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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW)

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156th MEETING

+ + + + +

MONDAY

DECEMBER 13, 2004

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear
Regulatory Commission, Two White Flint North, Room
T2B3, 11545 Rockville Pike, at 4:00 p.m., Dr. Michael
T. Ryan, Chairman, presiding.

MEMBERS PRESENT:

- MICHAEL T. RYAN Chairman
- ALLEN G. CROFF Vice Chairman
- JAMES CLARKE Consultant
- WILLIAM J. HINZE Consultant
- RUTH F. WEINER Member

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ACNW STAFF PRESENT:

NEIL M. COLEMAN

JOHN FLACK

LATIF HAMDAN

HOWARD J. LARSON

MICHAEL LEE

RICHARD K. MAJOR

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AGENDA ITEMS

PAGE

Time-of-Compliance for a Proposed
High-Level Waste Repository (Open)
(MTR/MPL) -- Discussion on Previous
Recommendations Regarding Time-of-
Compliance for a Proposed High-Level
Waste Repository

4

P R O C E E D I N G S

(4:04 p.m.)

1
2
3 CHAIRMAN RYAN: Okay. We'll reconvene, it
4 now being four o'clock. And next up is a presentation
5 on time of compliance for a proposed high-level waste
6 repository. And Bill, you're going to give us the
7 presentation.

8 DR. HINZE: Very good. And there are
9 slides that go along with this so if you don't
10 understand me, hopefully you'll be able to understand
11 the slides.

12 And I do want to certainly thank Mike Lee
13 of your staff who has worked diligently to bring me up
14 to speed, especially on those topics that have
15 occurred in time of compliance since I left the
16 Committee.

17 The whole issue of time period of
18 compliance for geological repositories has been a
19 controversial and a problematic issue for at least 25
20 years. It's been around and it's raising its -- I
21 shouldn't say ugly -- head once again.

22 If I may have the next slide. This is an
23 outline of the presentation or discussion that we're
24 having here today.

25 What I'm trying to do is to lead you to

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1 the previous ACNW views and recommendations. We'll be
2 looking at the basis for the time-of-compliance, the
3 Energy Policy Act of '92, which then set up the
4 National Academy Technical Basis Study which was
5 reported in '95. And then response of the EPA and the
6 DOE. And then the more recent court remand.

7 We'll say a few words about national and
8 international perspective. And I'm going to conclude
9 with some personal observations that hopefully will be
10 of interest to the Committee. And the Committee may
11 wish to consider what its role will be in time-of-
12 compliance from here on.

13 Then may I have the next slide please.
14 There are many ways that we can define this time
15 period of regulatory compliance but there are three
16 essential ingredients to it. There's the minimum time
17 that has to be, the time over which the repository
18 must comply with the standard, and the critical group.
19 Those are the REMI.

20 One way to express this is that it is the
21 minimum time period over which the repository must
22 meet the dose limits or risk to the reference
23 biosphere and the critical group. And this is
24 following an established repository standard.

25 We have had different types of time-of-

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1 compliance. If we go back to the late 70s, the early
2 80s, it was really a comparative time-of-compliance,
3 more or less looking at the safety factor in the
4 repository.

5 This, then, developed into a generic time-
6 of-compliance in 191 and 60. And more recently, in
7 the more recent CFRs of the EPA and the NRC, in a
8 repository-specific time-of-compliance.

9 Now when I started to bring together
10 materials that we might discuss, I thought about what
11 are the criteria employed in setting a time-of-
12 compliance. And in reading the documents, I could not
13 find a listing of the time-of-compliance. So I took
14 the liberty, if you will, to go through and -- next
15 slide please -- and look at the CFRs and try to dig
16 out the criteria.

17 First is that the time period has to be
18 sufficient that we ensure the safety of humans and the
19 general biosphere environment from a loss of integrity
20 of all of the barriers of the repository.

21 Closely aligned with that is that we
22 should have an adequate time -- this time period
23 should be adequate so that we incorporate those
24 processes and event which are going to impose the
25 greatest risk, that are going to be important. And

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1 generally I interpret this as being more geological
2 factors.

3 The opposite side of the coin is that the
4 period of time should be short enough, should be
5 restricted to a time period in which the uncertainties
6 can be prescribed with reasonable assurance so that
7 the uncertainties don't become too great.

8 The fourth criteria, which I look upon as
9 kind of a de facto criteria because it's used as a
10 justification, for example, in the EPA 191, is that
11 there should be sufficient time in this time-of-
12 compliance that the source term has been drastically
13 decreased and is roughly equivalent to the hazard that
14 would be imposed by a hypothetical equivalent ore
15 body.

16 If I could have the next slide please.
17 And fortunately there is NUREG-1538 that was authored
18 by our own Mike Lee and Tim McCartin and it has some
19 interesting diagrams in it, which relate to this
20 equivalence in 10,000 years, which was established in
21 this generic time-of-compliance.

22 And the diagram on your left, which you
23 can't read but hopefully you'll be able to look at in
24 the original NUREG, shows the radionuclide hazard from
25 the spent nuclear fuel. The initial products are

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1 primarily fission products, gradually going to the
2 natural products.

3 And on the right we have -- and I
4 apologize you can't read that but the horizontal scale
5 is from 10 to the first to 10 to the eighth. And what
6 we see is the, if you will, the radionuclide hazard,
7 the radioactivity from the spent nuclear fuel to the
8 natural ore body.

9 And by the time we have reached something
10 like 10,000 years, we're within -- the spent nuclear
11 fuel is of the order of the radioactivity from a
12 natural ore body of equivalent uranium content.

13 Thank you. Good. I'll try not to shine
14 it in anyone's eye.

15 If I might have the next slide please.
16 But then we go to the specific repository. And we
17 have the generic repository criteria that we've just
18 gone through. And then we have all of those things
19 that are involved in the performance assessment of a
20 specific repository, including the REMI or the
21 critical group.

22 And we can't list these all but we all
23 know what they are: source, inventory, waste form,
24 nature, level of activity, and rate of change --
25 that's important -- of various geological, tectonic,

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1 et cetera factors, underground igneous, location,
2 nature, and evolution of the biosphere and the
3 critical group. That is all, of course, part of the
4 criteria of a specific repository.

5 There are two other criteria here that
6 we've seen discussed related to Yucca Mountain and
7 that is regulatory consistency. That's a paradigm
8 that we would like to see invoked. And we look for
9 this on a national and international basis. And then
10 we also look at this in the low-level waste, the WIPP,
11 the RCRA requirements for injection wells.

12 The interesting thing is that if you -- I
13 have not studied this in depth but what I've been able
14 to look at here in the last week or so is that these
15 low-level waste is now being recommended by the NRC as
16 10,000 years. WIPP is 10,000 years.

17 We can't really say that this is
18 regulatory consistency because this is a big circular
19 action because many of these were really taken from
20 the 10,000 years going back to the early consideration
21 of 191. So the consistency argument might be
22 misleading.

23 And finally, the specific repository
24 should be -- whatever that means -- simple and
25 understandable. It has to be something that is going

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1 to be easily regulated. It's going to have to be
2 understood by the various components that are
3 reviewing the documents.

4 Next slide please. And then along came
5 the Energy Policy Act of '92, which told the EPA and
6 the NRC to develop new radiation standards and
7 repository regulations and specifically to do this for
8 the Yucca Mountain site.

9 A second aspect of this was that the
10 Energy Policy Act of '92 said you have to go to the
11 National Academy of Sciences to advise you, the EPA,
12 on the appropriate technical basis for the radiation
13 standards.

14 Next slide please. And as a result of
15 that, the Technical Basis Panel was set up, spent a
16 couple of years chatting with each other and picking
17 up a lot of useful information, and they presented a
18 number of conclusions.

19 And their principle conclusion, and
20 certainly one of their more controversial conclusions,
21 is, with respect to the existing 10,000 year time-of-
22 compliance, which had been established for the generic
23 repository in 191 and 63.

24 And there are three elements of their
25 conclusion regarding time-of-compliance. First of

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1 all, they stated that there was no scientific basis
2 for limiting the time period of the individual risk
3 standard to 10,000 years or to any other value. And,
4 of course, this was what was strongly emphasized in
5 the remand a few months ago.

6 Compliance assessment, they also made the
7 argument that it is possible to bound the assessment
8 for most physical and geological aspects on the time
9 scale of a million years.

10 Again, this was for one of the more
11 tectonic, dynamic areas of the world in comparison to
12 the, for example, the Canadian Shield, but they said
13 that they could predict for a million years.

14 And this had a caveat really, that the
15 compliance assessment be conducted for the time when
16 the greatest risk occurs. But it had this caveat
17 within the limits imposed by the long-term stability
18 of the geological environment.

19 That was one of the positions, one of the
20 statements that gave the EPA and the NRC some
21 opportunity to move around.

22 Next slide please. And the net result is
23 that on policy grounds and also with this caveat of
24 the long-term stability, if you will, we have ended up
25 with a 10,000 year time-of-compliance now not just for

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1 the generic but also for the specific Yucca Mountain.
2 And this, of course, has now been remanded.

3 If I may have the next slide please.
4 Currently, of course, and over the past couple of
5 decades, the DOE and the NRC and others have conducted
6 Yucca Mountain-specific performance assessments. And
7 at least the DOE and NRC have considered this 10,000
8 year time-of-compliance.

9 Incidentally, it's rather interesting that
10 EPRI, in our workshop here now almost a decade ago,
11 had a time-of-compliance of a thousand years.

12 The results of these assessments have led
13 to a peak dose occurring before 10,000 years. And you
14 all are knowledgeable of the fact that this is really
15 caused by the igneous activity issue which puts the
16 peak dose in a few millirem before the 10,000 years.

17 I should point out that in the 197 of the
18 EPA, that they not only set the 10,000 year time
19 period, but they also said that one has to look into
20 the future for a period of time up to the peak risk.

21 In contrast to that, Part 63 only says
22 10,000 years.

23 And so I don't know how far the NRC has
24 gone in looking at the post-10,000 years in any detail
25 but the Department of Energy, of course, has done that

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1 and has looked at the post-10,000 years and has found
2 several peak doses which are of considerably greater
3 amplitude than the igneous activity peak dose.

4 One of the results of the workshop on
5 time-of-compliance was the slight changes in the
6 performance assessment. And that was, you know, a
7 decade ago performance assessment, the peak dose could
8 shift around a bit in terms of time but not much in
9 terms of amplitude. In other words, depending upon
10 the conditions that one developed.

11 Next slide please. Now the international
12 time-of-compliance views largely come out of the NEA.
13 And I guess it's proper to say that there's no
14 consensus. The standards and approaches differ among
15 regulators. And, in fact, some regulators specify no
16 time-of-compliance.

17 Generally, however, they have a multi-step
18 approach with an early assessment in the 1,000 years
19 period and a longer assessment going up to -- well, a
20 million years or even, I think in some of the
21 Scandinavian, up to 100 million years.

22 My own feeling about this is that if you
23 look at their results, basically you'll end up with
24 that they have a time-of-compliance which is pretty
25 compatible with our 10,000 years but then look at it

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1 in a sensitivity analysis at least in to that period
2 extending into a million years.

3 May I have the next slide please? I asked
4 the staff to make a slide of this because I didn't get
5 a chance to read it. This is -- I don't know, Mike,
6 it's 400 pages or something like that -- but this is
7 an NEA document from a workshop in April '02 on the
8 handling of timescales and addressing the post-closure
9 safety of deep geological repositories.

10 This was brought together under the
11 leadership of Abe Van Luik, who you all know, and Abe
12 is the U.S. representative to the NEA's Committee on
13 Long-Term Compliance of Repositories. And don't quote
14 me on the exact words of the title of that.

15 But this is a document that I think the
16 Committee should become familiar with and some of the
17 references that are given in it because I think if
18 you're going to move ahead, you have to know what's
19 happened in the past. I'm a historian at heart.

20 Next slide please. Now in terms of the
21 activities of the ACNW, over the years there were
22 briefings regarding the EPA standards, the impact of
23 the Energy Policy Act of '92, and then also the
24 National Academy findings and recommendations.

25 Frye, the Chairman of that panel, came in

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1 and discussed that with the Committee. And it became
2 apparent in those days that there was this nagging
3 question of what should be the time-of-compliance.

4 And so the ACNW held a working group
5 meeting in spring of 1996. And the members, the
6 people that appeared at that, are in a background
7 slide if I understand correctly, Mike.

8 Basically there was really very good
9 contributions from the Department of Energy, NRC,
10 EPRI. And there were a number of academic and
11 commercial organizations that were represented as well
12 including a representation from the international
13 arena.

14 Andy Campbell, who was the staff person
15 that put this together -- there's Andy right there.
16 And did -- well, I think Andy did a fantastic job.
17 But my recollection of it, and he can back me up on
18 that, is that we had a difficult time coming up with
19 international representatives. But we finally did get
20 one international representative.

21 Thank you for nodding your head. I think
22 that was in a positive sense, right?

23 And so that will become -- the reason I'm
24 emphasizing that is because I think that we didn't
25 learn all we should have on an international back in

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1 those days. And the fact of the matter, I think there
2 was less intensity on the part of the international
3 community than we find today on time-of-compliance.

4 One of the good things are the bad things,
5 depending upon the way you want to look at it. It's
6 that this time-of-compliance working group meeting was
7 on both high-level waste and low-level waste.

8 It kind of diluted the high-level waste
9 but the idea here was that we could bring in some of
10 the criteria and the thinking from the low-level waste
11 group into the high-level waste group as well.

12 And there were many objectives. But one
13 is that we wanted the Committee to learn more about
14 the regulatory context of this, the technical,
15 scientific basis for the time-of-compliance, and
16 alternatives to that.

17 Now the Committee -- if one does a search
18 I think you find time-of-compliance in seven letters
19 -- but the truth of the matter is -- that the
20 Committee has produced -- but the truth of the matter
21 is it's only the June and November '96 letters that
22 deal with high-level waste that are really telling.

23 CHAIRMAN RYAN: Bill, just a quick
24 question. Does this international document from '02
25 -- I'm sorry, does the international document from '02

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1 deal with intermediate-level waste, which is a
2 European issue more than it is a U.S. issue as well?

3 MR. LEE: I'm not sure. I'd certainly --

4 CHAIRMAN RYAN: Okay.

5 MR. LEE: -- have to look.

6 CHAIRMAN RYAN: Because sometimes that's
7 the toughest of the three because it's kind of in
8 between low and high and, you know, what's the right
9 time is often discussed for those.

10 DR. HINZE: If you'll go back to the
11 transcript of the working group meeting, that was a
12 question that we did ask of the international
13 representative in terms of their use of intermediate
14 waste.

15 CHAIRMAN RYAN: Intermediate. Okay.
16 Thanks.

17 DR. HINZE: And so I feel certain that
18 since this was largely a European document, the NEA is
19 a largely European document --

20 CHAIRMAN RYAN: Right.

21 DR. HINZE: -- that there has to be the
22 consideration of intermediate.

23 CHAIRMAN RYAN: Okay. We will take a look
24 at it when you pass it around. Thanks.

25 DR. HINZE: But those two letters, if I

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1 could have the next slide please, the main ACNW
2 messages were that no specific position was taken
3 regarding the EPA-specified 10,000 year time-of-
4 compliance. But that the Committee did state that
5 certainly post-10,000 year calculations were valuable.

6 Now the Committee recommended a two-part
7 approach to defining the time-of-compliance:
8 reflecting the characteristics of the site of the
9 repository design and the critical group.

10 Next slide please. There are two parts of
11 this, as I said. One that deals with the definitive
12 measure. That's my word. You won't find that really
13 in the letter. But it's an attempt at a definitive
14 measure is Part One. And Part Two is more of a
15 sensitivity analysis.

16 There are three parts to this definitive
17 measure. First of all, that we're dealing with the
18 time that it takes for the first release of radiation
19 to get to the critical group.

20 So we have -- a performance assessment of
21 the site determines the anticipated time, that's what
22 we call the time-of-compliance, for release and
23 transport of radionuclides to reach the critical
24 group.

25 In other words, you make your best shot at

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1 performance assessment and get the time that it takes
2 to reach the critical group. Now understand that's
3 not a definitive cut off but it's a general range.

4 If the time-of-compliance is less than a
5 few thousand years, for example 3,000 years, the
6 repository is rejected or it can be redesigned because
7 of the low integrity of the system.

8 If the time-of-compliance is greater than
9 the several thousand years, then there is a comparison
10 made through TSPA with the standard. If the
11 performance is deficient or we reject or redesign the
12 repository, if the performance complies, then we
13 continue to Part Two.

14 In other words, at this time to reach the
15 repository, if you meet the standard and it is beyond
16 a few thousand years, then we go to the second part of
17 the recommendation.

18 Next slide please. And that's the
19 sensitivity analysis. And the repository performance
20 is evaluated against the standard at the time of peak
21 dose.

22 In other words, if there is more than one
23 peak dose, you go to them all. And I'm reading that
24 into it. It's a Bill Hinzism, if you will. But there
25 may be more one time of peak dose. And you don't just

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1 go to the peak dose but you look at it coming off so
2 you make certain you're not in a local rather than a
3 global load.

4 The uncertainties in the system need to be
5 identified in this process and probabilistically
6 quantified and their effects determined by bounding
7 calculations.

8 Now the question is how do you regulate
9 this. You know that's always the tough question. And
10 what the Committee said was that it accepts the
11 repository if the bounding calculations show that the
12 repository complies within roughly an order of
13 magnitude because the feeling that the uncertainties
14 gave us that much leeway, an order of magnitude of the
15 standard. Otherwise, you redesign or reject the
16 repository.

17 Now, ladies and gentlemen, bear with me.
18 Next slide please.

19 CHAIRMAN RYAN: Oh, my goodness.

20 DR. HINZE: Yes, well, this is why I'm
21 asking you to bear with me.

22 In the November letter, there was included
23 a flowchart which tried to make this a little simpler.
24 And this you can't read unless you're really in phase
25 with the fuzziness here. But I just wanted to show

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1 you that type of thing and you can see that in the
2 letter.

3 Next slide please. What we see is -- and
4 I'm not going to bore you with all of the details here
5 but this was an attempt to try to put this on some
6 type of a quantitative basis. And you reject the
7 repository, you redesign.

8 If it's not less than 3,000 years or so,
9 you do a TSPA. And if it meets the standard, then you
10 continue on to the second phase.

11 Next slide please. And the next slide is
12 -- we have the PA work here along with analogues and
13 experiments to study the time to reach peak dose,
14 TSPA. And again, comparison with the EPA standard
15 comparison. And if the repository complies, then
16 you've got a repository.

17 Next slide please. I'm glad there are no
18 questions. The --

19 PARTICIPANT: So far.

20 DR. HINZE: At the end of '96, the
21 Committee received a letter from the EDO regarding the
22 June and November letter. And it's an interesting
23 letter. And I strongly recommend that you read it.

24 First of all, the staff supported a tiered
25 approach. Now I might say that there is no tiered

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1 approach in 63. The ACNW's recommendation fails to
2 consider associated policy issues.

3 Well, that's just exactly what we're
4 trying to avoid. And that's what the court just told
5 us here, if you will. And the attempt of the
6 suggestion by the Committee was to avoid that.

7 Staff is concerned that there's too much
8 emphasis on quantification of exact time. I have some
9 personal problems with this because PA is what they're
10 doing all the time and coming up with numbers. And I
11 don't think the Committee has thought about this as a
12 very specific time.

13 Finally, the staff believes that the
14 10,000 years is adequate in the context of a tiered
15 approach, which is the recommendation that you have
16 made. The time-of-compliance also involves
17 programmatic issues such as contributions from
18 individual variants, the old defense in depth.

19 Now let me make some personal observations
20 about this and you can have fun with me. Most of the
21 problematic aspects of the time-of-compliance are
22 derived from these uncertainties in the post-10,000-
23 year repository period. And if you look at those,
24 most of those really are speaking in terms of the
25 geological barrier.

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1 And let's look at some sub-bullets here.
2 One of them is that we hardly have unanimity of view
3 point by very good scientists on this point that the
4 uncertainties are too large to deal with or that you
5 can deal with them.

6 For example, the Science Advisory Board of
7 the EPA -- and I only know one geoscientist that was
8 on that and he is very good -- they agreed that the
9 uncertainties beyond 10,000 years were too great to
10 bound.

11 And then we have the National Academy
12 Panel which says the opposite. It's interesting that
13 -- and I'll make an observation here, a Bill Hinzism,
14 that the two geoscientists on the National Academy of
15 Science Panel are -- one's a hydrologist and one's a
16 geohydrologist. There's no one involved really in
17 tectonics or seismicity or igneous processes.

18 And as I looked at this, I wondered in my
19 own mind how these panels would stack up to the NRC
20 regulation on expert judgment. What's the number of
21 it, Mike? You wrote it.

22 MR. LEE: I think it's 1536.

23 DR. HINZE: Well, right. We have very
24 specific requirements for expert judgment.

25 MR. LEE: Yes.

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1 DR. HINZE: And this is an expert
2 judgment, ladies and gentlemen. It's an expert
3 judgment because this is a subjective argument. And
4 it is open to differences of opinion.

5 Now there are variations in the geological
6 processes and events. And we know that. But these
7 can be minimized by collecting the proper data, doing
8 the analysis, and, in fact, a great deal has been
9 done, as we know, in the last decade.

10 And also the use of geological analogues.
11 I know Rod Ewing doesn't believe in -- even though he
12 is Mr. Geological Analogues. He's concerned about
13 using them for time-of-compliance. And he so stated
14 at your working group meeting in '96.

15 But nonetheless, geological analogues can
16 be used in this, especially with the transport. And
17 I'm thinking of Sierra Blanca, for example.

18 There are large uncertainties not only in
19 these geological barriers but certainly in the
20 climatic change and the whole area of biosphere and
21 critical group. And I should also include in here,
22 and we'll get to that in a moment, the near-field
23 environment engineered barriers.

24 Another statement that we -- I guess we
25 don't have to make is that absolute proof of

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1 repository behavior is unnecessary.

2 If I could have the next slide please?
3 Some more observations. There is an increasing
4 dependance on engineered barriers and a diminishing
5 role of geological barriers.

6 I guess -- I think it was Rod Ewing a
7 couple years ago, again, that wrote the article in
8 Science that says this is no longer a geological
9 repository.

10 He may be stretching it a bit, and I hope
11 he is, but the point is that with the recognition of
12 the fast pathways in the vadose zone, that what we
13 have ended up with is an enhancement of the engineered
14 barriers, that is a more robust cannister and drip
15 shields.

16 Now the question then is what is the
17 impact of this change on the concerns about the
18 uncertainty, which are the principle stumbling block
19 in the TOC. It's probably significant, in my view,
20 because of the limited knowledge of uncertainty in the
21 long-term performance of the engineered barrier.

22 And the canisters and drip shields, you
23 know, I attended the research review on that last year
24 I guess that was -- that was earlier this year -- I
25 don't have a warm, fuzzy feeling that we have a long-

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1 term feel for the uncertainties in there. And that
2 certainly also goes to the near-field geochemistry.
3 And you can go on and on with these items that deal
4 with the engineered barrier.

5 Another observation, and this is -- once
6 you become an emeritus professor, you're allowed a
7 certain amount of cynicism, the differences regarding
8 what a policy decision is. The NRC believes that the
9 post-10,000 is a policy decision. But then the
10 National Academy says it's a technical decision.

11 The time-of-compliance of 10,000 years
12 started off really in this comparative realm of
13 regulatory space as a safety indicator.

14 But with increasing use of performance
15 assessment, in my view we've forced ourselves into a
16 more rigid cutoff of this kind of compliance -- 10,000
17 years now means 10,000 years, .000. And I'm
18 stretching the point.

19 But -- and the net result is that PA may
20 give us a false sense of accuracy, a false sense of
21 security.

22 Next slide.

23 CHAIRMAN RYAN: But just a counterpoint
24 here, Bill. Doesn't the fact that you're doing a
25 performance assessment in a probabilistic way -- sorry

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1 -- doesn't the fact that you're doing this performance
2 assessment at a point in time in a probabilistic way
3 give you a range of outcomes that helps you understand
4 uncertainty?

5 DR. HINZE: It certainly should. But what
6 I'm concerned about here, Mike, is the fact that we
7 give this 10,000 years as a very specific cutoff in
8 time.

9 CHAIRMAN RYAN: Yes, if your point is you
10 could do that probabilistic assessment of 10,000, or
11 11,000, or --

12 DR. HINZE: Exactly.

13 CHAIRMAN RYAN: -- 9,000 --

14 DR. HINZE: Exactly.

15 CHAIRMAN RYAN: -- that's fine. But I
16 just wanted everybody to recognize that a PA that's
17 done as a deterministic is one question but when you
18 really do a probabilistic many hundreds of thousands
19 of runs, you do get a sense of uncertainty at least at
20 that point in time. And maybe the question you're
21 raising is if you do it on the y-axis --

22 DR. HINZE: Yes.

23 CHAIRMAN RYAN: -- why not do it on the x-
24 axis?

25 DR. HINZE: Yes, right.

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1 CHAIRMAN RYAN: Is that what you're really
2 saying?

3 DR. HINZE: Yes.

4 CHAIRMAN RYAN: Okay.

5 DR. HINZE: Well, not only that but also
6 the fact that we give this as a very specific time
7 despite the fact that we do PA in a probabilistic way.

8 CHAIRMAN RYAN: Well, and the key there
9 is, of course, you're doing the variation on things
10 that effect the y-axis.

11 DR. HINZE: Yes.

12 CHAIRMAN RYAN: Your point is maybe the x-
13 axis would be interesting, too.

14 DR. HINZE: Exactly.

15 CHAIRMAN RYAN: Okay. Thanks.

16 DR. HINZE: Next slide please. The ACNW
17 may wish to obtain additional information, vis a vis
18 a working group, and on international approaches to
19 time-of-compliance. I think since '96, there has been
20 an increase in interest in this and more thought.

21 And we also could look at long-term
22 technical uncertainties with regard to engineered
23 barriers and policy considerations with respect to
24 human physical evolution over a million years, the
25 changes in lifestyle, climatic change and so forth.

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1 I guess I would finish up here by saying
2 that the past ACNW's advice on high-level waste time-
3 of-compliance, I think it is viable. It's technical.
4 It's about as technical as we've seen.

5 It uses performance assessment in a
6 probabilistic manner. But it is complex. And not
7 everyone is going to understand it or believe that it
8 works. But I believe that this is technically
9 justifiable.

10 Now the question is what might be the
11 future role of the ACNW on this topic. And that's for
12 you to discuss. That's it.

13 CHAIRMAN RYAN: Bill, thanks very much.
14 That was a very informative presentation on the
15 history of time-of-compliance particularly from your
16 tenure on the ACNW. So we appreciate your bringing us
17 that body of experience in about 45 minutes. That was
18 great to hear all that.

19 As you talk, I guess the one question that
20 strikes me is what you finished up on is that the idea
21 for a working group. Maybe that's an approach we
22 ought to think more carefully about.

23 I guess it would be helpful if we could
24 review, Mike, and I don't know how many copies of that
25 International Workshop you have -- but --

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1 MR. LEE: You will have it on your --

2 CHAIRMAN RYAN: Tell me it will be on a
3 CD.

4 MR. LEE: It is.

5 CHAIRMAN RYAN: Oh, good.

6 MR. LEE: You have it in your CD. It's
7 one of the folders in --

8 CHAIRMAN RYAN: Oh, okay.

9 MR. LEE: -- in Tab 3.

10 CHAIRMAN RYAN: In the current one. Okay.
11 I didn't look at that folder.

12 MR. LEE: But I can send you a message to
13 let you know which one exactly.

14 CHAIRMAN RYAN: Okay. Great. And maybe
15 that's the thought is to digest them. I'm curious
16 what the international view is.

17 I have seen many of the NEA publications
18 come across on repository time horizons and time-of-
19 compliance and lots of other related time-dependent
20 issues. So there's certainly something there and of
21 recent vintage --

22 DR. HINZE: Well, I --

23 CHAIRMAN RYAN: -- that might help us.

24 DR. HINZE: Excuse me.

25 CHAIRMAN RYAN: Go right ahead.

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1 DR. HINZE: Well, I think we're very
2 fortunate, too, in that Abe Van Luik is the chair --
3 is the U.S. representative.

4 MR. LEE: Yes, I think Abe is the U.S.
5 representative.

6 DR. HINZE: Yes, the U.S. representative.

7 MR. LEE: And I'm not sure who the chair
8 is.

9 DR. HINZE: Okay. But he was the honcho
10 on that report.

11 MR. LEE: He's local.

12 DR. HINZE: Yes, right.

13 CHAIRMAN RYAN: And the other is the idea
14 of this -- there's actually two. I mean what, you
15 know, how does the time influence the barriers and how
16 they interact and then this idea that we've kind of
17 kicked on here at the end of what's the x-axis, in
18 fact, on uncertainty, probabilistic analysis versus
19 just the y-axis.

20 DR. HINZE: You know, I think --

21 CHAIRMAN RYAN: It would be interesting to
22 explore that, I think.

23 DR. HINZE: Yes, you know I really think
24 that things have changed since the thinking developed
25 for 197 and 63. So I think there's a place here to

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1 look at that again. So let me leave it at that.

2 CHAIRMAN RYAN: Okay. Any other questions
3 or comments?

4 MEMBER WEINER: I have a couple.

5 I take it from your comments, Bill, that
6 10,000 years is read by -- generally as 10,000 years
7 and not 20,000 years or 30,000 years. And it seems to
8 me we don't have that many significant figures that we
9 can do that. I mean isn't 10,000 years basically the
10 same as 20,000?

11 CHAIRMAN RYAN: From what point of view?

12 MEMBER WEINER: From the point of view
13 that if you are extending something to 10,000 years,
14 you really -- 10,0001 years doesn't mean anything,
15 10,100 years doesn't mean anything. So it's no
16 different.

17 DR. HINZE: Well, I was at a meeting one
18 time on markers and barriers for the high-level waste
19 repository and there was a large international
20 contingent there. And we were discussing the length
21 of time that these markers would have to be preserved.
22 And 10,000 years came up.

23 And one the international people stood up
24 and said just where did this 10,000 years come from?
25 And anecdotally, I think what we hear is that -- and

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1 that came out at that meeting -- and what we hear is
2 that this 10,000 years is kind of the cycling period
3 for glacial activity.

4 And that's -- I've asked that question
5 specifically of people on the SAB. And they say no,
6 it wasn't the controlling factor at all. But it is
7 mentioned by the EPA.

8 And so 10,000 years is not 20,000 years.

9 I guess another point that bears on this
10 is that I think we have this idea, rather simple, that
11 there was going to be one peak dose. And I think
12 that's what we see in this document. We see a peak
13 dose.

14 And I don't have a slide of this but this
15 is one of the realizations of the DOE. Notice here
16 how these --

17 CHAIRMAN RYAN: What's that from, Bill?
18 Could you just tell us what document it is in?

19 DR. HINZE: My friend Mike got this for
20 me.

21 MR. LEE: It's the final EIS for Yucca
22 Mountain.

23 CHAIRMAN RYAN: Okay.

24 MR. LEE: And I think Bill -- there's
25 actually a couple pages. And the one I Xeroxed for

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1 Bill, I think he's making reference to page 5-26,
2 which is --

3 DR. HINZE: Yes, 5-30.

4 CHAIRMAN RYAN: Okay. I just wanted to
5 make sure --

6 MR. LEE: Yes, 5-30, I'm sorry.

7 CHAIRMAN RYAN: -- we understood what he
8 was talking about.

9 DR. HINZE: I think we have -- if we're
10 going to have repository performance that's going to
11 reach multiple peaks, we have to make pretty certain
12 if we consider peak dose that we're not in a local --
13 have a local peak but that we have a global peak, if
14 you will. That I think bears heavily upon this
15 looking at time-of-compliance in the future.

16 CHAIRMAN RYAN: Yes.

17 Ruth, your question is an interesting one
18 because it made me think about is 10,000 different
19 than 20,000? When? Why? Under what basis? If it's
20 based on what's left and what's decaying, you know,
21 you always think about that as an exponential. It's
22 always going down so 20 is better than 10.

23 But if you think about a more complex
24 system where confinement and containment fractions
25 vary over time and get bigger with time or get bigger

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1 then smaller and maybe bigger again, I mean that's the
2 kind of thing that could be interesting to think
3 about.

4 So I think the answer to your question is
5 under what condition is it interesting? So maybe
6 that's some of the things, Bill, you're talking about
7 as having a newer view or more recent information on.

8 DR. HINZE: Right.

9 CHAIRMAN RYAN: That makes sense Mike? I
10 mean you've been reading a lot of this stuff?

11 (No response.)

12 CHAIRMAN RYAN: Other questions? Jim?

13 DR. CLARKE: Bill, I was curious, your
14 workshop you mentioned in '96, you said you invited
15 people to talk from both the low-level and the high-
16 level perspective, you know, to see if there would be
17 some synergy there? Would you do that again?

18 DR. HINZE: No, I wouldn't.

19 DR. CLARKE: Yes.

20 DR. HINZE: I don't think there's much to
21 be learned for the low-level waste. And looking at
22 the transcript again, I don't think that it really
23 gave us much information that was useful in the high-
24 level waste.

25 I think the cart and the horse are turned

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1 around there. I think the high-level waste is more
2 useful than the low-level waste.

3 DR. CLARKE: I guess you could argue it's
4 a common theme to, you know any waste --

5 DR. HINZE: Yes, yes.

6 DR. CLARKE: -- classification.

7 DR. HINZE: Right, right. And that's why
8 Andy and I, because we kind of set this up, felt that
9 we should look at both. And the fact of the matter
10 is, I think it was in February of '97, we did write a
11 letter suggesting a similar approach for low-level
12 waste, which I still think is extremely viable.

13 And perhaps there are certain advantages
14 to what the Committee recommended over some of the
15 recommendations that we have in front of us today.
16 Was that subtle enough?

17 DR. CLARKE: Yes, thank you.

18 DR. HINZE: Okay.

19 CHAIRMAN RYAN: And, of course, in the
20 international arena more than in U.S., there's the
21 intermediate waste class.

22 And to me that's just as interesting from
23 the standpoint that, you know, you think about things
24 like ruthenium and tech-99 and other radionuclides
25 that are in the same mode as some of the longer-lived

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1 species in the high-level game where they're
2 transcending boundaries of barriers that are
3 engineered.

4 So I think the trick is not so much
5 whether it's high, intermediate, or low but are the
6 confinement schemes such that they're challenged by
7 the life of the radioactive material is what I'm
8 getting it.

9 DR. HINZE: Right.

10 CHAIRMAN RYAN: So maybe that's the theme.
11 What's the containment and confinement strategy and
12 certainty versus how long is the radioactive material
13 going to be around.

14 DR. HINZE: I guess maybe, Mike, that was
15 one of the reasons that I wanted to show these
16 diagrams --

17 MR. LEE: Sure.

18 DR. HINZE: -- from the ore body versus
19 the SNF.

20 MR. LEE: Right.

21 DR. HINZE: I think those diagrams are
22 very useful in looking at this in the context.

23 CHAIRMAN RYAN: What ore body was that?
24 Was that rich ore or a weak ore?

25 DR. HINZE: Well, it would have to be a

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1 pretty rich ore.

2 CHAIRMAN RYAN: Okay. That's what I
3 thought.

4 DR. HINZE: Yes.

5 CHAIRMAN RYAN: Okay.

6 Any other questions? Allen, anything?

7 VICE CHAIRMAN CROFF: Yes. At the risk of
8 maybe going where I shouldn't but if we were to think
9 about let's say a working group on one of these topics
10 we've talked about and we learned a lot of things and
11 thought we had some ideas, who would we be advising?

12 I mean recognizing we sort of know the
13 legal situation and any nixed action is the EPA's.
14 Would we write a letter to the Commissioners
15 suggesting that this is something they might want to
16 express to the EPA someday? Or --

17 CHAIRMAN RYAN: Well, I don't know that we
18 -- first of all, I don't know that we'd have a working
19 group. Second of all, I don't know if the working
20 group would end up with a letter.

21 But to answer your question, to me, you
22 know, our advice is on technical matters. And our
23 advice is directed to the Commission. So I don't
24 know, you know, whether it would be information that's
25 new and emerging from some of these other documents

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1 and working groups that might be helpful to their
2 deliberations or not. So the answer is I don't know.

3 But I think the focus here that we would
4 have to any working group, as we have all the ones we
5 have had, is what are the technical issues? And, you
6 know, can we shed meaningful light on what's known and
7 what's not known? And what needs attention. And what
8 seems to be okay. And then what the details are on
9 the technical basis.

10 I don't think it's our purview to
11 recommend a policy decision. But certainly if there
12 is technical information that can better inform the
13 Commission, that's what we'd be after.

14 VICE CHAIRMAN CROFF: Okay. I think.

15 (Laughter.)

16 DR. HINZE: Could I interject something
17 there?

18 CHAIRMAN RYAN: Please.

19 DR. HINZE: One of the bullets that Mike
20 pulled out of the ACNW's letter, which I extracted
21 from the slides, was a bullet in which the ACNW has
22 made the recommendation that the time-of-compliance
23 not be included in the EPA standards but be included
24 only in the NRC regulations.

25 In other words, the EPA sets the dose and

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1 the risk and the NRC determines how to comply with
2 that. And so maybe there is a place here for some
3 advice.

4 CHAIRMAN RYAN: Other questions or
5 comments?

6 MR. FLACK: Yes, if I can.

7 CHAIRMAN RYAN: Please.

8 MR. FLACK: We talked about, you know, if
9 we do a calculation for 10,000 years that there may be
10 conservatisms in that calculation that might come back
11 to haunt you.

12 CHAIRMAN RYAN: John, just for the record,
13 would you let the --

14 MR. FLACK: Oh, I'm sorry, John Flack,
15 ACRS -- ACNW at this point, I'm sorry.

16 And the question might be entertained
17 within this working group, as we mentioned once
18 before, that you may want to look at what
19 conservatisms might be in the analysis that you do for
20 the first 10,000 years that might come back to haunt
21 you if you go further out.

22 In other words, going further out requires
23 a realistic assessment. There's no question about it.
24 It's hard, you know, to do a conservative analysis
25 because in the end, these things will tend to grow on

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1 you as you go further and further in time.

2 So maybe in that context, a working group
3 would be useful in identifying where these things may
4 have to be changed in the PA if you were to go beyond
5 10,000 years.

6 CHAIRMAN RYAN: Well, and that's -- I mean
7 if you had to pick a focal point, I think what we're
8 really saying when we say that is what we talked
9 through, Bill and I, just a minute ago, about we tend
10 to focus on what happens on the y-axis --

11 MR. FLACK: Yes.

12 CHAIRMAN RYAN: -- at a time. What
13 happens if we focus on the x-axis over time?

14 So that -- I mean that's really the
15 succinct way I think of agreeing with you that that
16 would be an interesting thematic approach to examine
17 that technical question.

18 Ruth?

19 MEMBER WEINER: I was wondering, as you
20 were talking and I reread some of the ACNW letters, in
21 your opinion, what does -- does meeting the dose limit
22 mean that the average meets it? The 95th percentile?
23 The 99th percentile? What do you think that should
24 mean?

25 DR. HINZE: Well, as long as you throw me

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1 the real easy questions, that's no problem.

2 Well, you know, what you're really getting
3 to is what is reasonable assurance.

4 MEMBER WEINER: Exactly.

5 DR. HINZE: And, you know, I was taught in
6 grade school that reasonable assurance meant that you
7 cut off the tails and you only looked at that central
8 portion. Perhaps the five to the 95. And
9 statisticians can give us support for that I suspect.

10 CHAIRMAN RYAN: Other questions or
11 comments?

12 DR. HINZE: Well, I guess --

13 CHAIRMAN RYAN: Yes, please.

14 DR. HINZE: -- one thing -- in the
15 discussion with John, one of the things -- John, if
16 you have a chance to look at some of the transcript of
17 the working group in '96 because there's this
18 discussion of the fact that it doesn't take much of
19 the performance assessment to move that peak dose
20 around. And --

21 CHAIRMAN RYAN: But you said -- the
22 interesting point that you made was it changes the
23 location but not the amplitude.

24 DR. HINZE: The amplitude, right, right.
25 And that's something that comes through strongly in

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1 that transcript. And EPRI, I know, was one of those
2 that -- John Kessler was one of those that was
3 discussing that. And there was at least another
4 person or two.

5 CHAIRMAN RYAN: So this is information now
6 that in performance assessments codes that were in the
7 eight-year-old time range now?

8 DR. HINZE: Yes, right.

9 CHAIRMAN RYAN: It would be interesting to
10 see --

11 DR. HINZE: Well, it's --

12 CHAIRMAN RYAN: -- if the more modern
13 versions --

14 DR. HINZE: -- ten years old now.

15 CHAIRMAN RYAN: -- or ten years old now.

16 DR. HINZE: Yes.

17 CHAIRMAN RYAN: It would be interesting to
18 see what the current view of that would be.

19 DR. HINZE: Yes.

20 CHAIRMAN RYAN: If that's been updated and
21 approved.

22 DR. HINZE: That's right. That's why I
23 say we're almost looking at a new animal here.

24 CHAIRMAN RYAN: Well, the x-axis question
25 is kind of intriguing to me.

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1 DR. HINZE: Yes.

2 CHAIRMAN RYAN: Any other questions or
3 comments?

4 (No response.)

5 CHAIRMAN RYAN: Well, Bill, you've given
6 us great food for thought. As always, we appreciate
7 your counsel and your views and the great information
8 you've provided. We've got a lot to study as we take
9 up the question of where do we go next.

10 Yes?

11 MR. LARSON: And remember one of the
12 reasons -- well, the reason why you did this was that
13 we put together a list of all of the letters the
14 Committee had written --

15 CHAIRMAN RYAN: Right.

16 MR. LARSON: -- related to the topic and
17 divided them up into different types of subjects. And
18 then we said okay, let's pick one and we'll look at
19 that one as to what the Committee has done over the
20 past. And decide whether that looks like it's a
21 worthwhile template for us to use for member and staff
22 to look at other particular areas.

23 So I guess my question is was this a
24 worthwhile process that we just did? And if it is,
25 then we ought to take a look at that divvying up of

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1 letters that we did and decide, you know, which ones
2 do you want to do next and who do you want to do them
3 with.

4 CHAIRMAN RYAN: I'd be happy to have
5 everybody comment on it. But it sure has been
6 informative and pretty efficient from my standpoint of
7 having all the materials and then having a well-
8 informed presentation like the one Bill gave. Yes,
9 resoundingly so. Anybody else want to comment?

10 MEMBER WEINER: That's a very good way to
11 look at the past.

12 MR. LARSON: So I guess then we've got to
13 take a look at that list of letters and decide if you
14 like this type of thing, recognizing that other topics
15 may not be as succinct.

16 CHAIRMAN RYAN: Maybe the thing to do is
17 to look at the letters and the groupings and see how
18 they line up with our action plan.

19 MR. LARSON: Okay.

20 CHAIRMAN RYAN: And use that to -- use
21 that as the guide to order them. I mean, you know, I
22 wouldn't want you working on something that wasn't
23 coming up on the calendar in a, you know, in a timely
24 way so you're working on things that are timely and
25 coming up and not rushed and not too far ahead and so

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1 forth.

2 DR. HINZE: A good example of that is
3 human intrusion. I mean there are a number of letters
4 on human intrusion. And yet that's not a topic of
5 immediate interest.

6 CHAIRMAN RYAN: Right. Okay?

7 (No response.)

8 CHAIRMAN RYAN: I think that brings us to
9 the end of -- Bill, your hour or so.

10 Our next item on the agenda is the ACNW
11 2005 operating plan. Who has the operating plan?

12 MR. FLACK: That brings us back to where
13 we were before.

14 CHAIRMAN RYAN: Okay.

15 MR. FLACK: And I guess we can -- at this
16 point, do you want to go off the record?

17 CHAIRMAN RYAN: Do we need to have the --
18 we can go off the record at this point? Okay, yes, I
19 think we're through with the formal part of the
20 record. So thank you very much.

21 (Whereupon, the above-entitled meeting was
22 concluded at 5:01 p.m.)

23

24

25