along with  
22 many others.

23 So, but the biosphere discussion right now  
24 I think is artificially truncated in space and time  
25 and also in scope. And I'll leave that with you for

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 your future -- for your discussion.

2 MR. COLEMAN: Steve, would you -- this is  
3 Neil Coleman, ACNW staff. Would you identify the  
4 spring deposits that you mentioned, where they are?

5 MR. FRISHMAN: Well, there's one where if  
6 you look at the blue flow lines, right at the foot of  
7 Yucca Mountain you see a white line that is another  
8 drainage. It's the first one that goes off to the  
9 southwest. It goes all the way down to the boundary.

10 Then just to the left of there is a red  
11 square or a red cross indicating a well. That's a  
12 well that Nye County put down in the area of that  
13 spring deposit. And then there's another one sort of  
14 on the other side of the hill just north of it, on the  
15 other side of the hill from there.

16 MR. COLEMAN: I believe these are the ones  
17 referred to as the Lathrop --

18 MR. FRISHMAN: Yes.

19 MR. COLEMAN: -- along 95?

20 MR. FRISHMAN: Right.

21 MR. COLEMAN: Okay. I think you mentioned  
22 that this was at the foot of Yucca Mountain, these are  
23 20 kilometers away, 12 miles, not quite at the foot of  
24 Yucca Mountain.

25 Also, the fact that you have spring

1 deposits there doesn't mean that you have -- you  
2 referred to standing water bodies. At one time it was  
3 thought that Las Vegas Valley was one big lake, and  
4 Marty Mifflin pointed out that these, in fact, were  
5 not lake deposits but spring deposits. You had,  
6 certainly, a lot lusher vegetation than you see today.

7 But I just wanted to clarify --

8 MR. FRISHMAN: I'm not suggesting that  
9 Amargosa Valley was one big lake. But at --

10 MR. COLEMAN: Well, you used the term  
11 "standing water bodies." I just wanted to specify  
12 this is 20 kilometers from Yucca Mountain, and these  
13 are paleo spring deposits.

14 MR. FRISHMAN: Right. And we do know that  
15 the water table, at its maximum, has been about 100  
16 meters higher than it is right now. And it's no  
17 coincidence that these spring deposits are at about  
18 that same elevation. So I'm not suggesting that I  
19 know that it was one large lake at one time, because  
20 there are lots of factors that control whether it was.  
21 But there was certainly surface water in the area.

22 And if you go back to I think a 1982 panel  
23 from the National Academy that was chaired by Tom  
24 Pickford, one of the things that they discussed about  
25 the Yucca Mountain site, or a site like Yucca

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 Mountain, was concern for it as a repository, because  
2 at some future time people would have access to  
3 springs that could be contaminated due to releases  
4 from a repository. And that becomes sort of the Yucca  
5 Mountain picture.

6 And they -- they suggested in that report,  
7 if I recall, that sites like that should probably be  
8 -- not be looked at because of the potential future  
9 danger to -- to people given climate changes and water  
10 table changes.

11 Well, for your consideration.

12 VICE CHAIRMAN RYAN: Thank you.

13 Other questions or comments? Are there  
14 other comments from other speakers? Yes.

15 MS. TREICHEL: Judy Treichel, Nevada  
16 Nuclear Waste Task Force.

17 In the discussion, there are suggestions  
18 that studies be done on victims of Hiroshima and other  
19 -- perhaps Chernobyl -- where there has been  
20 radiological damage and exposures to people. And I  
21 found it very interesting when the suggestion was made  
22 that there should be a baseline study in the area of  
23 Yucca Mountain. And you will find a lot of people in  
24 communities there that really want that to happen, and  
25 they've never been able to get DOE to actually do

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 that.

2 And I know that there's at least one group  
3 down around Shoshone and Tekopa and Death Valley  
4 Junction where they've tried to find their own money  
5 and find free -- free help in doing that with  
6 epidemiological studies, and so forth, and they've  
7 not -- I don't -- as far as I know, they haven't been  
8 able to get it on.

9 But it would be interesting to go from the  
10 reverse in this case and find out -- what you would  
11 find out is that, by and large, the people are well.  
12 And how come they're well? Why is this a good place  
13 to live? And why would it be justified to create a  
14 risk or to create the possibility that they would get  
15 sick?

16 And you've got Amargosa Valley, which as  
17 a place to live is also very attractive, and certainly  
18 more rain would make it even more attractive. But  
19 Nevada and Nye County and Clark County are one of the  
20 fastest-growing areas in the nation, and that's  
21 probably why.

22 And the Amargosa Valley region is one of  
23 the few places in this country where the land is  
24 affordable, and the opportunity is there that if you  
25 wanted to be a subsistence farmer, if you just wanted

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 to go out, have a bunch of children, live off the land  
2 so to speak, you could really do that.

3 And so that's why I think people out there  
4 and people like me and others who care really --  
5 really get sort of disgusted at some of the discussion  
6 that goes on about the contamination and what it would  
7 be and how it would work, and the idea that, well,  
8 maybe if you put in water softeners that would be a  
9 big help.

10 They don't need water softeners. They  
11 have very good water. And even if you put water  
12 softeners in, you wouldn't be irrigating with soft  
13 water. You wouldn't -- you don't even drink soft  
14 water.

15 But -- and the idea that you would ever  
16 pump the aquifer dry -- that doesn't happen. If you  
17 have wars now in the west, it's wars over water. And  
18 we don't allow aquifers to be pumped dry, and that's  
19 why the state engineer is sort of the sheriff in  
20 Nevada these days.

21 So I just don't feel that a lot of it is  
22 justified, and it certainly would do somebody some  
23 good to check and see why those people are as healthy  
24 as they are now and why Amargosa Valley is as  
25 attractive as it is.

1 Thank you.

2 VICE CHAIRMAN RYAN: Thank you very much.

3 Any additional comments?

4 I think the schedule that we have is we're  
5 probably at a break where we can break for lunch, Mr.  
6 Chairman.

7 CHAIRMAN GARRICK: Sure.

8 VICE CHAIRMAN RYAN: And I think what our  
9 -- let's just take a couple of minutes and think about  
10 the rest of our working group session. I'd like to  
11 come back after lunch -- we've had I think an  
12 excellent start this morning on summary comments.

13 I would like to do that again, based on  
14 this morning's presentations and any other comment you  
15 might like to make about the working group session  
16 overall, and then have further discussion with ACNW  
17 members and any comments from other participants, and  
18 spend from 1:00 to perhaps 2:00 or 2:30 with that  
19 discussion, and then have an additional period for  
20 public comments. And then we'll have a close of the  
21 working group session.

22 And keep in mind that I think we can  
23 combine -- the last item on our published agenda is to  
24 think about a letter that the ACNW will generate, and  
25 I think what I'd like to suggest is that we pick up

1 points for that letter in our discussion earlier, so  
2 we're not repeating the same points over again.

3 So we'll try and combine those two things,  
4 and then I think aim roughly at adjourning somewhere  
5 around the 3:00 time or so with the working group  
6 session to give people a little bit of advance for  
7 planning the rest of their day.

8 Does that sound reasonable, Mr. Chairman?

9 CHAIRMAN GARRICK: Yes.

10 VICE CHAIRMAN RYAN: Okay. We'll stand  
11 adjourned until 1:00.

12 (Whereupon, at 11:14 a.m., the  
13 proceedings in the foregoing matter went  
14 off the record and resumed at 1:01 p.m.)

15 VICE CHAIRMAN RYAN: Okay, thank you very  
16 much for your attention. This is our last session for  
17 this working group roundtable on biosphere issues and  
18 modeling.

19 I think what I'd like to do now is have  
20 each of the expert panel members offer their kind of  
21 summary and closing comments, being careful not to  
22 repeat too much of what was said in our summary this  
23 morning from yesterday, but maybe focusing on today's  
24 issues and then some of the global items and comments  
25 that you might want to talk to us about.

1 I think I'll then go starting my far left  
2 at the table and coming back this way, getting the  
3 consultant and member comments and then we'll bring  
4 our workshop to a close at that point. And that will  
5 give us, I think, an excellent review for the  
6 preparation of a letter which we might do.

7 I do not plan to have a separate letter-  
8 writing discussion because I think this will actually  
9 serve both purposes to both summarize and to give us  
10 specific things to think about as we then move into a  
11 letter-writing phase, perhaps a little later on. So  
12 that will be two separate activities.

13 Let me turn the meeting back over to Dr.  
14 Moeller for a review from the expert panel members.

15 DR. MOELLER: Okay, we'll go the opposite  
16 direction.

17 Dr. Thorne, would you begin, please?

18 DR. THORNE: Yes, I think there is not a  
19 lot that I want to add to what -- the remarks I made  
20 this morning. I think I'm still bemused a bit by this  
21 business of climate change. We heard that it had been  
22 studied in the program and I'm sure that's right, but  
23 there hasn't been a model underpinning of future  
24 climate. As I said yesterday, future climate is very  
25 much a new analog situation for the paleoclimate data,

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 so I find myself a little stuck. There hasn't been a  
2 modeling study looking at greenhouse warning, no GCM  
3 simulations undertaken. And then a statement you rely  
4 on the paleodata, but the paleodata doesn't apply to  
5 the new analog situation, so I'm still in this  
6 uncertain feeling about how you bound temperature and  
7 precipitation data for the future if you don't really  
8 on models and if you can't legitimately rely on  
9 paleodata. And there's a big question there about the  
10 adequacy of the models, but either you accept some  
11 sort of modeling projection of future climate or you  
12 have no way of specifying a bound on future climate,  
13 except sort of physical plausibility arguments that  
14 say something like I don't think it's going to turn  
15 into the Himalayas.

16 I'm struggling as to how DOE can provide  
17 a bounding argument for future climate change that  
18 allows them to eliminate it formally from the rest of  
19 the assessment, if that's what they're trying to  
20 achieve.

21 DR. McCARTIN: The regulation does limit  
22 the climate to arid to semi-arid, so there is some  
23 bound by regulation that can't go to say a tropical  
24 jungle certainly, but arid, semi-arid is provided as  
25 a limit.

1 DR. THORNE: Right, so I think that might  
2 be the point to build on and the question will be an  
3 agreement on how far you go before a climate stops  
4 being defined as semi-arid and that's perhaps the  
5 point for discussion.

6 DR. MOELLER: Any other comments?

7 DR. THORNE: No, that was the main one  
8 that arose, I think

9 DR. MOELLER: The regulations also say and  
10 Tim McCartin can undoubtedly help us, that you can  
11 only use something -- I'm paraphrasing. You can only  
12 use information that's on the table up to the day the  
13 license application is submitted or something like  
14 that although you've told us that we can incorporate,  
15 improved or reduced uncertainty or parameter. But I'm  
16 wondering in terms of climate change we're restricted,  
17 I gather to a model that's been developed before  
18 December 31st of this year or does it even apply?

19 DR. McCARTIN: I'm not sure what you're  
20 referring to. Certainly it's limited to present  
21 knowledge. We're looking at current conditions, but  
22 I mean with everything in NRC license, I mean, if  
23 after the license is submitted there's some scientific  
24 breakthrough and oh gee, we now understand this that  
25 would be expected to be evaluated. It would have a

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 significant effect.

2 DR. MOELLER: I'm wrong. I totally  
3 misinterpreted. Thank you.

4 DR. THORNE: If I can come back, I think  
5 in this case there is present knowledge in that when  
6 you do GCM calculations in the future, by definition,  
7 those are global simulations because they're all total  
8 globe models with a grid that covers everywhere. When  
9 we've used them for Northern Europe what we've done is  
10 extracted a sub-domain which applies to Northern  
11 Europe.

12 But you can do exactly the same thing for  
13 the Western United States. You can say here are runs  
14 that have been done by various people for various  
15 purposes. I can acquire the data sets, abstract the  
16 results and look at the range of variability of the  
17 results and this might help with Tim's point. If  
18 we're defining what semi-arid means, you could look at  
19 the results from those models, say what the range of  
20 them is and evaluate them against the semi-arid  
21 criterion and that might help you to come to an  
22 informed scientific view about how far you can  
23 legitimately go in that directly.

24 DR. MOELLER: Okay, thank you. Jeff  
25 Daniels?

1 DR. DANIELS: I'd like to just add to the  
2 comments I made this morning, that I think it's  
3 critical to have some quantitative approach that sort  
4 of allows us to look at all three of the modeling  
5 approaches, the NRC, the work that's being done at  
6 EPRI and the work that was done for DOE, so that  
7 there's a fluid understanding of where they are  
8 different and where the comparisons are the same.

9 I find it very hard to decipher from a  
10 qualitative presentation where all of the issues are  
11 specifically identified. Now we talk about it, but  
12 I'd like to see something more substantial in terms of  
13 dismissing some issues and how other issues have been  
14 addressed quantitatively, if I understood some of the  
15 presentations.

16 The other thing I'd like to point out is  
17 I think there has to be some further bounding analyses  
18 that take into account some of the uncertainty in the  
19 technetium issues that were brought up which includes  
20 both the potting soil in the field study environments,  
21 issues that relate to iodine biology and if there is  
22 an issue with a pathway specific uptake, that those be  
23 addressed as well.

24 And finally, I think that there has to be  
25 a definitive statement as to what is prescribed and

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 what is going to be varied. I think it's very  
2 confusing that we're following regulations on certain  
3 things and we're asking the same questions over and  
4 over again and I think it's very important that they  
5 be identified up front as to how it's prescribed and  
6 that there is an opportunity to improve those  
7 calculations, either by request or by new information  
8 that becomes available.

9 And I would recommend that DOE does  
10 request the opportunity to use the latest dosimetric  
11 calculation.

12 DR. MOELLER: Thank you. John Till?

13 DR. TILL: Just one point. I don't know  
14 if this is relevant at all, but if you think about the  
15 future and if there should ever be a challenge to  
16 compliance at Yucca Mountain, it's probably going to  
17 come from measurement data. In other words, somebody  
18 measures something in something. And my question is  
19 really how well the background at the site has been  
20 categorized and I know everyone's response is going to  
21 be to say well, I know this is done very well. It has  
22 to be done very well. This is of such importance.  
23 But quite frankly, I have not seen a DOE site where  
24 background has been characterized thoroughly and  
25 correctly. And what I mean is things like discerning

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 and defining plutonium background, for example, from  
2 the weapons, from the Nevada test site.

3 This might not be relevant to what you do  
4 at all, but I think in the long term, it's going to be  
5 absolutely crucial for the operation of this site.

6 DR. MOELLER: Well, for new data, of  
7 course, they do have QA hoops to jump through, but  
8 you're talking beyond that. What about baseline data?

9 DR. TILL: Yes, baseline data, exactly.  
10 But I'm talking about things like products that are  
11 grown, agricultural products and to define what  
12 exactly what background is right now for those  
13 products, water, surface soil, whatever the media, a  
14 very defensible characterization of the radiation  
15 background.

16 DR. MOELLER: Thank you. Okay, Dr.  
17 Kocher?

18 DR. KOCHER: Yes, I don't for one minute  
19 doubt the capabilities of any of the people working on  
20 these programs, but I must say that I'm kind of  
21 disappointed in the effort that's been put into the  
22 biosphere modeling. Much of it is not site specific,  
23 if I understood. We just saw the tips of icebergs  
24 here. We didn't really get into the details.

25 But I saw no evidence of any kind of site-

1 specific information on food chain transfer  
2 parameters, distribution coefficients, things like  
3 that that enter into the model.

4 Yes, I know that at the end of the day in  
5 terms of a licensing decision, these kinds of things  
6 probably don't matter, but if you're going to do  
7 something, do it reasonably well because you don't  
8 know what other kind of challenges are going to come  
9 along. It's not totally obvious, for example, what  
10 use, if any, will be made of these calculations beyond  
11 10,000. I mean a court of law may have a different  
12 view about what those calculations mean than what the  
13 NRC and EPA do.

14 One of the things I did a little bit of  
15 homework before I came here was I read this little  
16 slim blue report of a review of the DOE biosphere  
17 program that took place about three or four years.  
18 And I was kind of struck by the things that were sort  
19 of requested in here that still were left unattended,  
20 many of which deal with site-specific issues of  
21 transfer parameters and the model for retention and  
22 the soil root zone probably not being right and here  
23 are some things you think about.

24 I'm conflicted because it probably doesn't  
25 matter, but yet I'd like to see it done better.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 That's just not a very helpful statement. That's  
2 really the way I feel about it though. There are just  
3 some things that need some attention, if you're really  
4 going to pass muster as a biosphere model by itself.

5 VICE CHAIRMAN RYAN: Just so everybody can  
6 share in their thoughts today, would you tell us a bit  
7 more about that publication so we can know what it is?

8 DR. KOCHER: This was a report from the  
9 International Atomic Agency. It was a review of DOE's  
10 biosphere modeling program. It was a small committee  
11 chaired by Roger Clark. They did their work in the --  
12 I think it was December 2000, January 2001 time frame.

13 VICE CHAIRMAN RYAN: Is there a document  
14 number on it, that would be helpful?

15 DR. KOCHER: No, it does not have any kind  
16 of -- it was published by the agency in the year 2001.

17 VICE CHAIRMAN RYAN: Okay, thanks. That's  
18 fine.

19 MR. COTORNARY: Dr. Ryan, we're familiar  
20 with that report. We can get copies for everyone.

21 VICE CHAIRMAN RYAN: I'm sure you would  
22 be, but I just wanted to make sure everyone in the  
23 audience had a chance to hear it. Thank you, Neil.

24 DR. MOELLER: I wonder if it would be  
25 appropriate, Keith, you're waiting to speak.

1 DR. ECKERMAN: Well -- go ahead.

2 DR. MOELLER: What I was thinking, again,  
3 Dr. Wasiolek is here. Would you comment at all on  
4 that? Specifically in terms of whether the degree to  
5 which your input parameters are based on site specific  
6 data.

7 DR. WASIOLEK: Well, as far as -- well  
8 let's start with the recommendations that were in the  
9 IAEA panel report. We tried to address -- this is one  
10 of the reasons, this report was one of the reasons why  
11 we decided to change the model, so we could address  
12 many of the panel's recommendations and we did so.

13 A lot of these are discussed in our  
14 current documentation why we have chosen to select  
15 specific parameters, values and we tried to present  
16 arguments why we went with certain values and not the  
17 other.

18 Wherever we can we try to use site  
19 specific parameters when they are available. We  
20 certainly use site specific parameters when it applies  
21 to characteristics of dietary and lifestyle  
22 characteristics of the receptor because there were  
23 surveys that we have, census this data. These are  
24 available.

25 Yes, this is true that we lack in the area

1 of environmental transport. And therefore, we very  
2 frequently would go and use literature data. We will  
3 do literature review and base our model input  
4 parameter values on existing published information.  
5 We try as best as we can to go to reputable sources to  
6 grab something that is -- that has some weight behind  
7 it.

8 We are aware that there are like, there  
9 are data bases like Radflux which -- did it ever get  
10 released, by the way? Officially and not under the  
11 table?

12 DR. THORNE: You mean as a CD? That's  
13 what I have. It's never been officially released.

14 DR. WASIOLEK: These are details like  
15 this. I have had a Radflux for those who don't know,  
16 it's a European Community has under the auspices of  
17 International Union of Radioecology. There was this  
18 very precious effort to create a data base of transfer  
19 coefficients that are both under -- which incorporated  
20 all the IUR data base of transfer coefficients, plus  
21 coefficients, transfer coefficients that have time in  
22 them.

23 And then I mean I really had my hopes high  
24 because I got under the table a disk, a CD, and I've  
25 had it in my drawer for I don't know how many years.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 Can I use it? No. Because we are working in the  
2 highly regulated environment. These are not the types  
3 of publications that we can use although I mean you  
4 can use them in academia. You can use them under some  
5 other circumstances, so very frequently this was a  
6 problem that we were facing. We were aware of some  
7 available information, some data base. And it was a  
8 big effort. It's not something that you can do in your  
9 spare time. I mean there were a lot of people  
10 involved and yet, they could not finish the job and  
11 make the CD available in an official format to  
12 everybody.

13 So it has original data. It has the  
14 original measurements. It does not contain some  
15 chewed up something. So we were trying, as best as we  
16 could to rely on available information, adjust it  
17 wherever we could for site specificity and in terms of  
18 characteristics of the receptor, I think we did a  
19 pretty job of that.

20 In terms of environmental transport, we  
21 have a lot of generic information. But we try to bind  
22 it as far as we could, such that we made sure that we  
23 did not underestimate the value of the dose which  
24 certainly, I'm sure, is appreciated by the  
25 stakeholders.

1 DR. KOCHER: Can you do something about  
2 your item model in soil? Please.

3 DR. WASIOLEK: Well --

4 DR. KOCHER: Please.

5 DR. WASIOLEK: We can --

6 DR. KOCHER: You can't claim that that's  
7 an overestimation of dose.

8 DR. WASIOLEK: Maybe Dave would like to  
9 comment on that.

10 DR. KOCHER: It's possible that you're too  
11 low by a factor of a 100 or a 1000 given the way you  
12 modeled the system?

13 DR. WASIOLEK: I think that if you factor  
14 in iodine-27 we are too high by several orders of  
15 magnitude.

16 DR. MOELLER: There's work remaining  
17 there. Thank you. That was helpful.

18 We'll move --

19 DR. THORNE: Could I? I think I would  
20 just like to endorse the remarks that have just been  
21 made. I think it was behind one of my remarks this  
22 morning that for a small amount of additional resource  
23 and I don't point this on DOE, I point this on waste  
24 management organizations in Europe and the U.S.  
25 together. I think we could have moved to a much more

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 comprehensive data base at the sort of level of  
2 comprehensiveness that I think that we for internal  
3 dosimetry.

4           It's worth recognizing that we don't have  
5 the same well characterized, well defined data base  
6 for environmental transport parameters. We have a  
7 number of partial data bases as has been outlined and  
8 IAA technical report 364 is an absolutely wonderful  
9 example of that. You look through it. You think this  
10 is an IAA standard document. It's got all the numbers  
11 I need. No it hasn't. It's got a sprinkling of some  
12 numbers, some of which I trust and some of which I  
13 don't trust. And I'm hoping the current EMRAS project  
14 for the agency, if properly funded and directed, ought  
15 to deliver us the sort of level of comprehensive  
16 documentation of transfer factors that we haven't  
17 quite got in the Radflux data base and that we know  
18 that everybody has got in their drawer around the  
19 world. But it just needs to be brought out and  
20 systematized in that fully qualified assured for use.  
21 We just aren't at that stage yet.

22           DR. MOELLER: I wonder, David, if you  
23 could -- you said iodine doses in your opinion are  
24 under estimated by a significant. Now why -- could  
25 you share with us specifically why you believe -- why

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 you have adopted, reached that conclusion?

2 DR. KOCHER: As I understand it, and  
3 again, I'm just looking at -- I haven't seen the  
4 details. As I understand it, their model assumes that  
5 iodine is quite mobile in the surface soil region, so  
6 therefore that equilibrium or its steady state, the  
7 concentration of iodine 129 in soil is not that much  
8 higher than the concentration in water because it kind  
9 of just flushes right on through. You don't have this  
10 long-term build up over hundreds of years like you do  
11 for plutonium say.

12 But there's plenty of information out  
13 there to indicate that iodine is a lot less mobile in  
14 surface soils than people commonly believe and so the  
15 equilibrium, the steady state concentration of iodine  
16 129 in the surface soil compartment conceivably could  
17 be a lot higher than what they're assuming and of  
18 course, the food chain dose is directly proportionate  
19 to that increase.

20 DR. MOELLER: Thank you. Well, that  
21 clarifies it certainly for me.

22 DR. THORNE: Can I clarify as well? There  
23 is an experimental program in the Narick side which I  
24 mentioned this morning, where we've been putting  
25 iodine, actually using iodine-125 as a tracer and

1 putting it into soil columns with a moving water table  
2 and tensiometer and soil solution and Redox probes so  
3 we can try and get some handles on that. But  
4 obviously, it's a limited scale program and I think  
5 there's room for quite a lot more research in that  
6 area.

7 VICE CHAIRMAN RYAN: Michael, when do you  
8 expect results from those studies?

9 DR. THORNE: They're being written up at  
10 the moment.

11 VICE CHAIRMAN RYAN: Okay.

12 DR. MOELLER: Okay, we'll move last to  
13 Keith Eckerman.

14 DR. ECKERMAN: I'd just come back to some  
15 of our discussion with regard to the decoupling that's  
16 been done and we've talked a lot about the decoupling  
17 of the geosphere and biosphere, but there is a  
18 decoupling within the biosphere of man from the  
19 environment, particularly through the use of the  
20 committed dose coefficients.

21 Now the total problem, looking at it,  
22 there's a host of time constants in this problem and  
23 you really are approaching it largely by looking at  
24 the specific solution at a point in time rather than  
25 having wrestled with the general solutions of the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 problem. And part of the -- I talked about earlier  
2 this morning about calibrating the system and in part,  
3 sometimes instruments have a self-calibration in it  
4 that you could look at and in fact, there are aspects  
5 of a more general solution with coupling that would  
6 have been satisfying for individuals to look at to  
7 understand how the time constants are all working in  
8 this process.

9           Coming back to the dose coefficient, the  
10 assumptions that we're making in dose coefficients are  
11 part and parcel the same that you're assuming in the  
12 whole analysis that the system is linear and so there  
13 isn't a real hang up between chronic exposure and  
14 acute exposures, particularly when you look over the  
15 integral.

16           And in many of the new biokinetic models,  
17 we've dealt more with a lot of the short term  
18 compartments and so -- and when you're dealing with  
19 the effective dose you're seeing an approach to the  
20 integral converging a lot faster than what you may  
21 think based on looking at and thinking about the half  
22 lives of the materials we're dealing with.

23           But there's no reason you could not put  
24 the information that is available into the model and  
25 couple man tighter with the biosphere responses to

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 really look at this in detail and that may well have  
2 to be done and to answer some of the general questions  
3 and that would include the consideration of an  
4 individual as he ages through life in living in that  
5 postulated reference of biosphere that you've created.

6 I think you have to be a little bit  
7 careful again thinking through the issue of the  
8 coupling of the models and what you might gain from  
9 that in a more general analysis.

10 DR. MOELLER: All right, I personally  
11 really have nothing to add to what's been said, so I  
12 think, Mr. Chairman, with that, this side of the table  
13 is wrapped up.

14 VICE CHAIRMAN RYAN: Okay, well, thank you  
15 very much for chairing the expert panel. I want to  
16 thank each and every panel member for their time and  
17 efforts over the last few days and all the time you  
18 put into preparing to come and be with us today. I  
19 think we're -- we've been enriched by your commentary  
20 and observations and without this panel we wouldn't  
21 have gotten nearly as much out of this two-day working  
22 group session as we have.

23 So with that being said I'd like to turn  
24 our attention to Jim Clarke, do you want to start with  
25 any comments, observations? The floor is yours.

1                   MEMBER CLARKE: Thank you. Let me start  
2 with what I was going to end up with since many of the  
3 other comments that I had have been very well  
4 articulated already. But towards the end of the day  
5 yesterday, John Garrick asked what I thought was a  
6 very interesting question. He asked what about  
7 chemicals? What do we know about chemicals? Who  
8 might be able to help us here?

9                   And it strikes me that there are two  
10 reasons for that. One is to put radiation in  
11 perspective which I think needs to be done. It may be  
12 unique. It may not be unique, but it may not be  
13 helpful to dwell on that.

14                   Secondly, there are a number of chemicals  
15 that have been studied a lot. I would mention lead,  
16 benzine, vinylchloride, arsenic, just to name a few.  
17 And the whole area of biokinetic models for chemical,  
18 internal chemical exposures is an area of great  
19 interest, if only to replace our reliance on animal  
20 testing. The fact that we still do rely a lot on  
21 animal testing may help put it in perspective. In any  
22 event, I still think there's merit for pursuing this  
23 for a couple of reasons, the reasons I mentioned,  
24 putting radiation in perspective and seeing what the  
25 approaches that are being taken for toxic chemicals

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 could add to our analysis.

2 My other comments, environmental exposure  
3 analysis has always impressed me as a great example of  
4 the devil being in the details and this is not a  
5 meeting to get into the details. I understand that,  
6 but some things have come out along the way that  
7 suggest that someone should perhaps make a pass  
8 through the assumptions that are being made. For  
9 example, when we saw the information on relative  
10 contributions, there was, I thought, a good example of  
11 something that appeared very counter intuitive, that  
12 Dr. Kocher brought up and again it suggests to me that  
13 it's worth another pass looking at the assumptions  
14 that were made, if.

15 If only for a few reasons. One would be  
16 to check consistency. In some cases, bonding  
17 assumptions were made and others, distributions were  
18 made, so just an overall consistency check. And a  
19 check with the consistency of our understanding of the  
20 construct of RMEI. When you integrate all of this  
21 over all the pathways and all the different kinds of  
22 exposures, do you, in fact, end up with RMEI, as we  
23 understand it to be?

24 And then finally, I think that would go a  
25 good ways towards making a lot of this more

1 transparent. So a very nice list of here's what we  
2 did, here's what we assumed. This is the degree of  
3 uncertainty we think is associated with it. This is  
4 the degree of conservatism we think is associated with  
5 it and this is how we think it's consistent with RMEI.  
6 I think it would just be a nice thing to have.

7 VICE CHAIRMAN RYAN: Thank you very much.

8 DR. MOELLER: I'm sorry --

9 VICE CHAIRMAN RYAN: Please.

10 DR. MOELLER: This morning when the  
11 discussion or when Dr. Garrick asked the question who  
12 has looked at chemicals versus radiation, I'm sure  
13 Doctor, Professor Clarke is acquainted with Ed  
14 Calabressi at the University of Massachusetts at  
15 Amherst. I went up there last summer and he had a  
16 program on toxicology, you know, a seminar, a meeting.  
17 And his objective was to look at the health effects or  
18 health responses, human body responses as you increase  
19 the dose of chemicals and as you increase the dose of  
20 radiation.

21 And it was well attended. It was a  
22 toxicology meeting. There were only one or two of us  
23 who were not professional toxicologists, so I found it  
24 very educational from that point and I came away with  
25 the following fact or something that I gained, the

1 following lesson that I gained and he and all of the  
2 people who presented the papers, it was international.  
3 There were people from Europe and all over.

4 I came away with the conclusion that you  
5 should not just adopt a linear relationship or a  
6 threshold relationship, but he said look at the data.  
7 And he presented slide after slide of data on  
8 different chemicals and showed -- and he said that if  
9 you really look at the data, you'll come out with the  
10 fact that not everything behaves in the same manner.  
11 And he showed though slide after slide or graph after  
12 graph of reactions to chemicals in which a small  
13 amount was beneficial, the J-curve he called it, down  
14 and up and he really stressed the fact that you should  
15 look at the data and nonetheless, having said that the  
16 fact in terms of most of the chemicals was that the J-  
17 curve applies.

18 There were one or two speakers who claim  
19 the same J-curve applies for radiation, but that  
20 really wasn't the major subject of the conference.  
21 The conference was really more on chemicals. And I  
22 don't know if that helps at all, but in other words,  
23 he said look at the data, don't adopt a generic dose  
24 response curve for everything.

25 DR. ECKERMAN: I might just add that the

1 lead, an example you just mentioned, is one in which  
2 they -- the lead model that was developed for the  
3 radiation side recognized, of course, the skeleton as  
4 a storehouse of lead and that has been brought into  
5 the chemical considerations with regard to blood  
6 levels of lead in children.

7 And of course, the very early cross over  
8 link was recognized from Day 1 in the Manhattan  
9 Project was the nephrotoxin, the toxicity of uranium  
10 and of course, that had always been part of -- so the  
11 heavy metal kind of cadmium leads, there's direct  
12 applicability of a lot of the modeling that we do.  
13 Dealing with the organics is the difficulty, of  
14 course.

15 VICE CHAIRMAN RYAN: Thanks, Keith. Ruth?

16 MEMBER WEINER: Since my chemical thunder  
17 has been stolen, I'll confine myself to nonchemical  
18 comments. I think the point was made, but it deserves  
19 reiteration that you do really need a baseline of  
20 information about the biosphere.

21 Now the site was extremely well  
22 characterized. There are volumes and volumes of the  
23 site characterization report, but I did not see the  
24 results of that report connected to the biosphere  
25 analysis. And if that connection exists, I think it

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 should be made overt.

2 From that, I'd like to reiterate what  
3 several people said about the RMEI. I think Dr.  
4 Moeller began this workshop with a little lecture on  
5 realism versus conservatism and I'd like to know how  
6 the RMEI is correlated with a realistic picture, who  
7 is the RMEI? The regulation itself specifies two  
8 numbers and almost everything else, if you read the  
9 regulation is available for estimation. It just  
10 specifies the two liters per day and the 3,000 acre  
11 feet. That's it. And everything else you can  
12 estimate.

13 I think this is an area that needs to be  
14 very transparent to the public and I would second the  
15 notion that the RMEI be related in some way to the  
16 notion of critical population because critical  
17 population is something that has been presented  
18 publicly and people have some idea of what that means.  
19 And we need that same idea for the RMEI.

20 Sometimes we get bounding values and  
21 sometimes we get realistic values and that's in the  
22 nature of this kind of analysis. However, there  
23 should be some definition of the circumstance. When  
24 do you use a bounding value -- and this is really for  
25 NRC who is going to review this license application.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 When should a bounding value be used or what are the  
2 guidelines for using bounding value versus a realistic  
3 value and how do you really define realistic?

4 Moving to the question of climate change,  
5 we do need a very transparent definition of semi-arid.  
6 Dr. Clarke asked me what's semi-arid and I said  
7 Albuquerque is semi -- where I live is semi-arid.  
8 Twelve inches of rainfall a year. But that needs to  
9 be very clear.

10 We've heard two -- I heard two different  
11 views of the incorporation of climate change notions  
12 into the TSPA and Dr. Swift said that climate change  
13 won't exceed the paleoclimate changes as modeled by  
14 DOE if you represent climate change by infiltration.

15 I think NRC, if they look at this notion,  
16 it needs to be substantiated. I'd like to know if NRC  
17 agrees with it, disagrees with it, what they have to  
18 offer in that area.

19 And finally, since ash inhalation for the  
20 igneous event is considered to be the heaviest impact  
21 for the igneous event, we really do need a particle  
22 size distribution for the ash and by particle size  
23 both AMAD and density and size.

24 And as well as everybody uses the standard  
25 Galcian dispersion model to disperse everything.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 Well, an igneous dike is an area source. It's not a  
2 point source. We are not saying at what temperature  
3 it is released, whether there's thermal lofting.  
4 There is no detail given as to how good the modeling  
5 of the dispersion itself is and this is really part of  
6 the biosphere and I think that is something that needs  
7 to be looked at.

8 And I said finally, but I wasn't through,  
9 so I'm sensitive to what Dr. Eckerman said about  
10 lifetime dose. People move around. The Census Bureau  
11 has done a very careful analysis and has quantitative  
12 estimates of how long a person resides in a particular  
13 place. They've done a very, very careful job of that.  
14 On the average, people in the United States move every  
15 three years.

16 However, there is a good way to take the  
17 Census Bureau's quantitative estimate of residents in  
18 a given place and apply that and it's not just you  
19 don't have to apply the every three year average.  
20 This is a very carefully worked out thing.

21 If we are looking at lifetime doses,  
22 lifetime doses to adults, or however, the RMEI is  
23 defined and however that's correlated with childhood  
24 exposures and adolescent exposures, I think you also  
25 need to look at how long people live in a particular

1 place. That's all.

2 VICE CHAIRMAN RYAN: Thank you. I think  
3 Dr. Moeller had one comment on the RMEI.

4 DR. MOELLER: Well, there are two comments  
5 on the RMEI. If you read Title 10 part 20 and  
6 unfortunately, I just haven't read it in the last week  
7 or two, but it says that the dose limits that the  
8 Nuclear Regulatory Commission comments or sets in  
9 Title 10 part 20, that those dose limits are for the,  
10 I believe it's something like the individual receiving  
11 the maximum dose.

12 MEMBER WEINER: Yes, yes.

13 DR. MOELLER: All right, at the time that  
14 Part 20 was promulgated in 1991, I was heavily  
15 involved in the review as the regulations were being  
16 drafted and finally perfected and finally promulgated.  
17 And the review group that I was on pleaded with the  
18 NRC to not say to the individual receiving the maximum  
19 dose. We said the ICRP has developed this concept of  
20 a critical group and you should use that.

21 Well, apparently the process was too far  
22 along to make any change, so what the Nuclear  
23 Regulatory Commission did which we appreciated very  
24 much was they issued a Regulatory Guide and in the  
25 Regulatory Guide they said if a licensee or an

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 applicant desires to use the concept of the average  
2 member of the critical group in place of the dose to  
3 the person receiving the maximum, that was acceptable  
4 to them. So a regulatory guide is not a regulation,  
5 but it outlines a procedure that if the applicant  
6 follows it, the Nuclear Regulatory Commission will  
7 accept it.

8 So in the case of the Nuclear Regulatory  
9 Commission, the average member of the critical group  
10 is part of their regulations in a secondary way.

11 All right, let's just over to EPA. EPA  
12 initially directed their regulations and standards to  
13 the maximum exposed individual. A number of us  
14 pleaded with them, I didn't play a major role, but a  
15 number of people talked to them and they changed it  
16 from the maximum exposed individual to the reasonably  
17 maximally exposed individual and when they did so, if  
18 my memory is correct, they said our desire is to have  
19 this be synonymous with the average member of the  
20 critical group.

21 So I presume that if DOE preferred and  
22 desired and came to the Nuclear Regulatory Commission  
23 and said would it be permissible for us to use the  
24 average member of the critical group with Amargosa  
25 Valley, I'm not the NRC, but on the basis of what I've

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 heard, they would approve it.

2 DR. KOCHER: Yes, in fact EPA has  
3 regulations on the books that say the dose to any  
4 member of the public shall not exceed and that's an  
5 impossible standard to test.

6 VICE CHAIRMAN RYAN: George.

7 MEMBER HORNBERGER: My turn. I just have  
8 one major comment I want to make but I'll perhaps, as  
9 a preamble, may lead into it.

10 Let me say just a couple of things about  
11 climate change. I actually -- I don't disagree that  
12 somebody needs to make sure that this gets addressed.  
13 I actually think that it will turn out to be fairly  
14 straight forward and I think that I actually believe  
15 the EPRI position that they have looked at it and  
16 found that it really is a no nevermind.

17 I haven't seen any credible climate model  
18 forecast that converts southern Nevada to the tropics.  
19 That's just not credible. And so what you see is all  
20 of the climate models agree that it will be warmer in  
21 a greenhouse, not a lot warmer, a few degrees C.  
22 warmer. The precipitation forecast, as Michael has  
23 said, are a lot more tenuous and so some of them show  
24 drier and warmer. Some of them show a slightly  
25 enhanced monsoon which brings a little more

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 precipitation, but none of them, as Peter alluded to,  
2 gets anywhere near an interglacial 400 millimeters of  
3 precip.

4 Furthermore, if you then look at all of  
5 the TSPA models that have been done, it is, in fact,  
6 infiltration rate that drives -- is very, very strong  
7 condition on calculated doses. And so the higher the  
8 precipitation, roughly speaking, means the higher the  
9 calculated doses.

10 So I think that this is probably going to  
11 be fairly easy to take on. I don't disagree that it  
12 should be taken on. I'd be surprised if somebody  
13 hasn't already done so and perhaps we just haven't had  
14 the paper brought to our attention.

15 This leads me to the main comment that I  
16 have is that whenever we have discussions like this,  
17 it is really easy, I think, to point to science issues  
18 that we would like to see addressed because there are  
19 all sorts of fascinating questions out there like  
20 climate change and what it might do to change water  
21 use efficiency in plants and on and on and on.

22 And I think that we wind up always being  
23 faced with some kind of a balancing act. It's not  
24 necessarily best science. It is credible science. I  
25 like the word that John Till used. We have to

1 maintain maximum credibility. Sometimes that means  
2 that we have to use the absolute best science  
3 available. Other times, I think that we are satisfied  
4 with what loosely might be thought of as a bounding  
5 analysis because it just doesn't matter.

6 And the balancing act is being driven  
7 toward more and more measurements or better and better  
8 science and actually figuring out whether this site is  
9 suitable for a waste repository and those two things  
10 are not in my estimation one and the same.

11 And in this kind of venue we often get  
12 caught up with the interesting science questions and  
13 don't necessarily have that balanced view on getting  
14 the job done.

15 VICE CHAIRMAN RYAN: Thank you, George.  
16 John?

17 CHAIRMAN GARRICK: Yes. Coming from a  
18 background of nuclear safety and risk, there are  
19 certain things each time we have one of these sessions  
20 that I look for and one of the things that I look for  
21 is what we have been able to ferret out of a  
22 discussion that would allow me to write down some sort  
23 of importance ranking associated with the topic,  
24 namely, the biosphere.

25 Certainly issues were identified and

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 they're very interesting ones and they include  
2 everything that we've been talking about here,  
3 background characterization, uptake models, model  
4 coupling, the use of site-specific information,  
5 realistic calculations versus compliance, definition  
6 of the RMEI comparison with other interpretations and  
7 so on.

8           But still, I think that in terms of  
9 understanding what the issues are with respect to  
10 their contribution to performance, and how the  
11 biosphere plays out with respect to that, it seems as  
12 though there's still quite a bit of work to do  
13 although we got some very good insights into that  
14 yesterday.

15           So importance ranking and context is a  
16 very important issue here and we got some insight into  
17 that, but it appears that there's still quite a bit to  
18 do and that as far as risk insights are concerned, we  
19 don't seem to be anywhere near as far along in the  
20 biosphere as we are in the geosphere and I'm sure  
21 there's good reasons for that.

22           The other issue that is of great interest  
23 to me is this issue of who's doing the realistic  
24 calculation. We heard excellent discussions yesterday  
25 about the perspective that if you're getting a license

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 application, obviously you're going to gear your  
2 analysis and gear your application to meeting the  
3 requirements of the regulations. And no question that  
4 that takes you away from doing a kind of analysis that  
5 you would do if your whole view was to get the best  
6 possible result you could in terms of what  
7 realistically might happen.

8 And we have some very interesting  
9 discussions about that on the pros and cons, but I'm  
10 still not clear, it's still not clear to me who's  
11 accountable for doing the realistic analysis here  
12 because as best I can tell, it's not being done.

13 Now the other thing that I was very  
14 interested in at the outset here was the issue of the  
15 prescriptive nature of the biosphere calculations and  
16 whether or not they might mask realistic issues. And  
17 I thought we had an example of that. For example, if  
18 you take the 3,000 acre feet and assume that all the  
19 radionuclides that reach that region are -- have --  
20 are able to be pumped up into the surface and into the  
21 food chain, then you have on the one hand made an  
22 extremely conservative assumption with respect to the  
23 removal of radionuclides from the biosphere, but  
24 you've made a very nonconservative assumption with  
25 respect to the final disposition of radionuclides as

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 was very well pointed out by Steve Frishman. And I  
2 thought that was a very interesting observation.

3 And it reminds me of so much risk work we  
4 did in the nuclear power industry where you have  
5 several performance parameters, core damage frequency,  
6 release fractions and dose. And we discovered very  
7 early in our risk work that when you do a fix to  
8 reduce one of those, you don't necessarily fix the  
9 others. When you do a fix to reduce the core damage  
10 frequency, on the contrary, you may increase the dose,  
11 the off-site dose.

12 And I have questions about that here.  
13 When you make an assumption about the biosphere such  
14 as the disposition of the radionuclides, what does  
15 that mean in terms of how you've underestimated other  
16 things if your approach had been to do a realistic  
17 analysis.

18 Another area that I agree with David  
19 Kocher on this one and I didn't see much in that I  
20 would have liked to see more was are we getting our  
21 money's worth from the billions of dollars of site  
22 characterization work that's been done and how has  
23 that manifested, how is site characterization  
24 manifested in the biosphere work? And I didn't see a  
25 whole lot of evidence of that.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 I would think that the site specificity  
2 issue is something that is going to be of great  
3 importance to the public and the more that they can  
4 see a connection between what we learned from the site  
5 characterization program and how it impacted the dose  
6 calculations, I think the better off we are.

7 So those are some of the things that come  
8 to mind and I think that one of the things that I like  
9 to do whenever we have a session like this is to  
10 identify what appears to be the most important issues  
11 and I think the things that I've mentioned are in that  
12 category and some of them are analytical issues and  
13 some of them are data collection issues and some of  
14 them are modeling issues and what have you. But I  
15 think that's all I need to say right now.

16 VICE CHAIRMAN RYAN: Thank you, John.  
17 Boy, it's hard for me to add after all of these smarts  
18 who have said what's on their minds.

19 DR. KOCHER: Can I ask John a question?

20 VICE CHAIRMAN RYAN: Sure.

21 DR. KOCHER: If I understood you right,  
22 you said you didn't really come away with a lot of  
23 warm fuzzies about risk insights in the biosphere  
24 part?

25 CHAIRMAN GARRICK: Yes, that's correct.

1 I saw a lot of useful information and some risk  
2 insight, but I saw very little that would give me the  
3 feeling that there was a real risk analysis model that  
4 was the underlying driver of the results.

5 DR. KOCHER: Okay, I was wanting to  
6 explore what you meant by that.

7 CHAIRMAN GARRICK: What I would like to be  
8 able to see here is that the end of the exercise here  
9 we have a PDF on the dose and I'd like to be able to  
10 decompose that PDF into the contribution from  
11 different segments of the model that you might call it  
12 the infiltration model, the near field model, the  
13 geosphere model and the biosphere model.

14 That's the kind of models that we've  
15 learned how to develop on reactor risk assessments.

16 DR. KOCHER: And the question you posed  
17 early yesterday or the problem you posed about you'd  
18 really like to see, get a firm idea of uncertainty in  
19 the biosphere part compared with uncertainty on the  
20 other part and I don't really think you can come away  
21 with a warm fuzzy about that because it depends on  
22 when in time we're talking about and a host of other  
23 things, so I agree with you, that issue is kind of  
24 still -- most of us believe that the uncertainty is  
25 under the ground somewhere because we've studied this

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

1 stuff to death for 50 years. But there are issues --

2 CHAIRMAN GARRICK: But you can't take  
3 snapshots of different discrete time intervals. You  
4 can do things to at least develop a sense of  
5 understanding about how things might be for different  
6 discrete time pieces.

7 VICE CHAIRMAN RYAN: It's going to be hard  
8 to add to that, but let me try and add a few thoughts.  
9 I think first of all I'd like to recognize all of our  
10 speakers and presenters for these last two days. I  
11 know they put a lot of time and effort into preparing.  
12 I want to thank the staff at the Center who is on the  
13 TV screen for their participation and for their  
14 preparation and for their representatives here today.  
15 And I'd like to especially thank Mike Lee who has been  
16 the lead staff person in putting together the  
17 biosphere working group and organizing all of the  
18 attendees and participants and that's a tremendous  
19 amount of work and we all appreciate your effort very  
20 much, Mike, thank you.

21 Let me try and summarize with a few  
22 themes. I think the themes that I take away from this  
23 biosphere working group are some interesting aspects  
24 that are probably unique to this project. There's a  
25 very specified and stylized calculation and we've

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 heard a variety of opinions and issues regarding that  
2 stylized calculation, ranging from fixed values, we do  
3 it in that specific way. And then we underpin with  
4 examinations of models and supporting evidence and so  
5 on. That's one aspect.

6 So we have a fixed requirement and we have  
7 a lot of other science questions and modeling  
8 activities that are underpinning that assessment  
9 that's pretty fixed. The second to me and it comes  
10 from I guess my bias of focusing on short term  
11 exposures in the work place as an area of major  
12 concern as opposed to chronic exposures in an  
13 environmental setting of somewhat a complex nature  
14 that's very much protracted in time over lifetimes and  
15 many lifetimes and that, I think, is something we can  
16 all think about as having special aspects that maybe  
17 need our thought and attention.

18 I think we have to be careful to take too  
19 much away from this working group because it's part of  
20 many working groups that we heard about, you know,  
21 from package performance to the waste interaction,  
22 waste package interaction, the environment of the  
23 repository itself to performance confirmation and soon  
24 to be upcoming the geosphere working group that will  
25 examine the coupled part of this.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1           So in all of these pieces and parts will  
2 integrate in DOE's license application and it's the  
3 totality of all that that I think will be assessed and  
4 judged and I caution us all not to pick on one or two  
5 parameters or issues from this working group as  
6 critically central and that's part of the risk ranking  
7 process and I think everybody realizes that, but I  
8 just remind everybody that this is one slice of a big  
9 piece and it's helpful for us to look at them that  
10 way. In fact, it's the only practical way to do it  
11 without spending weeks on end in one room.

12           And with that I think, Mr. Chairman, I'll  
13 turn back the working group session and declare it  
14 closed and turn back the meeting to you.

15           CHAIRMAN GARRICK: Excellent. Okay, let's  
16 see. I think that probably what we ought to do is  
17 we've got -- it shows on our agenda that we should  
18 have discussion of the letter. Yes.

19           MEMBER HORNBERGER: At the risk of going  
20 backwards. it just struck me that probably one of the  
21 first things that Dave suggested was that we should  
22 have some kind of discussion on this age dose business  
23 and I don't think that -- did we bring that to  
24 closure? Did I nod off?

25           None of our panel mentioned that in the

1 final summary.

2 VICE CHAIRMAN RYAN: We talked a lot about  
3 age dose issues. What particular --

4 MEMBER HORNBERGER: Well, I mean we talked  
5 about it, but I didn't hear any resolution. I mean I  
6 heard it as a question, what are we going to do.

7 DR. ECKERMAN: I thought the dosimetric  
8 information you need to look at age is available. I  
9 thought we had passed that off to the supportive  
10 satellite calculations that have to be done because of  
11 the regulation focusing in on the adult.

12 There are other -- there are a number of  
13 other ways to handle that problem. One would have  
14 been to have looked at a per capita kind of a dose  
15 coefficient, but that largely forces you over to  
16 pretty much the adult anyway because most of one's  
17 life is spent as an adult rather than as a child. But  
18 I think the age in my mind, the age issue has to be  
19 addressed with respect to the supportive information  
20 and it may well not be an issue with regard to the  
21 compliance kind of calculations. So I would  
22 definitely encourage that -- that would be my  
23 resolution to the comment.

24 CHAIRMAN GARRICK: Yes.

25 DR. THORNE: Just a clarification on that

1 as well. I think if you're going to make that  
2 comparison, what you can't do is do the infant  
3 calculation and the child calculation and then compare  
4 with the RMEI because the RMEI isn't the same kind of  
5 thing that you need to do infant, child and adult as  
6 if you were doing a critical group calculation for  
7 each one.

8 DR. KOCHER: Yes.

9 CHAIRMAN GARRICK: Dade, do you want to  
10 add to anything that's been said about that, since you  
11 asked the question?

12 DR. MOELLER: I don't believe that I do.  
13 I thought that Keith wrapped it up in several ways in  
14 that the -- and I hope that I'm not misquoting you,  
15 but the fact that the dose -- that a person spends  
16 most of his or her life as an adult. The dose  
17 coefficient for an adult, if it's applied even over  
18 the full lifetime of an individual yields reasonable,  
19 very close estimate to the dose.

20 Now it's of interest to know the dose to  
21 an infant or a teenager, but that only takes place, I  
22 don't know what an infant is, you know, whether it's  
23 up to 2 or 3 years, but it's a short time. You're a  
24 teenager from 13 to 19, whatever that is, 7 years. So  
25 in that respect I felt that it was resolved.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 MEMBER HORNBERGER: I guess what wasn't  
2 clear to me was on a chronic exposure why this was or  
3 should be a big issue.

4 DR. ECKERMAN: And it shouldn't be a big  
5 issue.

6 CHAIRMAN GARRICK: Well, I want to add my  
7 thanks to what Mike said to the panel and the  
8 consultants and the members of the committee.

9 These working group sessions are extremely  
10 valuable. They give us a chance to bore in on issues  
11 that are important to the job we're trying to do. We  
12 know that all of you put in a lot more time than your  
13 pay scale probably warrants and some of you have come  
14 from long distances and they are a very valuable part  
15 of our whole process.

16 So we are very grateful to you and we hope  
17 that, of course, that we have an opportunity to  
18 interact with all of you more as we move closer and  
19 closer to a license application.

20 I think what we'll do now, the committee  
21 has to somehow figure out what we're going to do with  
22 all of these fine words of wisdom and we need to  
23 figure out and agree as a committee the points we'd  
24 like to cover in a report to the Commission.

25 And so what I think we'll do is we'll do

1 that, but I think that before we engage into that  
2 process, we'll take a 15 minute break and then come  
3 back and work on our reports.

4 Thank you.

5 (Whereupon, the proceedings went off the  
6 record at 2:07 p.m.)

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on

Nuclear Waste

148<sup>th</sup> Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings as recorded on tape(s) provided by the NRC.



---

Rebecca Silberman  
Official Transcriber  
Neal R. Gross & Co., Inc.

**NEAL R. GROSS**  
COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

# **Risk Insights for Biosphere**

Patrick LaPlante 301-881-0289 [plaplante@swri.org](mailto:plaplante@swri.org)  
Center for Nuclear Waste Regulatory Analyses

148<sup>th</sup> Meeting of  
Advisory Committee on Nuclear Waste  
February 24-27, 2004

# RISK INFORMING REVIEWS OF DOE BIOSPHERE DOCUMENTS

---

- ◆ Prior Biosphere Analyses Provided Basic Understanding
  - Process-Level Modeling and Sensitivity Studies
  - TPA Code Development
- ◆ Reviews of DOE Documents Emphasized Important Biosphere Parameters and Pathways
- ◆ Risk Insights Initiative
  - Biosphere Sensitivity in “Total System” Context
  - Used Significance Ranking to Prioritize Agreements
  - Provided Context for Closing Agreements
- ◆ Technical Work Plans Directed at Important Topics with Large Uncertainties

# RISK INSIGHTS FOR BIOSPHERE MODELING

---

- ◆ Groundwater Release to Biosphere
  - Groundwater Dose: About 50% Drinking Water and 40% Crop Consumption
  - Key “Process Level” Biosphere Parameters: Distribution Coefficients, Plant Transfer Factors, Crop Interception
  - Uncertainty is Low Relative to Other Abstractions
- ◆ Igneous Activity Release to Biosphere
  - Inhalation Pathway Dominates
  - Key Parameters: Mass Loading, Exposure Duration
  - Uncertainty is High (Continues to be Investigated/Quantified)
- ◆ Total-System Sensitivity Analysis Results: Mass Loading

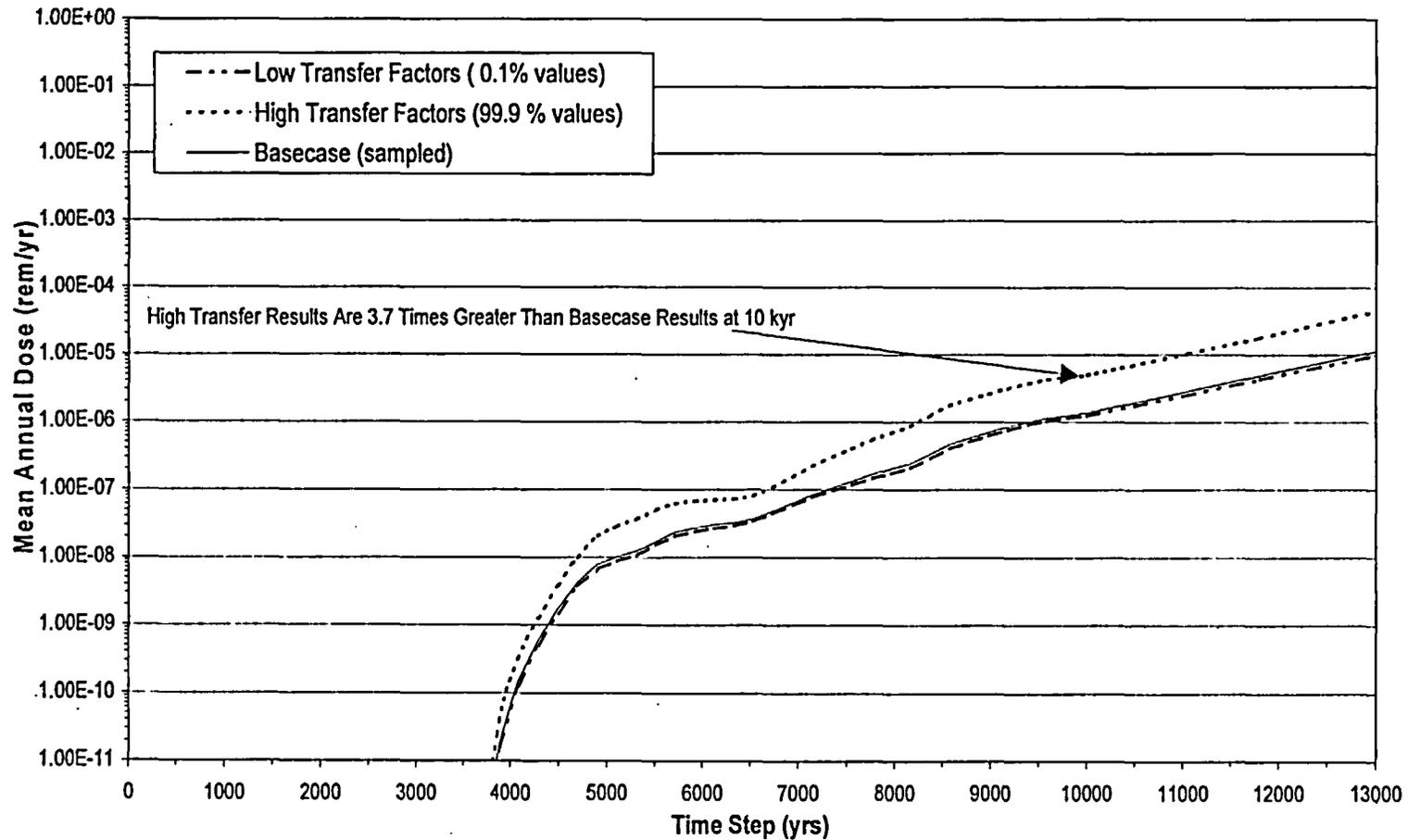
# BIOSPHERE AGREEMENTS: GROUNDWATER RELEASE

---

- ◆ Biosphere Groundwater Pathway Modeling Agreement Topics Are Ranked Low Significance
- ◆ Emphasized Important Parameters in Biosphere Calculations (But Low Importance to Total System Results):
  - Soil Partition Coefficients (Kd's) for Soil Leach Modeling
  - Plant Transfer Factors
  - Crop Interception
  - Biosphere Sampling Approach
- ◆ Effect on Biosphere Plans: Staff Have No Plans for Additional Technical Work
- ◆ DOE Improved Documentation -- Resolved 4 Agreements

# USE OF SUPPLEMENTAL RISK INFORMATION TO RESOLVE AGREEMENTS ON PLANT TRANSFER

Comparison of Dose Curves for Base Case and High/Low Perturbation of Biosphere Transfer Factors



# BIOSPHERE AGREEMENTS: IGNEOUS ACTIVITY (DIRECT RELEASE)

---

- ◆ Igneous Activity Biosphere Agreement Topics Have Various Significance Rankings
  - Agreements Related to Mass Loading/Inhalation of Ash (including remobilization) Ranked High or Medium
- ◆ Inhalation Pathway and Mass Loading Are Highly Significant in Total System Calculations
  - Inhalation is Dominant Pathway
  - Mass Loading is a Sensitive and Uncertain Parameter
- ◆ Low-Ranked Agreements Mostly Deal with Clarification of Documentation

# BIOSPHERE AGREEMENTS: IGNEOUS ACTIVITY (DIRECT RELEASE); cont'd

---

- ◆ Effect on Biosphere Plans: Ongoing Model Development and Risk Analysis
- ◆ Refine Inhalation Models and Parameters
  - Mass Loading and Exposure Times
  - Particle Size Effects
  - Remobilization of Volcanic Ash

# SUMMARY

---

- ◆ Use of Risk Insights is Integral to Planning and Conducting Staff Work
- ◆ Risk Informing Is An Iterative Process
- ◆ Inhalation of Volcanic Ash
  - High Significance -- Additional Work Ongoing
- ◆ Remainder of Biosphere Calculations
  - Low Significance -- No Additional Work Planned

# BACKUP SLIDES

# BIOSPHERE AGREEMENTS

---

- ◆ Groundwater Biosphere Pathway Agreements
  - TSPA13.33: Site relevance of soil partition coefficients (Kd's) (L)
  - TSPA13.34: Site relevance of soil to plant transfer factors (L)
  - TSPA13.35: Relevance of crop interception to radionuclides (L)
  - TSPA13.36: Document uncertainty in soil leach factors (L)
  - TSPA13.37: Justification for biosphere sampling (L)

# BIOSPHERE AGREEMENTS

---

- ◆ Igneous Activity (Direct Release) Biosphere Agreements
  - IA2.06: Link Soil Removal and Remobilization Processes (M)
  - IA2.07: Document Basis for Airborne Particle Concentrations (H)
  - IA2.08: Justify Assumption for Ingestion of Inhaled Particles (L)
  - IA2.11: Relate Dust Measurements to RMEI Behaviors (M)
  - IA2.12: Clarify How PM10 Measures Extrapolate to TSP (L)
  - IA2.13: Justification for Sampling Transition Period BDCFs (L)
  - IA2.14: Clarify How Blanket Thickness Effects Mass Load (L)
  - IA2.15: Clarify that External Exposure to Ash Was Included (L)
  - IA2.16: Document Conservativeness of No Climate Change (L)
  - IA2.17: Bases for Bounding Eolian/Fluvial Effects (H)



## ACNW Biosphere Working Group Meeting

---

# Biosphere Research: Food-Chain Pathways

148<sup>th</sup> Meeting of Advisory Committee on Nuclear Waste

February 25, 2004

**Cheryl Trottier, Chief**

Rad Prot, Env Risk, and Waste Mgt Branch

Division of Systems Analysis and Regulatory Effectiveness

Office of Nuclear Regulatory Research

(301) 415-6232

cat1@nrc.gov

# Research Activities

- **Research is generic in nature – mostly addressing decommissioning needs**
- **Research plan developed in 2002 identified a need to look at environmental pathways models**
- **Initiated project at PNNL to support biosphere modeling**

# Research Objectives

- **Provide Data and Information on Radionuclide Behavior in Plants and Animals for use in Performance Assessment Models and Computer Codes**
- **Assess Factors (e.g., Regional, Soil, Chemistry) Affecting Radionuclide Uptake in Plants**
- **Quantify Uncertainties Associated with Food-Chain Pathway Data**

# Project Tasks

- **Determine Radionuclide Soil-to-Plant Concentration Ratios**
- **Study Radionuclide Uptake of Vegetation by Irrigation Water**
  - **Radionuclide Uptake by Roots**
  - **Crop Intersection Factors**
- **Determine Radionuclide Animal Product Transfer Coefficients**
- **Evaluate Alternative Conceptual Models for Food-Chain Pathway**
- **Assess Biosphere Modeling Parameters and Data**
  - **Biosphere Dose Conversion Factors**
  - **Age Dependency Studies**
- **Coordination with International Studies**

# Experimental Matrix

- **Radionuclides:**  $^{129}\text{I}$ ,  $^{99}\text{Tc}$ ,  $^{237}\text{Np}$ ,  $^{239}\text{Pu}$ ,  $^{63}\text{Ni}$
- **Plants:** Alfalfa, Onion, Corn, Potato
- **Trees:** (Under Discussion) Pistachio, Pecan
- **Animals**
  - Large: Discussions with Foreign Investigators
  - Small: Chickens/eggs (Under Discussion)
- **Sampling Locations :** WA, NV, and SC  
(Soil and Water)

# Research Products

- **“Literature Review and Assessment of Plant and Animal Transfer Factors Used in Performance Assessment Modeling”, NUREG/CR-6825, August 2003. Contains Literature and Chemistry Species Data and Information.**
- **IAEA Working Group: Participant on Revision of TRS-364 “Handbook of parameter values for the prediction of radionuclide transfer in temperate environments”**

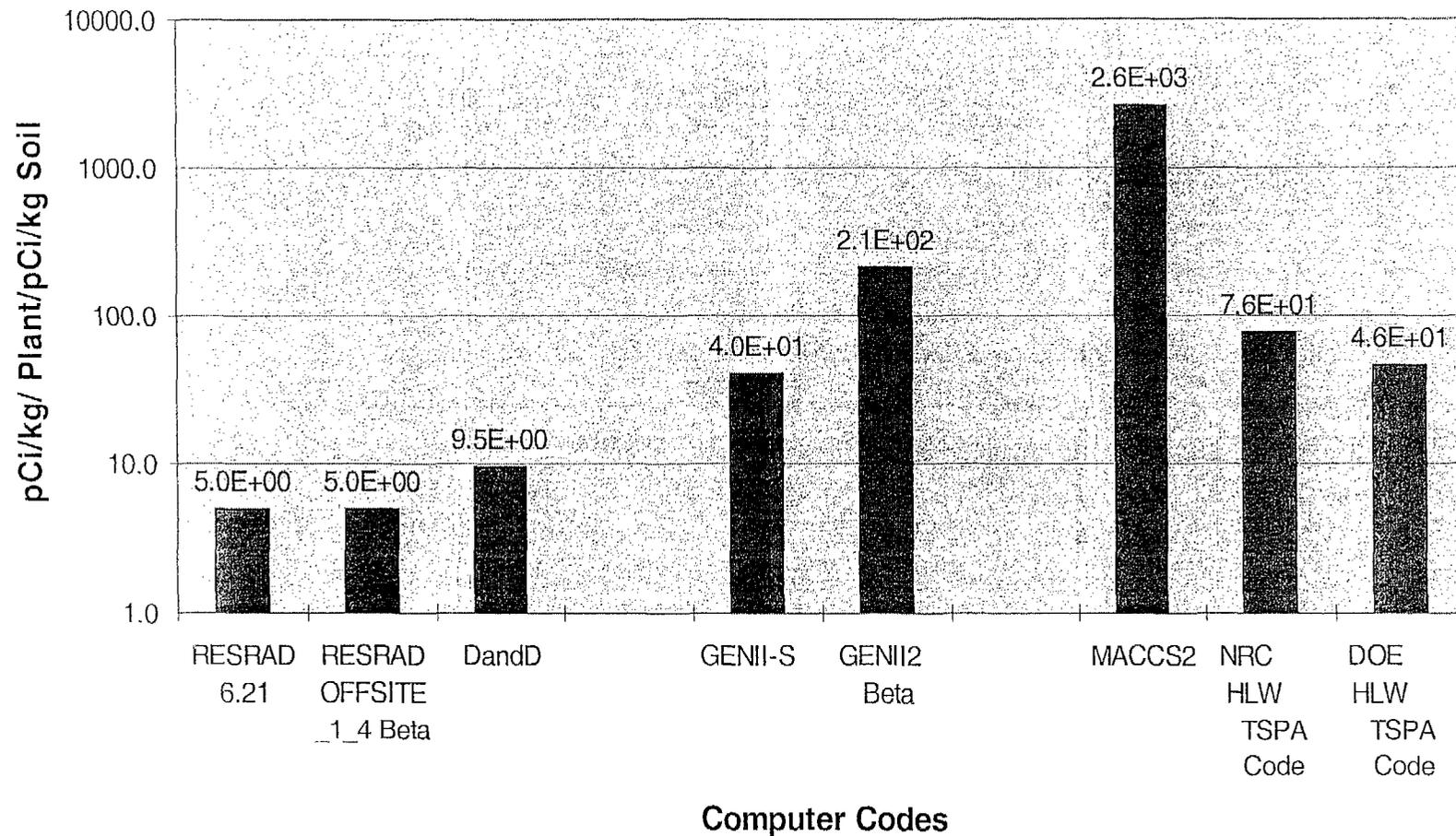
# Backup Slides

# Program Management

- **Program Manager: Phillip Reed (NRC) 301 415-7845**
- **Project Manager: Bruce Napier (PNNL)**
- **Principal Investigators:**
  - Bruce Napier (PNNL)**
  - Dominic Catalbo (PNNL)**
  - Lyle Lasser (PNNL)**
  - Ken Krupka (PNNL)**

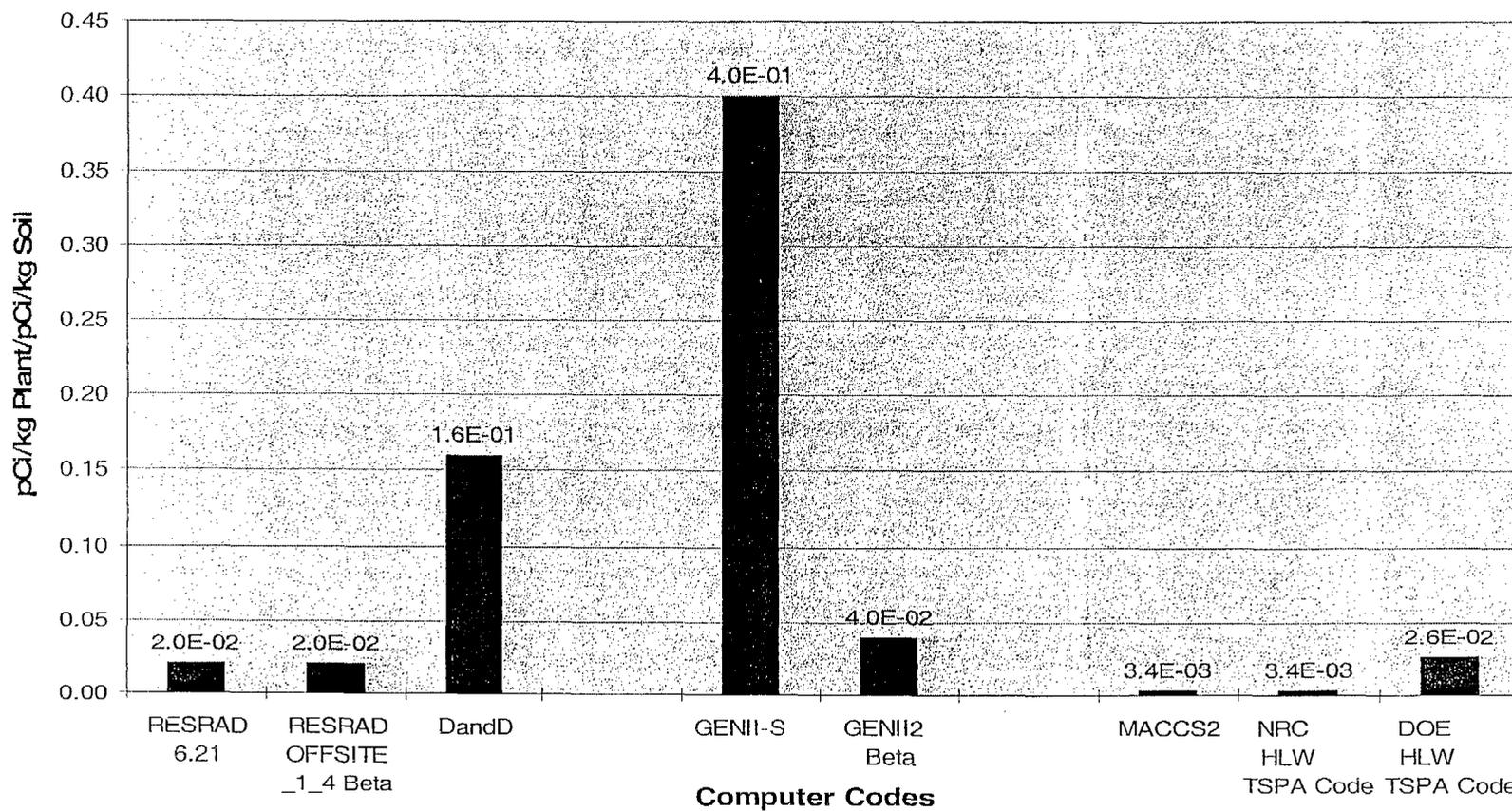
# Concentration Ratios in Computer Codes I

Technetium Concentration Ratios: Leafy Vegetables



# Concentration Ratios in Computer Codes II

Iodine Concentration Ratios: Leafy Vegetables



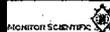
## Summary of EPRI Evaluations of the Yucca Mountain Biosphere

Matthew W. Kozak  
Monitor Scientific, LLC  
Graham Smith  
Enviros  
John Kessler  
EPRI

ACNW Meeting  
Two White Flint North  
24-25 February 2004

ENVIROS<sup>®</sup>

EPRI

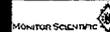


## Key Publications

- Smith G M, Watkins B M, Little R H, Jones H M and Mortimer A M (1996). Biosphere Modelling and Dose Assessment for Yucca Mountain. EPRI TR-107190, 3294-18.
- Smith G M and Kessler J (1996). Critical Groups for Geological Disposal Performance Assessments. In Proceedings of an International Conference High Level Radioactive Waste Management, American Society of Civil Engineers/American Nuclear Society, Las Vegas.
- Smith G M, Watkins B M and Little R H (1996). Biosphere FEP List Development Specific to Yucca Mountain. In Proceedings of an International Conference High Level Radioactive Waste Management, American Society of Civil Engineers/American Nuclear Society, Las Vegas.

ENVIROS<sup>®</sup>

EPRI



## Key Applications in TSPA

- EPRI (1996). Yucca Mountain Total System Performance Assessment, Phase 3, EPRI TR-107191, Electric Power Research Institute, Palo Alto, December.
- EPRI (1998). Alternative Approaches to Assessing the Performance and Suitability of Yucca Mountain for Spent Fuel Disposal, TR-108732. Final Report November 1998, Palo Alto, California.
- EPRI (2002). Evaluation of the Proposed High-Level Radioactive Waste Repository at Yucca Mountain Using Total System Performance Assessment: Phase 6, EPRI, Palo Alto, CA: 2002. 1003031.
- EPRI (in press 2004). Evaluation of the Proposed High-Level Radioactive Waste Repository at Yucca Mountain Using Total System Performance Assessment: Phase 8.

ENVIROS<sup>®</sup>

EPRI

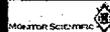


## International Activities

- EPRI participated in BIOMOV5 II and then BIOMASS
  - Focus on developing standard approaches to defining the biosphere for the purposes of long-term assessments for deep geologic disposal of radioactive waste.
  - John Kessler chaired a working group within BIOMASS focused on developing the principles for the definition of exposure groups.
- "Reference Biospheres" for Solid Radioactive Waste Disposal. IAEA-BIOMASS-6. Part of the International Atomic Energy Agency Coordinated Research Program on Biosphere Modelling and Research (BIOMASS), Vienna.

ENVIROS<sup>®</sup>

EPRI

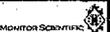


## Additional Publications

- Pinedo P, Wasiolek M, Wu W, Smith A, Smith G and Kessler J (2003). Biosphere Assessment Technical Issues, Comparison of Dry Sites. In Proc. International Conference on HLW, Las Vegas, American Nuclear Society.
- Smith G M and Kessler J (1998). Defining and Justifying Assumptions for Exposure Groups in HLW Repository Performance Assessment. Proceedings of International Symposium on Radioactive Waste Disposal: Health and Environmental Criteria and Standards, Stockholm, Swedish Radiation Protection Institute, the Stockholm Environment Institute and the US Environmental Protection Agency.
- Watkins B M, Smith G M, Little R H and Kessler J (1999). A Biosphere Modelling Methodology for Dose Assessments of the Potential Yucca Mountains Deep Geological High Level Radioactive Waste Repository. Health Physics, April 1999, Volume 76 No4.

ENVIROS<sup>®</sup>

EPRI



## Summary

- EPRI has contributed to understanding the Yucca Mountain biosphere since 1996
- Integration of developments in the international community with those in the USA
- Continuous integration with updated version of the EPRI TSPA
- To date, only deterministic biosphere dose conversion factors (BDCF)
- Probabilistic BDCF analyses planned in current year

ENVIROS<sup>®</sup>

EPRI

