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ADVISORY COMMITTEE ON NUCLEAR WASTE

JANUARY 8, 2002

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW)

131st MEETING

+ + + + +

TUESDAY,

JANUARY 8, 2002

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ROCKVILLE, MARYLAND

+ + + + +

The ACNW met at the Nuclear Regulatory  
Commission, Two White Flint North, Room T2B3, 11545  
Rockville Pike, at 11:00 a.m., George M. Hornberger,  
Chairman, presiding.

COMMITTEE MEMBERS:

GEORGE M. HORNBERGER, Chairman

RAYMOND G. WYMER, Vice Chairman

B. JOHN GARRICK, Member

MILTON N. LEVENSON, Member

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## 1 ACNW STAFF PRESENT:

2 HOWARD J. LARSON, Special Assistant, ACRS, ACNW

3 RICHARD K. MAJOR

4 LYNN DEERING

5 LATIF HAMDAN

6 SHER BAHADUR

7 AMARJIT SINGH

8 JOHN T. LARKINS

9 RICHARD P. SAVIO

10 CAROL A. HARRIS

11  
12 ALSO PRESENT:

13 TIM McCARTIN

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

(11:03 a.m.)

CHAIRMAN HORNBERGER: The meeting will come to order. This is the first day of the 131st meeting of the Advisory Committee on Nuclear Waste. My name is George Hornberger, Chairman of the ACNW.

Other Members of the Committee present are John Garrick, Milton Levenson and Raymond Wymer.

During today's meeting, following the planning and procedure session, the Committee will discuss proposed revisions to 10 CFR Part 63, discuss proposed letters and finalize plans for a Committee retreat.

John Larkins or Howard Larson is the designated federal official for today's initial session.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. We have received no written comments or requests for time to make oral statements from members of the public regarding today's session. Should anyone wish to address the Committee, please make your wishes known to one of the Committee staff.

It is requested that speakers use one of the microphones, identify themselves and speak with

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1 sufficient clarity and volume so that they can be  
2 readily heard.

3 Before proceeding, I would like to cover  
4 some brief items of current interest. It has been  
5 announced recently that Bill Reamer will become the  
6 Deputy Director, Division of Waste Management,  
7 replacing Josie Picone who will become the Deputy  
8 Director, Office of State and Travel Programs. Mr.  
9 Jack Sorenson, ACRS staff Senior Fellow, completed his  
10 term with the Office on December 31, 2001. He has now  
11 joined the Office of Nuclear Material Safety and  
12 Safeguards to assist in risk-informing activities.  
13 The trade press recently reported that politicians in  
14 the Swedish town of Oesthammar have voted to allow  
15 drilling in bedrock in the community to see if it is  
16 suitable for a final spent fuel repository. Mr. Phil  
17 Justice has been assigned as NMSS liaison for the  
18 ACNW.

19 We are going to proceed to our discussion  
20 of the proposed amendment to 10 CFR Part 63 and John  
21 Garrick is the cognizant member. I'll turn it over to  
22 John.

23 MEMBER GARRICK: Thank you. We're going  
24 to hear from the staff on a proposed rule on 10 CFR  
25 Part 63 which has to do with the specification of the

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1 probability for unlikely features, events and  
2 processes or as they are affectionately known as FEPs  
3 and as I understand it, the Commission has voted this  
4 proposed rule, but it has not been published yet for  
5 public comment because the SRM is still being held up  
6 for reasons that maybe Tim will explain.

7 What is involved here is that the EPA  
8 Yucca Mountain standard is really -- involves three  
9 standards, three separate standards: the so-called  
10 All Pathway standard, the Human Intrusion standard and  
11 the Groundwater standard.

12 And in the EPA standard, the concept of  
13 very unlikely events has been defined as a specific  
14 number and these are excluded from all three  
15 standards. So these numbers, these thresholds become  
16 very important because they drive the issue of what  
17 can be considered or what has to be considered and  
18 what doesn't have to be considered.

19 And for the Human Intrusion and  
20 Groundwater standard, the category called unlikely  
21 events may also be excluded, but the EPA left it up to  
22 the Nuclear Regulatory Commission to define what is  
23 meant by unlikely.

24 So this is a topic of considerable  
25 interest to the Committee. The problem here is that

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1 it is sort of after the fact advice that something we  
2 were talking about earlier and it's somewhat difficult  
3 for the Committee to have had much of an impact on the  
4 voting of the Commission. And this is one of the  
5 flaws that we've spoken about in the past that's  
6 inherent in this whole advisory process. But we don't  
7 want to dwell on that at the moment. We are going to  
8 talk about it at our retreat.

9 One of the things that I'm very interested  
10 in, in this whole discussion is I think maybe an issue  
11 that's just as important as what these numbers ought  
12 to be is the issue related to the process of  
13 assembling or disassembling or aggregating FEPs  
14 because you can imagine that you might have something  
15 that's just above an acceptable threshold and through  
16 redefinition of the FEPs or the scenarios or what have  
17 you, you end up with a set of conditions that are  
18 actually below the threshold and I'd be very  
19 interested in the discussion in being assured that  
20 that kind of manipulation is protected somehow.

21 So with that, Tim, Tim McCartin, we're  
22 looking forward to your clarifying where we are in  
23 this issue and perhaps answering some of our  
24 questions.

25 MR. McCARTIN: Hopefully. Thank you, Dr.

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1 Garrick.

2 As you noted, we'll be talking about the  
3 probability of unlikely events. I would like to make  
4 a few introductory statements and one would be, as you  
5 alluded to, although we are anticipating an SRM  
6 shortly, we do not have one, so this presentation  
7 should be viewed as the staff opinion. It isn't the  
8 Commission's opinion yet until a proposal is  
9 published.

10 Likewise, I do know that I believe we try  
11 to and get benefit from participation with the  
12 Committee and I would say it is unfortunate that we  
13 did not -- were not able to come to the Committee with  
14 our proposal prior to going to the Commission.  
15 However, we were aware of that. We knew the  
16 limitations of it. We were operating with an SRM on  
17 final Part 63 that directed us to do an expedited rule  
18 making and gave us a relatively short time period to  
19 do this. And so there really wasn't an opportunity to  
20 interact appropriately or as we typically would like  
21 to do.

22 However, we think that going out with the  
23 proposal, rather than getting the Committee's maybe a  
24 very hurried quick opinion, we're proposing a 75-day  
25 comment period. During that public comment period we

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1 would like to come back to the Committee, discuss the  
2 public comments we get and get the Committee's  
3 reaction at that time and certainly we would factor in  
4 any Committee's opinions, views in the final to this  
5 amendment. But it really -- we had approximately 2 to  
6 3 weeks to do this before getting into the concurrence  
7 process and so writing this in two to three weeks  
8 really does not lend itself well to getting a lot of  
9 input and thereby the Commission saying do an  
10 expedited rule making which is direction to skip some  
11 of the things you normally would do.

12 Also, along those lines, I'll repeat it at  
13 the end, but when we're talking about unlikely events  
14 in this context, I think it's very important to  
15 recognized that unlikely is for this application only.  
16 It is a very good qualitative word. We aren't  
17 suggesting that we're defining the word "unlikely" for  
18 all the uses that might be used in regulation at NRC,  
19 but merely in this application.

20 Generally, I'd like to give you a little  
21 of the regulatory background, some of the technical  
22 background that we thought about and then finally I'll  
23 give what our proposal for the probability value for  
24 unlikely events is.

25 I will probably slip into using the

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1 unlikely events. The language is actually features  
2 events and processes and sequences of events and  
3 processes, but a shorthand way of saying is I just use  
4 the word "events", but I mean the full spectrum.

5 The background, as actually Dr. Garrick  
6 alluded to, the EPA standards were finalized on June  
7 13th of last year. There were three standards: the  
8 individual protection standards, human intrusion and  
9 groundwater protection. Very unlikely FEPs are not to  
10 be considered in any of these calculations. Unlike  
11 FEPs are to be considered only for the individual  
12 protection standard. They're excluded from  
13 consideration in groundwater protection and human  
14 intrusion.

15 The final standards went a little further,  
16 obviously as proposed in the EPA standard the cutoff  
17 for very unlikely FEPs was a one chance in 10,000 of  
18 occurring within the 10,000 years, what we sometimes  
19 refer to as the  $10^{-8}$  per year cutoff. That's for very  
20 unlikely FEPs. The probability for unlikely FEPs were  
21 not defined and they left that to the NRC.

22 In looking at the preamble to the  
23 standards, it's important to look at how unlikely is  
24 to be applied. As I mentioned human intrusion,  
25 groundwater protection. They're very specialized

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1 calculations. The human intrusion calculation is done  
2 to look at the robustness of the repository to the  
3 consequences of intrusion. Likewise groundwater  
4 protection is to evaluate the degradation of the  
5 groundwater resource. They're very specialized  
6 calculations.

7 And further, in looking at these  
8 calculations, the preamble to the standard really  
9 talks to focusing the calculations on likely or  
10 expected performance, so the reason for excluding  
11 unlikely is you're trying to get to what is the likely  
12 behavior, expected behavior for these two specialized  
13 calculations.

14 Final part 63 was published in November of  
15 last year. In it, the Commission indicated that they  
16 intended to conduct a separate rulemaking to define  
17 unlikely and indicated that the numerical value would  
18 be somewhere between  $10^{-8}$ ,  $10^{-4}$  per year.

19 Our approach in looking at how to define  
20 unlikely, conceptually we thought it was easier to  
21 think of three broad categories: very unlikely,  
22 unlikely and likely. Clearly, we already had a  
23 definition, a quantitative definition very unlikely,  
24 the  $10^{-8}$  per year and in looking at those three  
25 categories we felt it was easier conceptually to think

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1 of very unlikely and likely. If you set the values  
2 for those two, you clearly have the middle defined and  
3 so looking at a lower bound for what should be  
4 considered a likely FEP, we felt that somewhere  
5 between  $10^{-6}$  and  $10^{-4}$  range was an appropriate value  
6 for what could be considered likely as a lower bound  
7 for likely.

8 Quantitatively, what does that really  
9 mean? The  $10^{-6}$  per year is essentially a 1 percent  
10 chance of occurring within the 10,000 year period. We  
11 felt that a 1 percent chance of occurring is neither  
12 expected nor likely.  $10^{-5}$  per year is a 10 percent  
13 chance of occurring within the 10,000 years. And then  
14 if we go to  $10^{-4}$  per year, it's a very high  
15 probability of occurring within the 10,000 years.  
16 Obviously, it's very likely that it would occur.

17 And I know I was accused early on of the  
18 Goldilocks Syndrome here and one's too low, one's too  
19 high, the middle one is just about right and the  $10^{-5}$   
20 per year would seem to be a 10 percent chance of  
21 occurring as the lower bound for likely, that if you  
22 got much lower than that, sort of like  $10^{-6}$ , 1  
23 percent, that should not be considered likely. The  
24  $10^{-4}$  per year, that would seem to be, you would want  
25 to be a little lower than that. It's almost certain

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1 to occur. It's very likely to occur.

2 And thus, our proposal, we felt that  
3 unlikely FEPs would be best characterized by a  
4 probability range and we're defining the unlikely FEPs  
5 as that value between  $10^{-5}$  and  $10^{-8}$  per year,  
6 essentially a 10 percent chance of occurring at the  
7 high end, down to the .01 percent chance which is  
8 really the 1 in 10,000 over 10,000 years at that for  
9 the very unlikely.

10 We think that upper bound of 10 percent  
11 for unlikely seems to be a prudent range for defining  
12 the unlikely events in the context of these two  
13 calculations. Once again, it's not intended as a  
14 precedent for other applications where the term  
15 unlikely might be used in NRC regulations. At the  
16 beginning of this exercise of writing the amendment,  
17 we looked at the word unlikely, where is it used? It  
18 appears in all kinds of places, other regulations. It  
19 really is the context and for this particular  
20 application it's appropriate. There are many other  
21 uses of the word unlikely and we are not setting  
22 precedent for that.

23 Where are we at? Right now, we anticipate  
24 that we will get an SRM shortly and the amendment will  
25 be published this month, 75-day comment period. We

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1 anticipate that we would have a final amendment some  
2 time in the summer to early fall. And once again, I  
3 would like to reiterate that I think during the public  
4 comment period, as we get some of the comments in,  
5 there could be an appropriate time, maybe more than  
6 one time, to come back to the Committee and discuss  
7 the comments we've gotten and where we think we're  
8 headed with this amendment.

9 And with that, if there are any questions,  
10 I'd be happy to try to answer them.

11 MEMBER GARRICK: Thanks, Tim. Milt,  
12 microphone.

13 MEMBER LEVENSON: You did what is fairly  
14 easy to do which is to confuse me, Tim. After you've  
15 defined that you're going to talk about three things,  
16 very unlikely, unlikely and likely, you then ring in  
17 a new one which is very likely. Is that intended to  
18 be a different category?

19 MR. MCCARTIN: No, no. It was just -- the  
20  $10^{-4}$  in terms of -- I guess we could have -- well, we  
21 were looking for the lower bound for unlikely or the  
22 -- the lower bound for likely and --

23 CHAIRMAN HORNBERGER: Just take the "very"  
24 off and you solve the problem.

25 MR. MCCARTIN: The reason "very" is there,

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1 that in terms of -- it's too likely to be considered  
2 the lower bound for likely.

3 (Laughter.)

4 MR. BAHADUR: Is  $10^{-5}$  likely?

5 MR. McCARTIN: That's the -- yes, the  
6 lower bound for likely. That's what our proposal is.  
7 The lower bound for likely, the upper bound for  
8 unlikely. You've got three categories. Obviously,  
9 there's that.

10 MEMBER LEVENSON: Okay, one other  
11 question. From a standpoint of risk informed and I  
12 know maybe probably it isn't possible for this, but  
13 I'd like your comment on the idea of defining these  
14 independent of consequences when they're a basis for  
15 screening out things. You're not -- there's nothing  
16 in here that allows you to throw something out because  
17 even if it's likely, the consequences are unimportant.  
18 There's a whole separate set of things, right?

19 MR. McCARTIN: Right. It does not look --

20 MEMBER LEVENSON: You still have the other  
21 screen, even if something is very likely, but has  
22 extremely low consequences, still have the ability to  
23 throw it out?

24 MR. McCARTIN: Oh, absolutely. I mean the  
25 regulation allows for something that does not have a

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1 significant effect and that would be certainly based  
2 on low enough consequences or low enough risk.

3 CHAIRMAN HORNBERGER: That would occur in  
4 screening the FEPs, is that right?

5 MR. McCARTIN: That's one area you could  
6 do it. You could actually have a FEP come in. You do  
7 the analysis you see that the consequences and/or risk  
8 is low enough that we -- it does not have a  
9 significant effect on the time or the magnitude of the  
10 dose. I can eliminate it. And that's really the --  
11 in the rule, it does say that. Things that don't have  
12 a significant effect on the timing and magnitude of  
13 the dose, do not have to be included in the analysis.

14 MEMBER GARRICK: Ray?

15 VICE CHAIRMAN WYMER: Once these  
16 categories are defined, then you get down to the  
17 really tough question of how do you determine  
18 probabilities. Where in the regulations is there  
19 criteria for doing that?

20 MR. McCARTIN: Well, the only thing -- the  
21 one thing we have said is that we, along the lines I  
22 know Dr. Garrick mentioned that could there be  
23 mischief by defining things a particular way merely to  
24 get it a low enough probability to get it out of the  
25 analysis and we have said that in general for events,

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1 categories of events and we're expecting a broad  
2 definition of the event, rather than a very narrow  
3 definition and maybe a simple example could be that if  
4 you have seismicity, seismicity as an event occurs.

5 If you wanted to define maybe a very  
6 narrow range of magnitude of the seismic event, you  
7 could get down to a very small probability and we're  
8 not looking at -- we're not expecting a narrow  
9 definition. It tends to be more of a broader  
10 definition, but other than that, there's nothing  
11 that's part of the NRC review. It would be looking at  
12 how a particular event was defined that potentially  
13 led it to be screened from the analysis.

14 VICE CHAIRMAN WYMER: So you take somebody  
15 else's calculation of probability and evaluate it?

16 MR. McCARTIN: Yes.

17 VICE CHAIRMAN WYMER: Okay.

18 MEMBER GARRICK: George?

19 CHAIRMAN HORNBERGER: Tim, let's see, how  
20 can I phrase this question? One of the things that I  
21 found a little confusing is this notion that you  
22 presented that should we have a probability range or  
23 a single number. At first I thought well, a single  
24 number can't be what Tim means because that doesn't  
25 make any sense. You're not going to pick the square

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1 root of 2 times  $10^{-6}$ , the single number for an  
2 unlikely event. So that isn't what you mean.

3 So what I don't understand is then what  
4 the distinction is between saying okay, I'm going to  
5 pick the single number, less than  $10^{-5}$ . How is that  
6 different from defining a range?

7 MR. McCARTIN: I don't believe it is.

8 CHAIRMAN HORNBERGER: Okay.

9 MR. McCARTIN: But --

10 CHAIRMAN HORNBERGER: So in terms of plain  
11 language, don't you think that you might be doing  
12 violence to understanding by raising this as a big  
13 issue?

14 MR. McCARTIN: Well, what it does is --  
15 the reason we use the range, we also have that lower  
16 end cutoff, that unlikely doesn't proceed on to zero,  
17 if you will, but it stops at the  $10^{-8}$  and from that  
18 point on it's very unlikely and it's really just  
19 creating that here's the range for unlikely and then  
20 here is likely. But you're right, it's just --

21 CHAIRMAN HORNBERGER: In the presentation,  
22 you can add confusion by saying well, we're not  
23 picking a single value. We're picking a range when --  
24 obviously, that's what you're doing.

25 MR. McCARTIN: Well, yes. Maybe a better

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1 way to say it is it's less than  $10^{-5}$  and therein is  
2 less than  $10^{-8}$ . That might --

3 CHAIRMAN HORNBERGER: I think you  
4 mentioned this. It is important to highlight that  
5 this decision, as Ray indicated well how do you decide  
6 on these probabilities. These would only be the  
7 unlikely events or event sequences or the whole -- I'm  
8 using event the same way you said you were going to  
9 use it. It's only for the stylized analyses for human  
10 intrusion and well, basically igneous activity.

11 MR. McCARTIN: Groundwater.

12 CHAIRMAN HORNBERGER: Or groundwater  
13 protection. So they're not screened out over the all  
14 pathways dose at all?

15 MR. McCARTIN: No, no. The individual  
16 protection would have the unlikely events, yeah.  
17 Obviously, very unlikely is excluded from everything.

18 CHAIRMAN HORNBERGER: Right.

19 MR. McCARTIN: But the unlikely is  
20 included in the individual pathway.

21 CHAIRMAN HORNBERGER: Thanks. That's all  
22 I have.

23 MEMBER GARRICK: Tim, how would you  
24 correlate FEPs with scenarios?

25 MR. McCARTIN: I would say that to me it's

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1 easier to think of the events and an event is like a  
2 scenario class. I think they're similar.

3 A scenario class would have some  
4 collection of FEPs within it.

5 MEMBER GARRICK: Yeah, yeah. FEPs also  
6 contains the word process.

7 MR. McCARTIN: Yes.

8 MEMBER GARRICK: So it's not impossible  
9 for a process to be characterized as a scenario.

10 MR. McCARTIN: Yes, right. Generally, to  
11 date, probabilities, explicit probabilities have been  
12 assigned primarily to events. The DOE and ourselves  
13 have not tried to assign a probability to a feature or  
14 a process. It could be done, but to date it generally  
15 is looking more at the events.

16 MEMBER GARRICK: Now I guess the other  
17 question I would want to ask is why are we doing this?  
18 Why aren't we just focusing on the risk of not meeting  
19 the standards and just calculate that risk? Why do we  
20 want these thresholds?

21 MR. McCARTIN: Probably as much for  
22 practicality purposes, I think. Certainly, the  $10^{-8}$   
23 cutoff for very unlikely, I think you come to a point  
24 where how low do I want to try to go to estimating  
25 what might happen? And I think  $10^{-8}$  in part, is due

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1 to practicality of how far I want to go in probability  
2 space.  $10^{-10}$ ,  $10^{-12}$ . I mean you get to some pretty  
3 outlandish kinds of things and a lot of speculation,  
4 depending on how far you go down. I think  $10^{-8}$  is  
5 there, as much for practicality in that it seems to be  
6 a reasonably low level. We don't want to go lower.

7 The unlikely events, in my opinion, is  
8 recognizing that we have two very special calculations  
9 here, human intrusion and groundwater protection and  
10 you're trying to get more -- you don't want to go to  
11 as extreme events as you've considered in the  
12 individual all pathway. But you're looking at, in a  
13 general sense, what's likely to occur. And it's one  
14 also of for these calculations will do a simpler kind  
15 of calculation. I would say it's one of practicality,  
16 once again and -- but I don't know, from a risk  
17 standpoint should you look at a  $10^{-10}$  event that has a  
18 consequence --

19 MEMBER GARRICK: Well, we've run into this  
20 problem in the large scope risk assessments of nuclear  
21 power plants and the reason I ask the question about  
22 scenarios is that you can look upon a risk assessment  
23 as a structured set of scenarios. And the question  
24 was if you impose screening levels, you need to be  
25 careful to not get in the position that there's  $10^{-4}$

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1 events and so what we did was stored all of the events  
2 that were screened and included them in the aggregate  
3 calculation of the final risk measure which could be  
4 something like an off-site dose or a release category  
5 or a core damage frequency or what have you.

6 But that, at least, protected us against  
7 any accumulated effect that might come from a class of  
8 scenarios that met the cutoff criteria, but we didn't  
9 throw them out. We kept them in the bottom line  
10 calculation. Do you anticipate a similar approach  
11 here?

12 MR. McCARTIN: To date, we have not been  
13 as worried about the completeness argument.

14 MEMBER GARRICK: Right.

15 MR. McCARTIN: That -- which is what I  
16 think you're getting at. Could we throw away enough  
17 things that indeed we're really not representing the  
18 risk of the facility any longer.

19 MEMBER GARRICK: Right.

20 MR. McCARTIN: And I believe in the rule  
21 where we talk about we're expecting the events in  
22 these types of things to be defined in a broad sense,  
23 that we have not seen an effect that would, that is  
24 throwing out big chunks of risk, if you will. I look  
25 at say volcanism, seismicity.

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1 I mean these things are in and they're in  
2 a broad sense, they're not things -- we have not seen  
3 things being tossed out that the cumulative effect  
4 would be that now we have 10 percent of the risk and  
5 90 percent of the risk was tossed out. Certainly, the  
6 desire was when we said that we were expecting a broad  
7 definition was trying to get at that fact. I think  
8 our review would have to look at it. We have to look  
9 at what gets thrown out, etcetera.

10 As you know, the rule also talks to not  
11 the amendment, but final 63 talks about we want to see  
12 DOE's basis for what they threw out and I think we  
13 would have to be sensitive and be able to answer that  
14 question. Have we thrown out more risk than we've  
15 kept in, but right now I think because the categories  
16 tend to be broad --

17 MEMBER GARRICK: Of course, another  
18 opportunity for accountability here would be the  
19 uncertainties, the uncertainties could be impacted by  
20 the impact that is judged from the FEPs that have been  
21 screened out.

22 In principle, I like the idea of a range  
23 versus a value, although as George says, the threshold  
24 is a value. But the range is an interesting concept  
25 and I think a step in the direction of accounting for

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1       uncertainty.

2               In the decision to do that did you  
3       consider going the next step of actually imposing a  
4       distribution function? I can imagine a p0 function,  
5       a probability frequency function that would  
6       characterize this parameter, this range even more  
7       fully in a risk sense.

8               Did you consider that at all?

9               MR. McCARTIN: No.

10              MEMBER GARRICK: Rather than a limit line  
11       as in the Reg Farmer limit line idea, you would have  
12       a limit distribution and that way --

13              CHAIRMAN HORNBERGER: Does that mean that  
14       you would partially include the analysis in the human  
15       intrusion?

16              MEMBER GARRICK: No, what I'm talking  
17       about is that if you do a calculation of the frequency  
18       of occurrence event and you characterize that  
19       calculation as a probability density function, does  
20       that function -- is that compatible with the criteria  
21       and the criteria could be a PDF. That's all I'm  
22       saying.

23              CHAIRMAN HORNBERGER: I guess I don't  
24       follow that. It seems to me that what Tim is  
25       describing is a way to conform to what is stated in

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1 the EPA rule which is to define when an event sequence  
2 or whatever, however we want to call it gets included  
3 in, for example, a human intrusion stylized analysis.

4 MEMBER GARRICK: Yes, I understand. But  
5 all I'm suggesting is that --

6 CHAIRMAN HORNBERGER: That requires a yes  
7 or no answer is what I'm saying.

8 MEMBER GARRICK: Yes. But I think that if  
9 you're starting to talk about criteria of what  
10 constitutes an acceptable value, you could do it in  
11 the context of distribution functions as well as you  
12 could do it in the context of ranges, as well as you  
13 could do it in the context of specific numbers.  
14 That's all I'm saying.

15 CHAIRMAN HORNBERGER: Not to define a  
16 likely event.

17 MEMBER LEVENSON: Well, in essence, it's  
18 the same thing. The EPA cutoff says that you run  
19 hundreds of analyses --

20 CHAIRMAN HORNBERGER: No, no. I  
21 understand the rule, but it has nothing to do with --

22 MEMBER GARRICK: George, all I'm saying is  
23 that you can represent likelihood in a number of  
24 different ways. One way you can represent it is with  
25 the frequency without regard to uncertainty. Another

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1 way you can represent it is with the probability and  
2 inherent in your probability would be an uncertainty.  
3 But another way you could represent it is in the  
4 probability of frequency and you could have the notion  
5 of frequency and you could say there's uncertainty in  
6 that frequency and I characterize that certainty in  
7 the form of a probability distribution.

8 And so all I'm suggesting is was there any  
9 thought --

10 CHAIRMAN HORNBERGER: But still, it  
11 strikes me -- suppose you now identify an events  
12 sequence and you say well, there's a probability  
13 distribution associated with it and with central  
14 tendency as  $10^{-6}$  or 5 times  $10^{-6}$  per year and some  
15 dispersion parameter around it. Is that event likely,  
16 unlikely or very unlikely?

17 MEMBER GARRICK: Oh, I would, I guess I  
18 left out a part. I would -- this is how I would go  
19 possibly instead of the concept of likely and unlikely  
20 and very unlikely.

21 CHAIRMAN HORNBERGER: Okay.

22 MEMBER GARRICK: To me, the concept of  
23 likely,  
24 very unlikely, etcetera, is an intermediate step 2  
25 that kind of -- that PDF kind of characterization.

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1 CHAIRMAN HORNBERGER: I understand that  
2 now. But what I'm saying is that it strikes me that  
3 what Tim is faced with doing is conforming with the  
4 existing EPA regulation which doesn't permit that.

5 MR. MCCARTIN: I guess I would prefer the  
6 -- in the regulation it be fairly rigid in terms of  
7 less than  $10^{-5}$ , greater than  $10^{-8}$ , but in terms of  
8 application and I don't know if this would get to some  
9 of your desires, would be when I'm looking at  
10 assigning a probability to a particular FEP, could I  
11 use a distribution for the probability of that FEP and  
12 I think the answer is yes.

13 Now the issue would be one of well, is it  
14 in or is it out? If I get a little bit over here and  
15 I think the intent of the rule where you're looking at  
16 mean kind of behavior, I would say if you use a  
17 distribution which is characterizing the uncertainty  
18 in your probability estimate, if the mean of that  
19 distribution would be -- you would use the mean to  
20 decide whether you're in or out. That's something  
21 that I think we probably will be looking at, possibly,  
22 in the context of the review plan.

23 VICE CHAIRMAN WYMER: But the real problem  
24 is going to occur when you come up with an event which  
25 is neither very likely nor very unlikely, but likely.

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1 Then you're on pretty shifting ground.

2 CHAIRMAN HORNBERGER: No, then it's in.

3 MEMBER GARRICK: Then it's in, yeah.

4 VICE CHAIRMAN WYMER: But then you're  
5 going to apply a judgment.

6 CHAIRMAN HORNBERGER: No, no, no. Then  
7 it's in the analysis. Then it has to be considered in  
8 the groundwater protection analysis and in the human  
9 intrusion, stylized human intrusion.

10 VICE CHAIRMAN WYMER: Okay, I see what you  
11 mean.

12 MEMBER GARRICK: One other comment, Tim,  
13 here. You describe these as qualitative evaluation  
14 guidelines. In order to establish compliance, you're  
15 really imposing a very quantitative requirement on the  
16 part of the analyst, right?

17 MR. McCARTIN: Absolutely, yeah.

18 MEMBER GARRICK: Because these thresholds  
19 are pretty definite.

20 MR. McCARTIN: Well, you are right and the  
21 qualitative was more in terms of the preamble in the  
22 EPA standard. This is a qualitative word. Here are  
23 some of the things they said in a qualitative sense to  
24 give you an indication of what the intent was and by  
25 that, if you look at qualitatively the words, they

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1 were intending to have expected conditions, likely  
2 conditions and so when I look at -- I've got this  
3 qualitative word unlikely and the intent as the way we  
4 read it is to get to likely expected conditions and  
5 that is what allows -- we then went okay,  
6 quantitatively, you're absolutely right.

7 We want a very sharp, clear indication of  
8 how we will implement that and that's why we're --  
9 there is no doubt there. I mean we're proposing  $10^{-5}$   
10 as the one end and  $10^{-8}$  at the other and likewise for  
11 very unlikely,  $10^{-8}$  is very sharp. There is no  
12 qualitative nature to that.

13 MEMBER GARRICK: I think the thing that  
14 you have to be very much alert to is that the analysts  
15 don't get so involved in these evaluation guidelines  
16 that they compromise the real issue here which is  
17 calculation of the risk of meeting the standard and  
18 that's -- no, that's the thing that a lot of these  
19 kind of bottom up considerations tend to do.

20 There is something people can get hold of  
21 and they run with them and it's one of the reasons why  
22 we, for example, were against subsystem requirements  
23 was we want the focus to be the measure of its been  
24 identified by law, in this case the three standards,  
25 15 milirem, 15 milirem and 4 milirem. That's the

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1 context. And that's something I think you'd want to  
2 be very careful with in this.

3 MEMBER LEVENSON: So is the total thrust  
4 of this as George just implied a minute ago, to these  
5 categories, to decide whether or not you do an  
6 analysis, whether or not it's in the --

7 MR. McCARTIN: Well, the analysis will be  
8 done. The question is what kinds of FEPs do I include  
9 in the analysis and in reality I mean you can look at  
10 -- and I'll talk to both cutoffs. The  $10^{-8}$  cutoff, as  
11 you know, I think on the plus side, you can -- do you  
12 consider all the important things at Yucca Mountain.  
13 I mean you have volcanism in that calculation.

14 We can't think of many things below  $10^{-8}$ ,  
15 I mean there's things that people --

16 CHAIRMAN HORNBERGER: A Bolide impact.

17 MR. McCARTIN: Which?

18 CHAIRMAN HORNBERGER: A Bolide impact.

19 MR. McCARTIN: Oh. Tsunamis. There's  
20 things --

21 CHAIRMAN HORNBERGER: No, no, no. A  
22 Tsunami isn't very likely to come over the Sierra, but  
23 if you look at a probability of a Bolide impact, it's  
24 not -- it's less than  $10^{-8}$ , but it's certainly not  
25 zero.

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1                   There are craters in Arizona.

2                   MR. McCARTIN: Yes, yes. But I think one  
3 is sufficient enough to disrupt the repository 300  
4 meters down, I think has been characterized as less  
5 likely than --

6                   CHAIRMAN HORNBERGER: I was agreeing with  
7 you. It's less than  $10^{-8}$  if you're screening it out.  
8 Potentially bit impact.

9                   MR. McCARTIN: Yes. So I think you've got  
10 those kinds of things in there. When you get to what  
11 should we include in human intrusion and groundwater  
12 protection, certainly igneous activity at  $10^{-5}$  falls  
13 out certainly and then you've got things like rock  
14 fall seismicity will still be in to some extent. At  
15 least qualitatively that's how we see the  
16 calculations. What is the impact of this particular  
17 amendment, that really is the primary effect and we  
18 think the calculations will be done. It's just a  
19 matter of what gets included.

20                  CHAIRMAN HORNBERGER: Tim, it strikes me,  
21 this is just a follow-up on John's last comment that  
22 you already have, I think, good experience to draw on  
23 that goes to two of the things that John mentioned,  
24 first of all, a distribution of frequencies and second  
25 of all, what happens, how you make logical decisions

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1 about whether something is screened and that is you  
2 look at igneous activity and DOE's analysis as I  
3 recall right below  $10^{-8}$ , but with a broad distribution  
4 and so it doesn't get screened out even though the  
5 mean or the median of the distribution is below  $10^{-8}$ .  
6 I think that you don't throw out good judgment when  
7 you draw these lines and I think that you have good  
8 experience with that already.

9 MR. McCARTIN: Right. I believe DOE's  
10 latest numbers have it slightly greater than  $10^{-8}$ , but  
11 it's on that edge, but that's one of the things,  
12 clearly, that we would be reviewing and looking at,  
13 things that are screened out that are near that  
14 boundary, be it the  $10^{-8}$  or  $10^{-5}$  and what's the basis.  
15 So yeah.

16 MEMBER GARRICK: How important do you  
17 think these categorizations will become in the  
18 analysis, the unlikely, very unlikely and likely?

19 MR. McCARTIN: The understanding we have  
20 to date would say that it's not very important. With  
21 the simple -- with one simple caveat that there are  
22 some things that the calculation will be somewhat  
23 easier to do without and the -- not having to include  
24 igneous activity in the groundwater protection  
25 calculation and the human intrusion calculation. It's

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1 one less thing to have to include there. The  
2 calculations we've done to date would say that isn't -  
3 - wouldn't have made a difference.

4 MEMBER GARRICK: In the nuclear weapons  
5 field they have a similar categorization and they have  
6 a very unlikely, well, they have unlikely, very  
7 unlikely and extremely unlikely. Was there any  
8 discussion or interaction with them on this whole  
9 process and how it has worked? They've been doing  
10 this for a number of years.

11 MR. McCARTIN: No. I can tell you when we  
12 first started on this amendment, we talked to a number  
13 of people in the Agency both within NMSS and NRR and  
14 the Office of Research in terms of give us some  
15 insights on the unlikely, very unlikely, etcetera.

16 MEMBER GARRICK: Right.

17 MR. McCARTIN: And the overall response I  
18 got from everyone was that it really depends on the  
19 exact nature of the calculation you're doing and the  
20 consequences and they said -- everyone was somewhat  
21 unwilling to do much without knowing more about the  
22 impact and what the application is. And so I think  
23 for now, I think we're comfortable defining it in the  
24 context of Yucca Mountain, in the context of the  
25 10,000 year compliance period, in the context of human

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1 intrusion, groundwater -- it's a very specialized  
2 application and for here, I think it makes sense.

3 There aren't many other people that deal  
4 with the 10,000 year compliance period in terms of  
5 looking at consequences and so we didn't get a lot of  
6 information from the people we contacted, but we did  
7 not go outside the Agency, I will say that.

8 MEMBER GARRICK: Any other questions?

9 MEMBER LEVENSON: It seems to me an  
10 important factor here, John, and that is that it looks  
11 like they no longer have to consider human intrusion  
12 occurring during a volcano eruption.

13 (Laughter.)

14 MEMBER GARRICK: We used to call those  
15 combined loads.

16 (Laughter.)

17 Yes, Latif?

18 MR. HAMDAN: Yes. Tim, do you have  
19 anywhere in the rule some basis for the  $10^{-5}$ , why it's  
20 not  $10^{-6}$  or  $10^{-4}$ , for example?

21 MR. McCARTIN: Well, that's what the  
22 amendment is doing is proposing  $10^{-5}$ . In the  
23 amendment, we certainly talk to the other three  
24 values,  $10^{-4}$ ,  $10^{-6}$  and give our rationale for it, but  
25 this is the proposal. And once again, when we -- I'll

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1 say we go up before the Commission and even though  
2 OGC, the legal arm of NRC, for a proposal for  
3 rulemaking it's just that. Is this a reasonable  
4 proposal? That's not to say it's going to end up here  
5 at  $10^{-5}$ , but it seems and I think people agreed that  
6 it seemed a reasonable value to go out for public  
7 comment.

8 Will it end up there? We've given our  
9 basis why. We'll see what the public comment says and  
10 likewise, I think for the Committee and once again,  
11 this will be the third time, but I still want to say  
12 we apologize for not coming early on, but I think this  
13 will give you a longer time to think through this.  
14 It's our first cut. That's why we go out for public  
15 comment and maybe  $10^{-5}$ , maybe there's a more  
16 appropriate number, but we'll see what happens during  
17 the public comment period.

18 MEMBER GARRICK: Any other comments from  
19 audience or staff or anybody?

20 Okay, I think that satisfies us. Thank  
21 you, Tim.

22 MR. McCARTIN: Sure.

23 CHAIRMAN HORNBERGER: Thanks very much,  
24 Tim. Anything that anybody wants to bring up that we  
25 could accomplish in 10 minutes or should we break for

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1 lunch adn reconvene?

2 So because John and I have a meeting with  
3 Commissioner Merrifield at 1 o'clock, what I would  
4 suggest is that Ray and Milt could get us started --  
5 I don't know if either of you have read this yellow  
6 letter, I haven't yet. But there are questions. The  
7 big thing is to look through this research report and  
8 try to come up with the key things that we need to say  
9 in our research report. So my suggestion is you  
10 should go ahead and have a read through that adn the  
11 two of you could discuss it. That one and this white  
12 one that Dick Savio handed around, research.

13 MR. SINGH: I haven't passed out the  
14 research report yet.

15 CHAIRMAN HORNBERGER: Oh okay, so it's not  
16 around.

17 MR. SINGH: But I have copies.

18 CHAIRMAN HORNBERGER: Okay, so what I  
19 suggest is Dick, why don't you give copies to Ray and  
20 Milt and --

21 MEMBER LEVENSON: When will you be back?

22 CHAIRMAN HORNBERGER: Probably around  
23 1:30. Okay? So we'll start our letter writing  
24 session around 1:30 and we don't need to be on the  
25 record at all this afternoon? Is that right?

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1 So this will end the record keeping.

2 Adjourned.

3 (Whereupon, at 11:54 a.m., the proceedings  
4 were concluded.)

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