

1 UNITED STATES OF AMERICA  
2 NUCLEAR REGULATORY COMMISSION

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4 PUBLIC WORKSHOP TO DEVELOP AN SRP  
5 FOR DECOMMISSIONING

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7 U.S.NRC

8 11545 Rockville Pike, Auditorium

9 Rockville, MD

10 Thursday, March 18, 1999

11 The above-mentioned workshop commenced, pursuant to notice, at 8:34 a.m.  
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## P R O C E E D I N G S

[8:34 a.m.]

MR. HOLONICH: Why don't we go ahead and get seated and start the program today. Folks are probably wondering who this strange face is standing up here, and I figure this was a good opportunity to come down and introduce myself.

My name is Joe Holonich, and I'm the new deputy director in the Division of Waste Management. I was appointed to the division late last year. I come from the Uranian Recovery Branch of the division, where I managed that program for about five years, and as a result of a reorganization taking effect and some movement of folks, I was moved into the division slot, so I've been there about four months getting acclimated to a number of different things that the division does beyond uranium recovery activities, one of which, of course, is decommissioning work.

So I wanted to take the opportunity to come down and introduce myself this morning, and Nick asked if I would make the opening remarks today, so I'm going to go ahead and do that.

Essentially, we're here -- this is the third of six workshops on the NRC's standard review plan development process outlining our reviews of decommissioning activities under the license termination rule. The earlier workshops we had were in December of '98 and in January of this year, and those two workshops covered dose modeling and restricted use.

Today, we're going to look at dose modeling as well as complying with the ALARA provisions in the license termination rule.

I would like to start off by thanking all of our speakers, both from the industry and government agencies. I think they're going to have some very interesting discussions just based on the information Nick has given me as background to outline what's in the agenda this morning.

I would also like to thank Paul Genoa from the Nuclear Energy Institute and

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1 Dave Colbersome from the Fuel Cycle Facility Forum for helping the staff get together and put  
2 the speakers together. Their help was invaluable in us being able to put together this agenda  
3 and outline the topics and the discussion we're going to have today.

4 What we're going to do is start off with two days, and this morning, essentially  
5 we're going to give you an update on the D&D screening model and sources of input  
6 parameters, and that will come from Walt Beyler -- is that how you pronounce it? -- from Sandia  
7 Lab.  
8

9 We're going to follow that with some talks from Beverly Good of GPU and Bob  
10 English from CE on partial site release, and Joe Nardi from Westinghouse and Bobby Eid from  
11 the staff will discuss conservatism and re-suspension factors.  
12

13 The afternoon, Carol Hornibrook from EPRI is going to report on her work on the  
14 modeling imbedded pipe, and Bobby Eid and Man-Sung Yin are going to discuss modeling of  
15 cesium and strontium.

16 Tim Harris from the staff is going to talk about modeling of former burials using  
17 RESRAD and D&D. Dick Sexton from Connecticut Yankee and Henry Morton will discuss  
18 problems with measuring alpha emitters, and then Claude Wiblin from WEM is going to discuss  
19 how to calculate indoor area factor.  
20

21 Tomorrow afternoon, we're going to look at ALARA in a little bit of a different  
22 format. Chris McKenney from the staff is going to handle an overview of the ALARA provisions  
23 in the license termination rule, and we're going to have a roundtable exercise which steps  
24 through draft Reg Guide 4006 and the methodology in there for demonstrating that doses are  
25 ALARA.

After lunch, Chris is going to have a group discussion on when during the  
decommissioning process, you need to address ALARA. So it's going to be a little different  
format tomorrow than what we have today.

There are a couple of administrative things I want to mention. First is that the

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workshop in June has been moved back to June 23rd and 24th. That's because this auditorium was taken the two days that we -- at least one of the two days that we needed it for the workshop on the 18th and 19th. So we need to move that back.

We recognize that's during the Health Physics Society summer school, but we wanted to get that workshop in before the annual Health Physics Society meeting and everybody went on summer vacation. So we've moved that back to the 23rd and 24th of June.

The June workshop is going to focus on modeling groundwater and is going to be held in conjunction with work that our research staff, in particular Tom Nicholson, is doing, and his workshop on the 22nd -- 21st and 22nd of the month on the same topic. So you have a number of days both on the research perspective and the program office licensing perspective on groundwater modeling.

Copies of the draft agenda are available in the atrium, so if you haven't got one, you can certainly pick one up for that workshop.

We're working on topics for August 18th and 19th. What we're thinking about is the first day, we would discuss comments we got on the draft standard review plan and go through what we see as those comments and what our responses are or what we'll be doing in the draft review plan or the final review plan. Also talk about comments we got in the D&D screen and on the draft Reg Guide EG4006.

We're thinking about maybe spending a day on issues associated with surveys. We're going to discuss the agenda for that workshop around 4:30 this afternoon, and what we wanted to do was kind of give you some preliminary thoughts of with our thinking was as possible agenda topics, and you guys can mull that over during the day, and then as we get into the 4:30 discussion, maybe you can add to it or help us focus better on what are those things we want to look at.

We would also like to add that the speakers from the industry, if they could come up and sit at the table and kind of sit around that side, that will help get a good mix up

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1 here at the table rather than just the staff sitting at the table. So if the industry speakers would  
2 come up and sit around the table, that will be definitely a help.

3 You've got a full day today. Unfortunately, I can't stay for the workshop, I've got  
4 other commitments, but I did want to come down and say good morning in introduce myself.  
5 Unless you have any questions, I'm going to turn it over to Nick and let him get started on the  
6 workshop.  
7

8 Okay. Well, welcome, and hopefully you have a very good day. I think you've  
9 got some interesting topics lined up. Thank you very much.

10 MR. ORLANDO: Thanks, Joe.

11 As Joe said, the first speaker is going to be Walt Beyeler from Sandia, and as  
12 soon as I get Walt wired up, we'll go ahead and get started.  
13

14 MS. BEYELER: Good morning. My name is Walt Beyeler and I'm with Sandia  
15 Labs in the Environmental Risk and Decision Analysis Department.

16 We've been supporting NRC in the development of their decontamination and  
17 decommissioning program for a number of years. Specifically, my involvement has been in the  
18 analysis that was used to set default parameter values for version 1 of D&D. I have recently  
19 been working with Teresa Brown in the development of version 2 D&D, and this morning, I  
20 would just like to give you an update on how that's proceeding.  
21

22 The project is really just getting started, so there is no progress to report. But  
23 what I would like to do this morning is to emphasize key differences between version 1 of D&D  
24 and the forthcoming version 2 which is sometimes referred to as Monte Carlo D&D.  
25

I understand that Teresa presented in an earlier workshop some of the technical  
underpinnings behind both the parameter analysis and version 2 of D&D, and so what I would  
like to do this morning is focus on the operational differences, what the user would see different  
between version 2 and version 1, what practical advantages we believe is offered in version 2.

Basically, the new features will be added in version 2. I hope to implement

1 some additional steps of the decision framework that's defined in 1549. Not all of the steps in  
2 that decision framework are -- will be supported in version 2, and I would like to discuss just a  
3 couple of the limitations associated with version 2 in that connection, and then go over the  
4 schedule with you, explain when capabilities are anticipated.

5  
6 The essential difference between version 1 and version 1 D&D is in the way the  
7 parameter uncertainty is treated. I should point out at the outset that that difference for a person  
8 who's doing a screening calculation is behind the scenes. A user would not notice that  
9 difference in the way the parameter uncertainty is treated. It really comes into play for users who  
10 are moving beyond the default screening calculation to do a site-specific calculation.

11 MR. EISENBERG: Your slide's off the screen.

12 MS. BEYELER: Oh.

13 MR. ORLANDO: Why don't we move the table back.

14 MS. BEYELER: I think that's got it. Thank you.

15  
16 But in both cases, we're interested in making a dose calculation that can be  
17 used to make a regulatory decision if we don't have specific information about the site  
18 parameters.

19  
20 The underlying idea is to look at the range or distribution of possible doses that  
21 might result from using site-specific parameters and to calculate a dose value that is appropriate  
22 for decisionmaking given the range of possible dose values.

23 The approach that's taken in version 1 of D&D is to use a specific deterministic  
24 set of default values that produces dose values in the upper end of that range for every source  
25 term, for every source nuclide that can be specified as input to the code.

The approach that's taken in version 2 of D&D will be to build that dose  
distribution directly given the specific input, the specific source term that applies for that site.

Again, that difference in the way the dose values is calculated is invisible to the  
user who's doing a generic screening calculation. In the case of version 1, there is a single

1 calculation using the default parameter values. In the case of version 2, there will be a set of  
2 Monte Carlo calculation that uses the default parameter distributions.

3 But the user will see basically the identical interface, will require the identical input, a source  
4 term for their site.

5  
6 What they will potentially notice is less conservative results in the case of  
7 version 2, the reason being that the default parameters in version 1 are required to produce a  
8 screening does value in the upper end of the dose distribution for every conceivable source.

9 In version 2, that value is specifically tailored to their site source term. Satisfying  
10 the condition in version 1 means that the screening dose value may be above the set threshold  
11 for some sources. In the case of version 2, that additional conservatism that comes from having  
12 to satisfy the constraint for every source does not exist, and again, the important operational  
13 difference is that the user who's doing a simple screening calculation would see a lower does  
14 that does not include that additional conservatism.

15  
16 They may also notice additional execution time. Again, version 2 will be building  
17 a dose distribution based on their input source term. That will require some hundreds of  
18 calculations rather than the single calculation that is done now. However, the dose calculation is  
19 computationally very fast, and so there may be some noticeable execution time as opposed to  
20 instantaneous execution time, existing version. But the intention of the design is to introduce  
21 very few changes for the user who's doing a simple screening calculation.

22  
23 MR. GENOA: Walt, will you entertain questions now or do you want us to wait  
24 until you're done?

25 MS. BEYELER: Well, I guess let's --

MR. EID: I believe, yes, we have open forum as long as the questions are not  
too long, they take a long time, you go ahead and make the question.

MS. BEYELER: That will be fine.

MR. GENOA: Paul Genoa with NEI.

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1                   Walt, you've mentioned several times a source term parameter. Are the  
2 parameters also other parameters that would affect things like groundwater infiltration, TEDE  
3 values, all those other things, aren't they also affected by this? It's not just the isotope-specific  
4 issues, are they?

5                   MS. BEYELER: I'm sorry, the -- I guess I'm not quite understanding your  
6 question.  
7

8                   MR. GENOA: In the deterministic method, if I were to -- you've determined  
9 groundwater or, excuse me, groundwater infiltration is an issue, and you have determined at the  
10 95th percentile how fast that groundwater will move through. And in the new version, there  
11 might be distribution of the speed with which that would move through. Is that accurate?  
12

13                  MS. BEYELER: That's correct.

14                  MR. GENOA: Okay. I wouldn't call that a source term. I guess that's where I  
15 was getting confused. When I hear the word source term, I'm thinking of radiological issues.

16                  MS. BEYELER: Okay. No, I'm sorry. The issue with the -- or the -- where the  
17 source term considerations enter into it is that the default parameter versions in the current  
18 version of the code -- the default parameter values must -- are required to produce a dose value  
19 that is in the upper end of the dose distribution, and a separate dose distribution is calculated for  
20 each individual nuclide that can be specified as input. So there are -- the parameters values are  
21 required to satisfy some 60, close to 70 constraints. That is, they're required to produce high  
22 dose values for close to 70 individual nuclides.  
23

24                  The version 2 code will not -- the calculation will not be required to produce high  
25 dose values for every conceivable source term, rather for the particular source term that is  
specified for in the site.

MR. GENOA: Walt, can I take a stab at trying to clarify that?

MS. BEYELER: Yes.

MR. GENOA: The problem we've got right now, the current version of D&D has



1 a single set of default parameters, and that single set of default parameters is based on all  
2 radionuclides, and so as a -- because it's based on all radionuclides, you have some  
3 conservatism built into it because you, as Walt said, you've got multiple solutions that you can  
4 actually -- there's multiple solutions to the criteria, and you're picking a single set of -- single set  
5 of parameters, and that's causing some parameters to be extremely conservative for certain  
6 radionuclides.

8 What the Monte Carlo version is going to do is you can put in a -- you can put in  
9 your source term, and then it's not tied to other radionuclides, it's for that particular set of  
10 radionuclides. I don't know if --

11 MR. EID: This is Bobby Eid. I would like to add more explanation. I understand  
12 your question regarding the other parameters like KD values, for example. Walt talked about  
13 the radionuclide, the specific radionuclides, and the question was, how about other KD values, I  
14 believe, other physical parameters.

16 I guess that are two parts in the conservatism that is there in the current version.  
17 One part is concerning the source term that is there. So because the source term considers all  
18 radionuclides, so there is one single default parameter for each physical parameter is there, that  
19 is conservative, that makes it conservative, and the PDF, it is above 90th percentile for all  
20 radionuclides. That's one part.

22 This means, you know, you have to get X more dose because you are  
23 considering the possibility that other kinds of radionuclides may exist at this site. It could be, you  
24 know, a billion, could be certain radionuclides not related to your site completely. So that's one  
25 part of it.

The other part, these parameters -- these parameters -- also, they do  
correspond to all these radionuclides like, for example, KD value. The KD value, if you look at  
the value that's selected, maybe it does not represent the 90th percentile for all radionuclides,  
could represent higher than the 90th percentile for that specific radionuclide that you are

1 interested in, because also should accommodate the other radionuclide that may not exist at  
2 your site because the screening tool for all kinds of radionuclides.

3 MR. GENOA: I guess my question is this. An example. Let's say that soil pH  
4 has an effect on the mobility of certain isotopes. Does this code artificially say that, well, for a  
5 certain isotope, it will migrate best in acidic conditions, so therefore, the input parameter for pH  
6 is acidic. However, on another isotope, the most -- it's most mobile in a basic environment, so  
7 therefore it's basic. So for one site, we're going to have an input parameter for ph that is both  
8 acidic and basic, and to me --

10 MR. EID: No, in this case, we are talking about site-specific conditions. So I  
11 believe currently the Code, you know, does not accommodate detailed site-specific conditions,  
12 and there is a question how you input the parameters based site-specific conditions for the  
13 current code.

15 For Monte Carlo version, which is version 2, so it will accommodate site-specific  
16 conditions, you may input KD values based on the condition that they pertain to your site.

17 MR. GENOA: Thank you.

18 MS. BEYELER: I'm sorry. There is -- the situation that you've described, there  
19 is a requirement -- the default parameter values must be the same for all nuclides. So the  
20 example you cite with pH, that's not an input parameter. But yes, for a soil moisture content, for  
21 example --

23 MR. GENOA: Okay.

24 MS. BEYELER: -- it is the same value of soil moisture content for every nuclide,  
25 and there is a, again, a common set of default parameters for all nuclides, and it is that  
requirement to find a common set of parameters that introduces this additional conservatism  
because the default parameters must produce a dose value near the upper end of the range for,  
say, a tritium source, for a cesium source, for a uranium source, for thorium source. For each  
potential source individually, that single set of parameters must produce a dose value near the

1 upper end of the distribution, and it is that requirement that there be one single set of parameters  
2 that adds this additional conservatism. The version 2 will make a specific calculation for your  
3 specific source term, so that the requirement that that same combination of parameters work for  
4 every source is not met here.

5 MR. GENOA: Thank you.

6 MR. BEYELER: Again the intention was to have in Version 2, something that is  
7 operationally indistinguishable from Version 1. There are some additional features for people  
8 who are moving towards a site-specific analysis that will be available in Version 2.

9 This is a list of some of those key features -- the ability to look at the  
10 distributions of parameters and to call up the text from NUREG-5512, Volume 3, or other  
11 sources of information that may be used to define those distributions -- the ability to look at the  
12 output distribution of dose and to look at individual pathway doses and peak arrival times, the  
13 capability to look at the parameter sensitivity, which parameters tend to be driving the dose  
14 distribution, and additional flexibility for modifying the input parameters in addition to the Volume  
15 1 provision for specifying single values for parameters, Volume 2 because there are two --  
16 dealing with the parameter distributions will allow the user to change the endpoints of those  
17 distributions, specifying modified distributions for those parameters.

18 There's also the source term as far as the model is concerned is simply another  
19 parameter. The existing version of the code requires a single number for the source term  
20 parameter as it does for the other parameters.

21 Version 2 can allow a distribution of source terms, so that there is a consistent  
22 and more comprehensive representation of the uncertainty in dose.

23 So what I would like to do now is just show you some proposed interface  
24 elements that will be available in Version 2. What we are intending to do is to take the new  
25 interface elements for Version 2 from an existing code SEDSS and so what I have here in the  
next three slides are some snapshots of screens from the SEDSS program. These are similar

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1 but not identical to the D and D Version 1 screens but the information content is the same.

2 Is that -- I am not sure that that is quite legible. This is an illustration of how the  
3 parameter distributions might be displayed. The background panel, which is grayed out, is  
4 where individual parameter values are specified. Again this is for the SEDSS interface. The D  
5 and D has a similar interface where particular parameter values are tabulated and the values  
6 that are assigned to them can be entered here.  
7

8 In Version 1 constant values can be specified for each of these parameters.  
9 Version 2 will retain that capability but then allow the user to pop up this overlaid display, which  
10 will show the underlying distribution for the parameter. It will allow the user either to assign  
11 different functional forms to that distribution and change the parameters of that distribution,  
12 again access the text that would support that particular distribution.  
13

14 MR. EID: Walt, I have a question.

15 MR. BEYELER: Yes.

16 MR. EID: These numbers, they do not correspond to a D and D model, right,  
17 because the thickness of the Vadose Zone is very high, right?

18 MR. BEYELER: Yes, sir. Again, these --

19 MR. EID: So those are just demonstration, how you change the numbers?

20 MR. BEYELER: That is correct.

21 MR. EID: They are not real numbers for D and D model?

22 MR. BEYELER: That is correct. These screens again came from the SEDSS  
23 program, which has similar but not identical groundwater and exposure models in it, so these  
24 are sort of example displays showing the sort of information, the organization, the information  
25 that will be available in Version 2, but these are not literally the D and D screens as they would  
appear.

26 This next display shows an example of how the output dose distribution might  
be viewed. The left-hand panel shows a cumulative distribution function for dose. Again the

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particular values here and the parameters are for a separate code, so don't focus on that, but rather the information displayed here is for different dose levels. The probability that the dose would be less than that value -- this is a cumulative distribution function.

There would be options to display the same information as a histogram of dose to select either the total dose or doses from individual pathways or to look at the distributions of peak arrival time.

There is also provision for looking at the sensitivity of the dose to particular parameters. On this graph the doses above a particular value are highlighted in red. The display on the right shows the distribution for a parameter that was used in this calculation, and in that display the values of the parameter that lead to calculations on the upper end of the distribution are similarly highlighted in that distribution, and so that sort of gives a quick visual indication as to whether there is a tendency for this parameter to control the value of dose.

If, for example, all of the parameter values of this part of the distribution were red and there were no red values in this part of the distribution, there would be a quick visual indication that that parameter is very strongly related to dose, and the same sort of comparison could be made either for the total dose or for individual pathway doses.

This next slide shows a little bit more about how that sensitivity information can be used and displayed. This just shows a set of distribution functions -- four input parameters, again to the model that is used in SEDSS. These don't directly correspond to input parameters to D and D -- just an example -- but each of these shows the distribution for the parameter values, again with the samples corresponding to high dose, highlighted in red, and it is also possible to look at the correlation basically between dose and parameter value and to highlight those parameters that have a significant correlation dose, and that is what is done in this display.

The lighter backgrounds have been identified as being sensitive, so that as you can see in the case of partition coefficient for cesium for example low values of that partition coefficient in this calculation corresponded to high values in dose.

1           So again as far as moving towards a site-specific analysis, the real advantages  
2 in Version 2 are in the ability to identify sensitivities of dose to particular parameter values to get  
3 an understanding of what ranges of parameter values might lead to substantial revisions in the  
4 calculated dose, but there are other elements of the decision framework that are not, that will not  
5 be automated in Version 2 and there are important considerations in making data collection  
6 decisions at sites.

8           Specifically in looking at what kind of data collection might be worthwhile at a  
9 site it is not just enough to look at the sensitivity of the dose to the parameter but the practical  
10 considerations -- what experimental programs are available for collecting data, how likely are  
11 those programs to succeed, and what sort of changes in the parameter value are practically  
12 likely, what are the comparative costs for collecting different types of data, so the sensitivity  
13 information that will be available in Version 2 will be helpful but it is not all that is needed in order  
14 to make an optimal decision about data collection activities.

16           Also, the types of options that are contemplated in Version 2 cannot include  
17 revision of the D and D model because the code implements and is built on the default models  
18 in D and D, and so that is also a limitation of Version 2 with respect to more comprehensive  
19 implementation of the decision framework.

21           The second figure is really just there to emphasize the same point. If the  
22 screening calculation determines that there isn't enough information now to release the site, then  
23 the next step would be to define the options that are available for data collection, remediation  
24 restricted use, and to analyze those in terms of the cost of the time that it would take to complete  
25 them and the likelihood of success.

          Again, Version 2 will assist in doing that analysis, but will not perform certain  
elements of the cost analysis, the likelihood of success.

          The types of options that are contemplated can't again look at modified pathway  
models, more elaborate pathway models, simply because Version 2 is built around the default

1 models in Volume 1.

2 Just to quickly go over the schedule again. We are just sort of practically getting  
3 off the ground on this, so these dates are assuming an April 1st start. A month from then we are  
4 to have the requirements defined in the letter report to the NRC. The beta software -- again we  
5 are using a lot of preexisting code, combining that with preexisting interface elements for D and  
6 D so we expect that development to happen very quickly.

8 We will deliver a beta version of the code to the NRC in September -- sort of  
9 concurrent with the development of the code we will be working on the development of test  
10 plans and we will do some experimental implementation of the test plans between September  
11 and November 1st.

12 Revised documentation will be submitted to NRC in June and then the final  
13 document, revised documentation, in August of next year. I spoke with the NRC Program  
14 Manager about this and she emphasized that she is interested in distributing our beta version to  
15 users for their evaluation as soon after the September 1st date as is practical, and so I think the  
16 intention is to have some intensive NRC review to make sure that it doesn't crash anyone's  
17 machine, but then to try to get that out for your evaluations as soon as possible after that.

18 Are there any questions I can answer?

19 MR. EID: Thanks, Walt. I guess the floor is open now for any questions.

20 MR. MORTON: Yes. Henry Morton. Will the Version 2 be, if you input a  
21 distribution of nuclides or a mix of nuclides, will it generate the concentrations at the time of  
22 maximum dose or at the time at which 25 millirem is -- that is the mix that corresponds to 25  
23 millirem?

24 MR. BEYELER: Well --

25 MR. MORTON: If, in short, the existing version seems to work in such a way  
that if you put in a source term you get the dose, but will it in effect derive in reverse?

MR. BEYELER: No, sir. It will not. It will not tell you the source concentration

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1 for a particular mix that corresponds to a dose of 25 millirems.

2 I would say it would be easy -- well, you can get that information if you have a  
3 particular mix of nuclides and calculate the peak dose and then scale in effect the peak dose,  
4 225 millirems. That same scaling factor applied to the mixture as a whole should give you a 25  
5 millirem dose.  
6

7 However, if there is some uncertainty about the combination of nuclides in that  
8 mixture, then that becomes a much more complicated problem and in any case the code will not  
9 be designed to give you the possible combinations of nuclides that would lead to a 25 millirem  
10 dose.  
11

12 MR. MORTON: It would seem useful to have something of that kind since in the  
13 field you need to measure concentrations. You need to have some kind of -- you need to know  
14 beforehand what those concentrations would be in order to design and execute the cleanup.

15 MR. BEYELER: Yes. If I can, I think the complication is that there is more than  
16 one value of concentration. It is not a unique problem and so there are many combinations of  
17 concentrations amongst, say, two nuclides that would -- each combination would lead you to 25  
18 millirems, and so I would say it is not a unique problem.  
19

20 MR. EID: Mark?

21 MR. THAGGARD: Well, to answer his question, couldn't you put in like unit  
22 concentrations and back-calculate what the equivalent -- I mean what would be equivalent to 25  
23 millirems by using the unit concentrations? I mean you know what the criteria, assuming you  
24 know what the criteria would be like, say you are trying to achieve like a 90 percent confidence  
25 that the dose isn't going to exceed 25 millirem, and so you know what the confidence is. You  
use unit concentrations, it seems like you should be able to back-calculate that fairly easily.

MR. MORTON: Yes, but the problem there is that the dose for different nuclides  
doesn't all occur at the same time, so if you put in unit concentrations and then mix them, you  
then overestimate the dose and therefore force a lower residual concentration that is allowed, so

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1 if we are going to clean up we need to know beforehand -- and this seems to force one to clean  
2 up or do the calculation to see if you are clean and get -- the field people need some knowledge,  
3 some information about what concentrations they need to clean up.

4 MR. BEYELER: Well, can I ask, in cases where you have multiple  
5 concentrations, are you fairly confident because of process knowledge about the relative  
6 proportions of the nuclides, and is there some uncertainty about the -- or is there also  
7 uncertainty about the relative proportions of the nuclides?  
8

9 MR. MORTON: So you have to go measure those.

10 MR. BEYELER: Yes, because again the difficulty is that if you have, say,  
11 strontium and cesium, if you're interested in what possible combinations of concentrations can  
12 give you a dose of 25 millirems, there are many answers to that question. And so it would not  
13 be possible to say you must have a concentration of strontium less than x, cesium less than x,  
14 because there are different combinations of concentrations that could potentially lead you to that  
15 25 millirem dose.  
16

17 And so I think what would be possible to do but what is not currently intended in  
18 version 2 would be to define what those combinations of concentrations might be. But it would  
19 not be a single number for each nuclide. Rather, it would be a family or a sort of curve or  
20 tradeoff function that would tell you for a concentration of this amount for this nuclide, that  
21 means a concentration of this amount for that nuclide.  
22

23 So that's kind of the best way I think of answering that question. But again there  
24 was not an intention to do that automatically in version 2.  
25

MR. MORTON: I'll have to see, but it isn't clear that that's what we need.

MR. BEYELER: Okay.

MR. EID: The next, please.

MR. DAUGHERTY: Joe Daugherty.

I was wondering if there was going to be any I'll call it tide parameter warnings

1 or something. If I go in there and change the annual rainfall will it tell me to look at say -- I don't  
2 know if this is true -- but soil moisture content? Or will it do that automatically? How will that be  
3 handled?

4 MR. BEYELER: There is no intention now to enforce changes in one parameter  
5 if changes to a second parameter are made.

6 So currently that requirement is not anticipated.

7 MR. ORLANDO: Okay. If that's it, move on.

8 The schedule shows that Chris Daily was going to give a little overview of  
9 sources of input parameters. That was something that had been requested at the last workshop.  
10 Unfortunately Chris had hoped to do that but isn't going to be able to make it, so Walt is going to  
11 fill in. So without further ado, I will turn it back over to Walt.

12 MR. BEYELER: Well, just one small ado.

13 MR. ORLANDO: Yes. We'll let you take a drink of water.

14 MR. BEYELER: Thank you.

15 MR. ORLANDO: But don't make it a habit.

16 MR. BEYELER: Again I -- shifting gears -- I'd like to talk about here are some of  
17 the issues surrounding defining input parameter values, site-specific input parameter values for  
18 the DandD code. There's a need in the standard review plan to answer a large number of  
19 questions regarding how that parameter replacement would happen, and there's nothing that is  
20 really been settled as far as the mechanics for replacing particular parameters.

21 There are a number of ideas that are being discussed. What I wanted to do  
22 today was to basically describe some of the issues we know will need to be addressed in the  
23 Standard Review Plan, to suggest a possible framework for organizing those issues, and to find  
24 out if there are some additional important questions that I've left out and that will need to be  
25 addressed in the standard review plan.

And what I'd like to do is to sort of look at a kind of chronological organization of

these questions, how they might -- the questions that might occur in the order that they might occur to someone who's trying to change input parameters to the model. That is, what are the sources of information that are available for changing the parameter, what sort of quality requirements or standards do they need or what sort of considerations are there for source quality, how is the information interpreted to define an input parameter for the model.

There are very few if any situations where an experimental program or study will directly go out and measure a value that is appropriate for the time scale and the spatial scale of the model. So there is some amount of interpretation that's required in going from the available body of information to an input parameter for a model, a number of questions associated with that.

Once the information has been assembled, then how is a revised parameter -- what is the mechanics of changing that value in the code? How is a deterministic value selected for the version 1 of the code? How is the distribution modified for version 2, the probabilistic version of the code? So this is sort of the order in which I've organized these questions.

The first has to do with the sources of information. What sort of criteria would be needed for including new sources of information? Is there some de facto acceptance of data from published peer review journals or from Government agencies? A sort of parallel question, what would be the criteria for arguing that studies that have been used in the past are not appropriate for a particular site? So that the idea is that the Standard Review Plan would ideally set out some specific guidelines for when a piece of information could be admitted for consideration when a particular piece of information is judged irrelevant for a particular site.

Perhaps these criteria would be different, depending on whether the information came from a site-specific data collection experimental program, whether it came from local weather station data, for example, regional data base, national data base.

Questions related to the required quality of information. Again, should there be a sort of a de facto acceptance of data from Federal agencies and refereed journals or selected

1 data sources?

2 Another question regarding the acceptable quality of information is whether  
3 there should be specific standards before data are considered or whether data having different  
4 degrees of quality should be all admitted to define the parameter value but given a different  
5 grade.  
6

7 And with regard to site-specific data collection, are there additional  
8 considerations for experimental programs that are conducted for particular sites? Should there  
9 be some requirements to adhere to nationally or internationally established QA requirements, for  
10 example? These issues presumably would be discussed as part of the Standard Review Plan.  
11

12 The next set of issues is again related to the fact that you don't often measure a  
13 parameter value. It's something that tells you something about a parameter value. Key things  
14 that should be considered in going from data to parameter values are measurement error, and  
15 then the difference between the time scale of the measurement and the spatial scale of the  
16 measurement and the time and spatial scale of the model. Just to pick an example, the latter  
17 Kd, there may be a large number of individual soil measurements for absorption coefficient. The  
18 model parameter is describing what's going on over a fairly large area. So how do we estimate  
19 the value for an average over that area given this batch of individual measurements at a very  
20 small scale? So that technical issue needs to be addressed in the SRP and some guidance  
21 provided as to how to make those kinds of interpretations.  
22

23 And there are also questions regarding the modification of the parameter value.  
24 There are sort of two types of questions here. Version 1 of the code requires a single value for  
25 the parameter. That single value can either represent the fact that you -- there is an  
unambiguous single value for that site that has been clearly established, or -- and in which case  
the uncertainty about that parameter value has been completely eliminated.

26 The second possibility is that there is still some uncertainty about the parameter  
value because the experiments are not completely determinative, and so the question is how is

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1 the deterministic value then specified, given that there is uncertainty in the parameter value. In  
2 the case of the probabilistic version 2 of DandD, how is that uncertainty described as a  
3 probability distribution for input to the code.

4 This is just a proposal, suggestion, for a possible way of answering some of  
5 these questions or I guess providing a framework into which specific procedures can be  
6 dropped. But one possibility is that the NRC would maintain for each parameter a list of  
7 references that have gone through a review process and would also define some criteria for  
8 adding other sources of information to that corpus, to that body, bibliography of data. But each  
9 one of these studies would be available to all users, and it would be characterized by some  
10 measures that would help people select data that is potentially relevant for their site.  
11 Something on the generality. Whether it's a study that would apply to all sites, sites in particular  
12 regions, sites that met particular criteria. What was the connection between the values that are  
13 discussed in that study and the spatial and temporal scales of the model parameters? Whether  
14 a rating as to the quality of the information in that study. And also some specific criteria related  
15 to say site conditions that would establish when that study is appropriate for use in establishing a  
16 parameter value or when it is appropriate to disregard the results of that study.

17 And again there would be some procedures defined for adding new studies,  
18 site-specific studies to this data base that would then be available for use by users in general.

19 And then in general that -- the procedure for using this body of information  
20 would be to using site conditions to search through to identify the pertinent references to  
21 determine whether or not a parameter value is clearly established. There may be a single  
22 determinative study that was done for the site. There may be some body of ten studies that are  
23 relevant.

24 And so the parameter would either be a unique value would be chosen because  
25 there is a determinative study, the parameter may be uncertain because there is a single  
uniquely appropriate study, a site survey, for example, but it was impossible to determine an

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1 unambiguous value on the basis of that study. The parameter value may be uncertain simply  
2 because there are a number of competing pieces of information or conflicting pieces of  
3 information in particular that might apply.

4 And the SRP would then ideally include some generic procedures for dealing  
5 with some of the common technical problems that show up in translating experimental  
6 measurements to parameter values.

7 Again one of those would be the question of differences in the spatial scale  
8 between experimental measurements and the parameter value differences in measurement  
9 time, how to go from a set of measurements over 24-hour periods to an annual average value,  
10 maybe standard procedures for defining those.

11 And also it might be possible to come up with some generic rules for using  
12 commonly available and commonly accessed data bases. For example, USGS regional  
13 coverages for groundwater, for example. There might be specific procedures defined for how  
14 those data sources would be properly used.

15 So those are basically some suggestions as to the types of information that we  
16 would anticipate supplying with the Standard Review Plan and some of the questions that those  
17 are --

18 MR. ROBERTS: Rick Roberts, Rocky Mountain Remediation Services.

19 In your presentation you talked about the uncertainty in the current environment,  
20 looking at uncertainty in environmental factors and the distributions maybe of things that could  
21 happen currently. What about the uncertainty in what's going to happen over the next thousand  
22 years? Do we need to take that into account, or is that something that we really don't need to  
23 take into account in looking at uncertainty?

24 MR. BEYELER: I guess my response to that would be that depth-to-water was  
25 perhaps an unfortunate example here, and that I think as far as a physical condition at the site  
that because it is meant to be protected for a thousand years that uncertainty in potential

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1 variations of the physical conditions of the site should be considered. As far as uncertainty in  
2 behavior, I think that is stipulated by the specification of the critical group, and that those kinds of  
3 uncertainties would not be included.

4 MR. EID: I believe there are two issues. One issue is the possibility for changes  
5 due to the critical group conditions. And I believe the current critical group conditions,  
6 specifically when we talk about residential farmers, they encompass different kind of variations  
7 within a thousand years. So whatever kind of behavior we assume in that scenario, almost  
8 every kind of behavior and every kind of activity that you could think of is already included in the  
9 scenario.  
10

11 However, regarding the physical parameters, you know, it's very hard to  
12 speculate what kind of physical parameters they could change, like Kd value. I mean, I expect  
13 you will see some changes, but the question how they could change, rainfall in 1,000 years,  
14 possibly the changes will be not that drastic. If you have specific examples about changes in  
15 physical parameters that could be significant, you know, those should be taken into  
16 consideration when you review and you look at the site conditions. I think it will be good if you  
17 now could give us some examples that we could pay attention to those physical parameters that  
18 may change in 1,000 years so we could look into that.  
19  
20

21 MR. ROBERTS: I guess I'm coming from the point of view that I would rather  
22 have the NRC come out and say no, use current conditions to model into 1,000 years because  
23 we really don't know the uncertainty over the next 1,000 years, but I've had questions come back  
24 to our group saying well, what about the uncertainty in the next 1,000 years? And I don't know  
25 how to quantify that in assessing cleanup levels. And I guess what I'm looking for more is some  
kind of statement saying no, you use current conditions to model 1,000 years in the future, and  
there really is no way to look at the uncertainty that may happen in the physical environment  
over the next 1,000 years.

MR. EID: I think when we talk about the uncertainties when you do a

1 measurement you could have different kind of variations because of the physical conditions.

2 You may have different soil types at your site. So when you determine Kd values you will have  
3 ranges of soil types based on these ranges of soil types that you may have at the site. So this  
4 means you do not put one single parameter of Kd value for that site, you may put ranges of  
5 those Kd values because the conditions that you have, you may have sand lenses, you may  
6 have, you know, clay material and distribution of those, they are not homogenous because the  
7 nature, physical nature of the site is not uniform. So because of this you will have distributions  
8 of those, you know, parameters that they are specific for the site.

10 You may have also ranges because of the experimental determination. When  
11 you determine Kd value, you are not going to get a single value for the site, even for the same,  
12 you know, kind of if you have different samples. You will have a variety of values for the Kd.  
13 The question is then you will have range of distributions of those values for the site. Even if you  
14 do, you know, site-specific analysis for the site.

16 MR. McKENNEY: Chris McKenney, NRC.

17 Actually, you described it fairly well. Exactly what the background is on not only  
18 decommissioning modeling but also for high-level waste and low-level waste, modeling of the  
19 biosphere is based on present conditions. We don't model evolution, complete evolution  
20 especially, of whether there's an ice sheet or whatever or it turns into a lake. It's all based on  
21 present condition assumptions. There may be uncertainties in what the present conditions are,  
22 but we're not looking at what it will be in 300 years.

24 MR. ROBERTS: Thank you.

25 MR. DARMAN: I would like to ask one more question, I guess. Joe Darman,  
Maine Yankee.

ADN In version 2 if we change one parameter, you know, we should look to make  
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sure that if there was any tied parameters, you know, that -- look at those. But what about all the  
other parameters that it came up with as defaults. Can we just leave those all alone?



1 MR. BEYELER: In version 2?

2 MR. DARMAN: Yes.

3 MR. BEYELER: In version 2, yes. It changed to a single parameter. The  
4 consequences for the other parameters are in effect automatically included. If that answers your  
5 question.  
6

7 MR. EID: I have a question. Now currently with the current DandD version, if  
8 the licensee, they have a value that you could trust and do a QC, physical parameter, can they  
9 input this value directly into the Code and they derive the dose for the site, or they have to run  
10 probabilistic, you know, Monte Carlo version in order to find the dose, the distribution of the  
11 dose?  
12

13 MR. BEYELER: They I think need to provide assurance that by changing that  
14 parameter value that the decision criteria are still met so that the default parameter values  
15 provide that assurance. The Monte Carlo calculation will provide that assurance for a  
16 deterministic replacement. And for certain parameter values that assurance is also provided  
17 with the current deterministic version of the code. But it is not the case that you can replace  
18 arbitrarily combinations of parameters in the code in version 1 and still be assured that the  
19 resulting dose is in the upper end of the revised distribution for doses.  
20

21 So did that --

22 MR. EID: No, it still is not clear for me what kind of vehicle, what kind of tool that  
23 the license could use to change the parameter. You are saying yes, they could change the  
24 parameter, but they have to look at the criteria? Yes or no? Can they change -- if they have a  
25 parameter that they could trust for their site, currently in the DandD code we understand you  
have the full parameters. Now they have one single parameter, say a Kd value, they measured  
it, we said that parameter is conservative, that fits the site, can they change it in the current  
version to say yes, that parameter fits our site? Can they change it, like Kd values?

MR. BEYELER: They can change certain parameter values, and a particular Kd

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1 value for a particular isotope, I think it would depend on the particular isotope. But we have  
2 made some tests to determine whether or not replacement of individual parameter values with  
3 deterministic site-specific values provides the same level of protection, in effect, or provides --  
4 satisfies the same decision criteria as the existing defaults do.

5  
6 So there's a table of parameter -- basically parameter replacements that have  
7 been tested for that purpose that presumably would be part of the standard review plan or  
8 guidance for operating version 1 of the code. That is a set of parameter values and ranges and  
9 combinations that have been tested for the purpose that you describe. That would be my  
10 recommended way of proceeding pending the completion of version 2.

11 MR. EID: Okay. I would like just to say this is an issue we are still discussing. It  
12 is not final. I mean, this is a point of view, and maybe, you know, we'll discuss it further, you  
13 know, within the staff even.

14  
15 Thank you for your answer.

16 MR. DEMODER: Steve Demoder, Department of Energy.

17 Relative to your process for identifying default parameter values, do you have --  
18 I believe you have a document in progress that has a compilation of the default parameters and  
19 where that information came from and how you're going about deriving the distributions of those  
20 parameters. What's the status of that report, and, secondly, do you envision putting that  
21 information into an electronic data base, or do you already have such a data base?

22 MR. BEYELER: That report is due to be released in the next -- it's supposed to  
23 come out final in the next month or two, I believe. So it's shortly to be released. There is an  
24 earlier draft that I believe is still available on the NRC Web page that describes the  
25 methodology. The information sources that are described in that earlier draft have been  
considerably expanded, and that will be available in the forthcoming final draft.

I believe it is the NRC program manager's intention to make that available -- to  
make the report as a whole available on the Web. Whether or not there will be an indexed data

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1 base or a searchable data base generated from that information, I don't know what her  
2 intentions are.

3 MR. DEMODER: Thank you.

4 MR. BEYELER: You're welcome.

5 MR. MORTON: Henry Morton.

6  
7 In version 2 it would be helpful if on an individual parameter basis one would be  
8 able to select whether you put in or enter a probability distribution or a single value. Do you plan  
9 to design that into the version 2?

10 MR. BEYELER: Yes, sir. I won't go -- try to find a particular display, but the  
11 version 2 will allow the user to type in in effect a single value in the same exact way that version  
12 1 does now. We'll also allow the user to double-click on that entry field and then bring up a  
13 display that would allow them to specify a distribution if they want to do that.

14 MR. EID: Any other questions?

15 [No response.]

16 MR. EID: Okay. Shall we proceed now?

17 MR. ORLANDO: Thank you, Walt.

18 MR. BEYELER: You're welcome.

19 MR. ORLANDO: The next presentation will be by Dr. English on partial site  
20 release, and before he starts talking I want to take a look at the throat mike a little bit here.

21 DR. ENGLISH: Good morning. I guess the men are displacing the ladies here  
22 regularly but Bev maybe will be able to answer some questions later on after I finish.

23 What I am going to speak about is how we are proceeding at Big Rock Point in  
24 decommissioning, the restoration project, and the examples of partial site release will be based  
25 primarily on what we are looking at at Big Rock and the condition of our facility.

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This is the site map, which illustrated the protected area which within that maybe  
10 or 15 percent has been utilized as a restricted area, so the protected area itself and the

1 adjacent developed areas represent probably only 10 percent of the total of 600 acres. We have  
2 maybe six acres that are developed. Of that, quite a bit less than an acre would be  
3 contaminated or covered by buildings that are potentially contaminated.

4 So the major portion of the site is basically non-impacted. The protected area is  
5 the area you can observe right around the sphere there, within that fenced area. We have a  
6 little more development at the left-hand side where we brought in trailers and that's the parking  
7 lot and so forth, but those again have not been impacted areas.

8 This is a view from the back side, an aerial photograph about half-way between  
9 the site boundary and the facility itself. It shows the slope of the land. It's higher behind the  
10 plant, sloping down to the plant. The area is basically undeveloped woodlands. There are just a  
11 few -- an old rail spur that ran down on the map that you saw going north and south and an  
12 east-west road that comes into the plant for access.

13 There are some fairly significant benefits of partial site release and not to  
14 mention the fact that there's a resource there, nearly 600 acres of property that's worth probably  
15 five to seven times what the original cost of the plant was when it was built.

16 The radiological control is certainly an area that we think would be benefitted by  
17 reducing the plant site size because there is always the temptation to utilize a lot of land for  
18 decommissioning activities such as laydown, shipping and receiving of goods and equipment  
19 that would cause you a lot more concern over the control of the area than if you reduced the size  
20 of the site, say to 10 or 20 acres.

21 Another benefit that we have of early partial release is that it requires us to  
22 identify those impacted areas early, identify the extent of them, provide early survey planning,  
23 implementation and fuel experience with the techniques that we are going to use for final  
24 termination, and then for the release, as I said, the financial asset recovery on the property,  
25 7000 feet of Lake Michigan shoreline and the release of that resource for beneficial use.

One of the first considerations one makes of course when you go into

1 decommissioning is the rules under 50.82. Those rules are particularly applicable to the actual  
2 site termination and if you go through looking at release of nonimpacted areas, you can step  
3 through the requirements of 50.82 there as shown.

4 Do you need a dismantlement plan for undeveloped, unimpacted, nonimpacted  
5 areas, and the answer is no, it is not applicable. Do you need a remediation plan for that area?  
6 No, it is not contaminated, so no remediation plan is required. Should you need characterization  
7 data -- you will need characterization to define the extent of the impacted area but as far as the  
8 nonimpacted area, the recommendations in MARSSIM and Draft Guide 4006 both say that it is  
9 characterization of the nonimpacted areas based on historical site review as opposed to actual  
10 characterization survey and they definitely state that no termination survey is required for  
11 nonimpacted areas.

12 Do we need a plan for restricted use? Well, obviously no, if there is no  
13 radioactivity there is no question of restriction. Do we need a decommissioning cost revision?  
14 No, it is not a cost to release the site -- no cost impact.

15 Do we need environmental report revision? Again, no environmental impact to  
16 releasing the site that is not then affected by plant operation.

17 Public meetings? I don't think so, because there is no significant action or  
18 hazard for releasing, again, the site from the license, that portion from the license.

19 Do we need an approved termination plan? We are not terminating the license,  
20 so the license will remain. The restrictions on the control of radioactivity will remain simply on a  
21 smaller portion of the site so again there's no requirement, no usefulness to taking that path.

22 The final requirement of 50.82 is amendment of the license to control the  
23 continuing decommission activities and so, yes, that is the area that does need to be followed. If  
24 the site is described in the technical specifications a license amendment is needed to change  
25 that site description.

Now since there's license -- the last slide indicated that we have come to the

1 conclusion that it's a license amendment rather than the full process of license termination that is  
2 required for partial site release, one has a couple options. The first one is to move the site  
3 description from the technical specifications into the final safety analysis report and one uses  
4 there 50.36(c)(2)(D)(iii)(6) as a basis, which basically says where changes to the specifications  
5 in decommissioning facilities you are allowed on a case by case basis to remove non -- you  
6 know, requirements that do not apply to operating plants from the technical specifications.  
7

8           Once in the FSAR, you would use the 50.59 process to then change anything to  
9 do with the site description. You would need an analysis to support 50.59 and Yankee Rowe  
10 has done the amendment change. They have not, however, changed the site yet through the  
11 50.59 process but they did receive, dated February 3rd, an amendment change moving the site  
12 description from the technical specifications into the FSAR.  
13

14           The second option is to change directly and by amendment the technical  
15 specifications, to exclude the nonimpacted areas, simply a new map and description of the site  
16 for the size to include the impacted area and any areas that you wish to, need to utilize to  
17 continue decommissioning in a safe and effective manner.  
18

19           You need to provide the basis for that change and basically the reasons why it  
20 is not impacted and the things that immediately come to mind are emergency planning and  
21 security plan compliance, because one of the main reasons one needed the large site boundary  
22 distances originally was in terms of the emergency planning, the TZ and the productive action  
23 guides and so forth which decommissioning plants have recalculated and we have at Big Rock  
24 Point and basically have done calculations with FSAR currently showing that we do not exceed  
25 the PAGs at our protected area boundary -- that little small area directly around the plant site.

          For either option again I would stress it is not important to not go overboard and  
try to restrict it to too small an area because you will need a significant facility area to complete  
decommissioning.

          In terms of technical considerations for the nonimpacted area, one needs to look

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1 at both the liquid and the airborne pathways. Liquid spill history, for example, surface water  
2 flows, aquifer flow, barriers to aquifer or to surface water flow, and the same things for the  
3 airborne contamination pathway -- surface spills. If you are in a more arid environment than we  
4 are at Big Rock, for example a desert type environment with wind erosion, one has to look at  
5 that and the surface and wind conditions.  
6

7 Now Big Rock, as the slide demonstrates, the slope of the land is toward the  
8 plant. It is well wooded. It's been wooded since the time that the plant was built. There are  
9 basically only -- the access is by the rail line, a road coming in. There's a power line that  
10 parallels the road coming into the plant and there was a small, predating the plant, development  
11 to the left-hand side from the plant into Charlevoix. There was a little two-track, probably wagon  
12 trail or something from the old days that we used pre-site basically only for a meteorological  
13 tower.  
14

15 We kind of had a novel situation. The pre-siting requirements for the facility  
16 required meteorological data and so we put up the tower and as soon as the plant was built we  
17 took it immediately down. We didn't have any tower until TMI days and we put up some  
18 meteorological equipment on the stack, so again that roadway was not used going back toward  
19 the Met Tower.  
20

21 The review as I mentioned for contamination is highly important. Burial sites  
22 would exclude your ability to call an area nonimpacted. Rather it would be impacted, by  
23 definition. Any scoping identified contamination would automatically exempt you from being  
24 able to call the area nonimpacted.  
25

Evaluations as identified in the MARSSIM manual are historical site  
assessment, scoping surveys is questionable. Draft Guide 4006 tends to speak more to  
characterization surveys. I believe the two are equivalent, although somebody from the NRC  
can say that MARSSIM talks scoping and DG 4006 mentions characterization. Either way,  
obviously, if any surveys show -- find contamination or your historical review identifies spills and

1 so forth in an area then it is by definition an impacted area.

2           There is some question and it probably needs more discussion between utilities  
3 or licensees and the NRC in terms of if you have cleaned up a spill, if you find a very small level  
4 of contamination somewhere in the site, can that ever return back to be called a nonimpacted  
5 area for purposes of release? The way the guidance is currently, it sounds as if not, but it  
6 sounds on a practical sense if you found one resin bead somewhere that it had dropped off of  
7 something, you picked it up and took it back to the plant and there was nothing else there, it's  
8 kind of envision why that would have to be called an impacted area and be classified as Class 3  
9 or whatever, but that is maybe another point of discussion.

11           Our characterization -- it uses in situ gamma spectroscopy. We are running the  
12 detector at about 7 meters in height so that we can circumscribe the 10 x 10 meter square and  
13 running with the columnator in a circle allows us to move the arm around the truck and not have  
14 to move the truck every time and align it north, south, east or west, as a square columnator  
15 would.

17           The truck looks like it might be inside the circle. It's not. It's because of the  
18 angle of the shot. We don't include the truck in the analysis.

19           We did scoping surveys earlier with just a one meter off the ground but that is  
20 equivalent to sampling. It gives you a fairly small area that you have analyzed. Moving it up to 7  
21 meters gives us a 159 square meter area.

23           In conclusion, we believe the regulations are in place to allow us to remove  
24 obsolete requirements under 50.36 and that the large land area is needed for emergency  
25 planning and/or for 10 CFR 50, Appendix I to reduce the offsite dose limits that are no longer  
required when we are not under power operation and we have had now at Big Rock a year and  
a half of decay, since shutdown.

          The areas that are nonimpacted should be removed from the license to provide  
rapid asset recovery and beneficial uses.

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1 The license termination surveys are not required for nonimpacted areas and  
2 therefore really isn't a license termination question. It is a matter of obsolete technical  
3 specification requirements and that the two options are the FSAR change, moving it, moving the  
4 description of the site to the FSAR or amendment of technical specifications and both of these --  
5 we have representatives from companies that gone in both directions here.  
6

7 Yankee Rowe did the move to the FSAR and Oyster Creek is in the process of  
8 attempting a change on their, amending their technical specifications to remove a portion of the  
9 site even though they are currently still operating, and so we think they are both viable options  
10 and we believe that we are in a process currently writing up the change. It still has to go through  
11 internal reviews but we will probably be submitting an amendment under Option 1 within the next  
12 month or so.  
13

14 Questions? That is what the site is going to look like when we are done.

15 Okay -- and thanks to Dave Parrish down here.

16 MR. EID: Do you have a question, Henry?

17 MR. MORTON: It's a question actually for the Staff. This presentation dealt with  
18 partial site release for nonimpacted areas.  
19

20 DR. ENGLISH: Right.

21 MR. MORTON: Could the Staff give some indication of what your  
22 considerations are for partial site release, impacted areas? For instance it's my understanding  
23 there's several applications in, in which the licensee is asking for partial site release for possibly  
24 impacted areas.  
25

MR. EID: This issue is still not really fully explored and evaluated, however one  
area for the partial site release, is it to release it from the license completely or to release it just  
for use until license termination?

The question of potential groundwater contamination below that portion of the  
site is an issue. The direction of groundwater flow is an issue. So we cannot talk much now

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1 about it. Maybe we could have a future workshop to discuss that issue, because it is a lengthy  
2 issue to try to address every aspect that pertains to partial site release specifically for affected  
3 areas.

4 MR. ORLANDO: Does anybody else have anything on partial site release? Any  
5 questions or anything you want to talk about? The idea was to use Dr. English's talk to stipulate  
6 discussion on the issue.  
7

8 If we don't have anything to discuss, we can take a little bit earlier break and  
9 then come back and start up with some discussions of the conservatism in the existing data on  
10 resuspension factors. Okay. Thank you very much.

11 [Recess.]  
12

13 MR. ORLANDO: I think we are going to try to get started again, please. If  
14 everybody could come on back in and sit down.

15 MR. EID: Good morning. My name is Bobby Eid. I am with the Division of  
16 Waste Management, Performance Assessment and High Level Waste Branch. And I am giving  
17 this presentation also jointly with Steve McGuire. I guess all of you know Steve. Steve made  
18 the presentation of resuspension factor in the previous workshop and he made some  
19 recommendations. This is a continuation of Steve McGuire's presentation. Steve could not  
20 attend here because he's on travel. I will be taking the blame for any mistakes or any problems,  
21 and I would like to give Steve credit for doing the majority of this work.  
22

23 With this opening again we have a disclaimer that this is a study. It is not final.  
24 We are still discussing within the staff. We did not make a decision or conclusions, final  
25 conclusions on that. They are just merely proposals and suggestions. So please do not take  
these values as a value that you could use in your assessment. They are only suggestions  
within the staff, that they need further discussion, they need further verification based on data  
that some of you engaged in collecting such kind of field data at your side.

So with this opening, I would like to start by referring to the previous workshop

1 and what was recommended in the previous workshop and the recommendation was to  
2 estimate the resuspension factor based on total activity rather than removable activity. I believe  
3 that's where we -- when we made the recommendation.

4 And we said we need to have more field data to support that recommendation.

5 Keeping this in mind, we'll proceed, and I would like to emphasize more on the  
6 reasons and rationale for considering, selecting the total activity rather than the removable  
7 activity for estimation of resuspension factor.

8 The first reason is because we believe that almost all residual activity at the  
9 remediated facility will be fixed. Most of it is fixed. A very, very small fraction of that activity is  
10 actually called removable contamination. Therefore we should look into the measurements of  
11 fixed activity rather than to emphasize on removable activity.

12 The second point is that because the resuspension driving forces from  
13 mechanical disturbances such as moving and other activities in the facility to be released is  
14 much greater than those involved in taking just a smear sample, putting smear sample on the  
15 floor or the wall and to say this represents the actual mechanical disturbance of that surface.

16 Therefore, the driving force will cause a deeper abrasion and gouging for the  
17 surface when you walk on the floor or when you have a vehicle or some kind of equipment that  
18 moves on the floor.

19 The third reason is because it is not exactly correct if we assume that only  
20 removable activity will be resuspended and fixed activity will not be resuspended. This  
21 assumption if we think that only the removable activity is not exactly correct because the fixed  
22 activity, whether on the wall or on the floors, will be potentially resuspendable. So it will be with  
23 time because of abrasion, because of any kind of other processes, ventilations, it will become  
24 resuspendable.

25 The other reason, as I guess I mentioned already, the abrasion of the driving  
forces will act primarily on the fixed activity because most of the activity, as we said, it's fixed.

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1           The fifth reason is because the small fraction of removable activity will not  
2 substantially affect the total resuspension factor. As we said before, most of the activity is  
3 actually on the surface and at the present time it is not resuspendable, it's not removable, but  
4 could be removable in the future.

5           The sixth reason for concentrating on total activity, because the smear samples  
6 are difficult to interpret and reproduce. As you know possibly from your measurements, the  
7 production of the smear sample is not highly reproducible, so there are large uncertainties in the  
8 smear samples that you take to measure the removable activity.

9           Then the seventh reason is because the data for the suspension factor should  
10 be based on measurement of residual activity and rooms that are representative of the residual  
11 activity in the building occupancy scenario. So this means you need to compare your data  
12 based on site-specific conditions. That's what we were talking this morning, and these could  
13 vary from one place to the other.

14           We would like to visit again Steve's presentation before, and this is additional  
15 kind of data that we included, and we have new ideas about what can you do about the  
16 resuspension factor. This represents the data for different references that were used in  
17 establishing the current default value. The current default value is actually it is on this end of  
18 this curve, and what we are suggesting that the 50th percentile value of the resuspension factor  
19 to be considered as a default in the DandD screen.

20           And I will mention the reasons behind this kind of proposal or suggestion.  
21 Again, this is a suggestion, it is not final, it is not staff decision yet, it is just only to throw it for  
22 discussion.

23           So the suggested value will fall into this area, and I will talk about it. And even if  
24 we take the 90th percentile value based on reconstruction of the data so it is less actually than  
25 the current default value in DandD screen.

          We are trying to collect additional data to support our suggestion. The

1 additional data we will use from Spangler, Dave Spangler, of BWX, and Dave is currently  
2 analyzing the data. The data was originally presented here and it was code data, so he's going  
3 through further analysis. That's why we would like to look into the QA/QC of the data in a formal  
4 matter so that we will have great confidence in the data that's submitted and say yes, it can be  
5 used in establishing the resuspension factor. So based on these data hopefully we'll try also to  
6 reconstruct the curve and to say this is the credible data that we could use.  
7

8 In addition we will look into the weighting pattern for data. If there is lots of  
9 information it's credible to a QC so we may give it a weighting factor in establishing the PDF  
10 curve for resuspension factor.  
11

12 Also Joe Nardi will be giving a presentation today. I'd like to thank him for  
13 volunteering to give his presentation about actual data at their site on the suspension factor, and  
14 we'll be interested to see how this data fits within the curve that I showed and whether our  
15 proposal is conservative or not conservative, whether again hopefully that this data will be  
16 credible, we'll look into it in terms of QA/QC of the data, and then we'll make judgments for  
17 inclusion of the data to construct the PDF curve for the resuspension factor.  
18

19 Further there was a proposal from the previous workshop that DOE, they have  
20 lots of data for their decommission site. We did send a letter to DOE, and we requested to  
21 provide us with whatever data that they have on their decommissioning site such that we could  
22 include it in consideration or reconstruction of the PDF curve for resuspension factor, so that we  
23 could justify on a solid basis for changing the resuspension factor.  
24

25 Now, I would like to address the issue of -- the suggestion concerning the 50th  
or the mean value for the resuspension factor when we established the PDF curve versus the  
90th percentile of the resuspension factor distribution. The suggestion for the 50th percentile is  
because the default for physical parameter were based on the 90th percentile, because the  
default currently in the D and D screen is based on the 90th percentile prove against the  
function, that is to start with, that is currently what we have.

1 And then we are proposing to select the resuspension factor based on the 50th  
2 distribution, or the mean distribution for the following reasons. First, if we really analyze and  
3 look at the anatomy of the resuspension factor, it is not a purely physical parameter. It is not like  
4 a Kd, that it is for the site, corresponds for the site, and you determine based on actual physical  
5 measurements there at the site, although you do some physical measurements to try to derive  
6 the resuspension factor. It is a combination of physical conditions, at the same time behavior  
7 conditions of the critical group.  
8

9 As I discussed earlier, that the resuspension factor will depend largely on the  
10 behavior of that critical group in that facility that will be releasing, such that behavior for the way  
11 they are working, the way the room is used, and the way the disturbance, that is used, the kind  
12 of ventilation is there. What is the room going to be used in the future, is it storage room? If you  
13 use the room for storage, of course, is different than when you use it and you consider, you  
14 know, a light industrial scenario, so you could make those changes.  
15

16 So it depends somehow on the behavior of the critical group, and in our  
17 analysis, and currently in D and D, we accepted to use the mean or the 50th percentile values  
18 for the behavior parameters. For example, the building occupancy parameter, we used the 50th  
19 or the mean values for the way the critical group will occupy that building. The inhalation, for  
20 example, the breathing rate. So we accepted those, we accepted the 50th percentile, or the  
21 mean, somehow for these kind of behavioral parameters, we call them.  
22

23 Based on our analysis, we believe the factors that they correspond to the critical  
24 groups will have significant or more impact on the resuspension factor value. In other words, the  
25 behavior of that critical group will do impact the resuspension factor value.

If we accept that assumption and that argument, then the question is why we do  
need to consider that the resuspension factor is a purely physical parameter and the 90th  
percentile confidence that to be selected. So that is one argument and that supports the  
possibility for selecting the 50th percentile of the resuspension factor.

1           The second point supporting the 50th percentile, in performing site-specific  
2 analysis using D and D Version 1.0, and then if we accept the 90th percentile value, and then we  
3 ask the users to go ahead and then try to collect site-specific data for their site, in order to justify  
4 changing that 90th percentile value, the question is what the users, they use, what kind of  
5 procedures in order to go and change that conservative value, the 90th percentile value.  
6

7           The question is, well, you go and collect data for your site. The question, to go  
8 and determine the resuspension factor for your room, the question is variability, a long time, or  
9 how much time you need to do, the sampling, again, the accuracy of the measurement, are they  
10 reliable or not reliable. So it is better to start with something relatively conservative, and then  
11 you say, yes, even I will accept for site-specific conditions rather than to say throw it on the users  
12 and say, okay, try to justify your resuspension factor. So, the justification for modification of the  
13 resuspension factor based on measurement, it will be, I believe, costly and could be also not  
14 easy to justify the specific values for resuspension factor.  
15

16           Again, also it is difficult to predict, if we accept that, you know, the mechanical  
17 disturbance of the surface is a major cause for the resuspension factor, is difficult to predict what  
18 kind of activities that could be conducted for the facility.  
19

20           The third reason is because all of the data points shown in the previous graph  
21 that I showed the graph before, and you could look at those values there, sometimes highly  
22 conservative values on the other end of the curve, that these values, they have biases that they  
23 cause the measured resuspension factor to be large, is an experimental determination,  
24 somebody in the lab trying to have a research paper to be published in the journal, try to cause  
25 these conditions to be exaggerated for a disturbance of the floors or the surfaces of the walls in  
order to collect some measurable data. So disturbance, walking, you know, possible hundred  
steps per minute on the floor or having some kind of fan on the floor, try to agitate the surface,  
try to have conditions such that you could measure the resuspension factor, measure air  
concentration there for low concentrations on the surfaces or on the walls.

1           So, because of this, we believe even the data that was used could be somehow,  
2           you know, exaggerated in order to get some numbers for the resuspension factor. So, none of  
3           the measurements were done on a remediated facility. In addition, they were not actually done  
4           on remediated facility where you clean to that level, because simply you can measure after that,  
5           so they were measured on -- either you spray the floor or you put some kind of loose dust on the  
6           floor, then try to make some of agitation, then you do the measurements.

8           For example, the measured values for Breslin, which is the source which was  
9           used in establishing the PDF curve, and Eisenbud, they may have airborne activity from ongoing  
10          operation. That is different than the case when you are releasing the site and the operation has  
11          been ceased. So this means the source term is regenerated, or there is more source term  
12          actually is there.

14          So the question is, you know, why we use this data in order to establish our  
15          curve, see, we are very highly conservative. So the Breslin data was taken while exaggerating  
16          the movement of workers beyond what they normally do, even for light industry scenario,  
17          thereby increasing the resuspension factor, and the purpose of the measurement was to  
18          produce an upper limit of the airborne activity that could be produced by disturbing surfaces.

20          In conclusion, we would like to see an effort to be made to obtain more factual  
21          data on the resuspension factor for the building of the scenario and we are engaged with  
22          industry and with DOE. Hopefully DOE will respond to our Recourse 2 to provide us with  
23          additional data, so in order to have sufficient basis for modification of the resuspension factor.

24          Also we are proposing -- again it is a proposal, it is not final -- we are going  
25          through lots of discussion. We are suggesting to consider using the 50th percentile of the  
            suspension factor distribution.

ADN           Also based on the current analysis, which still is raw analysis, it is not final, we  
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ATE           are proposing to consider using a default value for D and D of .75 times 10 to the minus 6 based  
            on total activity, so that is the number that we are proposing. Considering that number, currently



1 we have surface contamination limits for alpha emitters that is very low and in some cases you  
2 cannot measure it within the fluctuation of the background.

3 Here this table shows the Reg Guide 1.86 release limits for alpha emitters,  
4 specifically for U-238 and Thorium-232, and as you can see it is 5000 for U-238 and for  
5 Thorium-232 is it 1000, and --

6  
7 SPEAKER: What are your units?

8 MR. EID: Those are DMP per hundred centimeters.

9 Now in the current default value of Version 1.0, the release limits are 100 and 7  
10 DPMs. We recognize that dose limits here are very low and we said in our Federal Register that  
11 we are working to see what kind of parameters they can be changed and how these PDF values  
12 are justified.

13 If you will allow me just one thing -- just one more thing I would like say, and  
14 then we will open the floor for discussion. I am sure there will be also discussion, and using the  
15 recommended number that I just showed before, so we will have different values, which is for  
16 Uranium-238 surface contamination it will be 1800 and Thorium-232 it will be 140.

17 As you can see, still it is for U-238 specifically it is much below the release limits.  
18 However, it is measurable and it is much above the background fluctuation and it is, I would say  
19 it is somehow more reasonable but still it is a conservative number.

20 For thorium, still it is much below also, but it is possible detectable and is much  
21 above the current default values.

22 I believe this is a step toward trying to think about how we look more seriously  
23 into the current default input parameters and then to see if it can be justified or not. We are still  
24 in the discussion. Again, it is not final. Please do not take this as a value that we could go and  
25 just plug it in the code and quote NRC Staff. That is not the reason for that. It is just for  
discussion.

I would like to thank you again, and the floor now is open for any discussion.

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1 Yes?

2 MR. SEXTON: This is Dick Sexton, Connecticut Yankee.

3 I guess in terms of looking at your resuspension factors, did you or could you  
4 look at operating facilities? Many operating plants certainly in the reactors have many air  
5 samplers that are located throughout the facility that typically don't have any removable activity  
6 and see a fair amount of action.  
7

8 Have you looked at that data?

9 MR. EID: We did not have specific data in terms of numbers but if you have any  
10 data or anybody has data from the industry we would like to have it just to refer to us where this  
11 data can be obtained, but we did not go and look at every specific case to see what kind of data  
12 for example for the licensee that we have in monitoring, but if -- from the industry point of view, if  
13 you have any data like this kind of data that you are talking about and this data is reliable,  
14 QA/QC, or you could look at the surface contamination and at the air concentration and then the  
15 way to derive the resuspension factor would be very helpful for us.  
16

17 MR. KULZER: That's one of the questions I had or very similar to it. I was  
18 thinking in terms of --  
19

20 MR. ORLANDO: Could you identify yourself, please?

21 MR. KULZER: Ed Kulzer, Region III, NRC.

22 When you are talking about defining resuspension factors I was thinking more or  
23 less a similar process in asbestos removal where they take aggressive sampling, where they  
24 just go through the area with a leaf blower and suspend, put in suspension everything that can  
25 be suspended and then take an air sample and that way they get a pretty good example of how  
much is removable or resuspendable.

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Has anybody got any data like that to support the findings or resuspension  
information?

That might be an easy way to do it -- what's ever been in the facility for 30 or 40

1 years -- that before you start decommissioning activities is going to be suspended on rafters, on  
2 beams, and by going through and aggressively sampling and monitoring you are going to have  
3 pretty good, accurate data to compare things with.

4 MR. EID: Okay. Any other questions?

5 MR. BEYELER: Walt Beyeler from Sandia.

6 MR. EID: One second. Henry?

7 MR. MORTON: Henry Morton. I think this is an evolution in the right direction  
8 and with respect to measuring and getting data for fixed activity, it would seem to me that in the  
9 process of getting data, particularly new data, it would be helpful to know the material  
10 compositions of the floor, for example, because it would seem to me that the actual source term  
11 is going to be a removal rate which would be a physical abrasion rate of the material times the  
12 activity, the aerial density activity that is fixed on that surface.

13 MR. EID: Thanks. Walt?

14 MR. BEYELER: Yes, Walt Bayeler from Sandia Labs.

15 I just wanted a small point of clarification on the behavioral parameters. Those  
16 in the current version of the code were set to the average values of the distributions rather than  
17 the 50th percentile and the argument behind that was that those values are meant to  
18 characterize the average member of the critical group.

19 MR. EID: That is why I am trying to relate that it is the behavior of the critical  
20 group that the codes -- also they have impact on the value of the resuspension factor so if we  
21 accept that as it is part, a portion at least, of that parameter is based on behavior parameters of  
22 the critical group then we could think about -- you know, the question is is it necessary to be that  
23 extra conservative to have it the 90th percentile or higher currently -- in the current D and D  
24 version actually it could go much higher because you are concerning all radionuclides.

25 MR. BEYELER: And that would be an argument then for using something closer  
to the average of that distribution rather than the median.

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1 MR. EID: Yes.

2 MR. BEYELER: Okay, thanks.

3 MR. EID: Yes?

4 MR. SEXTON: Dick Sexton, Connecticut Yankee.

5  
6 In establishing these limits, is there any consideration given to the feasibility of  
7 making these measurements in terms of demonstrating compliance? When I see a limit of 100  
8 for U-238, I wonder about the feasibility of physically surveying and having current technology to  
9 make those measurements?

10 MR. EID: I believe that is a good question. That is one of the reasons we are  
11 trying to revisit, to see what kind of conservatism we have in the model, and as we said before,  
12 these values -- you cannot measure them, cannot demonstrate for some values -- 1.7, you  
13 know -- you cannot physically measure the dose, so the question is what is -- are we too  
14 conservative or because it is true, those are true numbers and they are risk numbers we need to  
15 care about, I believe we are trying to be a little bit extra conservative because of the screening  
16 process.

17  
18 Therefore, this means that cost and money and time and effort that you spend in  
19 measuring those maybe is not quite justifiable, so if you have different numbers, it could be, yes,  
20 it is justifiable and the cost and the effort could be more justifiable to go on and do the  
21 measurements.

22  
23 So the difference in the measurements -- if you are close to background, it's  
24 very difficult to measure. To be too close then you may not be able to measure or detect. If you  
25 go higher, then yes, there is reason for going -- trying to do the measurements. Yes?

MR. SAITO: Paul Saito, Combustion Engineering. I am kind of following up on  
what the last gentleman said.

This number I think is going to be much, much smaller because if you use a  
MARSSIMS type measurement at this point where you take source efficiency into account, this

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1 number will go do from our current measurement. You are probably back down to about the 100  
2 level again for an alpha emitter. This has to be taken into consideration when we start moving  
3 forward at this point.

4 We can't keep thinking of the old ways of measuring things, so when we start  
5 looking at this data, the resuspension factor I think should probably be an order of magnitude or  
6 two orders of magnitude lower than what you have suggested if we are going to move forward  
7 with the MARSSIMS type survey.

8 MR. EID: I think that is a very good point too, because when you do a survey  
9 you do not look at the DCGL value. You look at the value which is much below the DCGL value  
10 in order to measure it. You need to measure those low values then to justify releasing of the  
11 DCGL because at the end you are looking at the average, I believe, and in most cases you try  
12 not to exceed that DCGL value, so you are absolutely correct.

13 MR. MORTON: Excuse me. Henry Morton again.

14 I think part of the point here is the careful definition of those -- the units that are  
15 applied to these. The Reg Guide 186 numbers for the uranium and thorium series and the  
16 individuals -- it's actually the unit would be alpha per minute per hundred square centimeters,  
17 whereas for the derived value -- that is the value derived by D and D -- is expressed in  
18 disintegrations, that is, technically atomic disintegrations per minute per hundred square  
19 centimeters, so it becomes an issue if matching them up.

20 It turns out in this case that since you have derived the value for Uranium-238  
21 without daughters and Thorium-232 without daughters then you have got a one-to-one  
22 correspondence in comparing them, but in terms of measuring, as Earl was dealing with, you  
23 need to differentiate between those two units.

24 MR. EID: Yes, you are right.

25 MR. DORMAN: Hi. Joe Dorman, Maine Yankee.

I would like to reiterate that too, about all this data on this graph, that these

1 surveys probably weren't done using the MARSSIMS technology, the source efficiency and back  
2 scatter and taking into account all the things that we have to take into account now and perhaps  
3 if they were the contamination levels on the floor, the fixed might have been a little bit higher  
4 than what they have reported in those reports, causing the resuspension factor to be lower.

5 MR. EID: Yes. Those references, as you can see, they are very old references,  
6 and now the question is you cannot go and call the person to see what kind of measurement  
7 they did and so on. It is, by the way, I guess one of the references that was used. They were  
8 also measuring that fill sampling -- and unfortunately those results they were not considered  
9 even in this analysis. They were taking samples, they were put at different levels which many of  
10 them they were very, very close to the floor, within a few centimeters from the floor, the  
11 resuspension factor, so there is a question even about whether these values they correspond to  
12 the briefing zone that those we are quoting or not.

13 I believe there is an additional conservatism for where the measurement was  
14 taken. Dave?

15 MR. FAUVER: This is Dave Fauver, RSI. I have to agree with the previous two  
16 comments. The new MARSSIM method with the source efficiency is just a different approach to  
17 assessment that it is easy to assume was not applied to any of this dataset that you have up on  
18 the board there, so I think it is a very strong case to simply make that correction to this data  
19 across the board when you would apply the MARSSIM approach when you determine the  
20 resuspension factor.

21 MR. EID: Okay, thanks. Any other questions?

22 If not, I guess we will move to the industry point of view regarding the  
23 suspension factor. Joe Nardi will be giving the presentation, real data from their sites. We will  
24 be looking forward to see how the data will support our assumptions or not.

25 MR. ORLANDO: While they are wiring Joe up, I just wanted to mention -- Bobby  
did say something but at the last workshop Earl Seito mentioned that there was some data that

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1 was out there in the DOE world on resuspension factors and Earl sent me a list of questions that  
2 we needed to ask DOE and those were formed into a letter and we sent those out to DOE a  
3 couple of weeks ago, so as Bobby's slide indicated, we are out there trying to find some of this  
4 data.

5  
6 Now I guess how we manage it and how that was collected needs to be looked  
7 at too, so just to give everybody an update as to where that particular request was.

8 I think the letter was sent out a week or so ago.

9 MR. NARDI: Okay. My name is Joe Nardi. I work for Westinghouse. What I'm  
10 going to be doing is trying to get two objectives: to review some operational data that we have  
11 obtained during the decommissioning of one of our facilities, and I'll describe the facility a little  
12 bit more in my presentation, and more so to really take a look at some of the factors and what I  
13 think are going to be the limitations in our ability to measure resuspension factors in facilities,  
14 that this relates directly to your question of whether we could use operational facilities versus  
15 decommissioned facilities.  
16

17 This slide is not in your presentation. This was the one I handed out or showed  
18 on the board at the last workshop. My problem with the data -- this was very preliminary -- I was  
19 getting resuspension factors in the ten to the minus seven for total activity numbers in the ten to  
20 the minus seven values.  
21

22 The problem I had with this data was that the air sampling was for a period of  
23 operation, and we really -- in operational facilities, we don't make total activity fixed  
24 measurement kind of things. We do lots and lots of smear measurements, but not total activity  
25 measurements on the floor. So I was really using air sampling from one period and fixed  
sampling of the surface activity for another period of time. So I wanted to relook at that  
information to really try to see what we could derive.

First of all, to make sure we're all together, the definition of the resuspension  
factor as given in the NUREG 5512 is just simply the ratio of the airborne concentration to the

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1 surface concentration. If you look at their definition in the -- it's in units of picocuries per cubic  
2 meter, or picocuries per square meter. All my data is presented in microcuries for ML for air  
3 samples, DPM per hundred square centimeters for surface activity measurements, and therefore  
4 you need a conversion factor of 2.2 times ten to the tenth to get the equivalent resuspension  
5 factor.  
6

7 To describe a little of the facility history of the operation that I'm talking about,  
8 this is a pump repair facility. It's been in operation from 1957 approximately to 1998. The  
9 primary isotopes within the facility are cesium and cobalt.

10 We are currently decommissioning the facility under the NRC's pilot program,  
11 and doing quite well in that sense.  
12

13 The fixed head air sampling system we have left in place in the system. This  
14 amounts to 13 fixed head samplers on the perimeter of the building that we're going to leave in  
15 place as long as I can.

16 The final intent here is to decommission the facility to the point where we tear it  
17 down. We're going to demolish the building. But as long as I can, I'm leaving that fixed head air  
18 sampling system in place.  
19

20 Related to the characteristics of the facility, there are really two buildings, it's like  
21 two oblong constructions sitting next to each other. The main building, the floor area is 142 feet  
22 by 40 foot wide given about 57,000 square foot, with a height of 30 foot on the main building.

23 The tank room, which is the most contaminated area, is a smaller adjunct and  
24 actually at a lower level, but in terms of size it's 48 by 12 foot with a height of 18 foot.  
25

One of the problems in this facility is that we have no ventilation system  
operational any longer. It's basically static air conditioned. So I don't have the turnover of air in  
the facility.

Related to your comment, Henry, I didn't put it on here, but the floor is a  
concrete floor, painted, initially painted, and I'll show you some data. We've actually bead

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1 blasted the floor, so now it's a raw concrete floor.

2           Getting into where the information I have with regard to air sampling, as I  
3 mentioned, we have 13 fixed head air samples, points around the perimeter of the facility. The  
4 change frequency for those air filters is one to seven days, depending on somewhat when they  
5 get around to it. The facility is empty at this point in not operational. We're not really working on  
6 it right now. So we've gone as long as seven days before the guys got back to change out a  
7 filter. But in general, we do it twice a week, three or four day frequency.

9           The flow rate of the units is 17 liters per minute. There is a substantial dust  
10 buildup on the filters. The counting time of that sample is 20 minutes, that's after a decay time of  
11 at least 24 hours and usually a couple days to decay out the background uranium thorium.

12           We're using a Tenelec counter, an automatic gas-proportional counter with a  
13 background of about two counts per minute in beta.

14           I've got this information in there. I'm not going to go through any of the actual  
15 numbers, but it is in the slide. These are the actual beta air sample results in microcuries per  
16 ML times ten to the minus 13 for the units.

17           The main point on here is I've broken it up into two blocks. The top block there  
18 is measurements that were taken during the period when we were physically working in the  
19 facility, and the second is this block down here is measurements that were taken when there  
20 was basically no activity in the facility.

21           Graphically, this data does not look like what you have in your handout. The  
22 difference is that on the handout, I had just a linear scale on the side, and in this one, I thought it  
23 looked a little better if I -- you could see it a little better if I did a semi-log scale.

24           But you can see the activity, the difference in air concentration depending on  
25 what's going on in the building. This first section here is prior to entering our phase 2 of the  
operation. Phase 2 was primarily just to go in, remove all the equipment from the building, not  
really do any decon, but we did do a little bit on the floor, we did a one-pass bead blast. So

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1 what we were doing was waste packaging. We did do the period of shotblasting the floor, and  
2 then we've had this period where basically there is nobody in the facility except for the HP techs  
3 going in and doing the air sample changeout. So this last period is of very low use activity.

4 There is actually one piece of equipment that is still in the facility and still  
5 periodically used, so there is a little bit of activity. When I say its inactive, that's not quite true,  
6 but for practical purpose, it is.

7 The bottom line on those was that for the period -- I broke my -- I'm going to  
8 break my answer up into two pieces of data. Prior to and during the floor decom activities, the  
9 average air concentration is about 1.3 E to the minus twelve, and during that totally inactive  
10 period, it dropped by a factor of ten to about 1.3 times E to the minus 13 for microcuries per ML  
11 for the air sampling.

12 The air samples -- that graph really reflects the level of activity being conducted.  
13 As a point of comparison, the concentrations are very low. This is an operational facility but -- or  
14 was an operational facility, but even during the operation, we were not really much higher than  
15 that. That 1.26 E to the minus 12 was about the same as the prior six months of operation of the  
16 facility. We were actually during the prior six months where we were doing work in the facility,  
17 we were actually closer to one times ten to the minus 12, so this was a little bit higher when we  
18 were doing more aggressive packaging and bead blast.

19 Those are the results. As I said, it's about during that first section 1 times ten to  
20 the minus 12 dropping by a factor of ten.

21 The bead blast decom of the floor was strictly a one-pass operation, was not  
22 intended to decom the building. We just wanted to see how quickly the activity would come  
23 down on just one pass of it, and it really depends a lot on the construction and the age of the  
24 floor.

25 The section of the building -- the building is actually -- I only described it as one  
main building, but it's actually two buildings, the original building, which is about 40 percent of

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1 the total floor area, and a new building, which is about 60 percent of the total floor area.

2 If you look at the new building, which is only a little over ten years old, which  
3 about one coat of paint on the floor, bead blast took it down in almost one shot.

4 In the old building, which was very -- had been painted many times, had been  
5 resurfaced a couple of times and lots of things going on, bead blast didn't come down very much  
6 on one pass.

7  
8 Now let me move to the surface activity measurements, the other half of the  
9 equation. As I mentioned, the problem with an operational facility, and operational data trying to  
10 go back and look at it, is if I look at the last year worth of data that we have during the  
11 operational phase, we had thousands of air sample measurements and thousands of smear and  
12 zero fixed surface activity measurements, and that really becomes the problem when you're  
13 trying to take an operational facility, you're doing something, you're asking for more data than is  
14 normally collected in an operational mode.

15  
16 The problem I have with my data at this point is that at this point in time, I really  
17 only have 29 measurements of total activity measurements, fixed -- you know, total surface  
18 activity measurement. I've got lots of air sample data, but I'm really limited on that. So that's  
19 one constraint to what I have. We used 100 square centimeter gas proportional probes with a  
20 one-minute integrated count to do those measurements.

21  
22 Looking at the data, this is in your handout, forgetting about the whole thing, the  
23 bottom line really comes down to this: our average surface concentration during the period or  
24 the initial period and during the bead blast, using that data, that's really one set of data before  
25 we did everything. I used that to calculate the activity for the entire period, recognizing that as  
we're bead blast, the floor concentrations are going down. But we were at about 160,000 DPM  
per hundred square centimeters average over the facility.

After the floor decom, the one-pass bead blast activity, we dropped it down to  
about 65,000 DPM per hundred square centimeters.

1 With respect to the ratio of total to removable, supporting what Bobby was saying,  
2 we've had very little removable activity in this facility, at least a ratio of about 200. Before the  
3 bead blast, it was about 256. After the bead blast, we had a little bit more dusting on the floor.  
4 That ratio dropped down to 130. But that's still less than one percent of the total activity on the  
5 floor was related to smear.  
6

7 [Pause.]

8 MR. NARDI: No comments.

9 As I mentioned, we have very limited data during the normal operational phase  
10 with respect to total activity. We have lots of it on smear and air sampling.  
11

12 I have limited data at this point. It's only 29 sample points that were based on a  
13 grid pattern; intended to try to be non-biased; just a grid through the facility to try to get  
14 measurements that would be a reasonable average.

15 The instrument calibration would not comply with MARSSIM. We weren't trying  
16 to get real good things, so I don't have all of the factors of back scatter and all of the other things  
17 that would be in a MARSSIM type survey data. So that's a limitation I have. As I mentioned, the  
18 removable to the total activity ratio is around on the order of magnitude of 200.  
19

20 If I take that data, then, and break it out into the two periods, the one prior to and  
21 during the floor decom period with the air sampling and the surface measurements that I gave  
22 you, I come up with a resuspension factor in the order of  $1.7 \times 10^{-7}$ . For the  
23 inactive affect the floor decom was done and during that period when we're basically inactive,  
24 you start calculating a resuspension factor in the order of four times ten to the minus eight.  
25

Okay. Comments.

26 The operational data indicates that the resuspension factors should be closer to  
27 the range of ten to the minus seven, maybe down to ten to the minus eight kind of a range, not  
28 the ten to the minus six type of range that we're currently talking or potentially talking about.

29 They're certainly below the data that -- this is Bobby's slide. If you look at that,

1 that means that I'm sitting on for the phase where we're doing some work in the facility, down  
2 around 1.7 times ten to the minus seven, which would be this point there, or four times ten to the  
3 minus eight would be way over here. So I'm way down below the range of the experimental data  
4 that was given in this information.

5  
6 The data with four times 10 to the minus 8 has to be taken with  
7 considerations of the factors, but it really represents an essentially inactive facility. There's very  
8 little movement around there, so that perhaps represents too low of a range on what it can be.

9 Hopefully we're going to get some more additional data during the next phase of  
10 the decommissioning. As I mentioned, we'll be keeping the air sampling system operational as  
11 long as I can.

12  
13 This gets me into the second part of the comments that I want to make, and  
14 that's measurement considerations, how good can we do.

15 As I mentioned several times, operational data does not normally provide the  
16 data needed to calculate the resuspension factor, and supporting what has been said today, I  
17 really believe that using removable contamination is not appropriate. But this whole exercise  
18 has really led me to another consideration, and that is that it becomes very obvious to me that  
19 the minimum detectable activity on your air sample measurements are very quickly going to  
20 drive the limitation of what you can measure.

21  
22 And to give you an idea of this, this curve is nothing more than the mathematical  
23 equation that that resuspension factor, which is just a ratio of airborne concentration over total  
24 surface concentration, comes out for a family of curves where I'm looking at the lower end, 10  
25 DPM per hundred square centimeters, there's the bottom curve going up to 3,000 DPM per  
hundred square centimeters surface contamination for the top curve. So basically what it's  
saying is if you measure -- if you have an air sample concentration of 1 times 10 to the minus 13,  
3,000 DPM per hundred on your floor, that's going to be the resuspension factor that you  
calculate.

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1 This is strictly calculational. No data in here. But let's add some comments to it.  
2 First of all, this is some data based on a facility that we decommissioned at Large, Pennsylvania.  
3 Building 9 was a uranium fuel fabs type of a structure. That's what its original use was for in the  
4 seventies.

5 We decommissioned this in the beginning -- early part of the 1990 time frame. If  
6 you start looking at what I could -- the average total surface activity measurements for alpha and  
7 for beta, you really begin to realize that we're at very low numbers on a decommissioned facility.  
8 Looking at that last curve, you're way down in the bottom part of that family of curves. You're not  
9 up high. And that's going to be what I've seen in all of the facilities that I've been  
10 decommissioning.

11 The only place we had some measurements were really in the pipe chases.  
12 Those when they decommissioned a facility in '72 the pipe chases they didn't do quite as good a  
13 job as the general floor, and we had to go back in and look at those and do a little bit more  
14 decommissioning remediation of those. So if you look at the beta activity, you're in the range of  
15 the 2 to 300 DPM per hundred. And that was the highest place we had in the facility. And those  
16 are not really accessible surfaces. Very easy to just simply -- we could have just poured  
17 concrete in them and closed them out if we had wanted to for that.

18 The site average for all of the facilities on the site, and there were ten buildings  
19 used for various purposes, but we had 5,000 measurements of total surface activity for alpha  
20 and 5,000 for beta. We're way down on total surface activity measurements.

21 So that gives you a little bit of an idea of where we would be on that family of  
22 curves, I believe, for a reasonable effort to decommission a facility.

23 So my initial conclusions are that the total surface activities in a  
24 decommissioned facility are going to be low. The alpha surface activities are generally in the  
25 noise range and more subject to confounding factors of surface condition and self-absorption  
factors that you would have to take into account if you were really going to try to measure in an

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1 alpha-contaminated facility what your surface activity was.

2 And for the other part of alpha activities for alpha emitters is taking that curve  
3 again and adding onto it a reasonable range of what your MDA is for alpha measurements in air  
4 sampling. This is not surface contamination MDA, this is alpha air sampling MDA. These  
5 values derived from looking at what we get in our uranium fuel fab plant where we're only  
6 sampling for eight-hour periods, about the same sample flow rate, 117 liters per minute on the  
7 fixed head sampler. That's about what you get.  
8

9 What it means is you're never going to be able to measure down into the 10 to  
10 the minus 6, 10 to the minus 7 range of resuspension factor. You'll always be below your MDA  
11 on your air sampling. And I don't know how to drive that one down much further. That one is a  
12 real tough one because you get dust loading on your air sampler, you get dust loading factors  
13 and other things that keep you from really driving the MDA down for alpha emitters.  
14

15 So my conclusions then are that MDA measurements for alpha air samples  
16 essentially eliminates the possibility of using a decommissioned alpha-contaminated facility to  
17 obtain data for any resuspension factor of any value. Even using an operational facility to  
18 determine the resuspension factor may be very difficult. And as I mentioned, I derived that  
19 alpha MDA based on our operational fuel fab facility.  
20

21 Looking at the same factors for beta contamination, these are the MDA -- the  
22 range of MDAs that I'm getting for the pump repair facility, and that drops it way down so I can  
23 begin to measure lower resuspension factors, but at this point in time my surface contamination  
24 is up in this level. That's about where you would get that. I can see very quickly that as I  
25 continue to decon this facility, it's not going to be very long before I'm going to drop below that  
MDA for that technique for measuring air sampling, and I won't be able to get any further data on  
resuspension factors. It's the driving force there.

So my conclusions on that are the MDA sampling for beta measurements of air  
essentially eliminates the possibility of using a decommissioned beta contaminated facility to

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1 obtain any data on the resuspension factor. If you start looking at the 85 DPM per hundred that I  
2 showed you for our large facility, I don't know how I can drive my MDA down far enough to get a  
3 measurement on a facility like that. Using an operational beta contaminated facility to measure  
4 the resuspension factor is feasible, although it's complicated by trying to subtract out what are  
5 the contributions from operational factors.  
6

7 At least operational factors, all they do is raise the resuspension factor higher  
8 than what it would be if it were purely turned over for unrestricted use. Considering handling  
9 contaminated equipment and packaging and repackaging and opening packages, all of those  
10 are going to raise your air concentration value, and therefore calculate a resuspension factor  
11 that will be high.  
12

13 Even doing that, I am still getting numbers that are below those experimental  
14 numbers. So, my conclusions are that the recommended default value proposed, at least last  
15 month, is high by at least an order of magnitude. It is a little bit better today, given Bobby's  
16 presentation this morning.

17 If we are going to do this, I think we have to look for an operational beta  
18 contaminated facility to make the reasonable measurements, even though the resuspension  
19 factor is primarily important only for decommissioning an alpha contaminated facility. I don't  
20 think we are going to get by looking to alpha facilities.  
21

22 The impact of human activity levels within the facility has been obvious to me, I  
23 can see if it plot out the data, and I really -- there is some further opportunity for me to gather  
24 more data at pump repair, but it is going to be limited in time, because we are proceeding to a  
25 point where we expect to have that facility demolished down to ground level by the fall.

Any questions?

MR. BURKLIN: Rich Burklin, Siemens. Jerry, you keep on talking about the  
minimum detectables. When you were doing your beta measurements, if you got a zero  
reading, do you use the zero or do you plug in the MDA?

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1 MR. NARDI: All my measurements were above zero.

2 MR. BURKLIN: Were they above the -- well, let me rephrase it.

3 MR. NARDI: They weren't below the MDA. I have not seen any numbers on my  
4 air sampling that were below the MDA. So all of those numbers there are non-zero numbers.

5 MR. BHAT: Ram Bhat from U.S. Army at Fort Belvoir, Virginia. I have a  
6 question regarding this. You said that you used the gas per hundred centimeter square ADR  
7 gas proportional probe. Did you use the windowless or window gas proportional probe?

8 MR. NARDI: I'm sorry?

9 MR. BHAT: Did you use the windowless or window gas proportional --

10 MR. NARDI: No, no. That is a windowed gas proportional probe. That is like a  
11 Ludlum measurement.

12 Mike, do you want to get more specific about the model?

13 MR. BHAT: Is it a Ludlum model, Ludlum model?

14 MR. NARDI: Yeah.

15 MR. BHAT: You use the petane gas, petane gas?

16 MR. NARDI: Right. It is a 100 square centimeter opening.

17 MR. BHAT: I follow, yeah.

18 MR. NARDI: And with the mylar covering.

19 MR. BHAT: Yes.

20 MR. NARDI: And the petane gas.

21 MR. BHAT: Yeah. We had some problems, it was very much the temperature  
22 sensitive, and it was varying with the calibration, and we had to sometimes quite often  
23 calibration. The technology is not perfected. I think out of all the, Ludlum is the best.

24 MR. NARDI: Yes.

25 MR. BHAT: Compared to the other places I have seen. But, still, we had lots of  
radiation in the precision of the data and to the comparison. It was winter time, it was terribly

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1 changing. And, secondly, when you did the surface activity measurement, what do you get, the  
2 total activity, and you are subtracting the suspension from the air measurement and, so, the  
3 difference you are calling it as removable activity, am I correct?

4 MR. NARDI: I'm sorry, no.

5 MR. BHAT: You have got -- when you took the fixed surface, you get a total  
6 activity.  
7

8 MR. NARDI: That's right.

9 MR. BHAT: Yes. And then you are talking the air measurement and that is a  
10 suspension -- suspended activity. So difference between total activity and suspended activity,  
11 do you consider it as the fixed activity?  
12

13 MR. NARDI: No. The definition of the resuspension factor is strictly the ratio of  
14 the measurement.

15 MR. BHAT: I understood that. I understood, sir. So then my next question is,  
16 did you get a chance to take the wipes to find out how much of the removable activity?  
17

18 MR. NARDI: Right. Yes.

19 MR. BHAT: Did you do the wipes?

20 MR. NARDI: Yes. That is also on that curve, although I did not calculate any --  
21 or not the curve, but on the dataset. These two columns are the fixed measurement on the  
22 surface.  
23

24 MR. BHAT: Okay.

25 MR. NARDI: These two columns are the smear counted in the Tennelec.

MR. BHAT: Okay. Then next question I have is it is a little confusing to me, in  
the same table you are telling the -- in the last -- in the first column, the last one, total to  
removable is 256, and then in the next slide you say surface activity --

MR. NARDI: I rounded it. I don't --

MR. BHAT: No, that's fine. But you are -- it has become removable, removable

1 to total activity ratio is 200.

2 MR. NARDI: Right.

3 MR. BHAT: I mean has it been --

4 MR. NARDI: Yes. If you take this set of data and this set of data, you get that  
5 ratio of 256.  
6

7 MR. BHAT: Yeah.

8 MR. NARDI: If you cite this set and this set, you get the ratio of 130 --

9 MR. BHAT: No.

10 MR. NARDI: -- and kind of visually average them and said about 200.

11 MR. BHAT: That's fine. In your next slide, you have a next slide, there you are  
12 telling removable to total activity as 200.  
13

14 MR. NARDI: Oh, did I type that wrong?

15 MR. BHAT: A little confusing. Wait. Oh, I see. All right. Thank you then, sir.

16 MR. NARDI: I typed that wrong. I apologize, you are right. That ratio should be  
17 the inverse, it should be total divided by removable, yeah. I'm sorry, I did not catch that when I  
18 was looking through it. That is an error.  
19

20 MR. BURKLIN: Rich Burklin, Siemens. Okay. Again, you said that the air in  
21 this building was basically dead air, whereas in a -- I need to have a facility that is going to be  
22 reoccupied, because we are talking about that type of scenario, you are going to have a change  
23 of air. In the modeling and so on, does the NRC consider this, because that ought to be taken  
24 into account, that the amount of activity in the air is going to be constantly swept clean by  
25 recirculating air from the outside.

MR. EID: That's correct. When we look at this data, we will consider when  
there is activity in the facility and when there is no activity. So, most likely, we may consider the  
data, that they correspond to an activity, because our current scenario, which is called light  
industry scenario, although it is conservative because we did not consider all possibilities of

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1 using the facility, as I said, it could be storage, it could be classroom, it could be lab, so what the  
2 current scenario is the light activity scenario. Therefore, yes, the activities, the measurements,  
3 when you have activities within the room, it will be considered rather than the measurements  
4 when you have static kind of air flow.

5  
6 MR. NARDI: Yeah. In that facility, when we were doing the packaging and the  
7 other things, we did not have any building ventilation system on. Is that correct, Mike?

8 MIKE: Correct.

9 MR. NARDI: We only had the local ventilation, if needed for a specific task,  
10 which would be circulated internally through a HEPA system.

11 MR. EID: This has two actually factors. One factor is you may think that you do  
12 not have disturbances, mechanical disturbances to increase the resuspension factor. On the  
13 other side, you say, well, you do not have depletion of the source term, too. So the source term  
14 is not depleted by ventilation. So you have these two factors working against each other.

15  
16 MR. NARDI: If I think about it from my standpoint, using an operational facility,  
17 like in this situation, not having air movement and air change-out to remove the airborne  
18 concentrations, dilute it down, in essence, means that my air -- my resuspension factor is still too  
19 high, and, yet, I am way down below the experimental data.

20 MR. EID: Yes.

21 MR. NARDI: I just keep coming back to every time I look at where my data isn't  
22 good it tends to mean that I am higher than I should be.

23 MR. GENOA: I just wanted to -- Paul Genoa, NEI -- amplify that last point so  
24 that it doesn't get lost. In your activity scenario, you had activity going on that could generate, or  
25 suspension --

MR. NARDI: Right.

MR. GENOA: -- and, yet, in general, you do not have ventilation that would  
remove it. So it is a very conservative number.

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1 MR. NARDI: Yes.

2 MR. EID: That's correct.

3 MR. NARDI: Yeah. And that is the point I keep trying to make, is that, you  
4 know, based on what we have been looking at on experimental data, I really think that  
5 experimental data is up too high. I think it should be lower than that. And if I look at your last  
6 slide, at least with this, using a 50 percent, and everything you talked about, we are getting down  
7 into the range of where we can do measurements, but I think it is still conservative in terms of a  
8 dose calculation.  
9

10 MR. EID: I think that is a very important point, we would like to know if it is still  
11 conservative concerning the 50th percentile value or not.  
12

13 MR. NARDI: Right

14 MR. EID: Because we have some other kind of arguments here, well, you are  
15 not sufficiently conservative for screening analysis. So the data that you presented, you know,  
16 considering that the quality of the data is acceptable, I think is something to think about.  
17

18 MR. NARDI: And the other bottom line conclusion of mine is that I really think  
19 we have got to go looking for facilities that are beta contaminated facilities if we are going to  
20 gather, you know, real data, not experimental data on it. I don't think we have chance with alpha  
21 contaminated facilities. Henry.

22 MR. MORTON: Henry Morton. And intuitively, Joe, I am inclined to think that  
23 the beta contaminated facilities, if anything, are going to tend to give more conservative  
24 suspension factors than the alpha contaminated facilities. And, basically, the basis for this  
25 intuition is that we know from experience in operating facility -- plutonium facility, and the thorium  
facility, or uranium facility, but, particularly, contrasting plutonium facility and a thorium facility,  
where, historically, the airborne limits, occupationally, for plutonium, low burnup plutonium, and  
thorium, natural, are within a factor of 10 of each other, and yet we know that you have to keep  
the plutonium facility orders of magnitude cleaner than the thorium facility.

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1 And one of the things I looked at to try to see whether -- what might be responsible for the  
2 difference is to look to see whether the dust loading was beginning to be the limitation for the  
3 thorium on a mass basis, since suspension is really a mass phenomenon and not an activity.  
4 There is something that would seem to be different as a function of this vast difference in  
5 specific activity. But the air seems to be able to hold that much dust of either one, so it didn't  
6 seem to be that.  
7

8 I don't really understand what's going on, but intuitively it seems to me that the  
9 suspension factor for the really low specific activity materials is going to be less than it is for the  
10 higher specific activity materials like some of these fission products that you've dealt with as  
11 beta emitters.  
12

13 MR. NARDI: My last comment is if anybody can help me with an approach to  
14 drive that MDA down, I would like to hear it. But I can't see driving it down much further than  
15 what I am with a Tennelec type of approach. I am talking to the chem lab to see if compositing  
16 air samples for a long period of time and doing a gamma spec measurement may get me  
17 long-term averages. It won't get me individual sample measurements, because I don't believe  
18 that you'll ever see it on that. But it's really surprising if you start looking at an air sample of 1  
19 times E to the minus 16 and you calculate out how many picocuries you're going to get, even  
20 taking a quarter's worth of samples and compositing them for 13 fixed head samples, I only  
21 came up with three picocuries of activity on that total collection of air samples, and I don't think  
22 I'm going to get there. I don't see how I can drive that detection limit down to the point where I  
23 can make measurements in a decontaminated facility ever.  
24

25 MR. SEXTON: Dick Sexton, Connecticut Yankee. I agree with you that I think  
that is the limiting factor, but I guess operationally there are in many facilities areas that have  
fixed contamination --

MR. NARDI: Yes.

MR. SEXTON: Little or not removable contamination, and fixed contamination

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1 levels at easy-to-monitor levels. And many of those facilities have fixed air sampling that is  
2 constantly being obtained. And I think --

3 MR. NARDI: We just don't normally do the fixed --

4 MR. SEXTON: Right.

5 MR. NARDI: Measurements.

6 MR. SEXTON: But could --

7 MR. NARDI: You could.

8 MR. SEXTON: You could go back even in a retrospective manner go back to  
9 those locations, obtain fixed readings, and see where the data might lie. And I think  
10 operationally we know that the resuspension factors are very, very low because we have years  
11 and years of data both with the fixed head and also with sometimes even lapel air samples for  
12 those type.

13 The other thing I was wondering is has anyone looked at any other data for  
14 other type of contaminants? Lead? Anything else? Any other -- to look at the resuspension  
15 factor on some other type of component that would have a similar concern? The first thing that  
16 comes to mind is lead.

17 MR. NARDI: I don't have anything.

18 MR. POTTER: Tom Potter. I can't answer that last question, and I almost  
19 hesitate to bring this up with respect to your situation, Joe, but as a research situation kind of  
20 one-time-only kind of thing, it might be practical -- I agree that you will not be able to do it with  
21 radiological analysis of the air samples, but conceivably something like ICPMS analysis of a  
22 large number of composite air samples might be a way to do it. You can detect about 50,000  
23 atoms of uranium, for example. They're very expensive, a couple of thousand bucks a throw.  
24 But with single composites or a few composites of a large number it might be practical.

25 MR. NARDI: Okay.

MR. BEYELER: Walt Beyeler from Sandia Labs.

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1 I was looking at the distribution that Bobby had presented earlier, and I was just --  
2 it seems to me that some of the difference perhaps between the results that you're seeing and  
3 this distribution is due to a difference in the ratio between fixed and removable. I was interested  
4 to see the high number of 1 in 100 in your case, and I was curious if you felt that that was typical  
5 of other decontamination facilities and how difficult it was to collect that information on a ratio of  
6 fixed to removable.  
7

8 MR. NARDI: With respect to the ratio, I think that's very typical of every facility  
9 we've deconned. Invariably taking smear measurements on a decontaminated facility is  
10 essentially useless. I've said that in a workshop in the past. My smear activity measurements  
11 are almost always less than the minimum detectable on the counter. I just don't see it in a decon  
12 facility after remediation.  
13

14 MR. BEYELER: So that ratios of 1 in 100 are fairly common then?

15 MR. NARDI: Well, 1 in 100 is probably too low. It is probably more like 1 in 250  
16 or 1 in 500 I think would be realistic. If you looked at that data I showed for the large facility, it's  
17 like 1 in 85, but that is really fictitious because there's an awful lot of less than MDA numbers in  
18 that.  
19

20 MR. EID: Any more questions?

21 [No response.]

22 MR. EID: That is an excellent presentation and thank you very much.

23 I guess we have some real data we would like to take a look at and we would  
24 like to have this further kind of discussion and generation of more data, as much as we can, so  
25 we could have more confidence if we need to change the resuspension factor or any other  
physical parameter.

Do you think it is the time to break now?

MR. ORLANDO: Yes. It is about ten of 12:00. We will break and come back at  
1:00 after lunch.

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1 [Whereupon, at 11:50 p.m., the workshop was recessed, to reconvene at 1:30  
2 p.m., this same day.]  
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## AFTERNOON SESSION

[1:09 p.m.]

MR. ORLANDO: I guess we can go ahead and get started again.

The first speaker this afternoon is Carol Hornibrook. She is going to talk about a project that she has been working on on modeling embedded pipe.

MS. HORNIBROOK: Thank you very much for the opportunity to make a presentation. I am going to be talking about dose modeling of embedded pipe and there's a lot more to this than I thought, so unfortunately I am not going to go into actual modeling this time. I am hoping to be invited back again.

What we are really going to look at is source term development for embedded pipe because as all of you are aware, there's two important things when you are trying to do some dose modeling. One is to have a decent source term that you put in and the other is to have a decent model that you can put that source term into.

So the first question would really be why do I need a good source term, and obviously what you want to say is because MARSSIM is here, meeting the DCLG for building occupancy and here it is predominantly cobalt is the major nuclide and also meeting the DCLG for rubblized field or landfill.

The way I looked at this for EPRI -- okay -- well, let's look at measurement techniques and our approach to this was looking at it the same way that we do in a sense in low level waste in terms of scaling factors. The first three techniques that you would consider for development of these scaling factors and they would be developed against cobalt in this particular instance, would be using smears, a crud scraping or total etch, and actually these three techniques have been used successfully at utilities who are decommissioning and the first two, the smear and the crud scraping, are used pretty extensively.

Once you develop your scaling factor, you need to determine what your real concentration of cobalt is because this first part here has given you what the actual mix of

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1 nuclides are. Then what you want to do is figure out just how much cobalt you have, so then  
2 you can figure out how much of the other nuclides you have.

3           There are two possibilities for doing this. One is the dose to curie -- and I would  
4 ask you to correct this on your slide -- the other is gamma spectrometry -- it is not  
5 spectroscopy -- in order to determine what the actual Cobalt-60 concentration is.

6           Once you have this information, now you can actually calibrate the pipe crawler  
7 that you are using so that you can calibrate it for the actual mix of nuclides that you have in the  
8 pipe itself.

9           Now I want to stress actually when you use this technique -- when you use these  
10 techniques you don't have to do this for every single pipe, okay? -- you really just have to do it  
11 on a small number of them so that you can get a comfortable feeling with the source term that  
12 you have developed. It is not something I am encouraging people to do everywhere.

13           As I say, in the development of scaling factors, the industry has been doing this  
14 since 1981 when 10 CFR 61 came out so we have a lot of experience with it. We know it is a  
15 good approach to use.

16           Now in the dose to curie what we wanted to look at was with the utility that had  
17 used the etch technique, which is an acid etch -- what you do is you take a piece of pipe. I am a  
18 little bit lost because I don't have a pen in my hand. Could I borrow yours, Nick? Thanks. Now I  
19 feel more comfortable.

20           In this particular case it was a bleed line pipe and it was a 3 inch diameter pipe,  
21 a 3.5 inch long piece of pipe, so they took a little slice out and the wall thickness of the pipe was  
22 a quarter of an inch. What they did was acid etch that particular piece of material and what they  
23 came out with were the results here -- the concentration of the nuclides and I picked out the  
24 more important nuclides for this particular presentation.

25           They also did a smear of that particular pipe before they actually did the acid  
etch, and when they developed what their concentration was in the pipe, they summed these

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two columns and came up with their activity sum here.

So their total was 4.71 E to the minus 2 microcuries per centimeter squared.

Now when we looked at this and wanted to use the dose to curie approach, as opposed to gamma spec, what we did was ask them for data on dose measurements, which they took for us at one foot and two foot intervals, and we took this mix of nuclides. We took this data and turned it into a relative concentration and relative amounts, and then what we did was put it into the microshield code and compared it with the doses that they gave us, okay?

What we found was that the actual, the concentration the microshield projected for this particular pipe was very similar to what the utility itself had gotten.

I am assuming you are riveted to this -- okay. Now one other thing that we wanted to do was we wanted to develop scaling factors also for these two, the smears and the etches that the utility collected and we did that just to see what kind of comparison we would get with the smear data versus the actual etch data, and as you can see from here it is actually very close, very similar data. Granted this is only one sample, but I thought it was significant and should point it out.

The last thing is if you look at the percent of total activity of these nuclides you will see, as I start off with my premise in the original opening of this presentation, that the majority of the activity is Cobalt-60.

Let's hope shorter is better. Okay. So, what my -- you know, and this is just the beginning of looking at this larger question, but at this point our feeling is that it is really important, as I said before, to develop a good source term. The methods that I have shown you so far, that I pointed out earlier in the paper, will really help you to calibrate the detector to the nuclide mix that you have in the pipe, and, as I said, it incorporates the same methods that we use for low level waste, that we have been doing since 1981, and also the calibration only needs to be done on a limited number of pipes. I really want to stress that. Okay. So hang with me here.

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1           As far as future work, looking at source term development, what we would like to  
2 is more of these dose to cure conversions, get a little bit larger database that we are presenting  
3 on this. We also would like to look at gamma spectrometry, and do the same kind of  
4 calculations and see how well they match up. And, also, we would like to do more in terms of  
5 verifying this smear and crud scraping to look at the similarities that you actually get there.  
6

7           So, I think we have a good approach here. I would be curious to have input  
8 from you. No, huh? Are there any questions at all from what I have presented, or pretty  
9 obvious?

10           MR. SAITO: Earl Saito, Combustion Engineering. I am a little confused, and  
11 maybe you can help me out. What you are trying to prove, if you look at the numbers you had  
12 up there, you are talking about a two feet -- about .9 millirem a day from this pipe. So that  
13 clearly will be over 15 millirem a year, if you are looking at just the pipe. So you want to know  
14 what is there, and then you will model the rest of it? I mean what is the end goal?  
15

16           MS. HORNIBROOK: You are trying to model -- you know, if it were left in the  
17 walls itself, what the contribution would be. And you bring out a good point, we didn't -- I didn't  
18 show the background, the subtraction that would occur for background. I just wanted to look at  
19 the initial numbers and not confuse it with that discussion. Okay.  
20

21           But what you are trying to do is get, for the building that is standing, to try to  
22 understand what exposure. So it is one component of the total dose modeling.

23           Man-Sung, would you want to add anything to that response?

24           MR. YIM: Well, I think if the question is more about the importance of what she  
25 just described, we usually have some samples of smears, or we have some samples from the  
crud, and, basically, that is all have, we have a concentration or some smear sample. And can  
we use those numbers to characterize your source term? What are the uncertainties you are  
talking about?

So we wanted to see if we can develop new approaches, the same approaches

1 that we use low level waste characterization and see that approach actually make sense with  
2 this embedded piping issue, too. And, basically, she demonstrated that makes sense. Low  
3 level waste characterization technique can also be applied to embedded piping.

4 MS. HORNIBROOK: And, also, when you are putting your pipe crawler through,  
5 you want to be able to calibrate that -- sorry. You want to be able to -- no, can't move that hand  
6 either. I feel those Irish dancers now, no moving the arms. You want to be able to calibrate that  
7 pipe crawler, you know, pretty reasonably, reasonably well.

8 MR. SAITO: Okay. So then the dose -- even though the dose from this pipe  
9 would be above the limit if this pipe was out in the middle of the room, you will then take that and  
10 use it in some future scenarios for this pipe will then get torn up and thrown somewhere else.  
11 Okay.

12 MS. HORNIBROOK: Right. Right. I am sorry if I was confusing on that. Good.  
13 That it? Okay. Very good. Thank you.

14 MR. ORLANDO: Thanks, Carol. The next couple of speakers are Bobby Eid  
15 from NRC and Man-Sun Yim from EPRI, and they are going to discuss the differences between  
16 D and D and RESRAD for modeling strontium-90 and cesium-137.

17 MR. EID: Good afternoon. I guess I do not need to introduce myself. I  
18 introduced myself this morning. However, if anybody is interested to contact me, I have  
19 provided here my phone number and my e-mail. I did not do that in this morning's presentation.

20 The title of the presentation is regarding the differences between DandD and  
21 RESRAD for dose modeling specifically for Sr-90 and cesium-137.

22 The presentation outline will be to give you some idea about the background  
23 behind the study and then the comparison of Sr-90 and cesium-137 dose values using default  
24 conditions for the two different codes, RESRAD and DandD.

25 Then also I would like to talk about dose analysis for specific pathways. This  
means what kind of contribution for different pathways in the dose modeling from these two

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codes.

Then to talk about the dose analysis using different input parameters specifically for DandD. In case we change the parameters, what kind of doses we obtain.

Then talk about two specific parameters which as a result of this study I found are quite sensitive parameters, specifically for Sr-90, the soil-to-plant transfer factor, which is found to be a significant parameter, and the distribution coefficient for cesium-137.

Then try to say something about the causes of anomalies which was pointed out in the previous workshop regarding the doses obtained for Sr-90 and cesium-137 using DandD version 1.0.

And then hopefully we'll have some conclusions and some suggestions.

To start with the background, I would just like to refer that Sandia in their report did the comparison between RESRAD and DandD screen, and Sandia in their report indicated that there are differences in the dose results about 15 times greater using DandD screen when you compare to RESRAD. So, yes, there are some differences already in the two codes.

Then also during, as I indicated during the previous workshop, the industry indicated that there are some anomalies in the values of Sr-90 and cesium-137, and they requested us to take a look at those values. So we did. We tried to do our homework.

What we did, we conducted detailed pathway analysis and assessment of DandD parameters input that we may think that they may impact the Sr-90 and cesium-137 dose values.

We also conducted comparative analysis of the parameters between RESRAD and DandD and some sensitivity analyses of those parameters.

I would like to take a step-by-step approach so you can understand, you know, this work and what kind of conclusions we can derive from this work.

The first step, we like to look at the two parameters at the two codes that we are having, RESRAD and DandD. And then we say okay, forget about the models, what kind of

parameters differences between these two codes. So if you look at, you know, possibly about 300 parameters, you will get lost. But you focus on the most sensitive and most important parameters, and that's what I did in this table.

First of all, the contaminated zone area for DandD, I'm talking now about the default values for the two codes, is 2,400 square meters, whereas in RESRAD it's 10,000 square meters. So you have a much larger area for RESRAD.

The contaminated zone thickness for DandD is assumed .15 meters or 15 centimeters, whereas in RESRAD it is assumed to be 2 meters.

The contaminated and unsaturated zone density, they are more or less somehow similar, 1.5 versus 1.43, so we do not worry about the density.

The contaminated zone and unsaturated zone porosity, somehow there are some similarities, .4 and .46.

The infiltration rate, there are two now in the models, the one model assumes there is infiltration rate. The other one assumes there is a precipitation rate. So RESRAD will assume that not everything precipitated will go through. So there is, you know, there are some differences somehow.

Anyway, the infiltration rate assumed in DandD model is .25 meters per year, whereas the precipitation rate, it is between parentheses (P), for RESRAD is 1.0 meters per year.

The irrigation rate, also they are somehow slightly different, DandD assumes the irrigation rate for the whole year, and RESRAD assumes there is a period of irrigation. And for the whole year the assumption in DandD is .47, whereas for RESRAD it is .2. So if you consider the irrigation time possibly you may find some similarities between the two codes.

The unsaturated zone thickness assumed in DandD is 1 and now anyway you could change also this value, whereas in RESRAD it is 4.0.

The dust loading factor is specifically for DandD is for gardening, it is .0004,



1 whereas for RESRAD it is .0001. So there is a factor of 4 higher for DandD, although they are  
2 treated differently in the two codes.

3 The soil-to-plant transfer factor, which is the one I'll be talking about, is quite  
4 significant, so comparing between RESRAD and DandD you will find some significant  
5 differences.  
6

7 For Sr-90, which is the first value on the left, for DandD it's 64. However for  
8 RESRAD it's .3.

9 For cesium-137 it is .018, whereas it's .04.

10 So we'll find some differences in the soil-to-plant transfer factors.

11 The plant mass-loading factor is .1. We believe this is still highly conservative in  
12 DandD, and we have general consensus that this value should be changed. Correct me if I'm  
13 wrong. This could be changed, right?  
14

15 The distribution coefficient, differences between the two codes, you can see that  
16 for Sr-90 it's 31, for RESRAD is 30, they are almost identical, so we do not have much  
17 differences.  
18

19 Now the distribution coefficient for cesium-137 is quite different. One is 10; the  
20 other one is 1,000. And I believe those are, you know, significant differences between the two  
21 codes.

22 So to make it simple, we need to see, assuming that the two models they are  
23 the same, what differences you expect because of the input parameters. I believe the first look  
24 you think that well, yes, the contaminated zone area is different, the contaminated zone  
25 thickness is different, those are the major differences, and the rest in these two physical  
parameters, the soil-to-plant transfer factor and the distribution coefficient.

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So then the next step is, try to have the source term related to the contaminated  
area and the thickness of the contaminated zone, make those identical somehow between the  
two codes, and then you go a step further and see what are the differences.

1                   So this is the comparison between the two codes. First of all using each code's  
2                   own default parameters. In the first two lines, for example, for cesium-137 I used DandD default  
3                   values and the results were 28.3 millirem per unit concentration, which is 1 picocurie per gram in  
4                   the soil. For RESRAD the value is using RESRAD default values it's 2.3. So you could see  
5                   there is significant difference between the two codes. For Sr-90 it is 59 versus 5, so there is one  
6                   order of magnitude difference in the doses.  
7

8                   Now the next step you say okay, try to vary the geometry of the contaminated  
9                   zone, make it .15 centimeters, you know, for RESRAD, try to be close to what DandD code they  
10                  have, and try to vary the thickness of the contaminated zone -- sorry, in addition also the  
11                  thickness of the unsaturated zone, make these variations to make them exactly the same. And  
12                  what kind of results do you get using these two codes? So the next two lines you could see the  
13                  differences that still DandD dose values per unit concentration, 28.3, and RESRAD slightly  
14                  reduced to .1, but the reduction in the dose is not that significant. So it did not really impact, you  
15                  know, varying the contaminated area impacted somehow the dose, but not that much.  
16

17                  For Sr-90 almost the same phenomena you find that you have 59.4 did not  
18                  change practically when you vary the thickness of the unsaturated zone and the area of the  
19                  contaminated area you will find the differences still they are somehow similar, although you  
20                  started to get some reduction in the dose for RESRAD because of the different area and the  
21                  different thickness.  
22

23                  Then we tried to think to say, okay, where is the problem? In order to analyze  
24                  the problem, you need to think about what are the major pathways they are impacting the dose,  
25                  or they are causing -- where the dose is coming from. So I try to look at D and D and RESRAD  
                    to see what are the major pathways using the peak dose for each code, regardless of the time.

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So the extent -- as you can see, if you look at the column with Sr-90 for D and D, the dose that is  
coming from agriculture pathway represent almost most of the dose, or the majority of the dose,  
which is 99.75.

1 If you look under RESRAD and look at Sr-90, you will find also the dose is  
2 coming from the agricultural pathway. So you will find consistency in the dose related to these  
3 pathways.

4 When you look at cesium-137, the story is different. So you find that the major  
5 dose for D and D is coming from the aquatic pathway, whereas, for RESRAD, the major dose is  
6 coming from external exposure pathway. They are completely two different pathways.

7 And then you start thinking, say, why you have these differences. The  
8 difference is because you have two different models, because you are having a model which  
9 allows very fast removal of the radionuclide or infiltration of the radionuclide to the aquatic or to  
10 the aquifer, because you have three box model, whereas, in RESRAD, it does allow for  
11 retardation in the unsaturated zone and in the aquifer, that is the major reason, is because  
12 actually RESRAD just delay the dose rather than try to reduce the dose. And I will demonstrate  
13 that in the next slide.

14 So the peak dose was actually, I believe, the first year or the first five years, in  
15 the first analysis. Now, I said I will look -- assume that after 100 years, what will happen. Do we  
16 have the same pathway, the same proportions of the dose related to those pathways, or we will  
17 find some differences?

18 If you look at the -- if you compare these pathways for D and D and RESRAD,  
19 you will, yes, the story is now is different after 100 years. So you have the proportions of the  
20 pathways that are from aquatic. All those, still it is high from D and D, however, you will find also  
21 some additional pathways, they start to appear, it is called irrigation pathways. However, for  
22 RESRAD, we are seeing more significant pathways now from, you know, from the drinking  
23 water, which is now the aquatic pathway and the drinking water pathway is becoming significant.

24 This means, you know, it took that time such that these pathways to become  
25 significant. So RESRAD, it deals with it in a way that will -- it will adjust for retardation and going  
through the unsaturated zone when it goes to the aquifer, whereas, in D and D, it goes much

1 faster to move the material from the contaminated zone to the aquifer, and that is the major  
2 reason.

3           Okay. The next step, we said, okay, let's try to look at what are these  
4 parameters, they cause, you know, differences in the doses. We looked at the -- certain  
5 parameters that we believe they could impact the dose, and, for example, the gardening dust,  
6 we try to change the gardening dust now looking at D and D code only, try to analyze what are  
7 the sensitive parameters. So the gardening dust, if you vary it by a factor of 10, you change --  
8 you have no changes in the dose. If you look at the third column, with the default values in  
9 those millirem, versus the last one, you will find the dose is the same practically.  
10

11           And now when you change the soil-to-plant transfer factor, you change it by  
12 only, you know, by having, instead of 64, to have it 32, then you will find the dose almost is  
13 reduced by that magnitude. So this means reduce by 50 percent, because you reduced the  
14 soil-to-plants -- to plant transfer factor by 50 percent.  
15

16           So, immediately, you could realize that how this factor is important and quite  
17 sensitive. If you vary it by a factor of 40, you will find somehow qualitatively similar kind of  
18 variation. So you are getting from 59 to 3.52. So, immediately, we realize that this is a  
19 significant factor. So this way, actually, this is also to demonstrate how can you vary your dose  
20 based on some kind of information. You look at these parameters, that they could impact the  
21 dose and then you start thinking about them. Are they highly conservative, not conservative,  
22 appropriate the site, inappropriate for the site? That is the way the source of dose analysis, you  
23 look at and try to change your pathways, and to look at the sensitive parameter.  
24

25           Then we looked at the partition coefficient for Sr-90. We find the partition  
coefficient is not that significant to change the dose for Sr-90. Remember, this is for Sr-90.

Now, the story, it could be different for cesium. Then change the number of zone layers, instead  
of one zone layer, make it 10 zone layers, you will find, you know, the differences, they are  
small. Still, you increase by a factor of about 1.5 percent of the dose.

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1 Then look at the fish bioaccumulation factor, you change it by, you know, you  
2 divide by two, then you find also not much differences. The unsaturated zone thickness, we vary  
3 it from meter to 10 meters, the dose did not really change much, is by 1 percent or 1.5 percent.  
4 The plant mass-loading factor for that case also did not change that much. So I guess these  
5 parameters will depend on the specific radionuclide. Certain parameters, they do impact the  
6 dose, but for that -- for the specific radionuclide, other parameters, they may not.

8 So now we look at the cesium and to see how the dose will change for the  
9 cesium. For the cesium, gardening dust did not change much the dose. The soil-to-plant  
10 transfer factor did not change much.

12 Now, the partition coefficient, or the distribution coefficient, which is the  $K_d$ , you  
13 can see that it is 10.5, it changed by a factor of 10. By order, one order of magnitude, you can  
14 see how significantly the dose changed. So, from 28.3 to 2.42 is one order of magnitude  
15 difference. So this means the partition coefficient for cesium, it is the -- one of the most  
16 significant and sensitive parameters when you try to assess the dose. This means you will go  
17 and review your input values, say, are they -- these values, they are good for the site, or they are  
18 conservative, not conservative, what are the bases for selection of those sensitive parameters?

20 Then try to change the number of zone layers. Again, there is some difference  
21 here in this case, as you can see, and the difference could be, you know, by about 10-15  
22 percent. So it is, there is a difference, but is not as much as the partition coefficient.

24 The fish bioaccumulation factor, you could see that the difference is not that  
25 much. There is some small difference. The unsaturated zone, it is significant thickness. So if  
you have unsaturated zone thick of one meter, and thin meters makes a big difference in your  
assumption and in the dose that you calculate. So that is another parameter that you need to  
consider when you look at the site-specific information in the dose impact analysis.

Then I tried to look at the plant mass-loading parameter. Again, did not, for that  
specific case, did not change it.

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1 From this analysis, so the conclusion that we need to pay attention to two  
2 specific parameters, the soil-to-plant transfer factor for Sr-90 and the distribution coefficient for  
3 cesium-137. So try to go, to take one step background and to see how this data, you know, was  
4 adopted.

5  
6 For the D and D Version 1, the value that was adopted and we look at it in the  
7 input parameters, and you will find that the value for Sr-90 to soil-to-plant transfer factor for leafy  
8 vegetable, it is 64. For other kind of food diet, it is very small, that is why not bother to take a  
9 look at it, and it will have less impact. Whereas, for leafy vegetables, it will have significant  
10 impact. So it is a significantly high value, which is 64, and the question, is this value is justified  
11 to be adopted as a default value or not? That is really the question which I will be discussing.

12  
13 We also looked at the old 5512 Volume 1, what kind of value that was  
14 recommended, and we called it -- this is the deterministic value based on best estimate or based  
15 on best judgment of the technical reviewers and the value that was selected is 1.6, so you can  
16 see a difference by a factor of 40 between the current value in the D and D Version 1 and the  
17 value in the original Volume of 5512, Volume 1.

18  
19 But you could say, well, they are two different now because the Volume 1 is not  
20 probabilistic whereas D and D, 1, the parameters were selected based on probabilistic  
21 approach.

22 Sandia submitted a letter report almost a year ago or more in order to look at the  
23 soil to plant transfer concentration factors. They provided data based on lots of literature values  
24 and they listed data where they had the mean value and the geometric standard deviation and  
25 the geometric standard deviation plus the two sigma value or the two variation in the geometric  
standard deviation, so these values, the mean is 1.8. If you compare 1.8 versus 1.6, you will  
find them very close. Actually those are comparable values.

26  
27 The question, if you use the mean value you will find some kind of result they  
are similar, but however we are not using the mean values. We are at minimum selecting the

1 probability distribution function to the 90th percentile value, and then it could be actually higher  
2 than the 90th percentile value.

3 Then in the SAR letter report also they provided frequency sample soil to plant  
4 parameter distributions for the SAR and the 90th percentile value for the specific radionuclide  
5 that was given -- now underline the 90th. It is 9.4 whereas currently we have in the code 64.  
6

7 Go back and look at RESRAD, what kind of default value input for RESRAD.  
8 The RESRAD default soil to plant transfer factor is .3 It is also I believe the value of selected  
9 base on best estimate, I believe -- correct me, Dr. Charlie, if I am wrong, I mean how this value  
10 was derived, so the value that is quoted from RESRAD is .3; this is 5.81.

11 The Sr-90 literature value -- leafy vegetables and forage plants transfer factors,  
12 these values they are listed from different references. You can see it for all of these references,  
13 Napier and Kennedy and Streng. This is the 5512, Volume 1, and those are significant  
14 references. They collected lots of data and the value that was proposed for them is 1.3 for the  
15 soil to plant transfer factor.  
16

17 NCRP values, IAEA and for different kind of references it is .86 so this will give  
18 you perspective when you compare the number and the kind of default value, 64 versus what  
19 are the common values in the literature.  
20

21 What I gave you -- remember, the current version of D and D is based on  
22 probabilistic selection, the 90th percentile or higher, whereas those are based on the best guess  
23 or best expert judgment, what is the best value to use in the dose impact analysis.

24 Okay. With this in mind we will move to the partition coefficient or distribution  
25 coefficient. The current version has partition coefficient for Cesium-137 of 10.5 milliliter per  
gram. The partition coefficient is the ratio between the concentration in the soil versus what you  
have concentration in the leached water.

RESRAD version 5.82 default values is 1000. See the differences. I believe it  
is a significant difference between 10 to 100, two orders of magnitude. In NUREG 5512,

1 Volume 1, which also was based on best estimate and tried to be conservative it is 272, so you  
2 could see the differences between currently what we have in D and D, Version 1, and what we  
3 proposed originally in 5512 based on deterministic assessment or best estimate of that value.

4  
5 In the January 30th letter report from Sandia they looked into the -- in detail into  
6 the distribution coefficient and they said they reviewed the data based on the best estimate of  
7 individual measurements of Kd values. They based it on best estimate and variability of small  
8 scale experimental measurements in the field and they provided those references and also  
9 based on 11,000 experiment-based on partition coefficient values.

10  
11 We have here lots of data on partition coefficient and those were used by the  
12 Nuclear Energy Agency, NEA, for its sorption database, so we have a sorption database.

13  
14 So the letter report adopted an approach to develop 1 PDF for each element  
15 based on all data available. Now the current approach and the methodology to develop the  
16 default value, you do not differentiate between soil type, you don't differentiate between one  
17 geochemical condition which was raised this morning about the pH value. The data was  
18 reported that is an extreme -- you have pH value of 2 or 1.0 that causes immediate leach of the  
19 material, so you consider all kind of conditions, all kind of data available in the literature and you  
20 try to establish the PDF for partition coefficient.

21  
22 In the letter report the presentation was to propose radionuclide partition  
23 coefficient for Cesium-137, then they said look at the sample, the number of samples that we  
24 have, 564 samples, and to use the data source. I believe Sheppard and Thibault are the major  
25 contributors to the distribution coefficient literature values, and they looked at the sorption  
database and it was concluded out of this that the mean Kd value is 447 and the standard  
deviation, 10.2, and the variance is 10.5.

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Also it was indicated that the best estimate for Cesium-137 value range, this is  
the range -- you have high values and low values -- from the repository performance  
assessment study and the reference to McKinkley in 1991 and he did lots of work on the



1 distribution coefficient and he proposed the value range, the high and low values to be between  
2 100 and 10,000.

3 Remember, we have current in the D and D screen the value of 10, so we are  
4 more conservative by one order of magnitude considering the low value or the low range value.  
5

6 Also in the letter report the report presented cumulative frequency of sample Kd  
7 values and this curve showed that the 95th percentile, which here the 50th percentile, this  
8 means to be highly conservative in this case here, so you convert it -- 100, take away 5 and then  
9 it will be at the 95th percentile. You have a value of about 9, so currently the value that we have  
10 in D and D code does not represent the 90th percentile value for the specific radionuclide.  
11 However it represents almost the 95th percentile value for the distribution.  
12

13 The 10th percentile value, which is now converted -- it will become the 90th  
14 percentile value. It is 30 milliliter per gram so if we need to add up the concept of using the 90th  
15 percentile value, assuming you have one single radionuclide, not the rest of the radionuclides,  
16 the value to you is as a default it is highly conservative, the 90th percentile level is 30 milliliters  
17 per gram, it is not 10, so you have at least a factor of three.  
18

19 Of course the least conservative one is 10,000. This is not to say something  
20 about RESRAD but it looks like RESRAD is using 1000 and now the question whether it is --  
21 whether it is conservative or not -- you may argue that, so I believe maybe the values should be  
22 higher than what RESRAD -- sorry, lower than what RESRAD is here, whereas for D and D,  
23 because we are going to the extreme to make it highly conservative value.  
24

25 Now we go back to the issue of what causes these differences in doses and  
what causes to have 1 picocurie per gram of Sr-90 in the soil, correspond to 60 millirem dose. Is  
this really realistic or is it because of the current methodology that we are using?

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So based on the review of the Sr-90 default dose values, as you recall soil to  
plant transfer factor in D and D Version 1 it appears that the current concentration ratio, which  
gives you for every unit concentration will get about 60 millirem and this is much larger than the

1 upper 90th percentile, so we looked at the 90th percentile value for assuming you have single  
2 radionuclide, which is Sr-90 only, and assuming those, so even by doing that you will find that at  
3 the 90th percentile value you do not get a dose of 60 millirem, you get a dose of about 15  
4 millirem, so there is a factor of four or there is somehow excessive or extra conservatism in the  
5 current model because of the process, the procedure for using those parameters by minimum  
6 for this case, a factor of four.

8 When we look at cesium we will find also the same thing that for Cesium-137  
9 the dose conversion factor or the concentration ratio it is 28.3 millirem per unit concentration.  
10 However, this corresponds actually to the 95th percentile of the dose for when you have one  
11 single radionuclide, so the 90th percentile of the dose when you have single radionuclide it's  
12 actually 2.3, not 28.3. This means you are having extra conservatism because the process and  
13 the methodology by one order of magnitude.

15 Okay. What are the causes. The causes, yes, you have numbers that input  
16 parameters, that they were inputted to the code based on the current methodology that you  
17 select that they produce those which is very high and the current default dose, the anomalies,  
18 they are mainly due to the artifact in the current methodology used in D and D Version 1.0 to  
19 select a solution representing a single default parameter set for all radionuclides. That is the  
20 crux of the point.

22 We are assuming the source term not in the single radionuclide -- all  
23 radionuclide. We try to ensure that any radionuclide on the list that we have it is guaranteed that  
24 it should be above 90th percentile value so maybe you will find for a few radionuclides they are  
25 causing this dose to be exceeded, and you do not have it at your site, you are actually getting  
higher dose because of those radionuclides.

ADN But understand the screening methodology and we are trying to see where is  
RIL the extra conservatism in the screening methodology. As Walt indicated this morning, we hope  
EY that the Version 2 will resolve this problem.  
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1           These dose anomalies can be minimized, as I said, using Monte Carlo version  
2 code, Version 2.0, by having input of the specific radionuclide or mixture of radionuclides that  
3 you have at the site. Also it can be improved -- it could be an improvement in the current  
4 approach in the statistical measure used to select the solution vector. We try to rethink also how  
5 you select the solution vector in establishing the default parameters for D and D Version 2.  
6

7           Also we hope that certain parameters also will be changed. As I said, mass  
8 loading factor for the plant hopefully will change those, also the resuspension factor if we come  
9 to some kind of solid ground that we say yes, we need to move forward to change the  
10 resuspension factor. Those will be changed hopefully in Version 2 plus other parameters that we  
11 find that we have some extra conservative numbers.  
12

13           Conclusions and suggestions -- the anomalies in Sr-90 and Cesium-137 in D  
14 and D Version 1.0, they are primarily due to artifact, as I said, in the methodology, so please  
15 when you give those values do not be scared -- it's just a screening process. We are working on  
16 it. Most likely that the dose that you will get does not represent the real dose that you have at  
17 the site.  
18

19           The major parameters influencing the dose for Sr-90 and Cesium-137 when you  
20 try to look into it, the specific parameters for the site, you need to pay attention to the soil to plant  
21 transfer factor and the distribution of partition coefficient factor that you may have for the site,  
22 and you could change the dose significantly.  
23

24           Comparing Sr-90 and Cesium-137, dose values using D and D and RESRAD,  
25 they show that the D and D values, they are significantly higher than RESRAD currently as is in  
the version. However, comparable dose values were obtained when similar input values were  
used. Now we are talking only about these two radionuclide. When you vary the parameters,  
specifically distribution coefficient for cesium and the soil to plant transfer factor for Sr-90, you  
will have somehow comparable results. Although the models and the codes they are different  
for that specific case when you try to have a source term which is similar in the area and in the

1 thickness, you will have it somehow similar to this.

2 And this is not unusual. You expect it because both of them use somehow  
3 similar pathways, all pathways and also they use the same dose conversion factors, and the  
4 difference in the factors are not that great, so you actually expect to see those results, although  
5 you will find the dose sometimes earlier is coming in D and D whereas it is coming, picking up  
6 later in RESRAD because of the nature of the difference between the three box model versus  
7 what is called the pulse release model in RESRAD.  
8

9 In reviewing input parameters distribution it is suggested to consider Sr-90 soil  
10 to plant transfer factor as a sensitive parameter. Currently I believe -- Walt, correct me if I am  
11 wrong -- the soil to plant transfer factor is not considered a sensitive parameter -- some consider  
12 it a sensitive parameter because it does impact the dose.  
13

14 Finally, the floor is open for any questions.

15 MR. PETERSON: Harold Peterson, Department of Energy. I have a couple of  
16 questions.

17 One, your accumulation factor for fish, for cesium, from .002 I think and .0002  
18 are lower than anything I have ever seen. The lowest cesium accumulation factor that I am  
19 familiar with is in the range of 10 to 30 for marine fish and up to 44,000 for fresh water fish. Reg  
20 Guide 1109 uses 2000, so I think you might want to check that value. It almost looks like the  
21 concentration per gram divided by the concentration per kilogram in water, to get that number.  
22 Do you see the bioaccumulation factor there?  
23

24 As I said, that should be in probably for marine fish something in the  
25 neighborhood of 10 to 30 and for freshwater fish Reg Guide 1109 would use 2000 and it could  
be as high as four or five thousand.

MR. YIM: As a side comment, Mr. Yim from North Carolina State University.

MR. PETERSON: Excuse me?

MR. YIM: Both uses 2000.

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1 MR. PETERSON: RESRAD, right -- RESRAD follows, uses the parameters  
2 from Reg Guide 1109.

3 MR. YIM: I apologize. This is a typo.

4 MR. PETERSON: Okay, well, I am just pointing that out and --

5 MR. EID: It should be two times to the power --

6 MR. PETERSON: The comparison too of the soil bioaccumulation factor, again  
7 RESRAD follows Reg Guide 1109 and uses the value for wet weight, where your numbers are  
8 the value for dry weight. That could easily be a factor of five.

9 MR. EID: I am talking here about dry weight, okay? This is -- I converted those  
10 based on the dry weight.

11 MR. PETERSON: Right. But RESRAD isn't. RESRAD follows Reg Guide 1109.  
12 The BIV in 1109 is per gram of wet weight.

13 MR. EID: Okay, so the -- you need to multiply by a factor of four in this case?

14 MR. PETERSON: Factor of four or factor of five.

15 MR. EID: That's correct.

16 MR. PETERSON: If you want to include tomatoes it is a factor of 20.

17 MR. EID: If you multiply .3, I believe for RESRAD it is .3 -- multiply by a factor of  
18 four is 1.2. This means you will find consistency between actually NUREG 5512 Volume 1 and  
19 all of the rest of the values, so thank you for this point.

20 MR. POTTER: My name is Tom Potter and I think the problems that you have  
21 explored today are symptomatic on a microcosmic scale of the kinds of problems we are going  
22 to be pursuing in the future when we have the opportunity to go through this exercise at the  
23 same time deconvolving the various probabilistic distributions that we have used for various  
24 parameters.

25 I raise this question, second question, in connection with the importance of Kd  
here. The Sandia letter report seemed to lump all the Kd literature together to form one

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1 distribution and when I read that I sort of questioned it from two standpoints.

2 One is a lot of the literature data like the TBO and some of that literature that  
3 broke it out by soil type, identified distributions that clearly did not overlap, and if that is the case  
4 we ought to be maintaining that distinction.

5 I haven't done much in the way of Kd measurement but I do have some  
6 experience with radioactive material spills I am not particularly proud of, but my experience is  
7 that for a variety of nuclides they seem to run through sand a lot better than clay, and I wonder if  
8 we ought to be trying to maintain this knowledge.

9 The problem of lumping all the data together is you get very broad distributions  
10 and you are basically driven to a site-specific research project for Kd.

11 MR. EID: Well, the answer to this question, I tried to point out two issues. One  
12 issue that the current methodology that we have in D and D 1.0, that we do consider it is not just  
13 only what is the Kd value for that specific radionuclide. It is what kind of radionuclide we took  
14 into consideration when we established the PDF curve to select the 90th percentile.

15 I believe that is one issue and this needs to be corrected, so if you have only  
16 Sr-90 for your site you do not need to be penalized because the D and D considered other  
17 radionuclides. Although I acknowledge that, we say that it is a screening problem, okay, and  
18 that is the methodology currently.

19 But also we agree that it is an artifact of the methodology that the code will give  
20 you higher doses because of consideration of other potential of having other kinds of  
21 radionuclides in the source. That is one issue.

22 The next issue is you need to look at the uncertainty in the values of Kd and the  
23 Kd values is true for the site that for soil is different than clay is different than loamy soil so there  
24 are some significant differences. Kd values also depend on geochemical conditions. If you  
25 have a pH value of one, two or three it is different than when you have neutral conditions. It also  
is impacted by the oxidation reduction conditions at the site. It is also impacted by the

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1 particulate size of the formation that you have, so there are so many factors that you have.

2           The question is when you try to determine Kd for the site if you have the soil  
3 which is different. You do not have one uniform soil if it is sandy soil for the site, so currently  
4 more or less the Kd value you assume that you have more or less sandy soil because we try to  
5 be conservative because of the screening process, so I agree with you that the Kd value should  
6 not be taken as a single value.  
7

8           The first thing you need to take a look at -- what is the characteristics of the Kd  
9 value that compares to your site conditions, so that is a very, very significant and important  
10 parameter, and this is the example for Cesium-137, so either you try to say, okay I'll need to use  
11 surrogate data based on literature value that you have for example sandy clay soil and you know  
12 this is the majority of the site who have sandy clay soil.  
13

14           You go back and say I have a nuclear condition at my site. You look at the  
15 literature value based on experimental result determination that the Kd value for that specific  
16 radionuclide is such and such value.

17           So NRC staff, when you provide this value and this rationale for selecting your  
18 value, although it did not determine that specifically for the site, so maybe it could be acceptable,  
19 because you demonstrate that your sole pipe is different than what was proposed.  
20

21           So I agree with you, you need to take a look at your site-specific conditions and  
22 then try to analyze what is the best Kd value that's appropriate for your site.

23           The next question?

24           MR. LITTLEFIELD: Pete Littlefield, Duke Engineering.

25           There are some of us out there now decommissioning sites which started when  
we had nothing else available to us except NUREG-5512 and RESRAD, and I just ask that when  
we get to the point we're actually demonstrating that our sites meet the dose criteria that the  
NRC will remember the discussions that we're having today relative to the progress that we're  
making in trying to define these parameters, because it's very difficult for us to be deciding on a

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1 day-to-day basis what we ought to be using for parameters for our determining dose guideline  
2 levels and our dose assessments.

3 MR. EID: Thank you for the comment. I think we should hear what you are  
4 saying.  
5

6 MR. SEXTON: Dick Sexton. I guess a followup on that. I'm with Connecticut  
7 Yankee, and we're in the process of selecting a decommissioning operations contractor, better  
8 known as a DOC, and this uncertainty that is being discussed relative to the modeling is one that  
9 I'm really struggling with both from evaluating the likely performance of that DOC, and I wonder  
10 about what is the DOC using to evaluate the cost of cleaning up these sites. If they don't know  
11 what model they have to use or what will be acceptable, I really -- I'm wondering what are they --  
12 how are they estimating their cost.  
13

14 Again in the reactor decommissioning clearly the one fairly attractive model is  
15 for a fixed-bid contract, and without these models to go forward and allow the commercial  
16 decommissioning community to make some assessment on risk and how clean they have to  
17 clean the site up, I think this is something that needs to be addressed in a fairly succinct manner,  
18 and I guess I would ask if you have any words about what both a utility and a DOC today would  
19 do to make those assessments as to how clean the site has to be.  
20

21 MR. EID: You are raising a very important question and issue about the cost of  
22 cleaning, because when you try to estimate the cost for cleaning your site, you want to think  
23 about what kind of DCGLs you need to meet. And the way to find the DCGLs is to use dose  
24 modeling. That's the facts of life. You have 25 millirem and you do not go and measure in the  
25 field 25 millirem to measure concentration. So I guess the crucial issue is how you try to  
determine your DCGL.

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The way that we have it now and the reason for this presentation we say okay,  
we have a very conservative model that is available, a tool to use, which is DandD version 1.0.  
Now we said this is only for these purposes, for the next two years, already almost a year past,



1 and try to evaluate the model and the code. That's what the Commission told us to do, trying to  
2 evaluate the input parameters, to evaluate the conservatism in the code.

3 The reason for this presentation we are telling you yes, there are some  
4 conservatisms in the code, and I'm trying to point out those. So this means you do not try to run  
5 the code and say yes, I believe what is there and I need to take these values and establish my  
6 DCGLs and take it to the field and the contractor and ask your contractor based on the current  
7 version say clean up to that level and calculate the cost for me.

9 For example, if you say, you know, we take this example, cesium-137. You say  
10 from these values that you need to clean up to -- sorry, not cesium, take strontium, for example,  
11 to .5 picocuries roughly per gram of the soil.

12 Now what we are saying, there is an excessive conservatism already in the  
13 model that you have, and you try to do something else. Not try to go and estimate your cost  
14 based on that. This is only a screening tool. It is highly conservative, and even in the  
15 methodology we have artifact in the dose estimate. That's exactly what we are telling you here,  
16 and that's the purpose of the workshop.

18 So please don't do that and calculate your cost based on, you know, on the  
19 current values that you have -- to derive. Try to do more. Try to consult with the staff. Try to  
20 see what is the realistic value for releasing the site, to establish the DCGL value.

22 So my advice is don't take currently whatever is in the code. It is under test  
23 conditions now. And try to calculate your cost for remediation, take, you know, one step further.  
24 Try to assess more realistically the dose that you have at your site. In order to be more precise  
25 in estimating how much -- how clean is clean and how much it's going to cost you to clean the  
site.

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Harold?

MR. PETERSON: Yes, Harold Peterson from DOE again.

I'd just like to reemphasize something Tom Potter brought up, and that's the

1 problem of the variabilities of environmental parameters. And one thing to be remembered is  
2 that they are not random variables. They depend on environmental conditions. And if you can  
3 get the conditions specific to a site, you can considerably reduce the uncertainty in the dose  
4 estimates derived from those parameters compared to a broad distribution.  
5

6 And the other thing related to that is it's all too easy these days to throw three or  
7 four points into a computer and it will fit a distribution to those points, and in many cases we  
8 don't have enough data to characterize the statistical distribution of the parameters that we're  
9 using. So --

10 MR. EID: I agree with you.

11 MR. BEYELER: I'm Walt Beyeler from Sandia.

12 I just wanted to mention with respect to the Kd distribution, we did in fact look at  
13 the potential for defining separate distributions depending on soil classification from the  
14 Sheppard & Thibault data, and the statistical analysis suggested that as a group there was not a  
15 distinct set of distributions for clayey soil conditions versus sandy soil conditions. I understand  
16 this is counterintuitive. But that was the -- we did in fact look at that and made that conclusions.  
17

18 That might be something worth revisiting, and it might be a question as to  
19 whether for particular elements the Kd is demonstrably sensitive to a soil classification, whereas  
20 for particular elements it isn't. But in any case I wanted to mention that that was something that  
21 we did look at. There may be other classifiers such as pH that would be useful in helping define  
22 a narrower distribution of Kd's for a particular range.  
23

24 MR. EID: Thank you.

25 MR. POTTER: Tom Potter. If I could address that just quickly. The problem is  
that that work is not very visible to us, and if we do go to the literature of that values of  
distributions there clearly is not a lot of overlap in those distributions, which seems to be in  
conflict with the conclusions that you're reaching. So there must be a disconnect there  
somewhere.

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1 MR. BEYELER: Yes, and I think it's something that we do need to look at, and  
2 again my intuition might be that there is a distinction for particular elements, but there may not  
3 be for all elements, and --

4 MR. EID: Thanks.

5 DR. YU: Charlie Yu, Argonne National Laboratory.

6 Bobby, I have a question on the -- your peak dose for cesium-137, what is the  
7 peak dose time, what time did the peak dose occur?

8 Also, why the fish dose is a dominant pathway for cesium-137, how do you  
9 calculate the fish dose? If fish dose is the dominant pathway, why when you do the sensitivity  
10 analysis it doesn't show that? When you change the bioaccumulation by a factor of ten, why the  
11 dose is not changed by a factor of ten.

12 MR. EID: Okay. The answer to the first question I do not remember exactly the  
13 peak dose, but I believe --

14 DR. YU: Time zero.

15 MR. EID: About, you know, zero time, I believe. Yes, that's correct.

16 DR. YU: Okay. If it's time zero --

17 MR. EID: It's about time zero or the first year, I would say.

18 DR. YU: If it occurs at time zero, how do you calculate the fish concentration?  
19 Does the water reach the pond?

20 MR. EID: Because the model in DandD, it will have three box models, very  
21 simple model, will allow you directly to leach the material and to go to the aquifer and then to the  
22 pathway for, you know, the water pathway.

23 DR. YU: So it doesn't matter how thick your unsaturated zone is, ten meters,  
24 one meter, it doesn't matter?

25 MR. EID: I tried to change the thickness and did not change it in that specific  
case. Changed it slightly, but not that much.

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1 DR. YU: Okay. Then the second question is why when you do the sensitivity  
2 analysis it doesn't show that. When you reduce the bioaccumulation factor by a factor of ten, the  
3 dose is not reduced by a factor of ten.

4 MR. EID: That's a good question I did not investigate. I will look into that.

5 DR. YU: Thank you.

6 MR. EID: Thank you.

7 MR. SEXTON: Dick Sexton, Connecticut Yankee. Just one other comment.  
8  
9 When you're performing the sensitivity analysis and also making some assessments on the  
10 probability distribution, is there any consideration for the ALARA analysis and the resulting  
11 cleanup activities and the risk associated with that? How does that get factored into these  
12 decisions?

13  
14 MR. EID: For this specific exercise I did not look into ALARA and how it's going  
15 to be tied up with the cleanup. Possibly you could talk tomorrow about it. So I cannot talk too  
16 much about ALARA at the present time. But I believe the two together they should be, I agree  
17 with you, when you try to decide what kind of cleanup levels that you have, you need to look into  
18 the ALARA at the same time.

19 Henry?

20 MR. MORTON: Yes. Henry Morton. Yes.

21  
22 There are a couple or three things here. One, I think this groundwater pathway  
23 model illustrates the complexity of these things pretty well in that when we tend to think in terms  
24 of the conservatism being in one direction only, that is, as we vary the value of the parameter,  
25 for example, Kd in one direction, we assume -- we may tend to assume that you'll move toward  
the peak dose, but for example in terms of Kd, keep the Kd high enough, the cesium's going to  
set on top of the ground, in effect, and deliver the external dose. If it's low enough, then it'll tend  
to move to the groundwater.

But the magnification of the effect of Kd is, for example, when you go to thinking

1 about the differences between very sandy soil and the clay soil, is not dependent alone on the  
2 Kd, but since the sandy soil will tend to have a higher transmissivity than the clay, that  
3 movement of the water will tend to make that move faster as well. So it seems to me that it's not  
4 a simple separation of these variables to get a clear answer out of it in some of these cases.  
5

6 MR. EID: That's correct, Henry, we are trying to simplify the analysis now by  
7 taking one single parameter at a time, but typically when you do the sensitivity analysis, you  
8 combine all parameters to see when they are combined together what kind of dose distribution  
9 that you get. So in this case it is simplified analysis just to identify the most sensitive parameters  
10 that could impact the dose.

11 Any more questions?

12 Okay. Thank you.

13 MR. ORLANDO: According to the schedule, we are supposed to have a break  
14 at 2:15, but I would like to keep going, because, clearly, you all are not falling asleep or anything,  
15 given the quality of some of those comments. So I would like for Dr. Yim to go ahead and do his  
16 presentation and then we will take our break at 2:30 or quarter to 3:00, whatever it is.  
17

18 MR. EID: I would like to introduce to Dr. Man-Sung and Dr. Man-Sung is a  
19 professor, University of South Carolina, right?  
20

21 MR. YIM: North Carolina State.

22 MR. EID: North Carolina, sorry. And -- south and north, they are the same for  
23 me. And Dr. Man-Sung, he works for EPRI and we tried to do piece of the work that he did, and  
24 he did also the other piece, tried to exchange information to see, based on this exercise, what  
25 kind of data we have, are they -- we are getting the same data or different results. If it is  
different, we -- you know, we like to investigate it. Still, I have not look at his data, by the way.

So, Dr. Man-Sung will give his presentation almost on the same issue, but I believe, talking to  
him, he said he looked into iodine-129 in addition to these radionuclides. So we will hear from  
Dr. Man-Sung.

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1 MR. YIM: By the way, Man-Sung is my first name. Y-i-m is my last name,  
2 Man-Sung is my first name. People always confuse.

3 I work for EPRI as a contractor, so the program says I am representing EPRI,  
4 but I don't think EPRI would be happy to hear that. I want to put a little disclaimer of this,  
5 because the result I put in in my presentation is really a last minute work. For example, the code  
6 I am running for probabilistic D and D code, I got it really very recently, almost last minute work  
7 again. We had to compile it and we had to figure out to put inputs and how to read outputs and  
8 so on.

9  
10 So, and then my original goal was for the probabilistic RESRAD analysis, I was  
11 hoping to have enough information for inputs that is going into D and D and use the same  
12 information for RESRAD to try to make some comparisons, but I found that they were a lot more  
13 involved in that, so -- involved in that work, so what I am presenting is really tentative findings at  
14 this point.

15  
16 I want to start out with this table. As we saw Bobby showed the difference  
17 between the difference between the two codes. If you use one picocurie per gram, you need  
18 concentration in soil and use D and D 1.0 and then RESRAD 5.82, and you get this much  
19 difference, more than a factor of 10 difference. And Bobby showed where are those differences  
20 here. Basically, you have a big dose coming from external gamma for cesium for RESRAD, but  
21 then for D and D, you have a big dose coming from aquatic food pathway, which is basically fish  
22 consumption. Yes?

23  
24 MR. BHAT: I am fundamentally ignorant on it. Can you tell me where the  
25 difference would be?

MR. YIM: Could you use the microphone, please?

MR. BHAT: I am fundamentally ignorant of the basic difference and  
assumptions between D and D and RESRAD.

MR. YIM: That is what I was going to get into.

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1 MR. BHAT: Oh, I see.

2 MR. YIM: So, if you wait just one second. Well, at least we know what D and D  
3 1.1 -- 1.0 is, you know, what RESRAD 5.82 is. And Dr. Yu asked Bobby about why getting this  
4 high dose from D and D 1.0. And that, I think -- and I am going to actually explain those things  
5 here. I think it is the combinations of the parameters that you are using and the difference in the  
6 model, combinations of both. And then when I say difference in the model, what are the main  
7 differences between RESRAD and D and D? Actually, I was going to put some information on  
8 this, but maybe not now. Maybe in other workshops when I have more conclusive findings.

9  
10 But the main difference at this point we can say is D and D, as we heard, use a  
11 very simple three box model and basically you get into the aquifer region, there is no dilution of  
12 plume. You have put in some concentration into the aquifer, and then you will get the same  
13 concentration of materials out from the well. And at the same time, any of the surface water  
14 attached to this aquifer will have exactly the same concentration of whatever contaminant in the  
15 aquifer.  
16

17 So the fish, for living in the surface water, they are exposed to the same  
18 concentration the groundwater. So if you have enough bioaccumulation factor working for you,  
19 you will have, obviously, a lot of concentration in the fish, by the fish, and if you eat fish enough,  
20 then you will get high dose.  
21

22 So it is a combination of those modeling issues and then the bioaccumulation  
23 factor. By the way, for cesium, both RESRAD and D and D uses 2000, so it the same  
24 bioaccumulation factor, but the number is high enough, compared to other nuclides, so it may  
25 have an impact. Obviously, it will have an impact.

So what I did here was take a different twist approach, what if you use exactly  
the same input of RESRAD 5.82 and one -- D and D 1.0? And D and D gives very close  
numbers to what RESRAD produces. So this means maybe it is really the parameters that  
controls this whole thing, right. Almost identical, 2.29 versus 2.63. But then here you still have

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1 this contribution from aquatic pathway.

2 By the way, this is external gamma, this is inhalation dose, this is agricultural  
3 food dose, and this is water independent, okay. Soil ingestion dose. Up to this is all water  
4 independent dose, and the bottom three are water-dependent pathways mainly coming from  
5 groundwater transport.  
6

7 We do the same thing. Now you use RESRAD and then you use D and D  
8 default parameters, okay. So if you have a problem with D and D default parameters, that  
9 should show up. And that is -- I'll give it to you, it is shown here. Not really, I am sorry. Well,  
10 you use D and D input parameters and then you use RESRAD. Basically, you have -- yeah,  
11 external gamma still dominating, and then a little bit more agricultural food, but you don't really  
12 have this problem. So this indicates maybe the difference between the model. It is not just the  
13 parameters, but maybe the difference in the model, as we just discussed. There is no dilution in  
14 the aquifer, and assumptions we are making, surface water and groundwater have identical  
15 concentration, et cetera.  
16

17 Now, Bobby had said if you use probabilistic D and D code, you may get realistic  
18 results compared to D and D 1.01 -- I mean 1.0. So that is what I did. You run probabilistic D  
19 and D code. This is all default. I am not changing any parameters, I am just using what is  
20 provided, and then the dose predicted from the probabilistic D and D code is very close to what  
21 RESRAD produces, or what D and D produces with RESRAD input, just because we are using  
22 more realistic representation of parameters.  
23

24 If I use RESRAD probabilistic or it what it called uncertainty add in, again, that  
25 number is very close to this. One caveat to this, RESRAD probabilistic analysis and D and D  
both, it is very tricky. At this point I think RESRAD probabilistic analysis code is hard to use in  
some sense. It has user friendly features, but unless we are given prior information, you don't  
know what to expect. There is certain limit that you can change, number of parameters, they  
can vary. There are limits on your sampling, number of realizations. And without having those

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1 information with you up-front, you are just trying everything out of blue, trial and error. If you are  
2 lucky, you will make it. If you don't, you will not make it.

3 But then later I found that it is up to 17 parameters that you can change and up  
4 to a hundred realizations you can do in your sampling with RESRAD uncertainty add in. But  
5 then that is maybe not 100 percent true for some nuclides, at least that is my experience. And  
6 the code is very -- at this point, the interface of the code with the rest of the system in the  
7 computer is very unstable. Interface is probably just not good, so at some times the computer  
8 says, no, it just cannot do it.

9  
10 But what I heard, actually, yesterday from Dr. Yu, Charlie Yu, is they are working  
11 on this, and they will produce a revised version of uncertainty analysis code for RESRAD.

12 One more thing, when we say probabilistic analysis, I am putting standard  
13 deviation information, and you may wonder if you have mean value of 2.6 and standard  
14 deviation of 6-point-something, you are getting negative values, and that is just an artifact.  
15 Basically, you are getting something like this, load normal distribution, and we should use  
16 geometric standard deviation. I am just simply using a standard deviation.

17  
18 DR. YU: This is Charlie Yu. Can I ask you a quick question on previous slides?

19 MR. YIM: Yes. You mean the picture?

20 DR. YU: No, no. The --

21 MR. YIM: Cesium.

22 DR. YU: The table.

23 MR. YIM: Okay.

24 DR. YU: The fourth column D and D using RESRAD input parameters for fish  
25 dose, how did you guess so low dose, what have you done to run D and D?

MR. YIM: You mean why are we not getting any fish dose here?

DR. YU: The previous column, the left column.

MR. YIM: Right here?

1 DR. YU: Yeah.

2 MR. YIM: Why are we getting such a low dose?

3 DR. YU: 10 to the minus 6, right.

4 MR. YIM: Well, I guess that is -- you may have enough -- that's D and D, it is D  
5 and D. So you still get some contribution, right, you still get some contribution. For the aquatic  
6 pathway, D and D assumes there is no dilution.

7  
8 There is difference between D and D and RESRAD for the Kd value, that may  
9 be the reason. D and D uses 10-point-something, right, and RESRAD uses 1,000, it is a much  
10 higher Kd value. So you probably have much already significantly diluted concentration in the  
11 aquifer, so maybe the fish is exposed to relatively low concentration.

12  
13 DR. YU: So D and D code also use the Kd to control the radionuclide leach to  
14 groundwater?

15 MR. YIM: Yes. In the unsaturated zone and in the contaminated zone, they still  
16 use Kd. So you will get some dilution and, you know, retardation in the contamination zone and  
17 unsaturated zone even with D and D.

18 DR. YU: Okay.

19  
20 MR. EID: If the factor of 100, I mean there is two other magnitude difference  
21 between the distribution coefficient of RESRAD and D and D, and RESRAD, if the default value  
22 is 1,000, so when he input 1,000, instead of 10 in the current code, and then you could see the  
23 difference such that you will have retardation, although you have thick zone, but, still, it will  
24 account for the retardation when you put this value.

25 DR. YU: I see.

MR. EID: It is becoming now more significant.

DR. YU: Thank you for explanation, but I want to make one comment. Maybe  
this is appropriate time to make the comment.

Suppose the site measured the Kd. The Kd is 1,000. But DandD, you still insist to use 10. This

1 will generate results showing the dominant pathways, fish pathway, which is incorrect.

2 MR. EID: Well, I think we are talking about now site-specific analysis. There  
3 are screening analysis and site-specific analysis. When you say that you measure it for the site  
4 and you find it 1,000, and you are having 10, this means you have justification for changing that  
5 parameter. The question is how you change it currently in version 1. That's the issue. But you  
6 do need to change it, of course, because you have site-specific parameters that are different  
7 from the default value.  
8

9 DR. YU: Okay. Now does the licensee have the option to turn off the pathway if  
10 he can show that we don't have a pond on site? Can they turn off the fish pathway? In other  
11 words, they just consider all other pathways and based on your parameters if they turn off the  
12 fish pathway, they can get a very low dose and very high cleanup soil, cleanup --  
13

14 MR. EID: I'm not sure if it is possible currently.

15 Walt, can you elaborate that? That if you can eliminate certain pathways  
16 currently in DandD codes?  
17

18 MR. BEYELER: Walt Beyeler from Sandia.

19 There isn't a switch that will turn the pathways off, although there are certain  
20 combinations of parameters that have that effect.

21 MR. EID: So in other words you could put very low values or zero values for  
22 those parameters impacting the pathway.

23 DR. YU: I think my point is that if they can do that, they can turn off the fish  
24 pathway, but your code will show that the external dose is not a dominant pathway, you will get a  
25 very low dose.

Do you know what I'm trying to get?

MR. EID: Yes.

DR. YU: So essentially the licensee can show that we don't have a pond, we  
can get much higher soil cleanup criteria, which may not be true, which may not be right.

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1 MR. EID: Current dose becomes important with even DandD if you use  
2 RESRAD, that's 70 percent.

3 DR. YU: Anyway, let me go through the rest of the stuff.

4 For the cesium, Bobby already mentioned that soil-to-plant transfer is the  
5 important parameter here, and as we can see, it's agricultural food, both -- even though the  
6 magnitudes are different, it's the same pathway, okay? If I use DandD and then use RESRAD  
7 input values, the same pattern. You have this agricultural food pathway dominating, but then the  
8 numbers become very small.

9  
10 And now if I use RESRAD with DandD 1.0 input values, same pattern,  
11 agricultural food dominates, but higher dose. So it's probably more of a parameter issue than a  
12 model issue, especially with strontium I guess basically with small contributions from a  
13 waterborne pathway, the difference in the model is not evident here in the results. Which means  
14 if you have better control on the parameters, cesium probably will be taken care of.

15  
16 If you do the same kind of probabilistic analysis, the results from DandD is very  
17 close to what you get from RESRAD with their defaults or the default probabilistic analysis.

18 These two nuclides represent one of the more interesting ones according to  
19 what we saw in our last workshop. Then actually we wanted to do a little bit more study on this.  
20 I mean, is it just a cesium and strontium issue, or are there some other nuclides that may be a  
21 potential issue here?

22  
23 So actually what we did was we actually ran all the nuclides, sort of a base case  
24 simple analysis, and then basically try to identify what nuclides may potentially produce these  
25 kind of differences. And we found that there are a couple more nuclides, but actually for this we  
pick the most important four nuclides, and that includes iodine-129 and plutonium-239. Okay.

So you will see big differences if you just use default approaches between DandD 1.0 and  
RESRAD 5.82.

The numbers are relatively high, both of them, but then differences too -- higher.

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1 And there is a big difference in terms of its pathways, controlling pathways. For RESRAD it is  
2 drinking water, and in DandD it is irrigated food or aquatic food. Again, the fish pathway, and  
3 then some irrigated food from groundwater dominates. Because both RESRAD and DandD use  
4 these very small Kd values. DandD uses .1. RESRAD used .283. So both of them relatively  
5 very small. And so the small Kd values again, the difference in the model is not amplified and  
6 groundwater pathway becomes important in both cases.

8 If I run the same case, DandD with RESRAD default, we produce much smaller  
9 values, and you see changes in the importance and you see more importance in drinking water.  
10 So it's sort of coming closer to what you see from this.

12 If we do RESRAD 5.82 with DandD, we again see the same pattern, increase  
13 the dose significantly and it becomes almost identical between RESRAD and DandD if you use  
14 default parameters.

16 And in this case same aquatic pathway becomes important even with RESRAD.  
17 So it's again a more parameter controlled problem. So with the bioaccumulation factor and the  
18 small Kd values, you have plenty of contamination in the groundwater and enough for  
19 bioaccumulation. You will have higher concentration in fish, and that produces dominant  
20 pathway in these groups.

22 And the same thing with probabilistic DandD and RESRAD. But then  
23 interestingly RESRAD produces much higher dose with probabilistic analysis, and that's sort of  
24 an anomaly. The way RESRAD probabilistic analysis is done here, as I said, is default. The  
25 true comparison should be based on equal distribution functions you put in as input, and I found  
actually it was difficult for this, even the limitations in time, et cetera.

So I'm using whatever the code is giving as a distribution. And in the case of  
RESRAD uncertainty analysis, the Kd value the program gives you is very narrowly defined.  
Default Kd value is .1, and then distribution of Kd is even -- the maximum pair of the Kd value is  
even smaller than what's in the DandD. So we've got very small Kd value obviously RESRAD

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1 will produce higher dose. That's basically I think it. But that doesn't mean that that will happen if  
2 we had realistic distributions.

3 Yes.

4 MS. HORNIBROOK: Carol Hornibrook, EPRI.

5 May I say I'm getting a little bit lost. Are you trying to say that depending on the  
6 nuclide depends on whether it's a parameter or a model?

7 DR. YU: Um-hum.

8 MS. HORNIBROOK: Aspect.

9 DR. YU: Um-hum.

10 MS. HORNIBROOK: Okay. And then beyond that, by knowing that, how does  
11 that help you or where does that take you when you look at this?

12 DR. YU: I mean, obviously even though it is changing, you know if you're talking  
13 about iodine-129 you always know that it is water pathway. If you're talking about cesium, it is  
14 obviously more, you know, external gamma dependent. If you are talking about plutonium, it's  
15 maybe waterborne pathway controlling. So even though it's changing, we already know what  
16 pathway is important, et cetera.

17 So if you have a nuclide which has potential for groundwater contamination, and  
18 then subsequent high dose from that pathway, then you need to look at both the model  
19 differences and parameter differences. If you have a nuclide that doesn't really have much  
20 waterborne pathway involved, then it's probably easier. It's just maybe the parameter issue.

21 MS. HORNIBROOK: Carol Hornibrook again, EPRI.

22 So that helps you determine the pros and cons of the two models.

23 DR. YU: Um-hum.

24 MS. HORNIBROOK: Which would then maybe be better for the nuclear power  
25 industry or more representative of the nuclear power industry?

DR. YU: Um-hum. Actually I think before I did this analysis people said well, it's

1 really the parameters that control the differences. So if we use identical parameters, they should  
2 probably produce very similar results. And that is true, partially true. But then for some nuclides  
3 where again water-dependent pathway is important, the model differences pops out, and then  
4 even if you use all the same values, you will still see a significant difference between the two.  
5

6 This is plutonium. Big difference. High dose with DandD and small dose with  
7 RESRAD.

8 Obviously, with plutonium, you have relatively large Kd values. By the way, the  
9 Kd value used by RESRAD is 2000. For D and D, it is 13.6. There is a big difference in the Kd  
10 value. And if you know that plutonium will be controlled by waterborne pathway, the result  
11 shows that there will be a big difference. I mean there will be a big difference, and results,  
12 basically, supports that.  
13

14 In the case of RESRAD, again, you will have high concentration in the  
15 groundwater because you have a relatively small Kd value and then no dilution in the aquifer  
16 and no dilution in the surface water, so you have fish or all the food, or drinking water,  
17 contaminated with plutonium. That is really driving the whole thing. Also, RESRAD, Kd 2000  
18 big enough, no contamination of aquifer. So everything stays up there and then, basically, you  
19 get very small dose.  
20

21 If you use RESRAD input values, high Kd values, basically, it is the same thing.  
22 Even though you still get some contribution from waterborne pathway, just never --over  
23 contribution, so it is almost, actually, showing the same thing. But then if you use D and D input  
24 for RESRAD, you would start seeing this but not as magnified as this, because you have better  
25 control in the -- describing the dilution of your plume in the aquifer, that makes difference. So,  
again, this shows the difference in the model contributes to difference in the results. Yes.

MR. GENOA: Paul Genoa, NEI. If I could try to summarize my understanding of  
the parameters. If I understand it right, the models have two issues. The two different dose  
codes have two issues to deal with. One is the structure of the model itself. The second has to

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1 do with the selection of the parameters. Both are important in different situations.

2 And EPRI has been asked to provide some comparison data, and if I  
3 understand it right, you are handicapped by not being able to select a generic list of input  
4 parameters for distribution input parameters to run into both codes so that you can compare the  
5 results. Once you are able to do that, you then can start to refine which are the important -- or  
6 which two codes adequately model the results for the aquatic pathway. In other words, you  
7 have to be able to put in the same parameters first to do a comparison.  
8

9 MR. YIM: If you are doing -- you are talking about probabilistic analysis?

10 MR. GENOA: Yes.

11 MR. YIM: That is true, yeah.

12 MR. GENOA: Okay. What is holding him back from --

13 MR. YIM: Actually, the problem is it is not him holding me back, or anything, but  
14 the timing of all this. The information I got from Walt, for example, required processing of data  
15 using Fortran programs, reading all the data, sorting it out and then try to actually read the data  
16 as it is and then eventually you have to fit those data to figure out what kind of distribution they  
17 represent.  
18

19 Actually, the way the program is set up right now -- I am sure they are in the  
20 process of changing it, as they described this morning, I will change this, but the way I have --  
21 the program is set up, or the way I am running it now is -- it is two tiered approach, I think. First,  
22 you have LHS program, a sampling routine and then you put in distribution functions for different  
23 parameters that you are changing. And then you basically select 580 points from your sampling  
24 for all the nuclides -- for all the parameters. There are some exceptions, but for those  
25 parameters, they are selected from the LHS program.

And then you use that 580 data points for all the parameters that you are  
changing as database, it becomes big data table. And then that becomes an input to the second  
phase, that data becomes an input to your simulation, repetitive simulation, using each set of

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1 parameters, you run simulations 580 times, so you get dose representation for each realization  
2 and then 580 data points of the dose predicted will give you that distribution.

3 And since the distribution is already dictated by the first phase, you are using  
4 just the data, you cannot change your density functions at this point, unless you go back to the  
5 first phase and change your PDFs, run LHS again, produce new data table and then read it  
6 again.  
7

8 At this point, since it is already -- I mean put into this data table and some -- for  
9 some parameters, it is difficult to know, it is not simple, as simple as this is normal distribution  
10 with just standard deviation. This is normal distribution with this much -- or minimum, maximum  
11 or geometric standard deviation. There is no such thing available for some nuclides, some  
12 parameters. So the only way you can really characterize the solution is now plot all the  
13 distributions, fit the data, and then get distribution functions, and that is just time-consuming  
14 process. So that is why I couldn't really compare the two codes, probabilistic codes, in true  
15 sense, using --  
16

17 MR. GENOA: But looking forward, are there limitations, other than your work  
18 and time, to being able to do that for the D and D code on the one hand and the RESRAD code  
19 on the other.  
20

21 MR. YIM: I think if we work closer with Sandia, that could be maybe relatively  
22 easily done. If we have a better communication or working system.

23 MS. HORNIBROOK: Carol Hornibrook, EPRI. What do you mean could be  
24 easily done, overcoming this particular problem?  
25

MR. YIM: In other words, for some of the things, they have already done, I think,  
information is already there maybe, instead of we trying to do the same thing, we just get those  
data and we just focus on running the codes.

MR. EID: I think -- this is Bobby Eid. One area also to look into when you try to  
establish your PDF and you go to site-specific analysis, these distributions won't be that wide.

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1 Here you are using practically every piece of information in your distribution, whereas, in fact,  
2 when you look at site-specific conditions, you need to reduce those distributions so you will not  
3 get such kind of dose values, because you will have information about the sites. An example is  
4 given about the Kd, you may have uncertainty in the Kd value because your conditions at the  
5 site, they are -- could be clay conditions, or sandy clay conditions. This means you not need to  
6 use this kind of wide distribution that you are having here.  
7

8 MR. GENOA: Paul Genoa again. If I understand this right, what we are hoping  
9 to do is characterize perhaps two three generic cases, come up with what we think would be a  
10 generic case and then run it against two codes, get the answers and compare it.  
11

12 MR. YIM: Actually, that is exactly what I am doing at this point, cold data.

13 MR. GENOA: Okay.

14 MR. EID: That is what we call --

15 MR. GENOA: And I guess I am asking, I thought I heard you say that there were  
16 some limitations. I am asking you if you will be able to accomplish that. Are there limitations in  
17 your access to the code, or your ability to mess with the code to stop you from actually doing  
18 that?  
19

20 MR. EID: That is what we call the refined screening approach. In the refined  
21 screening approach, you try to group these kind of conditions and then to narrow the distribution.

22 MR. GENOA: So what's the answer, yes or no? Do you think you can do this?

23 MS. HORNIBROOK: Carol Hornibrook. The question, Man-Sung, is can you do  
24 it by September, that is the question.  
25

MR. YIM: Yes, I think we can do it.

Mr. BEYELER: This is Walt Beyeler from Sandia. I think the obstacle is really  
that Monte Carlo D and D right now is not user-friendly. I think you would agree. And so it is a  
matter of us communicating to overcome some of the non-user-friendly features of the code, and  
I think we have been fairly good in being able to do that. It is just that it takes a bit of time to

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1 explain some of the peculiarities of the file formats and work through some of those issues.

2 MR. YIM: Basically, if you want -- if anybody wants to use it, it is basically, you  
3 have to read the source code. You have to understand how inputs are going, how to read it out.

4 MR. GENOA: No, I understand this current limitation, and I just want to make  
5 sure.  
6

7 MR. YIM: One additional problem is with RESRAD, I understand that RESRAD  
8 is in the process of revising their uncertainty analysis version, and with the current version, I  
9 think -- I would say it is very difficult to do meaningful comparison between RESRAD and D and  
10 D.

11 MS. HORNIBROOK: Because of the code -- Carol Hornibrook, EPRI. Because  
12 of the code, Man-Sung, or because the difficulty in your running it?  
13

14 MR. YIM: Because of the code. Because right now RESRAD can only specify  
15 five different PDFs, only five different PDFs, and up to 17 parameters for some nuclides, and  
16 only up to 100 sampling realizations versus D and D, you have 580 sampling, you are changing  
17 maybe more than 100 parameters at the same time, and you have 20-some different PDF  
18 functions built in.  
19

20 MS. HORNIBROOK: So you are -- Carol Hornibrook, EPRI. So your  
21 comparison would be limited to what RESRAD can do.

22 MR. YIM: Yes.

23 MS. HORNIBROOK: And as big as what the D and D code can do.

24 MR. YIM: Yes.

25 MS. HORNIBROOK: Carol Hornibrook with a question. If the D and D code  
won't be ready for easy use and release until the year 2000, the question in my mind is how  
useful is it for us to use that code when it is not in a stable -- I mean I know codes are rarely in a  
stable point, but is the -- I mean my question is, do you think -- well, don't worry, Carol, we are  
going to get a certain amount of information out of this analysis that will then identify some

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1 changes that could be made, or, you know, or you are right, which is where I thinking I am  
2 heading. I am concerned I am working with a code that is not pinpointed somewhere in time,  
3 you know, that you can say this is what is going to represent the final code.

4 MR. GENOA: Paul Genoa, NEI. You are working on two -- you are working --  
5 we are trying to compare two unfinished codes that are not out for use yet, is that correct?  
6

7 MR. YIM: Yeah. That is exactly right.

8 MR. GENOA: And one of them is beta and one of them isn't?

9 MR. YIM: Actually, that is what I am trying to say here, my observations. Just  
10 let me first finish this part. With the user of same input values, the difference between the two  
11 codes are much smaller, okay, as we already saw, indicating that differences in the full input  
12 parameters dominates the difference at this point. At the same time, as we can in the cases of  
13 plutonium-239 and cesium-137, the difference also comes from the model. So model difference  
14 contributes difference even with the same input parameters and if you use probabilistic D and D  
15 code, obviously, you had much smaller dose and maybe much more realistic.  
16

17 And probabilistic D and D codes results also is very close to what is predicted  
18 from RESRAD in D and D 1.0.

19 Neither of these two codes exist in usable form. The probabilistic D and D code  
20 is still under development, not user friendly. Maybe it is an alpha version -- beta final release it's  
21 not known -- today. With the conversion the user cannot change the PDF and et cetera -- you  
22 just cannot just play with the code other than what's given.  
23

24 The probabilistic RESRAD code is a beta release version. With the current  
25 version it is difficult to perform defensible probabilistic analysis because the code is very difficult  
to use, sometimes it just stops. You don't know what you can change, what you cannot change.

There is no manual available. Maybe it is available -- that information may be available at  
Argonne but not to any member of the users. As I said, the number of premises that you can  
vary and the interface problem all very basically makes it difficult.

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1 But then Dr. Yu said they will be releasing a new version. Maybe it is very soon,  
2 which is supposed to be a much improved version. Maybe we may hear from Dr. Yu at this  
3 point.

4 [Laughter.]

5 DR. YU: This is Charlie Yu. It is true that we are going to have a new  
6 probabilistic RESRAD code release soon and this new version dose limitation measured by Dr.  
7 Yim will be removed and we are going to have 20 parameter distributions in the code and we'll  
8 have more user friendly interface and so on.

9 We will put this information -- when the code is available we will put it on the  
10 RESRAD website and you can send an e-mail to us and then we can send it to you.

11 MR. EID: I would like to add also that NRC's thinking, it is not final yet, of  
12 funding a project to Argonne, Charlie Yu and his group, Dr. S.Y. Chen, for probabilistic RESRAD  
13 based on the same methodology that Sandia is using, so we will have the comparison that will  
14 be more precise than currently that we are having.

15 Now the question is when this is to be completed. I would say it will take some  
16 time so I agree with you now. The question is what to do in the interim period. I mean this is an  
17 issue that we are discussing so far and then we could discuss it further and we would like to  
18 have suggestions from you regarding this question that was mentioned.

19 MR. GENOA: I guess -- Paul Genoa with NEI -- we have two questions but  
20 clearly we have a question about what to do today and we fully want to support development of  
21 codes that we can use in the future to construct and I see two agencies, two efforts that aren't  
22 well coordinated to move forward and we are trying to help validate the success of either one  
23 and I guess it sounds like we have an opportunity here where both codes are in development,  
24 but perhaps there is an opportunity to identify what are those things you would like to see  
25 developed or input into those codes so that they would be more user friendly in the end.

I guess we are giving you input. Maybe we are giving you input. I am not sure

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1 but I believe that we should -- there is an opportunity to sit down together and to see where we  
2 need to end up. If we begin with the end in mind maybe we will get there. Right now I don't see  
3 us doing that.

4 MR. SEXTON: Dick Sexton, Connecticut Yankee. I guess I'd take that a step  
5 further from a licensee's perspective. Why are we trying to compare two codes? Why do we not  
6 just select one code and continue with it? If we are going to continue on with this comparison of  
7 RESRAD and D and D and it looks like ultimately we are going to have two codes that are the  
8 same. I think that is just going to extend the time at which the licensees don't have a code to go  
9 to to make some decisions.

11 MR. YIM: I think there is some comment.

12 MS. TROTTIER: Cheryl Trottier, NRC. I want to clarify where we are on these  
13 codes.

14 First of all, the Office of Research is overseeing the development of both, so it is  
15 not two agencies working and no communication. Argonne is producing a version of RESRAD  
16 for NRC use and regarding what code we are going to end up with, this is a testing period.

17 We have D and D on the street. It seems foolish to just put it in the trashcan. It  
18 seemed like during this testing period it would be appropriate to give people an opportunity to  
19 use the codes that are out there.

20 If the decision is made at the end of the two year period once we have a  
21 RESRAD version that is probabilistic, similar to what D and D is, if we decide that it is  
22 meaningless or counter-productive to have two available codes we will make a decision at that  
23 point but the reason there are two out there now is that they already exist.

24 It just seemed worthwhile to give people an opportunity to test the codes that are  
25 out there. I realize that the Licensing Office has to make a decision on cases that come up  
between now and the end of the two year period. We in Research can't make that decision. All  
we can do is provide the tools.

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1 If it turns out that doing it this way is not useful, then we will rethink that but that  
2 was our thinking at this point, that it was better to continue with what we had during the testing  
3 period and then make a decision at the end of the two year period, which is now at the end of  
4 almost a year period but we are getting close to the two years.

5  
6 MR. EID: Thanks, Cheryl. I guess that is the right comment from NRC point of  
7 view.

8 MR. PETERSON: Harold Peterson, DOE. Just a point that Ms. Trottier said  
9 about the two codes. DOE of course has one code and will stay with one code, RESRAD.

10 MR. EID: I would like to say that, to add to this, that the two codes, D and D  
11 currently is based on probabilistic input parameters. We understand it is conservative for  
12 screening and we understand that these parameters need to be changed and we are working on  
13 it.

14  
15 Also, we will have the probabilistic version of the code.

16 RESRAD also is a good code, as was demonstrated here, so when you adjust  
17 the parameters to make them somehow identical, you are getting more or less closer results, so  
18 I guess maybe they will be meeting at one point so at the end, you know, if the industry, if they  
19 are somehow similar and there is sufficient justification for selecting the input parameters, I don't  
20 see any reasons that if you use D and D or if you use RESRAD at the end you are getting some  
21 comparable results, and with sufficient justification and sufficient conservatism to ensure the  
22 public health and safety on this.

23  
24 MS. HORNIBROOK: Carol Hornibrook, EPRI. I am not sure who I direct this  
25 question to. Now I am feeling almost more uncomfortable because I feel like after we fund this  
comparison of RESRAD probabilistic and D and D probabilistic that yet another code, NRC's  
RESRAD probabilistic, will then be ready and I am having a hard enough time with just those  
two codes and where they are now, so I guess I am looking for some input here.

MR. EID: What we are saying that, and as Cheryl said, that we are thinking

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1 about funding a research project for Argonne to develop RESRAD and to look at the  
2 methodology that we are using in D and D so we can compare and then to look at the  
3 conservatism in the two models and codes and look at the parameters, and at the end either we  
4 say one code is more suitable, more appropriate, the source term is better than the other one,  
5 and then we say okay, D and D, it is, you know, is history -- which I don't predict that -- I predict  
6 that both of them could be useful -- or we can say that at the end that we have comparable  
7 codes. If the licensee would like to use the RESRAD and they provide sufficient justification we  
8 will go ahead with that.

10 Now currently because RESRAD currently, as we heard, and when you talk  
11 about the probabilistic situation, does not have the appropriate probabilistic way of analysis, as  
12 Dr. Yim indicated, so they are working on it. We do not know when it is going to be ready. Also,  
13 it needs to have some testing period.

15 At the same time we are working on the proper way of probabilistic version of  
16 RESRAD similar to the current D and D version which we hope that it will be somehow  
17 producing comparable results. If they are not and there is reason for believing one code more  
18 than the other, then we will say that code is to be used rather than the other code.

20 MR. ORLANDO: Carol, do you mind if -- we can take this up at the end of the  
21 day. We are running somewhat behind and we just had a couple power surges and have lost  
22 the regions and I think we might have lost the PowerPoint, so if everybody wants to take a real  
23 quick break I can get the telefolks down here and we can pick this up a little bit later on.

24 [Recess.]

25 MR. ORLANDO: We are going to try and reconvene.

MR. HARRIS: Are you ready to go, Nick?

MR. ORLANDO: Yes.

MR. HARRIS: My name is Tim Harris, and I'm going to talk more about the  
same. I would really like to thank Bobby and Dr. Yim for getting everybody invigorated, excited

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1 about discussion of the two codes.

2 An overview of my talk, I want to talk about -- it's a former burial in Alabama. I'll  
3 give you some background on the site, site features, dose modeling that was done by the  
4 licensee. We also subcontracted the evaluation of that dose model to Oak Ridge and National  
5 Laboratories, so they did some dose modeling.  
6

7 Since that happened, staff produced some interim guidance, which was back on  
8 the back table, which was principally developed by Mark Thaggard, and we did some additional  
9 dose modeling in-house. So we've modeled this site a lot.

10 I'll talk about the results of D&D, RESRAD and then hopefully try to draw some  
11 conclusions which aren't controversial.  
12

13 This site was operated by the Tennessee Valley Authority. It's a former burial  
14 authorized under 20.304. The site location is Muscle Shoals, Alabama, which is in northwest  
15 Alabama. It was predominantly fertilizer research, but they did do some munitions research  
16 back in World War II. Maybe not if '66.

17 Basically, it's 40 individual burials at this site, which is a relatively small area.  
18 It's probably the size enclosed by the tables. The burials are two feet in diameter. They're  
19 basically caisson type geometry ten feet deep with a four-foot soil cover, and the average space  
20 in between the holes is about twelve feet.  
21

22 The site features, being in northern Alabama, it's underlain in a relatively  
23 epikarst topography with limestone and chert. Relatively humid site: annual precipitation, 52  
24 inches. The aquifer is, as I said, is an epikarst topography. The unsaturated zone thickness is  
25 relatively thick; it's about 18 meters. And with epikarst topography -- some of you may not be  
into geology -- limestone essentially dissolves with water and you end up with these big  
underground rivers or conduits.

26 The groundwater flows towards the Tennessee River and also towards  
Tuscumbia Spring -- very high transmissivity rate.

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1 Here is a picture of the site. The burial is down kind of in the lower middle area.  
2 You've got this in your handout. The Tennessee River I guess would be towards the top of the  
3 screen and Tuscumbia Spring would be over in this direction.

4 The source term is relatively large number of radionuclides, 54 radionuclides.  
5 These are the predominant ones, and of these, carbon 14 is the main contributor to dose.  
6 Here's a list of some others. Relatively small amounts of uranium and thorium, pretty low  
7 concentrations of these other isotopes.

8 Dose modeling, as I said, TVA modeled the burial site using RESRAD and came  
9 up with a dose of .6 millirem per year. When they did their model, the hydrologic parameters that  
10 they used assumed that the water released from the site got into one of these large underground  
11 conduits with high transmissivity, and basically you got a lot of dilution at that point, thereby  
12 getting low doses.

13 Oak Ridge, when they modeled the site, they said, well, you may have a chance  
14 where your groundwater doesn't get into one of these conduits, and what would happen if a well  
15 was sunk in the saturated zone that was basically similar to a normal aquifer. So they used  
16 different groundwater parameter.

17 The doses that they -- that Oak Ridge produced using RESRAD with most of the  
18 RESRAD defaults, with the exception of obvious things like the burial geometry and, like I said,  
19 the revised groundwater pathway, resident farmer was 15.1 millirem.

20 They also looked at changing the parameters as suggested in PG 8-08, and if  
21 you do that, you get slightly higher doses. They also looked at a worker scenario, and obviously  
22 there, you're going to get lower doses with the cover.

23 They also looked at an exhumation scenario, which they said what happens if all  
24 the waste is dug up, and when they modeled their source term, they assumed that the waste  
25 was mixed with the cover material.

For all these dose models, they assumed 1981 was the starting point, and with

1 RESRAD, the peak dose occurs relatively quickly.

2 As I mentioned, staff just recently released, actually this week, interim guidance  
3 on evaluating dose assessments, and again, if you need a copy, you can contact me. If you  
4 have questions, please contact Mark Thaggard.

5 When we looked at their additional dose assessments that we did internally, we  
6 used D&D for screening with all the defaults, which was a mass balance approach. We did a  
7 number of things -- the mass balance approach, which I'll describe in a minute, also a single  
8 simulation approach.

9 We also did a pseudo site-specific analysis with D&D where we changed the  
10 unsaturated zone thickness and varied the number of unsaturated zone layers. Essentially,  
11 D&D has a box model and the number of unsaturated zone layers are divisions within that box.

12 We also looked at site-specific analysis using RESRAD. The interim guidance  
13 suggests that there is a laundry list of parameters which they suggest that you input into  
14 RESRAD, which are basically the D&D defaults, and we'll discuss here in a minute what the  
15 impact of that is.

16 As RESRAD, we modeled the resident farmer scenario, and also an exhumation  
17 scenario. When we looked at this, we didn't mix the radionuclides with the cover soil, so the  
18 concentration for the resident farmer scenario -- that is, the material in the ground and the  
19 exhumation where it was brought up was the same. We didn't mix it with the cover soils. And  
20 this is pretty close. The exhumation scenario is actually very similar to the single simulation  
21 scenario with RESRAD -- I mean, with D&D, excuse me. We also looked at a parameter  
22 sensitivity to see which parameters were sensitive.

23 The mass balance approach using D&D essentially says you take the activity  
24 from the site and mix it into 360 cubic meters, which is the D&D default; that is 15 centimeters  
25 thickness over a 2,400 square meter area.

The single simulation approach is essentially the same thing, where you're

1 modeling the waste on the surface, but here, you're conserving the volume where you're  
2 keeping the thickness of the layer 15 centimeters, but allowing the area to be larger depending  
3 on the size of the contaminated area.

4 Here's some results with D&D. The mass balance approach, you get 190  
5 millirem, and again, that's mixing the entire source term with a relatively small volume of  
6 material, 360 cubic meters. If you look at the single simulation approach, you get 152 millirem.

7 Then we looked at changing one single parameter, which was the unsaturated  
8 zone thickness. We used 18 meter, which is the site condition, and also ten meters, to see what  
9 the difference was, and we varied the number of unsaturated zone layers. As you can see,  
10 when you change the unsaturated zone thickness, it dramatically changes the dose.

11 One of the surprises was when we changed the number of saturated zone  
12 layers what the curves looked like. The upper two curves, the upper curve is for the unsaturated  
13 zone thickness of ten meters. The lower curve was for 18.2 meters. And we also looked at  
14 changing the number of unsaturated zone layers for the D&D default, which is 1.22 meters. You  
15 can see you kind of get a little checkmark there, and the doses are sensitive to changing the  
16 number of these unsaturated zone layers, and essentially it has to do with the amount of mixing  
17 and dilution that you get. Is that right, Mark?

18 MR. THAGGARD: That's correct.

19 MR. HARRIS: The RESRAD results for the resident farmer -- again, this is with  
20 the changed default parameters. If you recall from the previous slide, you're getting doses in the  
21 range of 15 to 19 millirem with the RESRAD default parameters. When you look at -- I'm sorry.  
22 Yes, with the RESRAD default parameters. When you look at using RESRAD with the D&D  
23 default parameters, those doses go up from 68 to 157 depending on the groundwater model.

24 D&D allows you to choose two groundwater models. One is a mass balance approach, which  
25 shouldn't be confused with the mass balance scenario that we're proposing for D&D, and a  
non-dispersion case.

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1 We also looked at the exhumation scenario, as I said. Here, the doses between  
2 the two difference groundwater models were relatively significant, almost an order of magnitude  
3 different. In all cases, the key radionuclide was carbon 14 with the drinking water pathway.

4 The key radionuclide with the D&D results was also carbon 14, but the predominant pathway  
5 was the aquatic pathway.  
6

7 We also did a sensitivity analysis with RESRAD and found, as you probably  
8 would expect, that the contaminated zone density was sensitive, the saturated zone affected  
9 porosity and hydraulic conductivity were sensitive parameters, that the hydraulic gradient was  
10 sensitive, that the length parallel to aquifer was slightly sensitive, and watershed area was  
11 sensitive. Also well depth and KD.  
12

13 One of the big differences between RESRAD and D&D, RESRAD assumes a  
14 KD of zero -- basically you have no retardation -- and D&D assumes a KD of 4.3.

15 Some conclusions. Carbon 14 is treated differently from a model standpoint  
16 between the two codes, as I'm sure everybody is happy to hear. This is demonstrated by  
17 different principal pathways and the different time to peak dose, which is largely a result of the  
18 different KD values.  
19

20 D&D doesn't always produce the highest doses. I think what we saw when you  
21 changed the unsaturated zone thickness, you were getting doses -- I hate to say this, and Mark  
22 will probably hit me later -- you were getting doses similar to using RESRAD with the RESRAD  
23 default.

24 D&D is sensitive to variation in the number of unsaturated zone layers. I guess  
25 Bobby saw that a little bit in strontium. I think it was probably more pronounced here with Carbon  
14. And again, that's probably going to depend on your radionuclide mix.

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Using D&D default parameters in RESRAD as suggested by the interim  
guidance does produce higher doses than using RESRAD with the RESRAD default  
parameters. The RESRAD doses were sensitive for Carbon 14 to the groundwater model you

1 pick and also to variations in KD.

2 The big question is what do we learn from all this, running different models,  
3 different simulations, different parameters. I think what you come away with is that varying the  
4 parameters and models can lead to a wide range of doses that you predict, and that when you're  
5 selecting your model and your parameters, you need to think about properly justifying it. I don't  
6 think that using different models -- I think it's good to use different models. I think you can  
7 expect to get different answers. But as you go through and determine which model is  
8 appropriate for your site and you look at the default parameters and changes that you make to  
9 those parameters, your going to need to adequately justify those.  
10

11 That's basically it. I hope everybody was questioned out before, but I'll be happy  
12 to answer any questions.  
13

14 MR. SAITO: Earl Saito, Combustion Engineering.

15 I had a question here. Could you help me understand your results a little better?  
16 The site closed in '81.

17 MR. HARRIS: Correct.

18 MR. SAITO: And you have the maximal dose occurring within five years. So  
19 has the maximum dose already occurred at this site? I mean, what's the --  
20

21 MR. HARRIS: Hold on, Mark. That's true for RESRAD. For D&D, where your  
22 KD is a little bit higher, the maximum dose occurs in the -- I think it's 75-year range. So while  
23 that's true for RESRAD and one could make that argument, which I don't think Mark will buy, but  
24 if you use D&D as your code of choice to release the site, the doses do not occur until later on in  
25 the future. But I'll let Mark address the argument that doses have already occurred.

MR. THAGGARD: Well, I think the problem with the argument is that we're not  
really modelling reality here. I mean, we're trying to bound the dose estimate. So we are not  
properly modeling the groundwater system out there. We don't know what the KD is. So we  
can't say that we are anywhere close to modeling reality here. All we're hoping to do is to bound

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1 the estimate so that we're making sure that we're not under-estimating the dose. That's really all  
2 we can say about these dose calculations.

3 MR. SAITO: So as a licensee, if I took this data and then I went out and I put a  
4 well in right near the burial and could show that the doses -- that the concentrations in the water  
5 aren't even that high yet, we can say that the model is very conservative, and therefore these  
6 dose estimates are good and we should be able to move forward from that point? Would that be  
7 a reasonable path to take?  
8

9 MR. HARRIS: Well, I think if you had a well and you modeled doses during  
10 operation and you saw that the stuff was leaking out, that you could argue that it had already --  
11 that the contamination had already been flushed through. But if you put in a well at the end of  
12 operation, I don't know that that tells you much.  
13

14 MR. SAITO: Well, it's going to tell you what -- if you're saying it's already  
15 flushed through, then you're dose has already passed. If you're saying that it could --that it's  
16 flushing through at this point -- I mean, at some point, it's nice to be able to ground it into  
17 something that you can go out and measure that's measurable.  
18

19 MR. THAGGARD: Well, yeah, if you could validate these numbers, I mean, if  
20 you could somehow validate your model with real slight data, then I think you can make that kind  
21 of argument. I think what we're saying is we're a long way from validating any of these numbers  
22 here, so all we're hoping to do is to bound the estimate.

23 But yes, if you've got real data and you can somehow use that real data to make  
24 an argument that you're modeling the system correctly or appropriately, then I think that would  
25 be the kind of argument that you would want to make.

MR. SAITO: Okay. Thank you.

MR. EID: This is Bobby. I believe this question is quite important, and one of the  
models -- I'm not sure which one -- does allow you to place the source at the earlier date and  
then to recalculate the transport. So I believe your question is quite valid that all of the source

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1 was placed some time ago, and the question is what kind of dose that you are getting from the  
2 period that you are having now later on. But if you have any information that there is already  
3 contamination in the aquifer, for example, because of the placement of the source, you need to  
4 take this into account.

5  
6 MR. HARRIS: Any other questions? I saw Henry get up.

7 If not, thank you.

8 MR. ORLANDO: Thanks, Tim.

9 In case anybody is interested in what's going on, there's apparently some pretty  
10 severe wind outside, so we are experiencing some power surges here. Apparently we had  
11 some problems with some of the elevators, too, so use the stairs.

12 MR. HARRIS: I went through that pretty fast, I know that, in the essence of time.  
13 If people look at the slides later and have questions, please feel free to call me.

14 Thank you.

15 MR. ORLANDO: Next we're going to hear from Dick Sexton and Henry Morton  
16 talking about problems with measuring alpha contamination.

17 MR. SEXTON: Good afternoon. My name is Dick Sexton. I apologize for the  
18 video folks running in and out, but again we keep losing the regions, and they're wondering  
19 what's going on, and as you can see, some of them are getting ready to throw their controllers at  
20 the screen. So we're trying to keep them happy too.

21 Good afternoon. And I do appreciate the opportunity to address this crowd. My  
22 name is Dick Sexton, and I'm with Connecticut Yankee Atomic Power, the Haddam Neck plant.

23 Just as a background, the Haddam Neck plant is currently shut down and is in  
24 the process of being decommissioned, and as one of the issues related to this that I was asked  
25 to give a brief presentation on is alpha, and during the plant operation the facility did encounter a  
number of fuel failures, relatively significant in discussing our alpha situation at Connecticut  
Yankee it appears that I'm not saying we have the highest level, but certainly we have residual

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1 alpha contamination that does make it fairly difficult to monitor.

2 One of the first things that we did when we made the decision to permanently  
3 shut down was to initiate a site characterization, and some of this discussion that I will present  
4 today is really related to that site characterization that we performed.

5 The first step in any site characterization or scoping survey is the historical site  
6 assessment, and it was during that period of time that we looked at the fuel problems that they  
7 had, and we also looked at some of the historical data that they -- historical survey data that they  
8 had on the facility, and that was fed into our site characterization.

9 Our site characterization typically focused in on the areas that we had the least  
10 amount of information. So they didn't necessarily focus in on the areas of the plant that actually  
11 had the highest level of alpha contamination. But during the course of the site characterization  
12 we did develop some scaling factors. And these scaling factors also help us in our radio  
13 protective processes. And they're simply the ratio of the alpha contamination that we can't easily  
14 monitor to the relatively straightforward beta-gamma contamination that we have. And we use  
15 these scaling factors for both characterization purposes and also for protecting the workers from  
16 the more difficult to monitor alpha.

17 And what we found when we did this is that Connecticut Yankee's ratios are  
18 fairly dissimilar from what we found at other reactors. Our ratios -- typically the other reactors  
19 that we talk to are in the 2,000 to 1, 3,000 to 1, and we found areas in the plant that are 1 to 7, 1  
20 to 20, or even 1 to 50. So what that all means is that in our site it's fairly difficult to just monitor  
21 the beta-gamma contamination and ratio back and know reasonably what your alpha ratios are.

22 And so this required us to make some modifications in some of our instrument  
23 types and some of the sensitivities that we had to utilize.

24 I think one of the most significant challenges that we are a reactor, since we  
25 kind of have a mix, typically reactors that go through final survey and even scoping, they're using  
the scaling factors, and they're using those to essentially say that the presence of alpha is not

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1 there based on their results from their beta-gamma contamination. I don't think CY across the  
2 board is going to be able to do that, and I suspect there's other facilities that will fall into that  
3 category.

4 I think the other point that I wanted to make is that with alpha contamination I  
5 think it's going to require a somewhat different sampling and analysis process. And I think it's  
6 most troubling or most difficult in areas that -- the areas that are impacted, that you know are  
7 impacted, you're going to decontaminate, remove the paint. The most difficult areas in a reactor  
8 are those areas that you don't think were impacted, they could have been, and that they've been  
9 painted over. And then you have a very difficult monitoring process. And I think that's where the  
10 innovative sampling and analysis techniques are going to be needed to use and aren't really well  
11 described in MARSSIM. They are alluded to, and I think this is an area that we'll be looking at,  
12 trying to come up with simple yet defensible ways to monitor this.

13 I think the technique probably that we're going to use is really just to go into the  
14 facility where the paint remains and remove portions, sample the paint, do an analysis, and then  
15 allow us to calculate what is actually remaining in the paint, if any.

16 From what we've seen so far I think we've had a lot of discussions today on  
17 dose modeling. I think this is an area that we see as a licensee that both of the codes seem to  
18 be somewhat weak in defining the exposure scenarios for alpha contamination.

19 And the other thing that I'll talk a little more about is background, just the  
20 physical monitoring of alpha contamination, with gas flow or proportional-type counters you  
21 encounter significant background variations and typically or in many cases these background  
22 variations can exceed the limit that you're trying to look for, and it creates a very difficult  
23 monitoring sequence.

24 I guess I was asked to also just talk quickly about some background issues, and  
25 this is kind of a generic not just related to alpha contamination but also background. And I'm just  
going to really quickly touch on cesium-137 and some of the experience that we've had recently

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1 at Connecticut Yankee, some material backgrounds, and also some regulatory guidance that  
2 may or may not be needed.

3 Part of my presentation is related to our experience with some material that  
4 during the course of the plant operations at Connecticut Yankee some material was  
5 inappropriately released offsite, and we've spent approximately the last year to year and a half  
6 recovering that material. And as part of that process to recover the material, we really had to  
7 look very hard at the cesium-137 background. We had to go to properties, and our criteria for  
8 cleanup was no detectable. So we had to spend a lot of time looking at what the natural  
9 background was. And what we found that there is a high variability, I'm sure that's not a  
10 surprise, and that cesium-137 is easily measured, so it will be an issue for all soil, and it's out  
11 there in fairly significant quantities.

12 And I guess the other thing that we found as we went through this process there  
13 seems to be a very high interest in background evaluation, and I think we have looked at that  
14 interest and we see frequently that licensees are making the decision really just to accept the  
15 background in their -- as licensee added, and many times we're not so inclined to do a detailed  
16 evaluation of background. In many cases I think that's appropriate, because what we see is that  
17 at least if we get the code squared away that the 1 or 2 picocuries per gram of cesium that you  
18 can see out in the environment doesn't contribute that significantly to dose.

19 Some of the data that we collected, this was again to support our offsite cleanup  
20 efforts that we had to conduct at Connecticut Yankee, and as part of that we went out and  
21 collected about 80 samples, and these samples are from the general area of Connecticut  
22 Yankee, but they were collected in regions that were not impacted by plant operations.

23 We looked at where did the wind -- what's the primary direction of the wind, we  
24 got a certain distance away from the plant, but we didn't go so far away that the general  
25 background from weapons fallout was that dissimilar. And you can see the range of data that  
we got. Again, our criteria for this offsite cleanup effort was no detectable activity contributed

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1 due to Connecticut Yankee activity. So we really had to find out what is the background.

2 After much discussion with both of our regulators, which includes Connecticut  
3 Department of Environmental Protection and NRC, we worked out a technical basis document in  
4 which we established 1.68 as our default background value for evaluating our cleanup of these  
5 sites. We also beyond this we actually have up to 2.4 picocuries per gram. We are able to look  
6 at that and see if that could potentially be due to some specific condition at the site.  
7

8 Another issue that you see in background is that background -- this is more  
9 going now to background issues related to surface contamination. I think we've talked a little bit  
10 about measuring total activity, and there's very significant issues related to actually going into a  
11 site and monitoring the surface contamination. We find that background can vary significantly  
12 within facilities from one building to another with the same material yet they can have fairly  
13 significant different backgrounds.  
14

15 We also find that material background can depend on time of construction and  
16 certainly what type of material was used, and I guess the most troubling part of a final survey  
17 process relative to background and materials is many, many rooms or survey units can have  
18 many, many backgrounds, and it creates a very complex survey process. I don't necessarily  
19 have the solution, but I think this is an area that we really need to have more consistent  
20 application of regulatory guidance as to what is an appropriate range of background. It's not  
21 unlike the situation that we see with some of these input parameters.  
22

23 What is an acceptable range for these type of parameters? I have a slide here  
24 that shows an example of some issues that we ran into. This is actually from Yankee Rowe.  
25

What this is showing is that this was in the same survey unit so you have a  
technician surveying block walls and surveying poured concrete and you can see that while the  
value is significantly below the guideline value, and that is the limit that they are utilizing there,  
you can see that there is some variation and that is not unexpected. It really is not necessarily  
an issue, but I would say that our experience or my experience has been while it is not really an

1 issue, it takes a tremendous amount of time and effort to resolve because I think there is an  
2 interest in both the technical folks that are doing this type of work and the regulator to resolve  
3 difference in background. Again, my experience is it takes a tremendous amount of effort.

4 I guess in summary we believe that right now there is no clear practical  
5 guidance available to address the large variations in background. There are some techniques in  
6 MARSSIMS but the practical implementation of going into the room, scanning the floors, the  
7 walls with different material backgrounds -- that is not something that has been totally resolved  
8 so that it is simple and straightforward.

9 We expended significant resources resolving these backgrounds as you are  
10 going through and in many cases we believe that that effort really isn't justified. It does make for  
11 very pleasant data packages but we believe that it doesn't necessarily add value to the final  
12 survey process.

13 We see that in situ gamma spectroscopy is a viable technique. We think it  
14 needs wider use by the licensee and acceptance by all parties that look at the final survey, and I  
15 guess finally we see that as some states and some other regulators, EPA, as they reduce the  
16 limits that we're trying to achieve, that the complexity of actually going out and physically  
17 demonstrating compliance gets more and more difficult and these issues related to background  
18 really start having a tremendous impact to your efficient surveying of the site and achieving  
19 compliance.

20 That is all I have. Are there any questions?

21 [No response.]

22 MR. SEXTON: Okay, thank you.

23 MR. ORLANDO: Thank you, Dick. One comment. We are thinking about trying  
24 to have a workshop that talks specifically to surveys and I think a lot of the things you brought up  
25 here might be addressed then or that would be a good place to do it, so I would hope maybe you  
could come back and do that again for us.

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1 MR. SEXTON: Sure.

2 MR. ORLANDO: Are you ready, Henry? Henry Morton is the next speaker.

3 MR. MORTON: I have been asked to speak to issues involved in surveying,  
4 measuring alpha emitters on surfaces. Since we have heard basically more about the reactor  
5 side, I am going to tend to speak more to the remainder of the fuel cycle and other materials.  
6

7 In this regard what I will focus on are key radionuclides, the properties of  
8 interest, alpha emitting and for the key ones I will focus on the longest lived ones in these chains  
9 and then it will become apparent why somewhat later, but those for the most part are the  
10 Uranium-238, Uranium-234, Thorium-230, and Radium-226 in the uranium series; the U-235 in  
11 the actinium series, Thorium-232, Radium-228 and Thorium-232 in the thorium series; the  
12 transuranics and even Uranium-233 in a case or two.  
13

14 Basically these are found and we are going to encounter these problems in a  
15 number of the processes ranging through these power reactor fuel, mixed oxide fuel, some uses  
16 of U-235 -- I am going through these more quickly -- and some other processes, materials,  
17 extraction processes where from ores are extracted some of the specialty metals and the  
18 materials licensees then encounter -- these natural series emitters; then also the Yellowcake  
19 U-235 conversion and the fuel cycle.  
20

21 In dealing with the issues, basically we need to match up the issues and match  
22 up the needs and basically we have a measurements problem. Measurements basically I see  
23 as a signal to noise problem and the question, the spread of the signal increment due to the  
24 contamination, is greater than some multiple or some numbers of standard deviations of the  
25 noise of that measurement system.

The other portion of the problem is one of compliance and I see that as a signal  
versus a limit problem. How does the signal increment due to the contamination compare with  
the signal increment equivalent to 25 millirem per year.

Basically then, this boils down to the issue of minimum detectable signal

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1 increment due to contamination needs to be less than the signal increment equivalent to 25  
 2 millirem per year. So we will need to look at these two parts of the equation, the minimum  
 3 detectable aerial density on the surface of this alpha emitter and the aerial density of the same  
 4 equivalent to 25 millirem per year, and compare these and see where we stand.  
 5

6 What basically we have here is I have taken D and D, and for the default cases,  
 7 for the building occupancy scenario, calculate for these individual nuclides and change the total  
 8 effect of dose equivalent that corresponds to this unit input. In other words, for one dpm per  
 9 hundred square centimeters, first, what kind of dose does it give, that is the output of D and D.  
 10 And the way the code operates, it basically likes to do it on a per unit parent basis. Then,  
 11 because these -- that is, basically, then I convert that to the maximum acceptable average aerial  
 12 density of the radionuclide in units of disintegrations per minute, per hundred square centimeters  
 13 that gives a 25 millirem per year dose. So these then, for these nuclides and chains, would be  
 14 the limit.  
 15

16 In this case, by virtue of the way the code operates and the calculation goes, a  
 17 disintegration in this case is, in effect, it is the technical definition, that is, it is an atomic  
 18 disintegration. So we see that some things that may seem to be different from what we have  
 19 been used to seeing in the distant past, for instance, radium-226 alone seems to be elevated  
 20 somewhat, but look at the thorium series, we get quite low numbers, 7 disintegrations per minute  
 21 per hundred square centimeters for thorium, and you add the chain in, basically, it drives it down  
 22 to 6. And on the -- in the right column, these are the main contributors to dose. So if we look at  
 23 those, we are basically seeing that what D and D is telling us is that -- for, of course,  
 24 uranium-238, or uranium natural, it is without daughters grown in, of course, that is going to be  
 25 the uranium.

ADN But, otherwise, looking down the list, basically, it is mostly thorium and, in the  
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 case of the individuals, the radium and thorium in those chains. So those become the main --  
 the key nuclides, and the limits expressed in disintegrations per minute per hundred square

centimeters.

Then comes the question of which parameter to measure to begin to assess compliance with this, if we are measuring this material on the surface. So it becomes a question of whether to measure the total activity on the surface. That may be required for the direct radiation exposure pathway.

Then there comes to me the question that has been discussed today and previously, whether to try to measure removable. And there is that question of whether, depending on the model that is used, whether removable may be necessary to measure, or then the alternate question, or, finally, whether to have to measure both of them. The migration of the conversation today seems to be toward measuring total activity on the surface. And because that seems -- that is basically my preference, so the remainder of the talk, I am going to deal with the measurement of, in effect, total activity on the surface.

Then in doing measurements on the surfaces comes the question of what -- which of the radiations to measure. Alpha -- well, alpha, measuring alpha has the advantage of having a low background in the instrument or the measurement system, and, thus, you can get, relative to the other two, a relatively lower LLD. Disadvantages, it doesn't penetrate very well from a rough surface or a dirty surface, or a painted surface, or a greasy surface. Because of that, that is a prominent problem with measuring alpha.

The materials backgrounds can vary by 15 times or so according to the data in NUREG-1507. And then I have some other data later that you can see the range that we saw in particular materials. Other disadvantages, the detector windows have to be pretty thin and fragile, and in the work that we have done in the past, when you get to these low levels, trying to measure these, the lowest levels we can, we eventually abandoned gas proportional detectors, the field survey instruments, because they simply varied, they slowly varied too much. And so when I basically discuss most of the rest of these data, they are going to be oriented toward alpha simulation rather than gas proportion.

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Another radiation that might be measured or surveyed to detect the alpha emitters on the surfaces might be to measure the beta. Advantages here, from my perspective, it has almost -- of the three radiations, relatively, nearly the optimum penetration framework the surface. It is less variable in its dependence on surface roughness and on self-absorption. The materials backgrounds seem to be less variable and the source efficiency factor is better than for alpha and is less variable.

The disadvantages basically are for the enriched uranium, or the purified uranium sources, the uranium tends to emit weak beta and so surveying by beta is generally not done because of that. Measuring beta at the exclusion of alpha and gamma requires to measurements rather than the one for alpha or gamma. It does have a higher MDA than for alpha, and if there is a prominent amount of potassium-240 around, or may be, then you may need to account for that at these low levels and have to subtract it out.

When I think about using gamma, the advantages, the only one I can -- the one I really think of at the moment is the detector can be more rugged in the window than the others. The disadvantage is that basically the gammas tend to be strong enough to penetrate from down in the substrate and so you may be measuring something below the surface, particularly the background that you don't really want to be measuring and so that may tend to make the background high and variable and for that reason or for those reasons measuring gamma would not be my choice.

Now when I put the numbers up for the derived limits with D and D these are expressed in atomic disintegrations per minute per hundred square centimeters, but we don't measure that with the instrument. We really measure one of the radiations, so there is a translation that needs to be done here and in looking at these key nuclides and the change of these, basically when we go count the number of alpha or the number of beta and internal conversion electrons per parent disintegration we get these numbers -- that is, Thorium-230 which a lot of the instruments calibrate with, has one alpha per disintegration, but the uranium

1 series you can get, when it is in equilibrium, 8 alphas per disintegration of the parent, U-238;  
2 likewise, Radium-226, five; thorium natural and the chain, six; and so on.

3 Similarly, if we go count detectable betas, and these numbers happen to be  
4 ones that I concluded were the detectable betas -- that is, that would penetrate the window that  
5 we had on the beta instrument -- and that included the internal conversion electrodes.

6 Looking at the ratios of these we basically see in terms of detectable radiation  
7 you have got an advantage for the alphas -- not many betas are better detectable, so that affects  
8 the conversion and the derivation of the detectable radiation in alpha per minute per 100 square  
9 centimeters or beta per minute per 100 square centimeters.

10 Now when account for these detectable radiations and then compare it with the  
11 old numbers that we are used to, whether we think of it in terms of the same table from the Reg  
12 Guide 186 or FC 8323, remember that the tables for these natural chains in Reg guide 186 are  
13 really expressed in terms of the radiation per minute per hundred square centimeters. The  
14 practice has been to interpret the other nuclides in the same way because the other ones that  
15 we are interested in except for one basically emit an alpha per or beta per disintegration.

16 So when we look at the comparison of what D and D expressed in alpha per  
17 minute per hundred square centimeters, how it would compare with the old numbers, we  
18 basically see for example that the purified uranium has gone down by a factor of 50, natural  
19 uranium down by about a factor of 50, and this is -- the natural number is particularly I think  
20 interesting to fabricators because the number for enriched uranium is not going to be much  
21 different because basically the dose limits are not all that much different and these basically  
22 don't have the chain to add more alpha particles, so it is going to be pretty close to a one to one  
23 comparison with natural and enriched within not very many percent.

24 Uranium with daughters present, 152 compared to 5000 -- down by a factor of  
25 33; and going on down the chain the things that are interesting to see is that the radium for  
example, Radium-226 went the other way; radium with daughters is about the same; thorium, it

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1 went way down; thorium with daughters present, 28, it goes down, and so on.

2                   So the numbers, the differential, is not quite as wide as you might think without  
3 making that radiation to disintegration translation.

4                   I have taken some real cases, that is here are four buildings which we went in,  
5 took scrapings off the walls and floors, did alpha spectrometry to get the ratios of the nuclides,  
6 and this is a process that extractions and the ores had both uranium and thorium series in the  
7 ores, so this is among the more complex cases in deriving numbers that we'll see -- the uranium  
8 series, the thorium series have all six of the key nuclides and they are not necessarily in  
9 equilibrium. Fortunately it's old enough that the thorium series, the three key nuclides in it pretty  
10 much have to be pretty close to equilibrium. In fact, the measurements, the ability to measure  
11 shows itself to be perhaps not as good an indicator as the calculation from the decay chain and  
12 the age.  
13

14                   In this case for this mix, taking the values that are the minimum -- I'm sorry the  
15 Maximum Acceptable Average Aerial Density that we derived using D and D, gives these activity  
16 limits. They range basically from 10 to 19. I take those and convert them to an alpha limit and I  
17 have drawn out in this case the average number for these four mixes, the average number of  
18 alphas per disintegration.  
19

20                   Then because that is the case the conversion calculated differently but the  
21 conversion gives you in effect a limit of the 68, 134, 83, 111 alpha per minute per hundred  
22 square centimeters, so this would be in effect the compliance value that you test individual  
23 measurements against or test your measurements against to go into the building with an alpha  
24 survey instrument.  
25

                  Similarly, I have done the same thing for the betas and those limits are  
somewhat lower because you have fewer betas per disintegration for the same source.

                  So basically keep these kinds of numbers in mind when we go to look to see  
how well what is the minimum detectable aerial density that you can see with an instrument.

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1 I wanted from this point on to take two sources of information, one that is  
2 available and one for which there are already published data. In this case for the alpha I am  
3 taking these numbers out of NUREG-1507, where Eric Abelquist and the people at ORISE did  
4 these measurements and unfortunately this is the limit of what we have -- for some cases point  
5 sources and the efficiency tends to be high for a point source relative to a distributed source so  
6 when we have actually got distributed sources the source efficiency data that we have here  
7 overestimated somewhat probably, but the point is one of the values of parameters we will need  
8 is the source efficiency and here are the data for alpha I am going to use.

10 I put blue marks by a couple of them, one for scabbled concrete. That one is  
11 probably high for a couple reasons. They scabbled it and then put the source on. Secondly, it is  
12 a point source not a distributed source.

14 The other one I don't have an opinion about it, but I call it to your attention,  
15 because here's carbon steel with a source efficiency of .22 for alpha.

16 [Pause.]

17 MR. MORTON: This may have real significance by a factor of five relative to  
18 what you have been doing particularly for example for the power reactor work where you may be  
19 working on a lot of the steel plate.

21 Basically these numbers are based on Thorium-230 alpha, which is basically  
22 representative for these series for calibration for these series and talking about it there was a 74  
23 square centimeter zinc sulphide alpha scintillation detector. There are one minute counts and  
24 these data are in NUREG-1507.

25 So what I was interested in is basically in looking at this is what is the best we  
may be able to do, so one of the things -- no. Before I go to that let's see what these numbers  
give us in comparing what the minimum detectable is as reported in NUREG-1507 for this  
instrument compared to the Maximum Acceptable Average Aerial Density derived with the D and  
D for defaults.

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1 Fundamentally, this is the comparison. Probably a couple of general  
2 conclusions that one tends to see. Maybe you can see something for the really slick surfaces  
3 like stainless, formica, something else but the LLD or the minimum detectable is not below the  
4 derived limits for the other materials, particularly the rough surfaces, the concretes, the  
5 untreated wood, the carbon steel in any of the cases and in particular I have noted the natural  
6 uranium because again that carries over to a similar number for purified uranium or enriched  
7 uranium.  
8

9 For the others, for the chains, look at the uranium series when it is in  
10 equilibrium, it is 152; thorium series, 36; and then of course when you have the both of them, as  
11 in the numbers I showed earlier for the four buildings, these combine and you get those  
12 limitations.  
13

14 Now the next thing I wanted to do was see how well I could do with a better  
15 instrument. One of the things I looked at, and I had these data from some previous work that I'd  
16 done 3 years ago doing the same thing with respect to measuring beta as well as I could, and  
17 the same -- one of the things we have to look at is well, if these organized data were counted for  
18 one minute, how much better can I do if I count a longer time or measure for a longer time.  
19

20 Basically you see that you get a knee in the curve between around 2 minutes,  
21 2-3 minutes, so there's really not much need to measure more than 2 or 3 minutes with these  
22 instruments. You're just spending more time without getting much more advantage.  
23

24 So what I did then, take an instrument that was better. A, get a real clean  
25 instrument with a low background on it, and in this particular case about a count per minute per  
100 square centimeters, 100 square centimeter window, instead of 75, count longer, and then  
count the background longer.

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In this case basically what I did was for these data coming up a sample count  
time of 3 minutes, a background count time of 10 minutes, this instrument with a lower  
background, less noise, also had somewhat less efficiency than is sometimes seen, .15 for the

1 instrument efficiency, and then I used the source efficiency numbers, that I've just showed out of  
2 NUREG-1507, and derived the minimal detectable aerial density for this alpha scintillation  
3 detector for these cases.

4 And basically what they did for me was to take this instrument and go out and  
5 measure these different materials. So this accounts for the material background which is used  
6 in deriving the MDAD.

7 So this is probably the very best that one can do, as far as I'm concerned within  
8 reason the best you can do with a portable field instrument of this kind. Basically what you begin  
9 to see is slick surface like the Formica desktop, which I used, .5 as the source efficiency in that  
10 case.

11 When you look down through these you basically say the only place I've got any  
12 hope of a minimum detectable that's below the limits for a slick surface I can clean up anyway,  
13 and that will -- or a Formica top or something like that. The instrument's just not going to do it for  
14 any of the rest.

15 You get if you look down through here numbers and well, you've got, I use the  
16 slick surface number for the linoleum and the Formica and so on. I suspect the source efficiency  
17 is going to be lower for the concrete and thus lower for the concrete slab, the sidewalk, the bare  
18 brick, the fire brick, and so on, these things that are not coated with a lower source efficiency  
19 then they're going to have a higher detectable limit correspondingly.

20 More likely the instrument may more likely have instead of one count per minute  
21 may have two or three. If it has three, to give you an example, the minimum detectable with no  
22 substrate that is in the air would go up from 20 to 30. So a lot of these numbers would go up not  
23 necessarily linearly but they would go up more with an instrument that's not basicly a pure, clean  
24 instrument.

25 Now, some other things that are problematic with measuring alpha, although  
you can get the good minimum detectable, that is, relative to the other methods, Ablequist and

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1 Loris had looked at the effects of paint and the effects of dust, and you see a couple of things in  
2 here in these data. Basically, once he started adding -- once he started looking at greater  
3 thicknesses of paint, the minimum detectable goes up pretty fast. So, by the time you get to,  
4 say, the 2.77, you are already up at 135, up at three -- 223, so the 223 is above everything, all of  
5 these other limits we have seen, and that 223 at three milligrams per square centimeter, that is  
6 only 30 grams per square meter.  
7

8 By contrast, one of the real advantages of measuring beta begins to show up. It  
9 is not much affected because of the penetrating ability of the beta or the internal combustion.  
10 Not much affected through this range.  
11

12 Similarly, Loris' work, the same kind of thing in looking at dust on the surface.  
13 You can tolerate quite a bit of dust with the beta measurement, but not much dust and still stay  
14 below the limit, or have any chance of it for any of these for dust on the surface. So, 30 grams a  
15 square meter or so.

16 At that point, beyond those, I begin to summarize some of these issues and  
17 mention some others. The first question or issue, whether to measure total activity, removable  
18 or both, and the evolution of the migration today seems to be toward total, which is what these  
19 slides have dealt with.  
20

21 This has raised the question of detection sensitivity versus the limit.  
22 Fundamentally, with the field instruments we have got for these derived values, it is really not  
23 going to do it.

24 Suitable background material. The multiple backgrounds in a single survey unit  
25 and in buildings, which is -- this is a pretty prominent issue. I remember a survey unit that we  
were characterizing that had steel plate concrete floor, part-block wall, brick wall, Celtex ceiling,  
and glass windows and steel window frames. So after we had mentioned this multiple materials  
in one survey unit, there is some dealing with that that the MARSSIM Committee operated on.

Determining source efficiency. This is not a trivial issue to get it and get it right,

1 because it does require going and measuring. There is another issue I haven't addressed yet,  
2 and that is, for surfaces, if you have a radium to radon decay in the chain, do you get emanation  
3 that changes the number of alpha per apparent nuclide.

4 I'm sorry, I was talking about the multiple materials in one room as the third  
5 point. The suitable background material is sometimes just simply being able to find a suitable  
6 background material. We have had, in order to try to find some, taken bricks out of the building  
7 and sawed them in two and cleaned up the interior half, taken concrete bricks, sawed them in  
8 two to look inside the concrete to get a -- taken floors, sliced them in three slices so we could  
9 see the middle slice.

10 I'm sorry, let me see if I can switch pockets. Okay. And then some more  
11 problems. The dirty surfaces problem. At these low kinds of values, a couple of cases we have  
12 seen where, for some reason, the window sill looked like it was contaminated. Eventually, it  
13 turns out, we found out it was just dirt on the window sill. The top of a large storage tank looked  
14 like it was contaminated when the side was not, so we were able to find another one just like it  
15 two or three miles away, the same problem, it must have been dirt on the top of it. At these low  
16 levels, these are the kinds of things that are going to show up. Ordinary dirt and dust is going to  
17 have enough of a change in the background relative to some clean low background surfaces to  
18 trip you over the limit.

19 Finally, one of the provisions of MARSSIM is for an elevated measurements  
20 criterion. We need to be able to derive that and it appears that for the building occupancy  
21 scenario, for the building scenarios, it appears that D and D needs to have this, to have floor  
22 area parameters programmed into it so that you can vary the fraction of the floor that is  
23 contaminated in order to be able to derive these.

24 And, finally, if these instruments don't work well enough, then what is the  
25 measurement technique to be done or actually the right answer is work on the models to get the  
derived values to be more realistic and working on the suspension factor I think is the step in the

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1 right direction, because all of these numbers are dominated by the suspension inhalation  
2 pathway.

3 Finally, because of the timeliness rule and because the staff is encouraging not  
4 to quit and wait, we have had no choice but to continue to do the characterizations and the  
5 surveys and the decommissioning plans based on the best that we can do. So if these are not  
6 now good enough relative to minimum detectables, the fundamental question is what to do with  
7 the data. It has basically been -- not much choice except to keep going and we need to be able  
8 to use these data, both from an expense standpoint and from a time standpoint, not to have to  
9 regress a year or so to do our characterizations again.  
10

11 That's it. Any questions?

12 MR. DARMAN: I'll ask a question. Joe Darman, Maine Yankee.

13 Did you look at the effects of changing the resuspension factor? It looked like  
14 one of the big problems was the DCGL was below the MDA, right, of the instrument.  
15

16 MR. MORTON: In this particular case.

17 MR. DARMAN: The resuspension factor we're down at 1 E minus 6. Does that  
18 get rid of that problem or not?  
19

20 MR. MORTON: It would probably get rid of the problem. I didn't attempt in this  
21 case to tackle that problem. That was, you know, the earlier part of the workshop. The part that  
22 I tried to deal with is the ability to measure, how well can we measure, and how does that  
23 compare with the default values. I didn't try to work on changing the defaults or anything in the  
24 code.  
25

MR. EID: Okay. If there are no more questions, I believe we will move to the  
last speaker. We apologize for the last speaker because we tried to be on time, but because of  
the lots of discussions and questions, so I guess that's the purpose for this meeting.

And the next speaker, please, next.

MR. ORLANDO: The next speaker is Claude Wiblin from WEM, and he's going

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1 to talk about demonstrating how to calculate the indoor area factor.

2 MR. WIBLIN: It's a shame we can't hear the sound. We have great applause in  
3 this.

4 I've been asked to speak on calculating the area factor when you might want  
5 one and when you don't want one.

6 First of all we need to understand primarily that the second bullet, DCGLs, are  
7 based on the area of contamination. Henry started talking about this topic last. But anyway, if  
8 we have a DCGL for this entire room as far as clearing it in the final status survey, we should  
9 also be able to calculate an area much with a higher DCGL that's much smaller. All right?

10 This is important to us because it will allow us to release a Class 1 area with  
11 contamination levels in small areas with greater than your quoted DCGLs. And of course once  
12 you get through with it, you have a hot area or an elevated area, the rest of the room has to be  
13 somewhat downgraded in contamination levels, and the unity rule will apply.

14 First of all uniform concentration, as soon as this thing gets built up -- you guys  
15 are still awake, right?

16 This is basically a fairly representative uniform concentration, evenly spread,  
17 kind of what you'd like to expect after you've spent all of your money deconning the place. This  
18 represents an elevated area of contamination. It can be much higher than your average  
19 contamination, but when we average it using the rules and the formulas in DG4006, we can  
20 actually release this building, room, site, with some of the area having much larger  
21 contamination limits.

22 The importance, one of the areas you have to worry about, if your MDC scan is  
23 greater than your DCGL, you're going to have -- you may have to take more measurements in a  
24 Class 1 survey unit. Of course for all of us we think that's bad because at this point we've  
25 already spent our money, we've deconned the place, we took truckloads of dirt off, concrete,  
cinder block, whatever. And you do have to consider your area factor in every Class 1 survey

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1 unit whether you use it or not. You have to start looking at the MDC for your scanning survey  
2 instrument versus your DCGL.

3 But up here are some example comparisons of the MDG and DCGL. These  
4 values really come from a draft from MARSSIM. MARSSIM has some tables in there. I used  
5 RESRAD to come up with these numbers. Expect your actual DCGL to vary widely, of course,  
6 from site to site, area to area. No way any of us can come up with one that will fit all. But you're  
7 going to start getting into trouble when you're scan MDC is greater than your DCGL. These are  
8 the values that DG4006 alludes to that you can use and take as automatic as far as your scan  
9 MDC when you're walking around out in the farmer's field looking for that cobalt-60, cesium-137.  
10 If this is your given scan MDC, you can't see in some cases all that you're looking for.  
11

12 I'll give you an example as to why this is important to you. In MARSSIM they  
13 use a triangular kind of a base for calculating the number of points. I'm still a square kind of a  
14 guy. All the survey units that I've put out and looked at so far to date have been squares. We  
15 have not dealt in triangles and double triangles this difficult.  
16

17 Anyway, their example on page 5-39, they call it Example 2, you're given an  
18 area of 1,500 meters squared, a DCGL, an MDC of the scan, and by their other calculations that  
19 you do to get to this point, they came up with 15 data points, probably 15 soil samples that they  
20 have to collect in this area. You go through your square pattern calculations and determine how  
21 big this area is. Of course it's 100 meters squared.  
22

23 And moving on, you have to start looking at the area factor, and this is from that  
24 Table 5.6 in MARSSIM I just told you about. The area factor is 1.2. So with this area factor of  
25 1.2 AF, you multiply it by your DCGL, which is 3, you come up with 3.6. Well, you can't see that.  
There's just no way that you can measure that walking around with a sodium iodide detector in  
the field.

So you go back and redo your calculations and you come up with 50 points that  
you have to go back and measure instead of 15. That's a lot of dollars, an awful lot of dollars,

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1 it's a trap at the end of the survey cycle that you don't want to get yourself into. You want to look  
2 at that survey instrument before you go out there, try to find a survey instrument that's equal to  
3 the cause. Because you're probably out of money.

4 I put these up just as a reminder. New NRC acceptable screening levels for  
5 unrestricted use. These are, of course, in dpm per 100 centimeters squared. Everybody familiar  
6 with these numbers? I like to put them up because most people start to gasp at the 10 to the  
7 minus 8th.

8  
9 So one of the things that we have to start looking at to reduce our errors towards  
10 the end of the survey is how do we handle these MDC scan numbers. What is good, what is  
11 bad? Of course, we can look at the background. This new formula, surveyor efficiency, your  
12 instrument efficiency, and your source material efficiency. That, you can probably play with, mix  
13 it on your site and get maybe a 10 percent, 15, I forget what the number actually is, above the  
14 ISO standard recommended values.

15  
16 The one I want to talk about later on is this one, surveyor efficiency. These are  
17 what all those little things are -- you have the handouts, I hope.

18 One of the things that I have been doing is we are using data loggers. We are  
19 also controlling the speed of the data logger. Routinely, you are supposed to take this thing and  
20 push it up, and if the guy hears something or sees something, he is supposed to back up and  
21 wait about four seconds, right. One detector width per second. He stops and waits four  
22 seconds and says, yeah, was that a hot spot or was it not?

23  
24 I really just like to set that thing and let it go. That takes the worry from me is  
25 that guy surveying too fast, is he surveying too slow. It gets the job done. At the same time, we  
are recording the data. No longer do I have to ask the surveyor to write down what his high and  
low, minimum, his gas average type thing. I have it recorded. And we can make a report of it.

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In other words, the gross gamma, subtract the background away, number of measurements, this  
is on the gamma, this is the alpha beta, the minimum, the maximum, the average. We have got

1 it all. And the scan values are coming up to be very close to the direct measurement values.

2 But the question is, right now I am only allowed to use a value of .5 for surveyor  
3 efficiency. Because that is in the denominator and it is a square root, what do I get now? Do I  
4 go up to .75? Can I go up to 1? When I am approaching 1, I am getting real close to a static  
5 measurement type MDC. So, anyway, I think this is a point that needs to be negotiated with the  
6 NRC and find out where do we stand with those.  
7

8 And, of course, it is important because in Class 1 we are going to doing a 100  
9 percent scan.

10 Reg. Guide 4006, draft guide, it says you can use those. As soon as you do,  
11 one of your technicians is going to walk in and say but I have got a three by three, what is my  
12 MDC? So you have to go back and start looking at how they derived these equations.  
13

14 A distance of 10 centimeters above, this is out of MARSSIM, they claimed to  
15 have used, I guess they used Microshield. These are the values of the parameter inputs that  
16 they had. I am kind of rushing through this, I have a lot more I could say.

17 The area factors in RESRAD, they are given to you, by the way, an area factor is  
18 equal to the ratio of the dose rate per unit concentration at 10,000 square meters to that of that  
19 of other areas. In other words, they ran their RESRAD program for 10,000 square meters, then  
20 they ran it for 3,000, 1,000, 300 and so forth, then they compared doses. So when you have a  
21 small area, you are allowed to have more contamination.  
22

23 And they published a table similar to this. I ran the code over, the same  
24 numbers came up. This is the way it looks on a 3D kind of thing, comparing all of them. Look at  
25 the area factors I can get. For a real small area, wow. That means I can have some pretty hefty  
contamination levels in small areas out there in the floor. Wait a minute. I'm sorry, this is  
outdoor, out in the farmer's field.

They did the same thing with the -- except they used RESRAD Build and this  
time they started at 36 down to 1. Then they compared the doses. I believe this table was

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1 published in MARSSIM also. And this is the way they look. This means that for some small  
2 areas, I am going to have some pretty hefty multiples that will permit me to apply, at least, to  
3 release the building.

4 MARSSIM also said that you could interpolate between the points if you needed  
5 to. What we did, we have got a computer modeling code, came up with best fit equation. Just  
6 another tool that you can use if you have to. If you are close to the limit, you might want to take  
7 the effort to look at that.

8  
9 Then of course in the final status survey you have to come up with the numbers  
10 to the evaluations to make everything right and for this elevated area you are not just allowed  
11 one but you can have several, okay? Again I think I said that the unity rule applies, and that is  
12 where you have to start working with this unity formula.

13  
14 You have your average residual rate of activity for all sample points in the  
15 survey unit that are outside the elevated area over your DCGL and plus your average  
16 concentration in the elevated area over the area factor times the DCGL and it also says that if  
17 you have more than one include a separate term for each.

18  
19 So anyway, when all is said and done, we've scabbled, we've power sprayed,  
20 we've washed and everything else, hopefully not very many of us will run into an elevated area  
21 but if we do the tools are in MARSSIM for us to look at, consider, and try to convince the  
22 regulators that the site is acceptable.

23 MR. MORTON: Yes, Henry Morton. A question. When you derived the area  
24 factors for the indoor scenario, what did you use as a basis for those? Did you use --

25 MR. WIBLIN: RESRAD. Straight RESRAD. Pull it up on your screen, select  
your nuclide and go with it.

MR. MORTON: Indoor parameters, indoor scenario, indoor pathways?

MR. WIBLIN: RESRAD Build instead of RESRAD, but those aren't mine. Those  
are MARSSIM. This is the work of MARSSIM people.

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1 MR. ORLANDO: Okay. Anybody else?

2 [No response.]

3 MR. ORLANDO: Thank you, Henry. That concludes all of the presentations that  
4 we had for today.

5  
6 Traditionally at this point we open it up for anybody to sort of bring up anything  
7 they want to talk about or any discussions that we have been having earlier today -- start them  
8 back up.

9 Does anybody have anything they would like to say about any of the stuff we  
10 have talked about today?

11 MR. GENOA: Yes, thank you. Paul Genoa with NEI.

12 Appreciate your indulgence all day on some of my questions. I wanted to kind of  
13 focus on I guess five points that I picked up today, the first being that the earlier presentation on  
14 the available input parameters. I think the presentation was very well done, probably should  
15 have commented at that time that you asked all the right questions.

16  
17 My point would be when do we get the answers and what are people doing  
18 today? I hope that we can continue to decide how to answer that question -- what parameters  
19 are out there, what do you currently use, what do test on the codes, what are some ideas and  
20 let's keep open communications because these guys are out there trying to run these codes and  
21 come up with the right input parameters.

22  
23 Second, related is that the D and D code that you pointed out with the  
24 probabilistic functions added to it, it looks like it is more than a year away from availability, so  
25 again help us work on what people do in the meantime if there are ways to use existing Rev. 1 D  
and D code or other tools, things to do, because I heard some ideas that we discussed around  
that may help us work around that in the meantime until the new codes are available.

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The third point -- EPRI and the industry has been asked to help support some of  
these comparisons and we are certainly willing to do that and just speaking on behalf of EPRI

1 and Man-Sung, he is doing good work. I think he's working at somewhat of a handicap and  
2 Walt, I heard you offer that you are willing to be open in communication and you can perhaps  
3 help him work through this. I just hate to see him beat his head up against the wall if some of  
4 the information is out there that he is trying to understand, so if you want us to work for it, please  
5 help us or help him get that data, get the work and make it available for him, anything that might  
6 be helpful, and I just appreciate your openness because we will get the answers sooner, that's  
7 all.  
8

9 Third, a point that Dick brought up, I want to point out, ultimately we'd like one  
10 tool to get one answer to justify to the public. Two tools, the codes, probably results in two  
11 answers. Two answers result in adjudicatory hearings that judges want to ask why I shouldn't  
12 take the worst case. So ultimately as we get down the road, we probably want one code, one  
13 answer, or certainly a very clear understanding of why the two codes have different purposes,  
14 different applications, et cetera. And with that in mind, I'd like to help work towards kind of  
15 getting the effort in that direction so we ultimately end up with something that's very defensible  
16 for the industry.  
17

18 Finally, I don't know how to put this, but as all good engineers and scientists, we  
19 start with the end in mind. If your end is developing a tool that helps you assure compliance with  
20 the 25 millirem plus ALARA standard, I want you to recognize that in the greater world out there  
21 there are other agencies that have other ideas about what that dose criteria should be, and they  
22 continue to try to impose their will. If it was only another agency, that wouldn't be so bad, but in  
23 fact there are agreement States that are implementing your authority that also appear to have  
24 some different ideas about what the dose ought to be.  
25

I only raise this issue because as you're developing your input parameters for a  
code, you have a certain comfort zone of what your conservatism should be, and the  
conservatism to beat a 25 millirem number is one thing, the conservatism that will meet a 4  
millirem water pathway is a totally different thing. And I want you to be sensitive to that, because

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1 that is the reality.

2 And I guess those are my points. Thank you.

3 MR. ORLANDO: Anybody else?

4 MR. POTTER: Yes, Tom Potter.

5 I'd like to follow up with one comment that's a little bit related to that.

6 I actually spent some time in the probabilistic risk assessment area, and it  
7 appears that we're kind of evolving into that kind of approach here. But one problem I have is  
8 that we're evolving in a limited way. We're only looking at the variability or the risk or the  
9 uncertainty in one piece of this.

10 I think, for example, where the cases that are going to be the real tough nuts for  
11 the decommissioning regulation, the restricted release situations, for example, in the back of our  
12 minds, maybe not explicitly, but at least in the back of our minds we need to be thinking that  
13 these uncertainties are really contingent probabilities, contingent probabilities, for example,  
14 assumption of a probability of 1 for loss of institutional controls, which is not a reasonable  
15 assumption.

16 If you really wanted to explore through the whole or apply the uncertainty  
17 analysis to the whole process, you would assess the probability of losing institutional controls,  
18 which I think is low. We don't really have to carry it to that extent as long as we have in mind  
19 that we've got these extra conservatisms in the form of noncontingent probabilities back there.

20 One way of accommodating that kind of thing is to focus more on the center of  
21 the distribution for the piece of the problem we're analyzing rather than the 90 percentile or 95  
22 justified.

23 MR. ORLANDO: All right. Just to throw out a conversational or comment on  
24 that, I addressed the National Academy of Sciences a couple of weeks ago, and one of their --  
25 they were looking at institutional controls, and we got into a rather lengthy discussion because  
one of the individuals on the NAS panel felt pretty strongly that none of the institutional controls

1 that have been used for restricted sites up to this point, principally in the EPA world, really  
2 worked. He cited, you know, Love Canal and some other places.

3 So I hear what you're saying and I think we have to look at that. But there are  
4 others out there who think that the probability of institutional control failure always is 1. So --

5 MR. POTTER: If you really believe that, do you want that part of your  
6 regulation?  
7

8 MR. ORLANDO: Oh, I don't necessarily believe that we can't do it. I'm just  
9 saying that when we say definitively that the probability of the loss of institutional control is low, I  
10 think one of the things that we have to look at, NRC has to look at, is the institutional controls or  
11 the restrictions to try and make sure that that probability does get smaller and smaller.  
12

13 MR. POTTER: There is one other --

14 MR. ORLANDO: Why don't you come sit at the table, Tom? You're getting  
15 more exercise than I've seen you get all year.

16 MR. POTTER: Well, this is the last of what I think. But there's one other  
17 protective factor here, particularly for these tough nuts, and I'm talking uranium, thorium  
18 situations. I believe that we're talking here about a handful of sites that we're working on, and I  
19 believe there are lots of other sites in the country where these materials in comparable  
20 concentrations often are not regulated at all. So in a sense the worst we're doing is allowing for  
21 a small -- even with loss of institutional controls -- allowing for a small incremental increase in  
22 the number of such sites. That's another way of looking at the problem.  
23

24 MR. ORLANDO: By the same token, too, you know, there is a dose cap if there  
25 is a loss of institutional control, and that would be below the public dose limit anyway. So, I  
mean, the concern that that individual on the NAS panel had, and when you have a loss of  
institutional control or something like that at perhaps a hazardous waste site, the consequences  
I think are probably higher than if you have one under restricted use that NRC's put together  
where there is the dose cap in the event institutional controls fail.

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1           One thing that I want to take away is that Paul didn't mention was that I think you  
2 all are looking for some guidance on partial site release, whether it be either in the reactor world  
3 or in the materials world. We weren't able to do too much discussion of that today, and I guess  
4 there's multiple facets of that, both the release of unimpacted areas, large areas that have power  
5 reactors and some discussions I had with some folks during the breaks, release of sites where  
6 perhaps it's been remediated or you can just come in and carve off a chunk and say look, this  
7 was never used, and we've surveyed it out, and now we don't want this on the license anymore.  
8 I think there are ways to do that on the materials side through license amendments and what  
9 not, but it looks like that might be a little more difficult on the reactor side.  
10

11           So that's something I'm going to take to NRR and see if I can't maybe in one of  
12 the subsequent workshops have somebody come down and at least talk about what they're  
13 thinking about along those lines.  
14

15           Does anybody else have any observations, thoughts, or what not about what  
16 we've talked about today?  
17

18           MR. MORTON: I think what -- Henry Morton -- what you just mentioned I think  
19 has three facets, at least three facets. One was the breaking the nonimpacted from the  
20 controlled area. Second is a case in which you might want to separate the impacted area, part  
21 of a site, from the remainder of the site, also impacted, under the new guidance.  
22 Both under the new guidance. And then the third possibility is to separate part of a site under a  
23 grandfathered condition from the remainder of the site under current regulation.  
24

25           MR. ORLANDO: Do you mean grandfathered in that 20.1401 sense where it  
would be released under SDMP criteria?

MR. MORTON: Yes.

MR. ORLANDO: We are looking at that one, at least on the material side right  
now. There are some questions associated with that.

Paul, was there something you wanted to say?

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1 MR. GENOA: I was just trying to clarify. I think Dr. English pointed out two  
2 different options currently viable.

3 MR. ORLANDO: Pull the microphone --

4 MR. GENOA: Yes. I'm sorry. Paul Genoa, NEI.

5 Clarification. I believe Dr. English's presentation pointed out two different  
6 approaches we currently believe are viable and are fairly straightforward in the amendment of  
7 our existing Part 50 license to describe changes to license boundary that would allow for the  
8 early release of non-impacted areas. I'm not sure that I -- and if it was an impacted area, that's a  
9 different story, and perhaps we could talk about guidance on that, but I think we understand how  
10 you would do that as well. So we can talk about it some more, but I think we understand the --  
11 currently the release of non-impacted areas from a facility.

12 MR. ORLANDO: Okay.

13 MR. GENOA: Operating or not operating.

14 MR. ORLANDO: Well, maybe, then, it's something we just need to look at more  
15 on the material side.

16 That's about it, then, for the discussion today. I just have a couple of little  
17 housekeeping things for everybody.

18 First of all, there was a request made last time to try and put the transcripts of  
19 the meetings on the Web site. I looked into that and apparently there are some memory  
20 problems with doing that, so what I'm going to look into is having the transcripts available on  
21 diskette, and if you want some -- if you have a particular one you want to listen to, we'll go ahead  
22 and make copies and send it to you. I have to check into that. That's not a promise; that's one  
23 way I'm trying to make sure that everybody can see everything that was said.

24 There is a preliminary guidelines for evaluating dose assessments that was  
25 posted outside. I think we're going to try and put that on the Web here pretty soon. Everybody  
can take a look at that. That's what Mark used to -- well, Mark's gone -- as part of the

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development of Tim Harris' presentation.

Let's see. The last thing was just a discussion of what's going to happen over the next couple of workshops. The next one is groundwater modeling. I'm not sure if Tom Nicholson needs or is looking for any volunteers, but I will check with him and let Paul Genoa and Dave know, Dave Colbersome know, if Nicholson is looking for anybody to participate. I looked at the agenda and I think it's pretty -- there's a lot of folks on there already. But if you're interested in groundwater modeling, the week of the 23rd, here's the place to be.

As far as the August workshop, folks from the CRCPD had indicated that they had hoped to be able to say something at that workshop, so perhaps the August workshop, and we'll try and talk this up a little bit more, may look at perhaps surveys and agreement state issues, and maybe we won't have a day that's focused just on dose modeling the way we normally do.

I throw that out for consideration. The agreement state folks wanted to be able to come in close to the close of the comment period on the draft guidance so that they could verbalize concerns that they had.

Also, I'm not sure if we need to have one on surveys, but given some of the things that came up today, I think it's appropriate, plus -- oh, to give you a little bit of information, also we lost -- as you know, Dave Fauver is gone or has left NRC. He's sitting in the back somewhere; he's not -- there he is. And so we've had to -- Dave was putting together the surveys portion of the SRP, and to kind of give you an idea of Dave's value here, we had to mobilize to do it. So we're going to have -- Tim Vitkus and Eric Ablequist are going to be working on that for us.

We also don't have the individual who was working on the financial assurance section of the SRP. He rotated out. So we're going to have ICF come in and do some of the work on that. So we're hoping to -- as we lose staff, we're hoping to try and replace them using contractors or other staff. So we're still hoping to get the SRP out in the same time frame. But if

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1 we do have a surveys module workshop, I think that will involve bringing Eric and some of those  
2 folks down because I think they're the ones who can speak about it the best.

3 Does anybody have any thoughts or observations or anything before I kick you  
4 out of here?

5 [No response.]

6 MR. ORLANDO: No? Okay. I want to thank all of the speakers for speaking,  
7 and I want to thank all of the participants for participating, and I want to thank everybody else for  
8 staying as late as they have. One of the down sides, once you get rolling on comments, you  
9 don't want to shut people up, but by the same token, you want to make sure everybody gets out  
10 of here. So thank you all very much.

11 [Whereupon, at 5:17 p.m., the workshop was recessed, to reconvene at 8:30  
12 a.m., Friday, March 19, 1999.]

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