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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON NUCLEAR WASTE

JANUARY 9, 2002

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON NUCLEAR WASTE

131ST MEETING

+ + + + +

WEDNESDAY,

JANUARY 9, 2002

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ROCKVILLE, MARYLAND

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The subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., George M. Hornberger, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

GEORGE M. HORNBERGER	Chairman
RAYMOND G. WYMER	Vice Chairman
B. JOHN GARRICK	Member
MILTON N. LEVENSON	Member

1 STAFF PRESENT:

2 HOWARD J. LARSON, Special Assistant

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 JAMES ANDERSON

14 BILL REAMER

15 JIM WINTERLE

16 BRET LESLIE

17 NEIL COLEMAN

18 RANDY FEDORS

19 JEFF POHLE

20 PAUL BERTETTI

21 JOHN BRADBURY

22 ROBERTO PABALAN

23 GOODLUCK OFOEGBU

24 MYSORE NATARAJA

25 TAE AHN

1 ALSO PRESENT: (cont.)

2 BIS DASGUPTA

3 TIM McCARTIN

4 BANAD JAGANATH

5 WES PATRICK

6 DENNIS WILLIAMS

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A-G-E-N-D-A

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

2 (8:35 a.m.)

3 CHAIRMAN HORNBERGER: The meeting will
4 come to order.

5 This is the second day of the 131st
6 meeting of the Advisory Committee on Nuclear Waste.
7 My name is George Hornberger, Chairman of the ACNW.
8 Other members of the committee present are John
9 Garrick, Milton Levenson, and Raymond Wymer.

10 Today the committee will receive an update
11 on the status of key technical issues. Howard J.
12 Larson is the designated federal official for today's
13 initial session.

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

21 It is requested that the speakers use one
22 of the microphones, identify themselves, and speak
23 with sufficient clarity and volume so that they can be
24 readily heard. I want to emphasize the fact that we
25 need to have speakers, including those in San Antonio,

1 identify themselves clearly, because this is being
2 recorded. And also, here, for people on the other end
3 of the video, please make sure -- this includes all of
4 the speakers -- to clearly identify yourselves.
5 The key technical issues have been, as we
6 know, a focus of the interactions between DOE and NRC.
7 Key technical issues were the term that the NRC came
8 up with to guide their evaluation of DOE's work on
9 Yucca Mountain. There have been, as we know, many
10 technical exchanges and agreements with -- between the
11 NRC and the Department of Energy.
12 And today -- well, back up just a minute,
13 the Commission has expressed interest in having the
14 ACNW give them their views on the status of key
15 technical issues, and in particular where the most
16 difficult parts in reaching agreement between the --
17 reaching agreements between the Department of Energy
18 and NRC lie.
19 And also, the committee has, for many
20 years, been interested in all of the discussions of
21 KTIs as to how the NRC is risk informing their work.
22 And, in fact, we are -- we continue to be interested
23 in where the NRC sees the most risk significant issues
24 in the whole KTI system.
25 We've also, of course, been interested in

1 the past as to how KTIs cover the whole landscape and
2 have asked -- continually asked questions as to
3 whether there are gaps between the KTIs and how the
4 KTIs interface with each other, and how, in fact,
5 everything gets integrated at the end.
6 And so the committee has typically
7 questioned the NRC staff on these topics and others.
8 Today we're going to get a -- I think some fairly
9 detailed updates on the issue resolution -- the KTI
10 and issue resolution process, and we have a whole
11 series of presentations.
12 So Bill Reamer is going to kick us off on
13 the overview.
14 MR. REAMER: Good morning. Bill Reamer,
15 NRC staff.
16 We will try to accomplish each of the
17 items that you mentioned today. We've I think got
18 everyone here, although I know that the weather has
19 been a problem for some of the staff folks. We'll go
20 through the key technical issues issue by issue, give
21 you the status, describe our path forward with the
22 Department of Energy.
23 I can't give you a date when there will be
24 a Department of Energy license application. First
25 off, we don't know what the outcome will be of the

1 site recommendation process, when and whether the
2 Secretary will make a decision to recommend the site.
3 We also don't have the Department of Energy schedule
4 for possible license application as well, but I don't
5 think that that needs to necessarily impact our
6 discussions today.
7 I think this will become more clear in the
8 March timeframe, but today I don't have a date to give
9 you on when to -- we would expect a DOE license
10 application if there is one.
11 We do want to answer the committee's
12 questions completely on the relationship of the KTIs
13 to risk, but you're not going to find, at least in my
14 presentation and the presentations that follow, the
15 five top KTIs from a risk standpoint.
16 Someone said yesterday, "Today you will
17 hear everything that you need to know about KTIs, and
18 maybe something that you don't need to know." And I
19 think if you hear something you feel like you don't
20 need to know, you should ask, because our view is you
21 may need to know that.
22 So, just briefly, my agenda is to start
23 with the result for issue resolution as our goal and
24 to describe our approach to get there, where we are in
25 a programmatic sense, what we have planned in terms of

1 the path forward in a program sense, how we're
2 supporting that from the standpoint of using risk
3 information, program uncertainties that affect our
4 path forward as well.
5 So the NRC's role -- the NRC staff role is
6 to -- under the law is to be able to review a
7 Department of Energy license application, if there is
8 one, and make a decision on a possible construction
9 authorization in three years. Our prelicensing
10 activities with the DOE have generally been focused on
11 gaining confidence that any license application that
12 we get will be sufficient for us to commence a review
13 and write a safety evaluation report and make a
14 recommendation.
15 And so issue resolution and our path
16 forward on the KTIs takes its cue from this. If DOE
17 submits a license application, it should be
18 sufficient. It needs to be sufficient for the NRC to
19 commence a review. Generally, therefore, we would
20 take the position as the staff that if a license
21 application addresses some of the KTIs and not other
22 KTIs, that's not going to be sufficient for us to go
23 forward with the review.
24 Now that's obviously an extreme case.
25 It's never going to occur. But if some KTIs are dealt

1 with well and other KTIs are not dealt with, that's
2 putting a problem for us into the license review
3 process. That's saying that additional information
4 that we may need is going to have to be gained after
5 the license application is received, and that's not
6 our preferred course.
7 Our preferred course is to resolve the
8 KTIs with the Department of Energy before any license
9 application is received. And the key here, again, is
10 the three-year clock that the Nuclear Waste Policy Act
11 puts on the Commission to make a decision.
12 I think what I've just said is consistent
13 with what you'll find in the Commission's preliminary
14 comments to the Department of Energy submitted on
15 November 13.
16 Basic approach that we're following is to
17 identify gaps in the DOE supporting information. By
18 this we're considering the DOE story, the DOE
19 argument, the DOE performance assessment, the safety
20 assessment, what we need to review -- that story --
21 and reach conclusions.
22 We're taking into account information not
23 only that we get from DOE but information in public
24 literature. We're taking into account the views of
25 other stakeholders. We're taking into account the

1 views of this body, Nuclear Waste Technical Review
2 Board, the state.
3 We're looking at risk information and how
4 that impacts the identification of gaps. But
5 remember, we need to have confidence that overall
6 there is an understanding on the part of the
7 Department of Energy and ourselves that we understand
8 the full system, the total system, and that's why each
9 of the KTIs -- that's one of the arguments why each of
10 the KTIs is important. It's important to gain that
11 understanding of the whole system.
12 The reasons why we identify information as
13 being needed, that's important as well, and that's
14 what we'll be talking about with you in more detail
15 today. We also are taking the approach to get the DOE
16 agreement on what we see as the information gaps, and
17 by that we -- we get a signal from the Department of
18 Energy that they understand what we're saying and that
19 they are prepared to follow up and do something in
20 response.
21 We'll be documenting the technical basis
22 of issue resolution periodically, and we involve the
23 public throughout the process.
24 Where we are now is that we've identified
25 over the past two years what we think are the

1 remaining gaps for DOE to address with respect to the
2 key technical issues. I cannot overstate the effort
3 that the staff has made, the staff of the NRC, the
4 staff of the Center for Nuclear Waste Regulatory
5 Analysis, to evaluate the DOE supporting information,
6 and identify what information is needed and to state
7 the reasons why.
8 The results have been the 293 agreements
9 that are the product of the 18 technical exchanges
10 that we've held with DOE. I think people should
11 resist the temptation to say 293 agreements is an
12 indication that the process is not working. I think
13 it's a strong indication that the process is working,
14 that we are focusing, that we're reaching a
15 convergence, that the process of refining the
16 information gaps and what additional information is
17 needed is working, and that we have a reasonable basis
18 to proceed.
19 We'll be issuing the integrated issue
20 resolution status report in the spring of '02, and I
21 think we're on your meeting calendar in April to talk
22 about that. The path forward is to continue to
23 actively monitor the Department of Energy response to
24 the agreements.
25 We're working on two fronts. We're

1 specifically working on the -- from the standpoint of
2 tracking DOE schedules with respect to specific
3 agreements, to provide a response, reviewing the
4 responses that we receive, and providing feedback to
5 DOE. Looking to set up our next round of meetings
6 with the Department of Energy to further refine where
7 we are on the DOE information gaps.
8 But on another front, we're also looking
9 programmatically at the process, how close is DOE
10 getting in terms of their response to what we think
11 we've agreed to, and looking at ways that we can
12 improve the process so that responses are, from our
13 standpoint, on target.
14 We have a meeting tentatively planned with
15 DOE on February 5, I believe it is. I know that that
16 potentially conflicts with the committee's meeting,
17 but I think we ought to try to find a way that there
18 can be some coverage, some involvement, some
19 observation at least from the committee or committee
20 staff as to that meeting, because I think that may
21 provide some additional information that can --
22 CHAIRMAN HORNBERGER: What's the focus of
23 that meeting, Bill?
24 MR. REAMER: It's more in the nature of a
25 meeting on meetings. It's a meeting to plan our next

1 set of technical exchanges with DOE to get an
2 understanding of how the process needs to work in
3 order to make those meetings effective and to provide
4 feedback that we have to provide on the process, how
5 close is DOE meeting the target on the responses that
6 we've seen thus far, suggestions as to how we might
7 improve the interaction that exists in order to get
8 closer alignment.
9 DOE is working on a plan to -- of their
10 work from 2002 to a potential license application, and
11 we think that will be available in the March timeframe
12 from DOE.
13 Now, generally supporting the path forward
14 and the planned activities are all of the activities
15 we're doing with respect to risk informing the
16 process. We won't talk a lot about the Yucca Mountain
17 review plan, but it is an important tool to risk
18 informing our review.
19 The Yucca Mountain review plan really in
20 many ways reflects experience with the KTIs and the
21 criteria and the acceptance criteria and reasoning
22 that we've developed in the context of addressing the
23 KTIs. So I don't think it's going to be a major
24 impact.
25 It does address and move forward on the

1 basis of what we call the integrated subissues, which
2 is our device for assuring -- one of our devices for
3 assuring that the key technical issues are risk
4 informed. And that's also the format we will be using
5 in the issue resolution status report, so I think that
6 will be helpful to give a transparency to how the KTIs
7 are integrated with the overall performance of the
8 repository and our efforts there.
9 The presentation that follows mine will
10 get in heavily to our efforts in the risk information
11 area. But generally what we're trying to do is using
12 sensitivity analyses, examine the important risk
13 contributors, quantify the uncertainties associated
14 with those important risk contributors, and use them
15 as a basis to assure that the PA is routed in the
16 evidence and not in something else.
17 Next slide is really more for our
18 colleagues at the Department of Energy, to remind them
19 -- remind everyone that really the burden to address
20 or not address the key technical issues, the
21 regulators, the key technical issues or the
22 regulators' issues here, is on the potential
23 applicant, the DOE. The staff's role I think is to
24 actively focus on refining what's acceptable and why.
25 The KTIs are the logic that we are using

1 to do that. The activities I hope the committee will
2 feel at the end of the day are risk informed. I have
3 every reason to believe that this process can work and
4 will work, that if a license application is submitted
5 that it will be sufficient for the NRC to conduct a
6 review and reach a decision.
7 I did mention earlier the plan that DOE is
8 working on, which we view as the -- providing the
9 information to address this -- what I call this
10 program uncertainty.
11 So the gist, then, is the issue resolution
12 is progressing. We're monitoring the agreements, the
13 performance on specific agreements in the process as
14 well. We are factoring in risk insights continuously,
15 continuing the technical exchanges, the next round of
16 technical exchanges with DOE, and the -- what I
17 mentioned, the LA plan, the planned LA is an important
18 input that will be coming.
19 That's all I had.
20 CHAIRMAN HORNBERGER: Thanks, Bill.
21 MR. REAMER: Any questions for me?
22 CHAIRMAN HORNBERGER: A couple. Well, one
23 -- a comment and then a question for you. I'm really
24 happy to hear that you are moving forward with plans
25 to continue technical exchanges. My personal opinion

1 is that they have been extraordinarily helpful, the
2 technical exchanges between DOE and NRC.
3 My question related to that is I know that
4 you're moving forward with an integrated IRSR. And
5 the question, then, is the previous technical
6 exchanges were focused on KTIs, and in moving to an
7 integrated IRSR there is not a total move away from
8 KTIs but really taking a more integrated view. Do you
9 have any ideas on how future technical exchanges will
10 be structured in light of this integrated IRSR
11 approach?
12 MR. REAMER: Well, they are going to be
13 structured to basically accomplish two things to
14 assure that the KTIs, which are the logic for the
15 staff's prelicensing activities, get addressed in a
16 way that meets the goal that I described. So the KTIs
17 will continue to be a major player and focus.
18 But to do so in a way that's consistent
19 with the way we will do the license application
20 review, which is the Yucca Mountain review plan and
21 the integrated approach that we will take there. And
22 so we want both.
23 CHAIRMAN HORNBERGER: Okay.
24 Questions from the committee? Milt? Ray?
25 VICE CHAIRMAN WYMER: Yes, one. Will the

1 integrated approach tend to focus on the most risk
2 important issues? Is that what will emerge from the
3 integrated approach?
4 MR. REAMER: Well, the integrated approach
5 will surely make sure that that information is
6 available and known and assure its integration into
7 our approach.
8 VICE CHAIRMAN WYMER: Will it identify
9 them clearly or --
10 MR. REAMER: I think you will today get a
11 good sense of the -- from the presentations of what's
12 important from a risk standpoint.
13 CHAIRMAN HORNBERGER: John?
14 MEMBER GARRICK: Well, you partly answered
15 that. You said up front -- and I appreciate that --
16 that we weren't going to get an importance ranking of
17 the KTIs out of today's proceedings and --
18 MR. REAMER: No. I said you wouldn't see
19 a list --
20 (Laughter.)
21 -- in my presentation and the other
22 presentations.
23 MEMBER GARRICK: Yes, okay.
24 MR. REAMER: But I'm sure I -- I'm
25 satisfied that you came to the meeting with an

1 expectation, and that when the meeting is over your
2 expectation will be satisfied.
3 MEMBER GARRICK: Okay. Well, that's
4 encouraging.
5 CHAIRMAN HORNBERGER: Staff? Anyone from
6 the audience?
7 Okay. Well, we are going to move along.
8 We have a full schedule. Thanks very much, Bill.
9 Next up is Bret, is that correct?
10 MR. LESLIE: Let's see if I've got the
11 right angle to be able to push the slides down as I
12 talk through this.
13 During our preparations for this meeting
14 I got the short straw to make this presentation. And,
15 really, what I'm trying to do right now is to provide
16 an overview to directly address the concern. I mean,
17 Bill said that we're not going to have a list of what
18 are the most important KTIs, but I'm hoping to provide
19 enough of an overview on some of the ways we've tried
20 to look at prioritizing the KTIs so that you'll have
21 the necessary information to come up with whatever
22 conclusion you want to.
23 I'm going to expand on a few -- several
24 things that Bill has already addressed. So some of
25 this is a repeat, but I'm trying to provide a little

1 more detail, so that the following presentations on
2 each of the individual KTIs you'll try to -- see the
3 picture.
4 Okay. It's a little slower than me.
5 As I said, this is an overview. And what
6 I want to do is lay out the framework, see if I can
7 make some of the connections for you. And the
8 specific applications for each KTI will be later, so
9 if you start to ask me a question about a specific KTI
10 or an integrated ISI, I'll defer your question.
11 The idea is I want to do really three
12 things. I want to give an overview again of the issue
13 resolution, what that overall goal is, explain in some
14 respects, given the regulatory constraints, how we use
15 risk insights, then move on to what are the risk
16 insights we have gained from our performance
17 assessment.
18 And, finally, something that was just
19 briefly crossed -- touched on by Bill is a risk
20 insights initiative. And this is something that we
21 had planned on presenting to the committee in March,
22 and what you're going to see is a couple slides of
23 snapshots. We're just starting that process -- but
24 where we think we can do a better job.
25 Moving on to the risk -- issue resolution

1 overview, as Bill indicated, the goal is in terms of
2 a -- for a potential license application. The
3 information that we receive from the Department of
4 Energy must be sufficient and of high quality. So
5 that's the overarching goal, and we're guided by
6 what's in Part 63. In particular, when we're looking
7 for post-closure and performance assessment, we're
8 guided by Section 63-114, which are the requirements
9 for performance assessment, which say what is
10 necessary for any performance assessment for post-
11 closure.
12 So that's kind of in the background of
13 where all these agreements are coming for. If you
14 look at detail in the agreements, some of the same
15 words in Part 63 provide a technical basis. Those are
16 the types of information that we're trying to get in
17 closing those gaps.
18 In identifying the gaps, again, we're
19 identifying the gaps in the Department of Energy's
20 approach, and we're looking at the data and analysis
21 and models that they're using in their performance
22 assessment. And, again, how we identify those gaps
23 are based upon the requirements in 63-114, what is
24 required for a performance assessment in any potential
25 license application.

1 But also, it plays into risk insights.
2 And I'm kind of jumping the gun, but recall that the
3 risk triplet is answering three questions. You can
4 have risk insights not just about consequences but
5 what can go wrong, its likelihood. Okay? You can't
6 say what is most important in terms of risk by only
7 focusing on consequences because if DOE has left out
8 a technical basis for a process that could impact the
9 consequences, then how good is that assessment of the
10 overall performance of the system?
11 So, really, you have to have the
12 information for each of these to get the overall
13 importance of -- in terms of risk insights. And what
14 you'll see -- what can go wrong is really the
15 features, events, and processes. And this is a non-
16 negligible portion of our agreements. Many of the
17 agreements are talking about provide the technical
18 basis for screening something out.
19 And, again, you have to know what to put
20 in the performance assessment or provide a basis for
21 screening it out for removing it from the performance
22 assessment.
23 Those gaps, as Bill indicated, are also
24 identified by other people, gaps identified in
25 performance assessments by EPRI, or insights from the

1 ACNW or the NWTRB, or the State of Nevada. What
2 things are they focusing on?
3 Because, again, we're thinking in terms of
4 down the road for a potential license application we
5 need to have those gaps identified and addressed.
6 And, finally, our risk insights come not
7 only from our own work but from the Department of
8 Energy, from both their performance assessment and
9 what their safety case will be, because, again, we're
10 looking for a sufficient, high-quality license
11 application, but the safety case is the Department of
12 Energy's to make. So we have to focus on what they
13 are asserting or proposing to use in their performance
14 assessment and their licensing case, potential
15 licensing case.
16 So how have we been applying the risk
17 insights? Well, in terms of the issue resolution
18 meetings, early on, you know, we learned -- as Bill
19 indicated, we've learned things as we've gone through
20 these technical exchanges. And one of the first
21 things we realized is that we needed to have a proper
22 perspective on what the DOE considered in terms of
23 each KTI, in terms of performance base.
24 So we requested that after that first
25 meeting each subsequent key technical issue, technical

1 exchange, have a presentation on the Department of
2 Energy's performance assessment, so that we could try
3 to have this conversation in a risk informed manner.
4 Prior to these meetings, both the Center
5 and the NRC staff conducted numerous evaluations, both
6 at the system and the process level, to gain insights,
7 so that when we went into the meetings we were focused
8 on the things that were most important. With that in
9 mind, the agreements that we -- came out of those
10 meetings are a function of the risk insights that went
11 into them.
12 And so we believe that the agreements are
13 risk informed, again remembering in a broad sense risk
14 informed in terms of also any potential license
15 application identifying the gaps and providing that
16 information.
17 As Bill indicated, our products are
18 applying those risk insights. The Yucca Mountain
19 review plan, which is due out later this spring, and
20 the integrated issue resolution status report, which
21 will be out this spring, will show how we've applied
22 those risk insights.
23 But also, in the presentations that follow
24 you'll see in each of the KTIs how the independent
25 efforts that they're doing, the independent

1 investigations, are -- how they've applied those risk
2 insights to what information they're trying to assess,
3 what they've assessed last year, and also in the
4 upcoming year. So they're applying the risk insights
5 to figure out what additional information is needed.
6 Moving on to the second part of this
7 presentation, we have used the iterative performance
8 assessment approach, and the committee is well aware
9 of that. This iterative approach has been used
10 approximately for the last 10 years by the NRC and the
11 Center to focus on gaining risk insights and
12 information, and the value of the iterative approach
13 is that it allows us, as we go along, to refine what
14 the insights are.
15 Suppose the first iteration of a
16 particular portion of the code is coarsely
17 represented, and we do an analysis and say, "This area
18 is important." So when we go back and revise our
19 code, we may add additional complexity to the code to
20 see which part is causing the importance.
21 And this iterative approach is not only
22 for the post-closure, it's for the pre-closure. So
23 when we talk about identifying the parts important to
24 waste isolation, there we're talking about the TPA
25 code and the post-closure assessment. And when we're

1 identifying the parts important to safety, this is in
2 terms of pre-closure and the pre-closure safety tool
3 that we're using.
4 This iterative approach causes the staff
5 to focus our review and the prelicensing documents on
6 the data -- on quantifying the uncertainties. What
7 are the most important uncertainties? And so that
8 guides us in terms of, what are the gaps -- some of
9 the gaps that the Department of Energy should address?
10 And, finally, this iterative approach
11 allows us, if data are very scarce or very uncertain,
12 conservative approaches can be adopted in the first
13 cut. But as the data are gathered, conservatives are
14 reduced and realism is increased as we go on.
15 One of the outcomes of this iterative
16 performance assessment process is it allows the
17 identification of the risk important features of the
18 repository system. And this has been called the
19 flowdown diagram. And this is an important diagram to
20 understand, because these are integrated subissues.
21 This is the format of how we're doing our
22 reviews in the Yucca Mountain review plan. It's how
23 we'll be documenting things in an integrated
24 resolution status report upcoming. But it's really
25 the integration of information in KTIs.

1 And I put this post up -- it's slides 16
2 and 17, and this is kind of the road map. On the left
3 side of those two slides are the integrated subissues.
4 The titles are ENG1. I -- let me back up. Across the
5 top are the integrated subissue -- ENG1. On the left
6 side are the listing of all of the KTIs and their
7 subissues.
8 So from an integrated performance
9 assessment standpoint, if you look at ENG1, which is
10 degradation of engineered barriers, which I believe
11 the committee believes is highly important, you can
12 see that multiple key technical issues -- the thermal
13 effects on flow, the near field KTI, the container
14 life and source term, the TPA -- TSPA KTI, and the
15 repository design and thermal-mechano effects -- all
16 provide input. It's that integration of the
17 information of each of the KTIs that is important in
18 evaluating the performance assessment.
19 So I've kind of left this crosswalk up,
20 and I think it may help you, as you go through, or
21 asking a KTI, well, how do you fit into the
22 performance assessment? Well, this -- these two
23 diagrams are the key to understanding that when we're
24 talking about resolution of KTIs, you have to look at
25 where that information is fed in terms of performance

1 assessment.

2 As Bill indicated, we have been using

3 sensitivity analyses to understand, in terms of the

4 previous slide, what are the most important areas. So

5 here we go. Degradation of integrated -- degradation

6 of engineered barrier pops up as -- when we run the

7 TPA code as being one of the more risk significant,

8 integrated subissues. Okay?

9 And you can get to the point where you're

10 identifying specific parameters that are important to

11 the overall system performance. And you can also

12 address the barriers.

13 So we're using these various sensitivity

14 analysis techniques and total system performance

15 assessment code to gain insights on which portions are

16 important to waste isolation, which parameters matter,

17 and we can gain insights on the different barriers'

18 performance.

19 So what are -- in an overall picture, what

20 are some of the results? And what drops out? Now,

21 the committee has heard this information before, and

22 I'm just trying to summarize it in a different way.

23 What are some of the significant features

24 and processes that our sensitivity analysis tell us

25 are important? And this is a list. I'm not really

1 going to go through it. You should hear in the
2 subsequent talks how the KTIs are contributing to
3 things. Direct release of volcanism -- Brit will walk
4 you through that. But from an overall system
5 performance assessment, this is what our code is
6 telling us.
7 Okay. But -- those are the things that
8 our code is telling us are important. Well, you can
9 also get insights on what's less important. Less risk
10 significant features and processes in our own
11 assessment and our code, how we've seen -- well, we
12 suggest -- our results suggest that unsaturated zone
13 flow and transport is relatively unimportant.
14 This means that the two integrated
15 subissues -- flow paths in the unsaturated zone and
16 radionuclide transport in the unsaturated zone --
17 those integrated subissues are relatively less
18 important, at least in our view. That's only part of
19 the question -- part of the picture, and we'll get to
20 the rest of the picture in a second.
21 Also, direct mechanical disruption by
22 falling rock and direct mechanical disruption by
23 faulting are also of relatively low importance. But
24 those two items are focused and figure -- feed into
25 that mechanical degradation integrated subissue.

1 If you only focused on this, you'd say,
2 then, why are we spending any time on these items?
3 Okay? Well, you have to put it in the regulatory
4 perspective. Our focus of issue resolution is guided
5 by the identification of what is risk significant, and
6 also what is DOE's potential safety case. What is DOE
7 relying on?
8 So, again, the focus of the issue
9 resolution, as we went into these meetings, we knew
10 what were the most important things. These were the
11 things we tried to focus on in those meetings, in each
12 KTI, keeping in mind KTI might be unsaturated zone
13 flow and flow and transport under -- I mean, excuse
14 me, unsaturated zone, saturated zone, under isothermal
15 condition, USFIC.
16 Well, what portion of USFIC is important?
17 Well, it turns out the quantity of water. So
18 understanding the seepage is important, and so if you
19 look at the KTIs you'll see that there is a focus on
20 those things that are important.
21 In the latter part, in the Department of
22 Energy's approach, mechanical disruption of engineered
23 barriers is important for its absence in its
24 performance assessment. They're relying on -- they're
25 relying on screening out mechanical degradation.

1 Okay. So if you're going to screen out this process
2 that we suggest may have some impact, you've got to
3 have an adequate technical basis to provide that
4 screening out.
5 And our concern here, really, is as -- as
6 rock fall damage could lead to stress corrosion
7 cracking -- which, again, the waste package is an
8 important barrier that we know impacts the overall
9 system performance. So, really, we're asking for the
10 technical basis for them for screening out, and I
11 think the --
12 MEMBER GARRICK: Bret, when you say
13 quantity and chemistry of water, do you in the
14 chemistry mean also the quality of the water?
15 MR. LESLIE: Yes. The chemistry is the
16 quality. What --
17 MEMBER GARRICK: So the composition issue
18 is covered in the chemistry of --
19 MR. LESLIE: Exactly. The chemistry of
20 the water means the composition.
21 Also, again, the Department of Energy, in
22 their supplemental science and performance analysis
23 report, relies on the unsaturated zone quite a bit for
24 performance. Our own assessment suggests that it's
25 not very important. Okay? Well, DOE wants to rely on

1 it. They are under the -- they have the burden to
2 support that. And so what we're asking for is
3 information to support their assertions of significant
4 performance in the unsaturated zone.
5 So, again, issue resolution -- the big
6 picture is guided by what the Department of Energy is
7 proposing, us identifying the gaps and using our risk
8 insights.
9 Now moving on to the slide that you
10 probably want to know -- prioritization of the key
11 technical issues. What I just said is summarized in
12 this first bullet and what Bill indicated. All of the
13 KTIs are needed for a high-quality license
14 application, and that's, again, constrained by our
15 limit by law of a three-year review period.
16 So the answer is all of them are needed.
17 That's the first answer.
18 What is needed is a function of what the
19 Department of Energy proposes for their safety case.
20 If they had a simpler safety case or wanted to rely on
21 things that were less -- had less gaps, let's say,
22 then our request for information or our agreements
23 scope might be smaller.
24 So the agreements are, again, a function
25 of what the Department of Energy is proposing, our

1 identification of the gaps, and our request for DOE to
2 close those gaps.
3 And I'll give you an example. We can only
4 be as risk informed as the Department of Energy.
5 There might be things that they can screen out by
6 doing a simple consequence analysis. Criticality may
7 be one. Okay?
8 Well, the Department of Energy has chosen
9 -- that's their choice -- not to screen out on showing
10 what the consequences are. Instead, they've adopted
11 a different approach. We have to respond to what
12 their approach is. We don't decide what they do.
13 They decide what they want to do and the approach they
14 take.
15 If the approach that they're taking isn't
16 very risk informed, we can't make them become risk
17 informed. We can show the risk insights, but it's up
18 to the Department of Energy to decide how they want to
19 put their case together or address a particular issue.
20 The results from the performance
21 assessment, I went through that in the previous
22 slides, slides 6 through 10. We've also tried to get
23 at the overall complexity of the subissue agreements.
24 And we added these slides at the very end. And if
25 you'll kind of look at 32 and 33 -- these are in your

1 backups at the very end -- what we did is -- is -- and
2 this is a fairly recent -- well, not so recent effort.
3 It happened before the site recommendation, so this
4 table is somewhat dated.
5 The first thing you'll note is 282 does
6 not equal 293, and that's because we didn't include
7 pre-closure and we didn't include subsequent technical
8 change. So don't focus too much on the numbers. But
9 what we did is we tried to break out by subissue in
10 each KTI the number of agreements first.
11 And we polled the staff and said, "Okay.
12 Based upon what you're expecting in the scope of the
13 agreements, do you categorize the information need as
14 minor, moderate to major, or major?" So this is
15 another way of focusing within a key technical issue
16 where is the dominant focus.
17 And so I'm not going to discuss this
18 anymore. I just wanted -- it's information for you to
19 have in the backup.
20 And now I'd like to move on to the third
21 part. We realize -- and the committee has -- has
22 written -- that it's not always clear that we are
23 using risk insights or risk informed in the issue
24 resolution process. And there could be a couple
25 reasons. One, we're not communicating it. Okay? Or

1 we're truly not risk informed.

2 And so Bill and I and a couple others have
3 brainstormed and said, "Well, what can we do to
4 improve that communication and make sure that our work
5 is truly risk informed?" And we've come up with this
6 project that I'm going to be working on over the next
7 month, six weeks, and this is anticipation of the
8 DOE's rebaselining out in March, that we need to be
9 prepared for that discussion with the Department of
10 Energy.

11 But, really, it's to document the insights
12 and tie it to the resolution of the KTIs. And the
13 idea is that we need to be better communicating to the
14 ACNW and others what are those risk insights tied to
15 those agreements. Why are we asking this information?
16 Both from a regulatory perspective, but also from a
17 performance assessment perspective or a risk
18 perspective.

19 We also want to make sure that we're
20 properly implementing risk insights into the program.
21 The timing is near term. Again, the Department of
22 Energy, in the March timeframe, is likely to come out
23 with a rebaselining of their activities, what they
24 think are most important to complete.

25 And so in the near term we expect to have

1 some -- make some -- make some observations and
2 document them and create some guidance. But at the
3 end of the year, the total system performance
4 assessment KTI is planning a major intermediate
5 milestone that would document all of these risk
6 insights.
7 But the idea is that we get our staff
8 prepared for that exchange with the Department of
9 Energy. Again, the idea is that we document very
10 clearly in terms of the agreements, why are we -- why
11 do we have this agreement? What risk insights can we
12 apply to this agreement? What are the drivers for
13 this agreement?
14 And, finally, the outcome -- the other
15 outcome is guidance from staff. Are there areas where
16 we -- if we find that there are ways we can better
17 communicate this risk information, we'll try to
18 document that and make sure it's implemented.
19 So who will participate? There's a core
20 group that's leading it. It includes Chris Grosman of
21 the PA staff, myself, and a couple people from the
22 Center. Everyone is going to participate. We're
23 going to be working together with the issue resolution
24 staffs.
25 We're going to sit down with them and kind

1 of go through what information can they bring to the
2 table, what can the PA people bring from -- to the
3 table in terms of the overall system -- you know,
4 overall and -- and system level, and detailed process-
5 oriented level analyses, what are the risk insights.
6 And so we'll be going down and talking to
7 the key technical issue teams. Again, we're getting
8 the risk insights from and for each key technical
9 issue. We're going to be going through the issue
10 resolution agreements, each of the agreements, to see
11 indeed that they are risk informed.
12 And also, we may try to get some of the
13 insights from the recent licensing activity such as
14 PFS. What have they found in terms of their risk
15 informed analysis? What insights might they give to
16 us to help us along on our path as well?
17 So I think by now you understand what the
18 purpose of this presentation was. It's, again, to
19 reiterate what the overall goal of issue resolution
20 is. It can't -- it's informed by risk insights, but
21 the overall goal guides our work. In other words, a
22 sufficient and high-quality license application, it's
23 dependent upon what the Department of Energy's case
24 is.
25 I think you have seen that the risk

1 insights are derived from a variety of techniques and
2 from different sources, and you'll hear more about
3 those risk insights from each of the key technical
4 issues. And we're also interested in improving our
5 program through the risk sights initiative.
6 That's kind of a summary of my
7 presentation, but I want to kind of lay out the
8 groundwork for the rest of the presentations. This
9 might not be the right order. This was the order that
10 we had proposed a couple days ago; management had
11 agreed.
12 But basically we want to start off with
13 the total system performance assessment perspective
14 with James Weldy, and then we're going to go to
15 igneous activity, Brit Hill. This is one of the areas
16 that the committee is keenly interested. We want to
17 get your enthusiasm up early in the morning. And the
18 other two that we had -- that I know Ray and others
19 are interested in are later in the afternoon, so we
20 can wake you up again.
21 (Laughter.)
22 But each of these presentations is going
23 to have the same format and feel, and this is -- this
24 is because of the short time constraints we had, we
25 have relied on presentations we have already given

1 elsewhere. And so it might not be the right title on
2 the top of the slide, but we think we're trying to
3 address the information.
4 And, basically, each of the following key
5 technical issues presentations will talk about the
6 status of the subissue resolution, discuss the risk
7 information insights which include what DOE needs to
8 provide before any potential license application, and
9 what the NRC needs to do before any potential license
10 application.
11 And the idea is that they are going to be
12 providing select examples of how those risk insights
13 have been applied to the Center's work. Why is the
14 center focusing on in the near field what salts
15 matter? Okay? And Bobby will go through why that --
16 why is that important and the type of work they've
17 done, and how they will apply risk insights in this
18 fiscal year coming up. And then each of the KTIs will
19 have a summary.
20 And we'll be flexible. If you're finding,
21 you know, after two or three or four of these that a
22 particular portion of the presentation isn't
23 scratching the itch and we're running short on time,
24 we'll be flexible and revise on the fly as needed. So
25 that's kind of -- yes?

1 MR. REAMER: Bret, Bill Reamer. Just on
2 the sequence. I think the order has been changed
3 slightly. The fourth item, unsaturated and saturated
4 zone flow, will be moved to the container life and
5 source term item, and it will be moved up to the
6 fourth item.
7 MR. LESLIE: Right. We had intended to
8 keep these two together. They're intimately related.
9 But one of our staffers -- I think Tae Ahn -- who is
10 involved in container life and source term can only be
11 here this morning, so we switched it around. So it
12 won't -- we'll only have half the punch in the
13 afternoon.
14 The backup slides, again, are -- I'm not
15 going to go through, but the first two are the
16 relationship to this chart. You know, you probably --
17 might not be able to see this chart, but you might
18 want to pull them aside, so as you're going through
19 you can see the relationship to the KTIs and the
20 integrated subissues.
21 And then the subsequent pages from
22 pages 19 through 30 are really out of our comments,
23 the sufficiency comments, the November 13th letter.
24 And they are a synopsis of what kind of information we
25 need from each of the key technical issues. They also

1 provide the reference for where our agreements are.

2 And, again, you might want to rip that

3 page out as you go along and have it in front of you

4 as we go to each of the key technical issues. And,

5 again, the final two of the backup slides are the

6 level of complexity.

7 With that, I'll stop. I know that's a

8 lot.

9 CHAIRMAN HORNBERGER: Thanks, Bret.

10 Questions for Bret?

11 MEMBER GARRICK: Bret, the key technical

12 issues have been around several years. Has the list

13 really changed?

14 MR. LESLIE: I think the statement stands

15 by itself. Yes, they've been around. The list hasn't

16 -- the key technical issue list hasn't changed.

17 MEMBER GARRICK: Yes.

18 CHAIRMAN HORNBERGER: Have the subissues?

19 MR. LESLIE: Have the subissues changed?

20 MEMBER GARRICK: Well, I guess what I'm

21 thinking of, when the key technical issues were first

22 generated, the discussion and thought processes were

23 very much geotechnical oriented. There wasn't nearly

24 the emphasis that now exists on the engineered

25 systems.

1 So I guess what you're saying is that they
2 are sufficiently global or high level that they
3 probably haven't changed, but to be sure the subissues
4 have been quite dynamic and affected by that -- by the
5 change in emphasis with respect to engineered
6 barriers, for example.
7 MR. LESLIE: Right. While the emphasis
8 might have changed, we believe that to describe the
9 overall system these -- this is the information you
10 still need to do.
11 MEMBER GARRICK: Right.
12 MR. LESLIE: You can't just do an analysis
13 on a particular barrier. The idea is that the
14 emphasis and the resources and the focus may have
15 changed, but overall to describe repository
16 performance you still need that information on all
17 those issues.
18 MEMBER GARRICK: Yes. I guess the other
19 thought here is, how complete is the set? In the
20 course of time, at least at the KTI level, have we --
21 if we had our druthers, would we add or subtract any
22 KT -- one of the things you said was that all of the
23 KTIs have to be addressed I think you said by law.
24 MR. LESLIE: Well, I didn't say by law,
25 but --

1 MEMBER GARRICK: And so as far as the
2 overall and global considerations are concerned, there
3 hasn't really been any change in several years, since
4 the list first pretty much came out. And that's --
5 what's that been, five years or some time --
6 MR. LESLIE: Something like that.
7 MEMBER GARRICK: Yes.
8 MR. LESLIE: You could bend this a lot of
9 different ways.
10 MEMBER GARRICK: Yes.
11 MR. LESLIE: And what we're focused on is,
12 do they have the necessary information? You could
13 bend it by integrated subissue, and then you'd have 13
14 or 14. The information I believe remains the same
15 however you bend them. I -- we have worked by KTIs.
16 I don't think we're planning on changing the number of
17 KTIs. It's the information that matters.
18 MEMBER GARRICK: Okay. At one time we
19 were trying to --
20 MR. PATRICK: Bret, could I interject?
21 MR. LESLIE: Yes.
22 MR. PATRICK: Bret, if I could, please,
23 just interject, I think Dr. Garrick did make an
24 important point, that the KTIs are quite broad in
25 their scope. We continue to reexamine, as we conduct

1 process level modeling, to assure ourselves that they
2 continue to cast a net that's sufficiently broad that
3 nothing is missed on the one hand, and on the other to
4 eliminate those items that are no longer in some cases
5 even relevant, frankly. The part where the evolution
6 has occurred and is most visible is at a much lower
7 level, down in the subissue level.
8 A good example, you mentioned, Dr.
9 Garrick, the emphasis on container life. Even more
10 specifically, you can point out that as the selection
11 of metals that DOE is proposing has evolved over time,
12 there are new phenomena that we did not consider in
13 1996 for instance that we now see as very important,
14 because different classes of materials are being used.
15 Likewise, there are some phenomena that we
16 were examining back in those days that are no longer
17 relevant for these new materials that are being
18 considered by the Department of Energy. So at that
19 level, there has been a good deal of evolution, but
20 it's still -- in that example case, it's still all
21 within the broad container life and source term key
22 technical issue.
23 MEMBER GARRICK: Yes.
24 CHAIRMAN HORNBERGER: For the record, that
25 was Wes Patrick from the Center.

1 Wes, you weren't here this morning when I
2 asked everyone to make sure they introduced
3 themselves.
4 MEMBER GARRICK: Thanks, Wes.
5 MR. PATRICK: Thank you.
6 CHAIRMAN HORNBERGER: Raymond?
7 VICE CHAIRMAN WYMER: Yes. As you know
8 very well, we've been interested in the degree to
9 which evidence supports the DOE case. And so you've
10 been very interested in that, too. But my question
11 is, then, one you probably can't answer very
12 precisely, is what criteria or formal process or what
13 mechanism do you have for deciding how much evidence
14 is needed?
15 MR. LESLIE: Part of that depends on how
16 the Department of Energy -- for instance, in screening
17 out, they must provide a technical basis for screening
18 out. Well, it talks in terms of you can screen it out
19 if it -- or you do not need to examine it in detail if
20 it does not make a difference in the magnitude or time
21 of dose. Okay?
22 If DOE came in and did a calculation that
23 it did not matter in terms of times and dose, and we
24 could agree that that was a robust calculation, that's
25 sufficient. If they want to make arguments -- and

1 I'll give the example of rock fall, that -- that they
2 are suggesting that they would design away rock fall.
3 Okay?
4 Without having given us a design, okay, we
5 need to ensure that the information that would go into
6 the design decision is complete. So that means how
7 many rocks, how big rocks. You know, it depends,
8 again, on how they frame what they want to do.
9 VICE CHAIRMAN WYMER: It's a very
10 judgmental thing.
11 MR. LESLIE: Yes.
12 CHAIRMAN HORNBERGER: Milt?
13 MEMBER LEVENSON: Yes, I've got I guess
14 two questions, one a very broad one and one a very
15 narrow one. The broad one -- the objective of the KTI
16 program, as I understand it, is not to resolve
17 specific issues. That gets done when you review a
18 license application. It's to assure yourself that
19 you've identified all of the issues to be addressed in
20 the license application. Is that correct?
21 MR. LESLIE: It's not just the
22 identification. It's that sufficient --
23 MEMBER LEVENSON: No. What information
24 would be provided to back up those issues? That
25 doesn't mean that just because you've identified that

1 information that it will be acceptable. You still
2 have to review it all --
3 MR. LESLIE: That's absolutely --
4 MEMBER LEVENSON: -- the license
5 application.
6 MR. LESLIE: -- correct.
7 MEMBER LEVENSON: Okay. My question is:
8 Isn't there a loose end in your ability to identify
9 everything you're going to need, since you have not
10 seen the formal safety case that will be presented by
11 DOE in its license application?
12 MR. LESLIE: I'll answer this -- that
13 this --
14 MEMBER LEVENSON: I mean, what you're
15 looking at is everything you need to know to review
16 not the generic question but specifically a license
17 application and the safety case it makes.
18 MR. LESLIE: We define issue resolution as
19 in terms of what we know now, and we've emphasized
20 that to the Department of Energy. As they make
21 changes in design, or provide additional detail, there
22 may be additional questions.
23 So in a way, yes, you're right. We're
24 hoping, you know, that whatever DOE decides they stick
25 to it, because if they change in a big sense and bring

1 in a lot of new issues, we're going to have to review
2 it to make sure that whatever they propose is, you
3 know, supported.
4 MEMBER LEVENSON: But what I'm saying is
5 that you're not in a position to say you have
6 identified all of the necessary KTIs until you've seen
7 their actual formal safety case.
8 MR. LESLIE: I would disagree with that,
9 because this is what is needed in terms of knowledge.
10 Whatever their design is has to take into account what
11 the reality of the situation is, that certain
12 processes occur, you know, groundwater flow, and so on
13 and so forth.
14 How they emphasize things in their
15 potential safety case is up to them. The emphasis
16 might change, but we believe we have everything that
17 is necessary to describe the system.
18 MEMBER LEVENSON: Regardless of what their
19 safety case is.
20 MR. LESLIE: I believe that's where we're
21 at.
22 MEMBER LEVENSON: Okay. The other is
23 very, very detailed. What is subissue RDTME4?
24 Because it's on your slide but not on your chart
25 there. And, secondly, while it's on your slide, it

1 isn't relevant to any integrated subissue?

2 MR. LESLIE: Where is it on the slides?

3 MEMBER LEVENSON: And it has major impact,

4 right?

5 (Laughter.)

6 MR. LESLIE: Well, I --

7 MEMBER LEVENSON: I just want you to know

8 I looked at your slides. It's number 18.

9 MR. LESLIE: Yes. Part of this -- and I

10 didn't state that when I showed this in the backup

11 slides. This is a crosswalk. We have -- you know,

12 we're evolving, and as we've written the Yucca

13 Mountain review plan, and as we're developing the

14 integrated resolution status report, the boxes might

15 change, the overall perspective might change.

16 When we first started KTIs we didn't have

17 a Part 63. RDTME number 4, repository design and

18 thermal mechanical effects, subissue 4 was seals.

19 Okay? Well, seals was in Part 60. Part 60 is no

20 longer relevant. So this is an old slide, and you'll

21 see that I -- I actually caught it here and bend it --

22 you know, there's no RDTME4 on this thing. I just

23 didn't have an opportunity to change the slide last

24 night after I saw that, so thanks for --

25 MEMBER LEVENSON: Okay.

1 CHAIRMAN HORNBERGER: Bret, I guess I have
2 a question that follows on Ray's and Milt's question
3 I think. It's hard for -- I know I want to ask you a
4 general question and not a specific, but just to give
5 the flavor I'll just refer to one specific. But my
6 question is general.
7 There is plenty of room for disagreement
8 among scientists on these -- the kind of issues we're
9 dealing with here. So as an example, you showed in
10 your slides that your analysis of the unsaturated zone
11 is significantly different from DOE's analysis of the
12 unsaturated zone. And there may even at the end of
13 the day be room for disagreement among scientists.
14 And my question is: are you comfortable that you have
15 a process, either through -- well, somehow I guess
16 through the issue resolution process, to deal with
17 these kind of disagreements.
18 MR. LESLIE: That's a great question,
19 because if you look -- for instance, we'll give the
20 example the conceptualization of the unsaturated zone.
21 Part 63 says evaluate alternative conceptual models.
22 And, in essence, that's what you're saying. The
23 Department of Energy has a conceptual model where
24 transport times are very slow in the unsaturated zone.
25 Okay. If you look at what the unsaturated

1 folks have asked for in information is adequate
2 information to support evaluation of both conceptual
3 models. In other words, give us your results of the
4 chlorine 36 study, which suggests that the DOE's
5 conceptual model may not be correct. We need
6 sufficient information to evaluate both alternative
7 conceptual models. There's a requirement to -- for
8 the Department of Energy to do that.
9 So, yes, disagree -- we're not saying that
10 a particular model is correct. But if there are
11 alternate conceptual models that can address the same
12 issue, that adequate information -- and that those
13 alternate models are considered in the performance
14 assessment.
15 CHAIRMAN HORNBERGER: Questions from the
16 staff? John?
17 MR. LARKINS: Quick question. I'm just
18 curious. What constitutes major, moderate to major,
19 and minor? Are these levels of uncertainty? Timing?
20 Data needs? Or what types of considerations went into
21 this categorization?
22 CHAIRMAN HORNBERGER: Tim McCartin will
23 give us a presentation on that next time.
24 (Laughter.)
25 MR. LESLIE: No, that's not the answer.

1 (Laughter.)

2 I'm not intimately involved with what --

3 this was an effort put together by the Center, and it

4 incorporated the KTI resolution staff here. But the

5 idea was, okay, take a look at the agreements you've

6 asked for. What is the scope of information? Are you

7 talking about long-term testing? How large are those

8 uncertainties?

9 We'll go to the engineered degradation

10 barriers -- or degradation of engineered barriers and

11 container life and source term. Of those subissues,

12 what is the key driver? Okay. And how much

13 information is needed to support that?

14 So it's qualitative. It wasn't

15 quantitative. This was an informal type of analysis

16 to try to get -- another way of trying to get a handle

17 on how much information is really required. So the

18 answer is there aren't specifics. It was staff's

19 effort to try to assess what level of effort was

20 really needed or the complexity of the information

21 needs.

22 MR. LARKINS: Okay.

23 CHAIRMAN HORNBERGER: Okay. Thanks very

24 much, Bret.

25 Let's see. I think the schedule says

1 we're due for a break, and I think that we'll take a
2 break. Let's reconvene at 9:50.
3 (Whereupon, the proceedings in the
4 foregoing matter went off the record at
5 9:40 a.m. and went back on the record at
6 9:53 a.m.)
7 CHAIRMAN HORNBERGER: The meeting will
8 come to order again.
9 So the schedule that I have says that
10 we're next going to hear from James Weldy on
11 performance assessment. Is that right?
12 MR. WELDY: That's correct.
13 Good morning. I'm James Weldy, and I'm
14 going to be talking today about the status of
15 resolution of the TSPA and I key technical issue. The
16 outline of my talk is we're going to talk about status
17 of issue resolution, what DOE needs to provide, what
18 NRC and CNWRA are going to be doing before license
19 application to prepare for the review, talk about what
20 we've done in fiscal year 2001 and what we're planning
21 on doing for fiscal year 2002.
22 Current status of issue resolution for all
23 four key technical issues, subissues, is closed
24 pending. We've reached agreements with DOE to provide
25 the appropriate information by the time of license

1 application, so all four subissues are closed pending.
2 None have reached closure at this point.
3 And, of course --
4 CHAIRMAN HORNBERGER: James?
5 MR. WELDY: Yes.
6 CHAIRMAN HORNBERGER: I just want to
7 check, is the microphone adequate? Any need to move
8 it closer? Is it okay for the recorder? Oh, it is
9 okay. Okay.
10 MR. WELDY: Are there problems in the back
11 of the room hearing me? Is this better? Okay.
12 And I just wanted to point out the
13 limitation within the overall performance objective
14 subissue that the achievement of closed pending -- the
15 closed pending status is only related to methodology
16 issues, not related to any sort of determination that
17 -- as to whether DOE has met the standard or will meet
18 the standard or not. It's not a comparison of the
19 dose limits and the groundwater protection limits.
20 So going into detail about what DOE needs
21 to do, based on our agreements before license
22 application, within subissue 1, multiple barriers, DOE
23 has presented a number of different methodologies,
24 different techniques that they have in mind to make
25 their case for -- that they have multiple barriers.

1 But they really haven't put together an overall case,
2 how they're going to use these techniques to address
3 all of the issues and concerns within multiple
4 barriers.
5 The issues such as barrier -- variability
6 of performance of the barriers, independence and
7 interdependence of the different barriers, and
8 parameter model uncertainty considerations -- how are
9 they going to put all these techniques that they have
10 together and make a case to say we do have multiple
11 barriers in the repository system?
12 And to -- their schedule for addressing
13 these issues is that in fiscal year 2002 they will put
14 together the approaches, and by the license
15 application they'll present the results. And we -- it
16 resulted in two agreements for which the NRC and DOE
17 came to agreement, and we have not, of course,
18 received any information yet due to the late date of
19 the TSPA technical exchanges in August 2001.
20 This will be a common theme throughout,
21 that we haven't received much information to resolve
22 the agreements at this point.
23 MEMBER GARRICK: Can you just say
24 something briefly about the -- the content of the
25 agreements -- not a big elaboration, but just to give

1 us some sense of your own classification of minor,
2 major, etcetera?
3 MR. WELDY: I would say that they are
4 relatively minor in the sense that they really do have
5 the techniques already that they've put together, and
6 it's just really explaining how they're going to make
7 that determination as for what they need to reach
8 closure on the issue.
9 Since they have a lot of the information
10 put together, all of the -- a lot of the techniques
11 put together already, and the techniques seem pretty
12 reasonable, and they're the types of things that we
13 would consider using as well to make that sort of
14 argument, we believe that it shouldn't be too
15 difficult for them to put together all of the
16 different techniques and put it together in a
17 comprehensive argument that they do have multiple
18 barriers.
19 MR. BAHADUR: May I ask --
20 CHAIRMAN HORNBERGER: Go ahead, Sher. You
21 need to use the microphone and --
22 MR. BAHADUR: This is Sher Bahadur of ACRS
23 staff, ACNW staff. The total system performance -- I
24 was looking at the number of agreements in the list
25 that was provided before, and 42 elements are

1 classified as major. And so it -- most of these have
2 not been resolved yet, or do you have any feel for
3 those?
4 MR. WELDY: As for status resolution, like
5 I said, we had a late technical exchange where we
6 reached closure, so -- a closed pending status. It
7 was just in August, so DOE hasn't provided a lot of
8 the information -- much of the information yet to
9 close those agreements.
10 As for the number of agreements, the 42
11 classified as major, I'd --
12 MR. WHITMEYER: May I interject? This is
13 Gordon Whitmeyer from the Center. I don't know
14 exactly which chart you're reading from, Sher, but I
15 believe what is shown or should be shown, if there's
16 the word "major" next to one of the subissues it may
17 be TSPA and I number 3.
18 MR. BAHADUR: Right.
19 MR. WHITMEYER: And there are 42
20 agreements. That's a summary that's saying that if
21 you look at the total number of agreements, and the
22 amount of information that's required of DOE to meet
23 those agreements, it requires a fairly major effort on
24 their part. Doesn't necessarily mean there are 42
25 major agreements. I don't know if that helps clarify

1 things or not.

2 MR. PATRICK: And that also deals with

3 model abstraction and --

4 MR. WHITMEYER: That's the model

5 abstraction --

6 MR. PATRICK: -- multiple barriers --

7 MR. WHITMEYER: -- for subissues.

8 MR. WELDY: That's subissue 3, which we'll

9 be getting to shortly.

10 MR. BAHADUR: Thank you.

11 MR. WELDY: Okay. Within subissue 2,

12 scenario analysis, DOE has completed FEPS database,

13 which they have made the argument is comprehensive and

14 complete. And, in our opinion, it seems to cover

15 everything, but the biggest problem we've found with

16 it is more transparency and traceability issue.

17 The real concern is that they really have

18 different levels of broadness for their different

19 FEPS, and for a number of the FEPS it's difficult to

20 tell features, events, and processes. I apologize for

21 the acronym.

22 For a number of the different features,

23 events, and processes that they've defined, it's

24 difficult to tell exactly what falls within the scope

25 of that features, event -- that FEP. It's just some

1 things are so broad that they can lump any issue that
2 they -- that gets brought up into that FEP and
3 indicate that it will be covered -- that they will
4 address it during the modeling rather than during the
5 screening argument.
6 So it's -- it's hard to tell whether they
7 have put together a completely comprehensive list, if
8 you can't tell what's in with -- within each of the
9 FEP, and what they actually thought of when they were
10 developing it.
11 So the -- that's the major theme of the
12 issues that we've brought up in the agreements that
13 we've made with the DOE -- is that we really need to
14 be able to tell what's in the FEP and what they're
15 doing with it and how it's getting propagated into the
16 performance assessment.
17 Of course, there are additional agreements
18 on clarifying their screening argument or providing a
19 more acceptable screening argument for some of the
20 FEPs, but we don't think that there is anything -- any
21 huge issues that they've missed that wouldn't be --
22 couldn't possibly be covered by some of their
23 currently defined FEPs. It's just not very
24 transparent or traceable to find out what's going on.
25 Of course, this information is required to

1 demonstrate that the -- they have considered
2 everything that's important within their performance
3 assessment. And we reached seven agreements within
4 the subissue to achieve closed status, and we have not
5 received any information from the DOE on those
6 agreements at this point.
7 For subissue 3, model abstraction, this
8 one is a very broad category, and the agreements cover
9 a number of different issues. Primarily, we tried to
10 focus on methodology issues, but there are also a
11 number of specific technical issues that -- for which
12 we had to reach agreements in this category.
13 But they tended to boil down into some
14 major categories, such as how they've represented
15 uncertainty within the system, and have they done it
16 consistently from abstraction to abstraction, have
17 they represented the uncertainty from detailed process
18 level models appropriately within the abstraction when
19 they went from the detailed model to the abstraction.
20 Other issues include the integration of
21 the different process level models. Are they
22 consistent between the different models? And
23 transparent explanations of how they've simplified
24 models, how they've used conservatism, how they've
25 represented parameter uncertainty.

1 There were a number of consistency issues
2 that they found that while not necessarily wrong or a
3 real problem just were not consistent between
4 different models and was not clearly explained why
5 they were inconsistent, which we didn't -- we thought
6 definitely needed a little more explanation within
7 their safety case.
8 And, of course, the information on model
9 abstraction is necessary to ensure that data
10 collection, model development, and treatment of
11 uncertainty are adequate to provide a basis for their
12 performance assessment. And we've reached 43
13 agreements within this subissue, and so at this point
14 they have provided information to complete one of the
15 agreements, and that information was sufficient to
16 provide the information that the NRC needed. So it is
17 considered resolved by the NRC staff at this point.
18 CHAIRMAN HORNBERGER: Are these -- again,
19 just to get a general feeling for the nature of these
20 agreements. Are these agreements for DOE to either
21 modify or augment their AMRs to provide the
22 traceability to the model abstractions? Is that the
23 flavor?
24 MR. WELDY: That's probably a reasonable
25 characterization of a lot of the agreements. Based on

1 the wide range of the model abstraction, there is a
2 mixed bag, of course. There's a number of very
3 detailed, specific technical comments that we included
4 in here. Everything on the biosphere was included
5 under the model of the TSPAI KTI, since it doesn't
6 have a KTI of its own to reach closure on. So there's
7 a number of detailed technical comments related to
8 that within this group. So it's a fairly wide range.
9 Now, has that addressed your question?
10 MR. BAHADUR: Yes.
11 MR. WELDY: Okay, good.
12 CHAIRMAN HORNBERGER: Yes, Jim?
13 MR. FIRTH: James Firth, NRC staff. I
14 guess I would point you back to the presentation that
15 we gave back to the committee where we laid out some
16 of the specific agreements that we got, and this was
17 the August 29th presentation.
18 That goes through -- a lot more specific
19 in terms of what the agreements were. And to
20 reemphasize what James had said is that a number of
21 these things address similar concerns to what was
22 being addressed by the KTIs in their meetings, but
23 reflect what was the information in the TSPA SR
24 documentation which was not available at that time.
25 So there's a range of modeling questions

1 and concerns -- questions that we had that were being
2 addressed through the agreements.
3 There were also cases where, as we started
4 doing things from the ISI perspective, to make sure
5 that everything was covered in the KTI meetings
6 earlier, that there were a couple things that we felt
7 that we didn't have the information, to make sure that
8 we have the information consistent with what we would
9 see in the eventual Yucca Mountain review plan, and to
10 show -- to meet the acceptance criteria. So we'd have
11 the information to be able to do a review.
12 MR. WELDY: And, finally, subissue 4,
13 overall performance objective. The agreements that we
14 reached -- one of the bigger issues that we found and
15 had with them is their strategy and implementation of
16 their software verification and model support or
17 validation that the DOE has been doing for their
18 software.
19 We really need to get some more
20 information and get improved results from that from
21 DOE to have confidence in the results of their models.
22 Other things that we've reached agreements
23 on within overall performance objective is looking at
24 more details on their -- how they are running their
25 TSPA, how they're demonstrating convergence of the

1 results, how they're demonstrating that they've
2 addressed variability sufficiently with their time
3 steps, with the level of discretization, and make sure
4 that they're not running into incorrect results just
5 due to the way that they set up the models.
6 And this information is required, of
7 course, to provide confidence in the results of the
8 TSPA and any decisions that might be made on -- as a
9 result of the TSPA calculations. And within this
10 subissue, we reached seven agreements and have not
11 received any information on these agreements yet.
12 Well, that's what DOE is going to be
13 doing. What are NRC and CNWRA going to be doing up
14 until the time of license application? Of course, one
15 of our primary jobs is going to be monitoring what DOE
16 is doing, reviewing the information that they provide
17 us to meet the agreements and make sure that the
18 information is acceptable and provide them feedback
19 where we find that it's not acceptable.
20 And we're going to continue to participate
21 as an observer in the DOE quality assurance audit to
22 monitor issues such as validation, verification,
23 transparency, and traceability within their documents,
24 and make sure they are moving forward in the right
25 direction.

1 We're going to complete development of our
2 own TSPA, the TPA code, perform sensitivity analyses
3 and visualization tool to help us get insights into
4 how the system is behaving, focus our review and
5 enable us to really focus on those things that are
6 most important to the DOE's safety case based on our
7 own independent modeling.
8 And we're going to conduct a thorough
9 review of the consideration and propagation of
10 uncertainties from detailed models to the TSPA model
11 and look at where you could run into problems, where
12 you could run into issues of risk dilution, so that
13 we're able to do a good review of the DOE work.
14 In fiscal year 2001, the CNWRA and NRC
15 staff outside of the issue resolution activities,
16 primarily we've been working on developing tools to
17 help us review any DOE potential license application.
18 We've been updating the TPA code, which is, of course,
19 our own tool for assessing the performance of the
20 system. We've been performing uncertainty and
21 sensitivity analyses to identify the scenarios,
22 processes, models, and parameters that influence the
23 results the most, so we can really focus our review of
24 the DOE work.
25 We've been working on approaches to

1 understand and gain insights on overall performance of
2 the system, and we've been doing some confidence-
3 building efforts on our own tools. So we've been
4 starting to develop a software validation test plan
5 for our own TPA code, and also the TPA code was
6 subjected to an external review a couple of years ago,
7 and we're continuing to work on responses to the
8 external reviewer's comments and have just about
9 completed that activity.
10 And those sorts of activities will help to
11 provide confidence in our tools, so we are focusing on
12 the right thing, make sure we're focusing on the right
13 things for -- of the DOE TSPA.
14 We've also been working on pre- and post-
15 processors for the TPA code to make it easier to use,
16 make it easier to extract results, and make it easier
17 to understand what's going on in the system.
18 Some more details on the sensitivity
19 analyses that we've been doing over the past fiscal
20 year, we've been looking at distributional
21 sensitivity. Some of the distributions defined within
22 the TPA code may be defined on just a few data points,
23 and we have to assume what distribution corresponds to
24 those data points. And so we're looking at what would
25 the effect be on the results if we -- instead of a

1 normal distribution we selected a log normal? What if
2 we shifted the mean up a little bit? How much would
3 that affect results?
4 We've been looking at alternative
5 conceptual models and how that could affect results.
6 If we replace the model of one repository system with
7 an alternative, such as the dissolution rate of the
8 spent fuel, how much will that affect performance?
9 And we've been doing barrier analyses to
10 gain insights on barrier capabilities and importance
11 to the performance of the repository, and also to get
12 insight into barrier capabilities through the --
13 looking at intermediate results, how barriers affect
14 the transport of materials through the system.
15 For 2002, we plan on continuing some of
16 the similar activities and adding some new ones. We
17 plan on continuing the issue resolution process,
18 reviewing DOE work, providing comments, resolving
19 issues, narrowing down those agreements and seeing if
20 we can reach closed status on some of the TSPAI
21 subissues.
22 We're going to be developing Version 5.0
23 of the TPA code which will be another major step
24 forward in the TPA code, replace -- evaluate some of
25 the simplifications in the code, try and improve the

1 models, and get an idea of what some of these
2 uncertainties will have on the performance of the
3 system.
4 We're going to be doing more uncertainty
5 sensitivity analyses, the quantitative evaluation of
6 the TSPA and TPA code results. We're also going to be
7 looking at detail at the DOE's TSPA code. We've
8 acquired the software, and we're going to be looking
9 at the implementation of how they're doing things and
10 see if we can -- if we identify any concerns with
11 what's going on, that you can't do just by looking at
12 a document but you actually have to look at the code
13 itself.
14 And we're also going to be starting off on
15 a risk insights project where we document those issues
16 that -- the risk insights that we use to help develop
17 the agreements with the -- within TSPA and with the
18 other KTIs. And what we did and what we looked at to
19 identify those things that needed agreements and were
20 important to the performance of the system, and also
21 work on a way to communicate those risk insights to
22 members of the public and other NRC stakeholders.
23 And brief summary -- we achieved closed
24 pending status on all four of our subissues in the
25 last fiscal year, and we're going to continue to

monitor DOE work to ensure that they are keeping up with the agreements and submitting high-quality products that meet the needs of -- the informational needs that we identified to write the agreements.

We're going to continue to work to improve our understanding of the repository system, and we're going to put some more effort into identifying, documenting, and communicating risk insights that we have with other NRC stakeholders.

And with that, I'll open up the floor to questions.

CHAIRMAN HORNBERGER: Thank you, James.

Questions from the committee? Milt?

MEMBER LEVENSON: Since today is January 9th, it's time for me to ask the two questions I ask every six months. Since you're presenting on the overall assessment integration, does the system current -- have they added conservation of mass to the overall analysis and system, or is it still lacking?

MR. WELDY: Within the DOE TSPA code?

MEMBER LEVENSON: Yes.

MR. WELDY: My indication is that they have not done a full conservation of mass at this point. Randy, would you like to explain?

CHAIRMAN HORNBERGER: You have to come to

1 a microphone and identify yourself and -- for the
2 record.
3 MR. FEDORS: Randy Fedors from the Center.
4 I believe there's a technical agreement on those that
5 they will look into that, and I -- it's a closed
6 pending because they'll develop the approach.
7 MEMBER GARRICK: So you can ask the
8 question again in six months.
9 (Laughter.)
10 MEMBER LEVENSON: I think this is now the
11 fourth year, so --
12 (Laughter.)
13 The second question is a similar one. We
14 got a presentation a few months ago at which one of
15 the analyses -- they just removed a few of the extra
16 so-called conservatisms. It changed the result by a
17 factor of 10^4 on the dose. It's my feeling that we
18 have no idea how many places things are either
19 overestimated or underestimated in the name of
20 conservatism, because it seems to be done by modelers,
21 by data input people, by abstracters, all along the
22 way.
23 Are you people making any effort to try to
24 not necessarily correct all of this but get a feel for
25 how far from realism the analysis has been pushed in

1 the name of -- I don't like the "conservative" because
2 overestimates and underestimates are not necessarily
3 conservative, even if you think they might be. But it
4 seems to me it would be fairly important in the final
5 analysis, before you can identify what is the real
6 risk, you have to have a handle on all of these
7 perturbations.
8 MR. WELDY: Yes. And, specifically, to
9 answer your question, we do have an agreement in the
10 TSPAI subissue, under subissue 3 -- I don't know the
11 number off hand -- but that specifically relates to
12 DOE doing a much better -- a better job of documenting
13 how they're using conservatism, where they're using
14 conservatism, the guidance they're giving to their
15 modelers and staff on where and how to use
16 conservatism.
17 So we are looking at that issue and
18 ensuring that they are doing a consistent job across
19 it of at least documenting -- across the different
20 KTIs and different technical areas of at least
21 documenting where they are claiming conservatism and
22 why they believe it is conservative, or, if you don't
23 like the word "conservative," will lead to higher dose
24 estimates rather than not -- lower dose estimates.
25 Of course, when we're developing the

1 agreements, we look at -- if we find an issue that we
2 -- a technical issue that we have concerns about, we
3 do think about, well, will this lower dose or increase
4 dose at the critical group location? And if it's
5 likely to lower dose, we -- if the issue -- if the
6 problem results in a high -- is likely to result in a
7 higher dose, we generally still submit it to them but
8 at a lower priority level.
9 We do it as an issue of clarity and
10 documentation and generally won't get it -- a specific
11 agreement written for it. But if it's something that
12 results in an overly conservative -- or a result that
13 lowers dose, then we'll generally write an agreement
14 for it.
15 MEMBER LEVENSON: Our concern -- my
16 concern is that such complex systems -- it is seldom
17 obvious where it would lead to a higher or lower dose.
18 The classic case is, why don't we make the containers
19 a lot smaller so that as you analyze each container it
20 contributes a small amount to the risk. But a large
21 increase in the number of containers does not
22 necessarily reduce the final risk.
23 MR. WELDY: Right. And that's actually
24 the third category is where we just can't tell we --
25 MEMBER LEVENSON: Well, in a significant

1 fraction of the cases in -- especially non-linear
2 systems, but even when it is linear but complex, it is
3 not obvious what the effect of overestimating,
4 underestimating, which is why we keep coming back to
5 let's do the most realistic job and then add the
6 safety margins.
7 MR. WELDY: Yes, and there are certainly
8 areas where you can tell for sure, such as in igneous
9 activity. If you assume that the waste package
10 provides no protection and all the waste is -- that is
11 contacted by the magma is extracted from the mountain,
12 that's going to lead to higher dose results than if
13 you do more complex modeling and are able to defend a
14 greater level of protection.
15 MR. FIRTH: James, could I add a few
16 things?
17 MR. WELDY: Okay.
18 MR. FIRTH: James Firth, NRC staff. I
19 guess, Milt, going back to your original question, I
20 guess one of the important aspects is, has DOE
21 provided a sufficient basis to show that the
22 repository would be safe in terms of the long-term
23 performance? And that's slightly different than
24 knowing what the actual performance would be, and we
25 have regulations in place that we will be evaluating

1 what DOE is coming in with, and we'll be evaluating to
2 see that it is sufficiently safe.
3 That's a different question, and we don't
4 necessarily have to push DOE to find out what the
5 exact level of risk is. And I guess the second point
6 is on your follow up question -- we recognize that it
7 is very difficult in some cases to evaluate whether
8 something really is conservative in terms of leading
9 to higher dose estimates or not.
10 And that's why we do have an agreement
11 with the Department of Energy, so that they will be
12 more rigorous in terms of providing the evidence and
13 the basis to show -- to support their assertions that
14 this is the effect of this assumption or this way of
15 analyzing it. So that it's not quite as liberal in
16 terms of the use of asserting that this is
17 conservative, that it does get more evidence-based.
18 MEMBER LEVENSON: I just want to make one
19 thing very clear, and that is that I am very much in
20 favor of it being conservative. I just want to make
21 sure that what we think is conservative really is
22 conservative.
23 MR. FIRTH: Yes, and we would -- James
24 Firth, NRC staff. We would agree that we want the
25 basis to support that they are not being non-

1 conservative or leading to lower dose estimates
2 because they've not looked at things in enough detail,
3 that they are backing up their assertions with some
4 evidence.
5 CHAIRMAN HORNBERGER: Raymond?
6 VICE CHAIRMAN WYMER: Yes. Well, there's
7 quite a few subissues that are still to be resolved.
8 Some of them are not very important with respect to
9 the overall risk of the repository. Some handful are
10 important.
11 And in order to answer some of the
12 questions with respect to these subissues there's been
13 a request for a lot of detailed work to be done by
14 DOE, in some cases experimental work that will require
15 some time to complete.
16 My question is: with respect to timing,
17 and this may be kind of an unfair question, but are
18 there some agreements that are not likely to be
19 resolved by DOE within the time available for -- by
20 the time the license application is submitted?
21 And the kind of thing that comes to mind
22 right off the top is some of the corrosion issues like
23 alloy 22 that it's kind of hard to determine what the
24 10,000 year behavior will be of an alloy in a six-
25 month experiment. So are there issues like that?

1 CHAIRMAN HORNBERGER: What we might do is
2 actually defer that question to the rest of the
3 presenters, and perhaps ask you, in fairness, if there
4 are any with respect to TSPA itself.
5 MR. WELDY: Within TSPA itself, most of
6 them we expect will be resolved by the time of license
7 application. I mean, it's primarily modeling issues
8 and issues related to the DOE safety case itself, so
9 there is not really much there that can be deferred
10 until later.
11 There might be some model validation work
12 that will continue to be done to just confirm that
13 they have completed the work and confirm the
14 confidence in the model. But I believe that the
15 majority of it we would expect to be completed and
16 needs to be completed by the license application.
17 Jim?
18 MR. FIRTH: James Firth, NRC staff. I
19 just -- in terms of the performance assessment, like
20 demonstration of the overall performance measures,
21 multiple barriers, and scenario analysis, those things
22 -- the agreements there deal with things that we would
23 need in time of a license application.
24 Some elements of model abstraction --
25 there becomes more of a line in terms of what's needed

1 to make the decision for -- in terms of what DOE is
2 provided in terms of demonstrating that it's safe.
3 That may be confirmed through a performance
4 confirmation that would come later, but the premise of
5 all the agreements is that this is information that we
6 believe we would need to review a license application.
7 We're not establishing what DOE's schedule
8 is, so --
9 CHAIRMAN HORNBERGER: Yes, we know that,
10 and I don't -- you know, just to interrupt you, James,
11 I think what we're looking for is not necessarily a
12 long discourse on what your agreements expect. I
13 think Ray's question was we are interested in your
14 gut-level feeling as to whether there is -- might be
15 a potential problem in terms of delivering information
16 that you think is necessary in time for a license
17 application.
18 So pretty clear cut, the answer is no, we
19 anticipate that all this information will be
20 delivered. That's fine. We're just interested in any
21 insights that you might have, and maybe if Gustavo
22 wants to go out on a limb and say, well, I don't think
23 they can get this information in three years --
24 (Laughter.)
25 -- that's what we're interested in.

1 MR. CRAGNOLINO: Why me?

2 (Laughter.)

3 CHAIRMAN HORNBERGER: Did you have a

4 follow up?

5 MEMBER LEVENSON: Well, I was just -- you

6 know, inherent in the question Ray and you have asked

7 is an implication that these guys have some

8 information which I don't think they have, which is,

9 when are they going to get -- how long is it to

10 license application -- if you can estimate how long to

11 get the data.

12 CHAIRMAN HORNBERGER: Well, we realize

13 it's a question that puts people on the spot. We

14 recognize that it may be a question that people don't

15 want to answer directly, and yet it is a question that

16 occurs to us that as you go forward with these

17 agreements to provide information, as scientists you

18 might have a good sense as to how long this might take

19 and whether or not it's doable within a reasonable

20 licensing timeframe.

21 You may decide you don't want to answer

22 that question, but that's the thrust of our question.

23 John?

24 MEMBER GARRICK: I found several of my

25 questions answered in the backup slides, which are

1 very helpful.

2 MR. WELDY: Glad to hear it.

3 MEMBER GARRICK: And several issues that

4 you have planned to deal with in this following year,

5 in this year.

6 But I would like to ask, on the -- your

7 review of the supplemental science and performance

8 assessment, do you consider this a part of the TSPA?

9 MR. WELDY: It's additional information

10 that DOE has collected. It's certainly something that

11 we need to look at and understand what they've done

12 there, what new information they've found and what

13 sort of sensitivity analyses they've done to help us

14 get an understanding of the system.

15 And if there's new information in there

16 that wasn't in other TSPA documents that they've

17 provided us, we need to consider that and make sure

18 we're aware of it for a review of other documents.

19 I don't think DOE intends that to be any

20 formal part of their licensing case, but I can't

21 answer that for DOE. But there is certainly useful

22 information in there that we need to review and

23 understand what -- what they've collected and what

24 they're doing.

25 MEMBER GARRICK: Well, I had kind of a

1 different impression. I had an impression that it was
2 very much -- very well could have been just an
3 amendment to the TSPA because they sharpened up a lot
4 of the assumptions in the TSPA model, particularly
5 having to do with things like solubility, and some of
6 the -- what they identified as very conservative
7 assumptions in the TSPA SR were -- took a much more
8 realistic scope in the supplemental report.
9 MR. WELDY: And I think it also gives us
10 an opportunity to prepare for where DOE might be
11 going. So we can start looking at the issues --
12 MEMBER GARRICK: Right.
13 MR. WELDY: -- that they are trying to
14 sharpen the pencil on and make sure that we understand
15 any additional concerns we might have related to those
16 issues.
17 James Firth, what --
18 MR. FIRTH: James Firth, NRC staff.
19 Anything that DOE is going to be carrying forward from
20 the SSPA is going to be working its way into the AMRs,
21 the TSPA, so we're going to be focusing on their
22 changes to all of those documents.
23 And that's where we're going to be
24 focusing on our review, so we'll consider the
25 information there to help inform the questions that we

1 ask, but we're really focusing on the safety case that
2 they may be developing if they go forward with the
3 license application.
4 MEMBER GARRICK: Thank you. That's all.
5 CHAIRMAN HORNBERGER: Okay. Thanks very
6 much, James.
7 MR. WELDY: Okay. Thank you.
8 CHAIRMAN HORNBERGER: Okay. We are going
9 to move on to it looks like one of our favorite topics
10 here -- igneous activity.
11 MR. HILL: I always wonder what you mean
12 when you say "favorite."
13 (Laughter.)
14 Well, since we had our last interactions
15 in July and August, there have been a few new things
16 that we can talk about on igneous activity. We can
17 have a new update on issue resolution and also put the
18 risk information into a little more straightforward
19 path on what are the most risk important topics and
20 how are we going to move forward with the Department
21 of Energy on these topics?
22 We'll also use that information to show
23 how we're focusing the work last year and this year on
24 the most risk significant aspects for issue
25 resolution.

1 Now, probability -- the first main
2 subissue for igneous activity -- has been closed
3 pending since August 2000. We have one agreement
4 that's fairly minor, one that's probably minor but has
5 the potential to become a larger level of effort --
6 I'll talk about that in just a moment. But,
7 basically, probability is well in hand.
8 On consequences, in September we had a
9 very productive technical exchange with the Department
10 of Energy. We reached four major agreements that are
11 going to give us a path forward for closing the
12 igneous activity consequences subissue.
13 The remaining agreements that we had
14 reached, the previous technical exchanges, and
15 including the September technical exchange, there's a
16 number of minor agreements that appear to be very well
17 on track to completion in this fiscal year and the
18 following fiscal year. So I think we're in very good
19 shape for them.
20 The four major agreements, however, it's
21 really been too soon to tell. That only occurred in
22 September. We've got ongoing discussions with the
23 Department and plans for updates regularly throughout
24 the year to keep track of progress.
25 Hello? Okay. Just to bring you up on

1 probability, the risk insights for probability is that
2 there are a number of published alternative models
3 that give probability values anywhere from a factor of
4 10 to a factor of 100 higher than the DOE mean value
5 of 1.6 times 10^{-8} per year.
6 Now, the way that we've resolved to go
7 forward with the Department is that DOE has agreed to
8 conduct a sensitivity analysis in any licensing
9 application that should arise using a probability of
10 10^{-7} per year. And that will give us a way to
11 evaluate whether these differences between the
12 Department's preferred value and the value that we
13 would prefer, whether those differences are truly
14 significant to risk or not.
15 DOE has also agreed to evaluate some new
16 aeromagnetic data that's been collected by the U.S.
17 geological survey. This aeromagnetic data will give
18 us insights as to whether there are additional buried
19 features in the Yucca Mountain region that could
20 represent basaltic volcanoes.
21 We received the technical update impact
22 report right around Thanksgiving that has a
23 preliminary interpretation of these aeromagnetic data
24 that say there could be 13 additional igneous features
25 in 30 kilometers or so of the proposed repository

1 site. That is a preliminary analysis that's subject
2 to ongoing interpretation by the Department and their
3 contractors.
4 We're going to be meeting with the
5 Department some time this spring and will be holding
6 a teleconference in February to go over some of this
7 information. But if that interpretation stands or if
8 there are additional features that haven't been
9 incorporated into existing probability models, the DOE
10 has agreed to evaluate the impact of that new
11 information on the probability models.
12 We'll also need to determine if there are
13 additional basaltic igneous features in the Crater
14 Flat Basin that may be present but undetected by this
15 new aeromagnetic technique or any existing geophysical
16 technique that's been used to characterize the site.
17 Well, consequences -- to focus on the four
18 major technical agreements that we have with the
19 Department. The first of these is probably the most
20 important to understanding risk on -- it's about magma
21 repository interactions. We talked about this quite
22 extensively in the July meeting.
23 But, basically, how can repository
24 structures affect normal igneous processes? As magma
25 continues -- or if magma is rising, it interacts with

1 the subsurface system. How could alternative flow
2 paths develop as opposed to a normal volcanic conduit?
3 The risk significance of all this is these
4 alternative flow paths may increase the number of
5 waste packages that we have potentially disrupted
6 during an igneous event.
7 Now, we have received, again, a very
8 preliminary scoping calculation from the Department in
9 its technical update impact report that says now
10 they've looked at just potentially some of these
11 alternative flow paths. They don't agree that there's
12 a technical basis to support these flow paths. But if
13 these flow paths occurred, they would have a risk
14 impact of about one millirem per year with an event
15 probability of 1.6 times 10^{-8}.
16 Now, it is important to note that using
17 that scoping calculation and using a probability that
18 would be sufficient for prelicensing issue resolution
19 -- 10^{-7} per year -- that would change that risk
20 significance up to about 10 millirems per year. So
21 you can see that alternative flow models, in addition
22 to alternative probabilities, have a truly
23 demonstrable risk impact on the total system
24 performance assessment.
25 The way forward here is that the

1 Department has agreed to evaluate how repository
2 structures can affect igneous processes, in particular
3 how magma may be affected during its accent and rise
4 in the subsurface, how conduits -- the pathway to the
5 surface, how those conduits localize in drifts or in
6 pillars or away from the repository itself, and how
7 that conduit and flow system may evolve for the
8 duration of an event.
9 MEMBER LEVENSON: Before you leave that,
10 how does the probability affect the dose?
11 MR. HILL: It affects the risk.
12 MEMBER LEVENSON: Yes. But you're quoting
13 a dose.
14 MR. HILL: No, I was quoting the risk.
15 MEMBER LEVENSON: Not the probability of
16 a dose, which is --
17 MR. HILL: No, that was a risk. The DOE's
18 risk was one millirem per year at a probability of
19 10^{-6} for the event.
20 MEMBER LEVENSON: Yes. Now, you change
21 the probability, but might be much more likely
22 somebody would get that dose, but how does it increase
23 the dose?
24 CHAIRMAN HORNBERGER: It's a weighted
25 dose. It's a probability weighted dose. You need

1 to --

2 MR. HILL: Yes. It's the expected annual

3 dose. Now, if you change the probability of the event

4 by a factor of 10, the risk would increase by a factor

5 of 10. The risk is the probability times its

6 consequence. So we have --

7 MEMBER LEVENSON: Yes. But millirem is --

8 MR. HILL: -- two components. Pardon?

9 MEMBER LEVENSON: But the millirem per

10 year is only half of that.

11 MR. HILL: I'm sorry. I -- half of it?

12 MEMBER LEVENSON: Well, okay. Never mind.

13 MR. HILL: No. The probability weighted

14 expected annual dose is one millirem per year. That

15 includes the dose consequences multiplied by a 1.6

16 times 10^{-8} event probability. If that probability

17 increased by an order of magnitude, the resulting

18 expected annual dose would also increase by an order

19 of magnitude.

20 MEMBER GARRICK: If it were not weighted,

21 it would be one big dose.

22 CHAIRMAN HORNBERGER: Yes. So if a

23 volcano occurs, the dose is much higher than one

24 millirem.

25 MEMBER GARRICK: Yes.

1 MR. HILL: That's been documented in the
2 issue resolution status report for a number of years.
3 Okay. The second area of major agreement
4 would be on magma waste package interactions. And,
5 again, how could potential igneous activity affect
6 waste packages? The reason this is risk significant
7 is that controls the source term for both volcanic
8 release and intrusive release or subsequent hydrologic
9 flow and transport.
10 There's really very little technical
11 information on how the alloys that would make up the
12 waste package and drip shield -- how all of these
13 would behave under igneous conditions. So we're
14 having to extrapolate from fairly limited information.
15 The Department recently agreed to evaluate
16 waste package response for a realistic range of
17 igneous conditions. That would include the
18 temperatures and pressures and dynamic pressure
19 variations that would be representative of typical
20 basaltic igneous events, and also consider the
21 potential effects of magmatic gas affecting corrosion
22 processes -- waste packages located some place away
23 from the direct impact of magma.
24 We also need to make sure we're looking at
25 a duration of an igneous event, because these events

1 can last for days to weeks to potentially a month of
2 duration. And so these thermal, mechanical, and
3 chemical loads can be impacting the system for many
4 years following the igneous event.
5 Also, after the event we have to worry
6 about seismicity, because one of the characteristics
7 of alloy C22 is embrittlement after exposure to 1,000
8 degree Centigrade temperatures and cooling back to
9 ambient conditions. So even if we had an intact waste
10 package following exposure to these sort of magmatic
11 conditions, any sort of shaking could potentially
12 cause a fracture to occur in the waste package. So we
13 have to look at the post-event impacts on performance
14 as well.
15 The third area is magma waste form
16 interaction. So if waste packages are disrupted, what
17 is the likely process for waste entrainment? This is
18 a very difficult problem because there is no natural
19 analogs to this. We don't have experience with
20 10 gram per cubic centimeter material being
21 incorporated into basaltic igneous events before.
22 But the risk significance is that if there
23 isn't effective incorporation of this material we
24 could be reducing the source term for volcanic
25 disruption or also affecting the waste form for

1 subsequent hydrologic flow and transport.

2 So we really have to understand, and the

3 DOE has agreed to evaluate, how a potential magma flow

4 can affect the cladding of the waste, changes in the

5 waste form, and also mechanically how that affected

6 waste and waste products can be incorporated into a

7 flowing igneous system. And that, of course, is going

8 to have to build on the knowledge from the magma

9 repository interaction studies as well, to get the

10 appropriate flow conditions.

11 And, finally, the last part is on tephra-

12 fall remobilization. So if we have a repository

13 penetrating volcanic event, how could the tephra from

14 that volcanic eruption erode and be remobilized on the

15 surface in the years after the event? The reason

16 that's risk significant is that the rate of erosion

17 and deposition strongly affects the long-term risk

18 calculation.

19 The risk really can be broken into two

20 main components. First is the risk of an event in the

21 year of an eruption. That would be weighted by the

22 probability of 10^{-7} of having an eruption in that

23 year. There is also an accumulation of risk from

24 prior events that also have, in each year, a 10^{-7}

25 probability of occurrence.

1 And when you look at calculations for an
2 expected annual dose in any given year following
3 closure that expected annual dose for most years is
4 dominated by the accumulation of risk from prior
5 events and not by the event occurring in the year that
6 you're calculating.
7 So this process of remobilization by wind
8 and water, where potential tephra is mobilized off the
9 slope surrounding the volcano on the Yucca Mountain
10 where you have a fairly steep topographic gradient,
11 transport down the Fortymile Wash basin by both
12 flowing water and by wind and deposition in the area
13 that would affect a reasonably maximally exposed
14 individual.
15 These processes are key to understanding
16 the expected annual dose that's going to need to be
17 used for compliance with 10 CFR 63.
18 What do we need to do? What does the NRC
19 need to do before license application? Again, we're
20 focusing on evaluating the DOE models and reasonable
21 alternatives for these four most risk significant
22 issues. We have to confirm the numerical and analog
23 experimental investigations for flow dynamic on
24 sustained magma repository interactions.
25 Again, there is no data, there's no

1 analogs, there's no simple way of doing this except
2 through numerical modeling and some analog experiments
3 to really understand the flow dynamics of a repository
4 penetrating event.
5 We also have to evaluate the risk
6 significance of long-term remobilization by wind and
7 water. The reason that's difficult is because the
8 youngest eruption in the Yucca Mountain region is
9 80,000 years old. The deposits from that volcano, the
10 distal tephra deposits, the ones that are most
11 analogous to this situation, they've all been eroded
12 away and have been deposited down in other basins.
13 So we have no site-specific data to
14 evaluate how tephra erodes and is transported from the
15 Yucca Mountain system. And analogs have some very
16 important limitations in terms of their eroding and
17 transporting processes.
18 We can get some good insights, though,
19 from analogs and field investigations of magma ascent
20 processes. How do conduits localize? What are the
21 controlling stresses and rock mechanical properties
22 that can affect conduit localization once you get a
23 dike going? And I think that's one area that we're
24 going to be investigating in the next couple of years
25 to come up with a good basis for reviewing DOE work in

1 this area.

2 And, finally, we need to review -- review
3 new information on the responses of engineered
4 materials to igneous events, and this is an area we
5 see a lot of work coming in from the Department trying
6 to explain how igneous temperatures and conditions can
7 affect the engineered materials proposed for the
8 repository systems.

9 So our technical accomplishments last year
10 really were the bases to reach the closed pending
11 agreements. We talked about these quite a bit at the
12 July ACNW meeting. And, very quickly, it was the
13 numerical models for initial magma repository
14 interactions, the Bokhove and Woods paper if you will.
15 Some of the preliminary models for sustained magma
16 flow will redevelop the alternative flow paths. That
17 was the Woods et al. paper. And some of the initial
18 evaluations for long-term tephra remobilization, where
19 we talked about rates of remobilization being
20 important.

21 So in fiscal year two, the emphasis is
22 going to be on sustained magma flow, not the initial
23 interactions that we looked at last year -- but how
24 does a conduit develop and flow develop occur during
25 a potential igneous event? Really, it comes down to

1 two options. Do we have a normal vertical conduit
2 that can come up through a drift where there's a
3 potential for circulation and wall erosion through
4 time?
5 Could we have some entrainment of waste
6 away from the conduit? We're going to be trying to
7 answer that question this year. But also for the
8 second flow path where a breakout occurs at some
9 distance away from the point of interaction, how could
10 that occur?
11 What would be the potential for a
12 segregation of flow and waste entrainment during this
13 inclined part of flow in the system? And could high-
14 level waste be concentrated in a low velocity zone?
15 Or would the normal convection, back pressure, and
16 churning in the system essentially give you waste
17 incorporation?
18 We're going to be doing numerical and
19 analog experiments this year to try to answer some of
20 those questions on sustained flow in different
21 geometries.
22 Also, we'll be continuing the
23 remobilization work and parameter evaluation, complete
24 the Yucca Mountain petrology studies. Those are the
25 studies of the origin of the basalt. They give us

1 some very important insights for evaluating the
2 probability of the event.
3 Finalize updates to PVHView. This is the
4 computer code that puts in the probability models. It
5 will allow us an independent tool to evaluate impacts
6 of new volcanic centers and new repository footprints.
7 And also to continue to work with NRC staff for some
8 alternative high-level waste incorporation models
9 during flow.
10 The model we're currently using is just a
11 simple mathematical relationship. We're trying to get
12 a better mechanistic understanding of how high-level
13 waste could be incorporated into an erupting volcano.
14 So to wrap this up, moving igneous
15 activity from closed pending to closed is going to
16 require substantial effort by the Department of
17 Energy. The reason is there are very few data, there
18 are limited analogs, and it's a complex physical
19 process. We also have the need for model validation
20 and alternative conceptual model requirements, and
21 these are things that are going to need to be done
22 before licensing.
23 Our current risk calculations
24 unfortunately do not capture these uncertainties in
25 the intrusive and extrusive event source terms for

1 these alternative flow paths and also for waste
2 incorporation. Also, we're not looking at the range
3 of uncertainty for long-term remobilization.
4 These uncertainties directly understand --
5 directly affect our understanding of risk to health
6 and safety, which is currently on order of a millirem
7 per year in terms of expected annual dose, the
8 probability weighted dose. DOE is going to need to
9 resolve these uncertainties before we get to the
10 license application stage, if that stage arises.
11 There is a little supplemental information
12 in your package about the links to sufficiency, and a
13 few more details of the technical work for this fiscal
14 year.
15 I'm sure you've got some questions for me.
16 CHAIRMAN HORNBERGER: Thanks, Brit.
17 Perhaps we could start with Ray's question. Do you --
18 as a -- your personal view as a scientist, do you see
19 any data that is absolutely essential to have that is
20 unlikely to be forthcoming in a short time period?
21 MR. HILL: I think the Department can meet
22 the technical needs to support its models by licensing
23 in all of these four areas in the time remaining.
24 CHAIRMAN HORNBERGER: Thank you.
25 John?

1 MEMBER GARRICK: You mentioned earlier
2 that it was very important to consider the post-magma
3 events with respect to things like seismicity, and
4 what have you. Now, that's not a combined load
5 situation. That's a sequential load kind of
6 situation.
7 MR. HILL: Yes.
8 MEMBER GARRICK: Doesn't that really
9 introduce some rather serious modeling challenges?
10 MR. HILL: I think we can abstract the
11 process to a very simple level. Part of this is going
12 to depend on the engineering results, but a lot of the
13 need right now is looking at the embrittlement that
14 would occur in C22 following an event, where the
15 impact toughness drops to a very low level. I think
16 it's on order of 10 foot pounds is the impact
17 toughness from an original approximately 250 foot
18 pounds impact toughness.
19 So even the sort of ambient seismicity,
20 the things magnitude four or so that would be part of
21 base case scenarios, could have a potential impact on
22 the canister performance quite significantly. So I
23 think we could look at a generalized model for --
24 given the amount of -- extent of magma flow given a
25 likely failure distribution, what would be subsequent

1 to the event, the risk significance of that sort of
2 canister failure, without having to get into a complex
3 mechanistic model.
4 We'll just start up -- you know, we run
5 for various times of the initiating event, run
6 seismicity with the appropriate failure fraction, and
7 see what the risk significance of that is. So I think
8 we can evaluate that quite easily.
9 MEMBER GARRICK: Yes. Now you mentioned
10 here on the consequence end of the scale, the risk
11 scale, that there is considerable work yet to be done
12 with respect to the uncertainties, the quantification
13 of uncertainties.
14 Now, on the probability side, I assume
15 that -- and I seem to recall that the uncertainty
16 analysis is -- has been done. Otherwise, you wouldn't
17 really be able to identify those numbers as true
18 means, because means have to come from a distribution
19 -- a distribution that would manifest uncertainties,
20 I assume.
21 One strategy that is often employed is to
22 not necessarily try to quantify the uncertainty in the
23 consequences but quantify it in the context of the
24 probability in terms of specifying a consequence and
25 asking the question, what is the likelihood of that

1 consequence occurring?

2 And I'm just asking what kind of strategy

3 might you employ here. Will you be identifying a

4 specific consequence and asking the question, what is

5 the likelihood of that consequence occurring? Or are

6 you really going to try to do an uncertainty analysis

7 of a range of consequences, for example?

8 MR. HILL: I think part of this comes down

9 to how we're going to treat alternative conceptual

10 models. And right now the cleanest way of looking at

11 this is evaluating them independently and not trying

12 to assign probabilities to alternative conceptual

13 models.

14 MEMBER GARRICK: Yes.

15 MR. HILL: I think it's a big enough

16 technical challenge just to find the consequence

17 events -- excuse me, the consequence model that we're

18 going to have to abstract and evaluate. Trying to

19 assign a probability for a range of different

20 consequence models I think is, in the time available,

21 would be extraordinarily difficult to accomplish.

22 MEMBER GARRICK: Yes, and that's why I

23 asked the question, because you indicate on there some

24 commentary about identifying the uncertainties.

25 MR. HILL: The way I'm looking at it is

1 the probability of an igneous event, either volcanic
2 or intrusive, impacting the proposed repository site.
3 And I think that's as far as we're going to be able to
4 get to probability in order of having a technically
5 defensible way of assigning probability is the -- if
6 you will the initiating event. I --
7 MEMBER GARRICK: Yes.
8 MR. HILL: -- realize we don't quite say
9 it that way. It's the initiating probability is about
10 all we can get to.
11 MEMBER GARRICK: Okay. That helps. Thank
12 you.
13 CHAIRMAN HORNBERGER: Raymond?
14 VICE CHAIRMAN WYMER: Yes. It looks like
15 this whole issue of the effects of a volcanic eruption
16 right in the vicinity of the waste repository is going
17 to be kind of a focal point of a lot of discussion and
18 a lot of dispute for the -- in the time of the license
19 application.
20 And also, the -- you're still trying to
21 zero in on the probabilities. And from your viewgraph
22 -- the probability of such an event. And from your
23 viewgraphs it looks like in the one extreme that the
24 dose that somebody might get is flirting with the
25 limit of the dose all by itself, without any other

1 contributors that would be tolerable from the
2 repository, given all that, then.
3 Is there any serious study, assuming that
4 maybe things will come out adversely, of the use of
5 backfill as an ameliorating mechanism for reducing the
6 effects of the volcanic eruption?
7 MR. HILL: That's certainly within the
8 Department of Energy's realm, to consider any design
9 option that they wanted to implement for --
10 VICE CHAIRMAN WYMER: The question is --
11 MR. HILL: -- potentially adverse impacts.
12 VICE CHAIRMAN WYMER: -- is there any
13 serious study being made of it?
14 MR. HILL: By us or the Department?
15 VICE CHAIRMAN WYMER: Anybody.
16 MR. HILL: I think the Department
17 seriously considered the effects of backfill in the
18 first round of the analysis model reports that we
19 received.
20 VICE CHAIRMAN WYMER: By considering --
21 MR. HILL: When they had a backfilled
22 repository design, and that the Rev 1 updates were
23 looking at the no backfill option.
24 VICE CHAIRMAN WYMER: I know when we were
25 down at the Center recently there was a fairly good

1 presentation on the potential effects of backfill.

2 MR. HILL: Right.

3 VICE CHAIRMAN WYMER: That you've done

4 down there. And I wondered if that sort of preempts

5 or supersedes or agrees with what DOE had done.

6 MR. HILL: Well, I think we look at --

7 we're evaluating what is the currently proposed

8 design. If that design changes, we'll evaluate the

9 impacts on that. But as we talked about in August,

10 clearly having backfill in the drifts would

11 significantly affect the ability of igneous magma to

12 flow down the drifts.

13 How far and the reduction in risk impact,

14 we don't know quantitatively, but it's logical to

15 assume it would ameliorate some of the adverse

16 affects.

17 Okay. So if we got to the scenario that

18 you were introducing of having a risk that could be

19 approaching a very uncomfortable number, then there

20 are mitigation strategies that could ameliorate some

21 of the igneous impacts.

22 VICE CHAIRMAN WYMER: And you are poised

23 to deal with DOE's efforts to ameliorate these --

24 MR. HILL: I think we have the ability to

25 respond to whatever design changes the Department

1 proposes.

2 CHAIRMAN HORNBERGER: Before going to

3 Milt, I just -- just a clarification. I believe that

4 the result that you reported, DOE's calculation of

5 about a millirem per year on that consequence, is an

6 all pathways analysis. It's not only volcanic

7 activity. It counts everything. It's a probability-

8 weighted dose, right?

9 MR. HILL: I believe it was portrayed as

10 just a disruptive igneous event and didn't really

11 consider the hydrologic impacts.

12 CHAIRMAN HORNBERGER: So that was just a

13 one off analysis, then. They didn't use their TSPA.

14 MR. HILL: It was essentially looking at

15 an increase in the volcanic source term. Say that

16 your volcano had an alternative flow pathway. And,

17 again, I want to emphasize the Department has not

18 agreed that that pathway would occur.

19 CHAIRMAN HORNBERGER: No, no, right.

20 MR. HILL: It's in response to the models

21 that we have put out there in the Bokhove and Woods

22 and Woods et al models as a scoping calculation.

23 CHAIRMAN HORNBERGER: Oh, okay. So that

24 was a scoping calculation.

25 MR. HILL: And if your source term for

volcanism --

CHAIRMAN HORNBERGER: I didn't understand that, then.

MR. HILL: -- incorporated that alternative pathway, it would give a probability-weighted dose with the Department's model on order of a millirem per year.

CHAIRMAN HORNBERGER: Okay. Thanks.

Milt?

MEMBER LEVENSON: Yes. You mentioned that there --

MEMBER GARRICK: Microphone.

MEMBER LEVENSON: Sorry. You know, both new boys and old men forget these things.

(Laughter.)

You mentioned that there is no natural analog, but we come close to having a manmade one called Chernobyl where a couple hundred tons of molten UO2 flowed across some floors. All of the models that I'm aware of, all of the computer analysis, all had predicted that that would just go right through there a la The China Syndrome, etcetera.

In reality, of course, none of it did. It flowed across the floors and poured down stairwells or other places that were existing openings. Do you know

1 whether DOE is looking at that type information? And
2 were -- as a follow up to that, it has been going on
3 almost continuously in Sweden at the Royal Institute
4 of Technology, on the matter of interaction between
5 things like molten UO2 and various materials, is
6 anybody following that?
7 MR. HILL: I'm not aware of any Department
8 of Energy investigations in looking at the flow
9 analogies for UO2 at Chernobyl. And I'm not aware of
10 any investigations we're looking at either.
11 MEMBER LEVENSON: The basic thing is that
12 the common wisdom at the time was wrong.
13 MR. HILL: Yes.
14 MEMBER LEVENSON: Are we using that same
15 common wisdom? is my question.
16 MR. HILL: Depends whose perspective of
17 common wisdom.
18 MEMBER LEVENSON: It's an unfair question,
19 because we're talking about what --
20 MR. HILL: Well, it depends on whose
21 common wisdom we're talking about here.
22 MEMBER LEVENSON: -- DOE is doing --
23 right, yes. Okay.
24 CHAIRMAN HORNBERGER: Thanks.
25 Latif?

1 MR. HAMDAN: Brit, of the consequences
2 that you went through in your presentation -- and
3 there are quite a few -- can you tell us how many of
4 those are already incorporated in one way or another
5 in the TSPA?
6 MR. HILL: In terms of consequences?
7 MR. HAMDAN: Yes, the consequences that
8 you went through. Are they incorporated in the TSPA
9 right now, or are they not?
10 MR. HILL: Do you mean the four areas that
11 we have agreements --
12 MR. HAMDAN: Yes.
13 MR. HILL: -- in?
14 MR. HAMDAN: Yes.
15 MR. HILL: Aspects of those already
16 incorporated.
17 MR. HAMDAN: Okay.
18 MR. HILL: For example, we currently
19 assume that waste packages fail when they're put into
20 a conduit. The Department makes the same assumption.
21 We recognize there is no mechanistic basis behind
22 that, and nobody has done a full-blown engineering
23 analysis to look at the impacts. But it's a
24 reasonable interpretation that's in the performance
25 assessment.

1 If new information comes out that shows
2 there is resiliency, we can modify that appropriately.
3 The same thing for waste incorporation. There is not
4 an efficiency factor for incorporation, because nobody
5 has proposed a technical basis for that. But it would
6 be a very simple way to incorporate that new
7 information into any of the performance assessments.
8 So the critical aspects are there, and we
9 can evaluate them.
10 MR. HAMDAN: So that's not going to be a
11 big -- it will not take too much time to modify the
12 code, or what have you, when we --
13 MR. HILL: I think most of this can be
14 evaluated with simple parameter distributions and some
15 code modifications we're doing right now in TPA5 for
16 remobilization. But the problem isn't in making the
17 code do what you want. It's to come up with a
18 technical basis that justifies why you're taking
19 80 percent credit for a certain process.
20 MR. HAMDAN: Thank you. Thanks.
21 CHAIRMAN HORNBERGER: Other questions?
22 John?
23 MR. LARKINS: Just a quick question. I
24 notice that you're going to do an FY2002 continued
25 remobilization modeling and parameter evaluation. How

1 sensitive is the -- those calculations to the
2 composition of the material that's deposited either
3 aerosol or other material from a volcanic event?
4 MR. HILL: The volcanic material doesn't
5 have any impact on dose. It's only the waste
6 incorporated in it.
7 MR. LARKINS: Yes. But what I meant is
8 the form of that material.
9 MR. HILL: Okay.
10 MR. LARKINS: Or the composition.
11 MR. HILL: I believe we're just assuming
12 the form is the standard or high-level waste form.
13 There has been no change to that waste form as part of
14 the process.
15 MR. LARKINS: No, to the chemical
16 composition.
17 MR. HILL: There has been no oxidation
18 effects, no other chemical reactions during
19 entrainment and transport.
20 CHAIRMAN HORNBERGER: But you do make an
21 assumption about particle size.
22 MR. HILL: We do make the assumption on
23 particle size.
24 MR. LARKINS: Yes. Well, I know it's
25 sensitive to particle size. I just -- also, it seems

1 like there may be some changes in oxidation, which may
2 increase or change the -- how soluble the material is
3 in terms of reentrainment.
4 MR. HILL: Well, the real -- the two
5 leading isotopes of concern are americium and
6 plutonium, and under the range of fairly rapid
7 transport from igneous we don't think there is much
8 instantaneous effect, if you will, from the minute to
9 hour of transport, because the igneous system itself
10 is very reducing.
11 It's only when you get atmospheric mixing
12 at temperature do you have any potential oxidation
13 effects. And we think those are fairly small for
14 americium and plutonium isotopes of concern.
15 Of course, for the overall waste form,
16 following the event, in the years following the event,
17 at the surface you certainly think that we'd have to
18 get a better handle on the kinetics of oxidation and
19 other sorts of chemical processes.
20 CHAIRMAN HORNBERGER: Milt?
21 MEMBER LEVENSON: Yes. You just mentioned
22 that the principal isotope is plutonium, americium, so
23 that must mean that the external dose is not the
24 primary aspect here. It's an inhaled dose?
25 MR. HILL: Correct. It's an inhalation

1 dose is 90 percent of the total dose.

2 MEMBER LEVENSON: Okay. Does your

3 calculations for resuspension and the inhaled dose,

4 etcetera, include the mass of everything there? The

5 context of my question is some years ago an analysis

6 of -- near Rocky Flats of a motorcyclist driving

7 around contaminated soil and steering up a cloud

8 indicated that in order for him to have gotten maximum

9 allowable dose his lungs would have contained between

10 two and three pounds of dirt, and the dose was

11 insignificant in health effects.

12 MR. HILL: Right. We --

13 MEMBER LEVENSON: Is such an analysis

14 being done here? Are you including the mass of the

15 carrier when you calculate inhalation?

16 MR. HILL: The answer is directly no.

17 It's not explicitly put in there, but we have done

18 scoping calculations to show that the amount of mass

19 per year per lung for total particulate -- it's not

20 just respirable particulate, but the total suspended

21 particulate -- is small compared to what the lung and

22 tracheal/bronchiole system can absorb.

23 So we're not talking about putting two

24 pounds of dirt into somebody's lungs in an unrealistic

25 sort of inhalation model. The concentrations we're

1 using on average are one milligram per cubic meter of
2 total suspended particulate. And of that there is a
3 much lower concentration of high-level waste.
4 MEMBER LEVENSON: Well, you know, I come
5 back to my -- one of my pet hangups. If your code
6 doesn't contain conservation of mass, I don't know how
7 you -- if you're distributing this plutonium over
8 hundreds and thousands of tons of magma --
9 MR. HILL: Yes.
10 MEMBER LEVENSON: -- how you get
11 significant amounts in somebody's lungs without having
12 massive amounts of magma.
13 MR. HILL: Well, it comes down to the dose
14 conversion factors that are being used and the
15 efficiency. This is why we're backed down for a lot
16 of this being from the inhalation dose, because of the
17 dose conversion factors that are being used for
18 americium and plutonium for inhalation dose.
19 You do not need a large mass of high-level
20 waste to effect those levels of total effective dose
21 equivalent impact.
22 MEMBER LEVENSON: Well, you don't need a
23 big mass of spent fuel, but -- but it's -- well, I
24 guess it comes down to your assumptions about how much
25 dilution occurs.

MR. HILL: I'm not positive if you want to talk about a mass or a particle number basis, but I believe we're talking 10^{-2} grams per square centimeter for ash loading and about 10^{-6} grams per square centimeter of waste loading. So about a four order of magnitude ratio between the mass of ash and the mass of waste at 18 kilometers.

MEMBER LEVENSON: Okay.

MR. HILL: I could be corrected --

MEMBER LEVENSON: What was the ratio of plutonium to magma in your masses?

MR. HILL: Plutonium or --

MEMBER LEVENSON: Of fuel.

MR. HILL: -- of all waste, of high-level waste.

MEMBER LEVENSON: Yes.

MR. HILL: The waste form.

MEMBER LEVENSON: Yes.

MR. HILL: Is about four orders of magnitude smaller, off the top of my head, and a number that should be checked. I'm trying to go from what I remember from the TPA outputs on aerial loading at 18 kilometers.

MEMBER LEVENSON: Okay. So for the plutonium it's maybe six orders of magnitude.

1 MR. HILL: I believe somebody who knows
2 the inventory better than I do would put that --
3 MEMBER LEVENSON: Yes.
4 CHAIRMAN HORNBERGER: Tim?
5 MR. McCARTIN: Yes. If I could just --
6 Tim McCartin, NRC staff. We do conserve mass with
7 this calculation, and there is an explicit amount of
8 ash and radionuclides at specific locations, and it is
9 accounted for. But I can assure you it is -- you
10 know, what Brit's referring to, there isn't an --
11 there aren't some explicit numbers you'll see in the
12 output of the code, but in -- within the code it is
13 determining how much mass is getting there.
14 We keep track of it. There is a dilution
15 mechanism of the radionuclides getting mixed into the
16 soil to a certain depth, how much of that is ash, how
17 much is radionuclides, and a certain percentage of the
18 overall dust in the air is comprised by looking at how
19 much of the stuff there, let's say in the top 15
20 centimeters, which I'll just throw out -- I don't know
21 the exact number -- is radionuclides.
22 But we do -- it is -- there is an
23 accounting for that, but it --
24 MEMBER LEVENSON: In your analysis.
25 MR. McCARTIN: Yes.

1 MEMBER LEVENSON: Okay. So --

2 CHAIRMAN HORNBERGER: I think we should

3 move on. I mean, I think that we can explore this

4 further. As Brit says, we could check the numbers,

5 but the question has been posed. Any other --

6 remaining issues? Okay. If not, let's move on.

7 Thanks, Brit.

8 Our next presentation is on structural

9 deformation and seismicity.

10 John, you can introduce yourself, so I

11 don't mispronounce your last name.

12 (Whereupon, there was a long pause while

13 the next set of slides were being set

14 up.)

15 CHAIRMAN HORNBERGER: So what happened?

16 Did we have an earthquake that wiped out this

17 presentation on the computer?

18 (Laughter.)

19 MR. STAMATAKOS: It wants to start halfway

20 through, wants me to be done quicker.

21 CHAIRMAN HORNBERGER: Well, we don't mind

22 that.

23 (Laughter.)

24 MR. STAMATAKOS: Won't let me get to the

25 introduction.

1 I'll go to Plan B.

2 CHAIRMAN HORNBERGER: Plan B.

3 (Laughter.)

4 MR. STAMATAKOS: Okay. Okay. How's that?

5 My name is John Stamatakos, pronounced

6 originally Stahmatacos (phonetic), so you had many

7 options.

8 (Laughter.)

9 You had many, many choices that you could

10 have -- I'm going to talk about structural deformation

11 and seismicity. And I'm going to apologize from the

12 outset in that in my haste, even though I was told to

13 do it, I forgot to include an outline slide, although

14 my outline follows very closely with what everybody

15 else has done.

16 The other point I would just make in terms

17 of introduction of this particular subissue is

18 recognition that of all of the KTIs I think we're the

19 -- one of the ones that could be considered most

20 upstream. A lot of the things we do really feed into

21 a lot of the other issues in terms of the description

22 of the site and site characterization. So at times

23 it's actually most difficult for us to sometimes see

24 how what we do ultimately comes out in a risk

25 calculation.

1 Also, I think you'll see that a lot of the
2 work that we're doing now is really well integrated
3 with many of the other KTIs, not just in issues that
4 were originally identified under structural
5 deformation and seismicity.
6 And, finally, I think a lot of what we do
7 contributes directly to pre-closure, so there are some
8 instances where I'm going to talk a little bit about
9 how the work that we do relates to pre-closure.
10 In the SDS KTI we had four subissues that
11 were originally identified -- tectonics, faulting,
12 seismicity, and fractures. I've lumped the faulting
13 and seismicity together because they contain many very
14 similar agreement items. The first of our issues is
15 closed, and tectonics -- it has been closed for -- for
16 some time now.
17 In faulting and seismicity, we have a
18 small number of agreement items. Most of them I would
19 classify as minor. Some of them are moderate and have
20 the potential to be more significant, depending on the
21 outcome of the agreements.
22 Of all of the remaining subissues that we
23 have, the fracturing and structural framework one is
24 the one that is directing most of our attention now,
25 and that one is one where we think most of the

1 remaining work needs to be done by the Department of
2 Energy.
3 So I'm going to go through them in stages.
4 I'll first talk about seismicity and faulting. I've
5 prepared my organization in a way of first trying to
6 identify what the risk is, looking at a DOE approach,
7 and then where the status is. I'll follow these with
8 slides that give some specific information about the
9 things that we need to do and the things that we think
10 DOE needs to do to reach closed status on the
11 subissue.
12 The risk for seismicity and faulting
13 mainly has to do with the degradation of the
14 engineered system, damage to waste packages, damage to
15 the drifts themselves. Up until probably last fall,
16 the DOE approach has been to screen these disruptive
17 events by looking at or promising to develop a robust
18 enough design so that any impacts would be able to be
19 handled by the design of the waste packages and the
20 repository.
21 So we didn't have a direct link in TSPA in
22 that way, because everything was evaluated as
23 something that was essentially screened out of the
24 TSPA. In answering our questions from the technical
25 exchange and in our agreements, DOE now proposed to us

1 in a letter that was sent in October to do an
2 alternative approach to looking at specifically
3 seismicity, and that is that they now propose to do a
4 full sort of seismic risk assessment in order to
5 quantify inputs that they're going to incorporate in
6 TSPA-LA.
7 We've only seen the plans for that. We
8 haven't seen exactly how they're going to implement
9 that, but that's a pretty significant change in the
10 approach, I think pretty significant change in the
11 approach that they have in looking at seismicity issue
12 for -- for post-closure.
13 So in terms of status of the -- we had six
14 agreement items that were outstanding with DOE, plus
15 some additional items that are integrated with the
16 other KTIs -- pre-closure, RDTME, and some of the flow
17 issues. It looks to me like this new DOE approach, if
18 it's what it says it is, may satisfy many of the
19 agreements in seismicity and faulting.
20 What DOE needs to do prior to LA is most
21 importantly we need now to see the details of how they
22 propose to do their seismic risk approach. They say
23 it's a sort of standard type of seismic risk approach,
24 just propagated out to the large time period. So I
25 think that will be the biggest challenge is, how do

1 you take -- how do you do that kind of an assessment
2 for a 10,000 year repository?
3 One of the other issues that I think has
4 the potential for some effort on DOE's part is that we
5 have some questions about their -- when they did their
6 seismic hazard calculations, they did it as an expert
7 elicitation. During that elicitation, we've raised
8 some questions about the procedures that were used,
9 particularly one component of the expert elicitation.
10 And we're asking for some documentation,
11 and we have some ongoing discussions with DOE on
12 whether or not that documentation exists or what form
13 of documentation would be required to sort of satisfy
14 the completeness of their expert elicitation process.
15 CHAIRMAN HORNBERGER: John, could you just
16 say a couple words about why it's a challenge to do
17 this for 10,000 years? It seems to me it should be
18 straightforward?
19 MR. STAMATAKOS: Well, I think the trick
20 part has to be in coming up with fragility estimates
21 for components out in the -- not the seismic part.
22 The seismic part -- you've got to involve it with the
23 fragility to come up with the risk.
24 And then a large part of what's left in
25 the seismic has to do with site-specific information,

1 and this really relates to pre-closure and surface
2 design questions more than post-closure. But DOE has
3 collected information, but we don't yet have all of
4 the information for developing a site response model
5 and all of the things that come with that to develop
6 design ground motions that will be inputs for the --
7 MR. LARKINS: Quick question on the expert
8 elicitation.
9 MR. STAMATAKOS: Yes.
10 MR. LARKINS: Is there a standard or
11 something that you're using for --
12 MR. STAMATAKOS: Yes, there's an NRC NUREG
13 that they agreed to follow, plus their own
14 documentation that they agreed to follow in -- in
15 conducting and documenting --
16 MR. LARKINS: And that's where the
17 difference is.
18 MR. STAMATAKOS: That's part of where the
19 differences are. There's kind of an interesting twist
20 to that, because where we see the differences actually
21 leads to potentially some of the ground motion experts
22 having inputs into the process that led to what we
23 might characterize as very large ground motion.
24 So when you look at the -- this is the
25 seismic hazard curve for Yucca Mountain, and the

1 ground motions at the low probabilities is 10^{-6} here,
2 10^{-7}. I don't even have the -- extrapolate 10^{-8}. So
3 ground motions are quite large and the uncertainties
4 are quite large.
5 And so there's sort of an interesting
6 twist in the sense that, you know, what's come out of
7 the ground motion part are some of these very large
8 uncertainties that lead to very large ground motions.
9 And I think it speaks to the questions about, you
10 know, where they may be potential very large
11 overconservatisms in the analysis.
12 What we need to do prior to LA, most
13 importantly I think is we need to -- our continued
14 interactions with DOE. We're very anxious now to see
15 what their new approach is going to entail. We would
16 like to meet with DOE, and DOE just yesterday or day
17 before yesterday sent us some documentation on
18 proposals to resolve our expert elicitation questions.
19 We're working on developing some
20 additional technical bases to help evaluate the DOE
21 ground motion results, and we'd like to continue to
22 work on that.
23 The last two items really pertain to
24 issues more in line with pre-closure. DOE is going to
25 provide information in what's going to be called

1 Topical Report 3 with a companion seismic design input
2 report, and those reports will summarize the
3 information that we need for the site-specific
4 information that will get us from the generic hazard
5 curve to the design basis inputs that will be used for
6 the pre-closure design issues.
7 The other subissue that we're looking at
8 has to do with fractures, and this is a much broader
9 issue and is very diversely integrated with lots of
10 the other KTIs.
11 Basically, we recognize that fractures and
12 faults and other parts of the geologic setting control
13 many aspects of groundwater flow, and also those
14 features are very important in developing accurate
15 pictures of the rock mass properties that are used for
16 modeling in rock fall calculations or drift stability,
17 things like that.
18 The DOE approach is sort of two-fold. For
19 their flow calculations, DOE mainly relies on bounding
20 assumptions or modeling results to constrain the
21 fracture properties. And so our work has mainly been
22 trying to see how -- sort of validate those modeling
23 procedures against what the fracture information and
24 characterization tells us on the site.
25 For the rock fall analyses, DOE is using

1 direct measurements that they got from the ESF and the
2 ECRB, but we have some questions about the
3 applicability of that data directly, and so we've
4 raised some questions related to how that data is
5 used.
6 But it's been the process of sort of an
7 active, ongoing interaction between DOE and ourselves.
8 We have about four agreements with DOE, plus, as I
9 said, some other additional agreements that are
10 integrated with the other KTIs. DOE is considering
11 some of our responses, and we're currently considering
12 some of their responses. So we are involved in an
13 active discussion of this particular issue.
14 In particular, some specific things that
15 DOE needs to provide us is the -- a response to a
16 review that we had of one of their major documents on
17 fractures. This is sort of the focal point of a lot
18 of the discussion about the fracture database and the
19 fracture characterization.
20 And in addition to that, there are some
21 things that DOE has to do that we're working on but
22 are really related to items that -- from the
23 unsaturated flow KTI and from the NT KTI. These have
24 to do with characterization of the stratigraphy and
25 sedimentology in the alluvium and valley fill portion

1 of Yucca Mountain as that relates to flow models.

2 And we've been working on the issue

3 related to the potential for hydrothermal activity,

4 the whole fluid inclusion debate. We've done some

5 independent studies related to that as well.

6 What we plan to do before LA is to

7 continue to establish our technical basis for

8 identifying which parts of the fracture database are

9 really critical to performance and which ones aren't,

10 and that's a highly integrated effort with a lot of

11 the other KTIs.

12 We're working on developing some

13 independent stratigraphy and stratigraphic studies

14 that we can use to help the flow people in the

15 alluvial part of the aquifer. We've done a lot of

16 work on the fluid inclusion work, and we're about

17 ready to submit a paper of our own independent

18 evaluation of some of the secondary mineralization as

19 it relates to this hydrothermal question in the ESF

20 and ECRB.

21 CHAIRMAN HORNBERGER: Can you tell me the

22 bottom line of your analysis of the fluid inclusions?

23 MR. STAMATAKOS: I think the bottom line

24 of fluid inclusions is that there are still a lot of

25 contradictory interpretations of those results. I

1 think ultimately what we would argue, along with I
2 think probably what the -- parts of the GS would say,
3 is that we think that a lot of the evidence for that
4 is that they are quite old and not modern.
5 We don't necessarily agree with some of
6 the interpretations of the sort of long-term heating
7 that led to some of the younger ages in the fluid
8 inclusion studies, but it's still a very I think
9 technically challenging issue.
10 One of the things that I would point out
11 is in terms of potential developments, it has to do
12 with modifications that might come about in the
13 design, or in this case if DOE proposes an alternative
14 operational mode in which there are other parts of the
15 repository that are their proposed use rather than the
16 original primary block.
17 We've done some work to evaluate what
18 significance that might have on characterization, and
19 what we would say is that there is the potential that
20 -- for a significant amount of additional work, or at
21 least some work on DOE's part to how they would
22 provide a technical basis to justify the applicability
23 of existing characterizations of the details in this
24 particular part of the repository to other elements of
25 the repository.

1 So in 2001, a summary of some of our work
2 and accomplishments. Obviously, we've done a lot of
3 work trying to continue our discussions with DOE on
4 our -- all of our agreement items. We've worked on
5 developing some technical assessments for that
6 potential alternative load -- thermal load option in
7 the repository design.
8 We've completed some work on issues
9 related to some of the other KTIs. In particular,
10 we've done a lot of work on looking at the issues
11 related to hydrology in the alluvial part and these
12 fluid inclusion questions.
13 In FY2002, we're going to continue much of
14 that work, although we are now focusing more and more
15 on looking at how the site characterization relates to
16 pre-closure safety as well. We're going to continue
17 to work with the other KTIs on issues related to their
18 agreements.
19 We certainly want to try to continue to
20 understand how aspects of faults and fractures are
21 most important to performance, and we're going to
22 continue to work on issues related to the seismic
23 hazard, both as they relate to pre-closure and post-
24 closure.
25 So, in summary, I would say that for SDS

1 we've reached a significant amount of progress. Our
2 tectonics subissue has been closed. It is closed for
3 some time. We see substantial progress on many of our
4 agreements related to faulting and seismicity. Most
5 of our remaining work is going to be related to the
6 fracture characterization and how those fractures and
7 faults -- what role they play in both groundwater flow
8 and in repository design and drift stability
9 calculations, how that integrates with the other KTIs.
10 So, in summary, I'd say that our work is
11 highly integrated with much of the agreements reached
12 in the other -- on the other KTIs.
13 And with that, I hopefully got us back on
14 schedule, and I'll take your questions.
15 CHAIRMAN HORNBERGER: Thank you, John.
16 Milt? No? Ray?
17 VICE CHAIRMAN WYMER: Yes. You've already
18 touched pretty heavily on something I'm going to ask,
19 but I'm going to ask it in -- the question in slightly
20 a different way than you have dealt with it in your
21 viewgraphs. And it relates to how sensitive are the
22 results that you obtain with respect to detailed
23 knowledge of the site characteristics?
24 MR. STAMATAKOS: Which results?
25 VICE CHAIRMAN WYMER: The calculations of

1 the --

2 MR. STAMATAKOS: Of ground motion?

3 VICE CHAIRMAN WYMER: Yes, and of the

4 impact of this on the ultimate dose.

5 MR. STAMATAKOS: Well, that's a hard

6 question to answer because the -- the approach that's

7 been taken over the last several years has been one in

8 which the seismic hazard has been sort of an input

9 into design decisions to say we will maintain waste

10 packages and drip shields, so that they can withstand

11 any rock fall size that the repository can deliver

12 during any size earthquake. So in a sense they've

13 just become sort of a benchmark.

14 VICE CHAIRMAN WYMER: So what you really

15 said is all of this work is meaningless.

16 MR. STAMATAKOS: Well, I don't think that

17 it's meaningless. I think the new approach is going

18 to be -- is going to be able to directly answer your

19 question in the sense that now what DOE proposes to do

20 is to actually incorporate the seismic results

21 directly in a TSPA-type calculation.

22 VICE CHAIRMAN WYMER: You're going to

23 challenge the statement that everything is designed so

24 that it won't make any difference?

25 MR. STAMATAKOS: Well, their response to

1 some of our questions is now -- is that instead of the
2 approach that it won't make difference, they're going
3 to incorporate it into a sort of risk-type calculation
4 by doing this seismic risk approach.
5 VICE CHAIRMAN WYMER: Is the site well
6 enough characterized to do everything you need to do?
7 MR. STAMATAKOS: In terms of seismicity?
8 VICE CHAIRMAN WYMER: Yes.
9 MR. STAMATAKOS: I think so. We haven't
10 seen the final specifics. You know, we have a generic
11 -- that hazard curve I showed you is a generic hazard
12 curve for some hypothetical site, and what we have to
13 now do is propagate that seismic energy through the
14 soil and rock column to the surface and do those kinds
15 of calculations.
16 But I think in terms of the overall
17 seismic hazard results, yes, I think that the DOE is
18 well characterized, minus that one question about --
19 VICE CHAIRMAN WYMER: Extending the site?
20 MR. STAMATAKOS: -- the ground motion and
21 extending the site, yes.
22 And in answer to your generic question, I
23 think that in terms of our KTI we're well on the way
24 to being able to have almost or nearly everything that
25 we need well before license. I don't see any reason

1 why all of the information won't be available for --
2 before licensing.
3 CHAIRMAN HORNBERGER: John?
4 MEMBER GARRICK: Well, that was going to
5 be my question. Most of the other speakers -- I guess
6 all of them have expressed considerable optimism that
7 the path forward is pretty optimistic relative to
8 resolution of the agreements. So I assume you feel
9 the same way?
10 MR. STAMATAKOS: Yes. Yes.
11 CHAIRMAN HORNBERGER: We haven't heard
12 from --
13 MEMBER GARRICK: Well, that's right.
14 Okay. No, that's all.
15 CHAIRMAN HORNBERGER: John, I have a quick
16 question. I know that -- let's see, the DOE saturated
17 zone model uses, if I recall correctly, a fracture
18 spacing on the order of 20 meters or something on
19 average. Do you think that's about right?
20 MR. STAMATAKOS: It may be right in that
21 ultimate abstraction, but the -- what we've found in
22 our fracture studies -- and my fracture guy is not
23 here, so I'm going to reach a little bit -- but is
24 that -- that the -- it's much less uniform and
25 homogeneous than that.

1 So that fracture spacing may be correct
2 only on a small scale, and there are clusters of
3 fractures that -- of large fractures that occur very
4 close together, and there are areas that are not
5 nearly as heavily fractured. So it's much more
6 heterogeneous than that, but we don't -- I don't -- I
7 can't answer whether or not that heterogeneity
8 ultimately plays a significant role.
9 On the large scale of the saturated zone,
10 we know that the large faults certainly play a role in
11 the flow path, and that the flow is not just
12 controlled by the surface of the water table, but that
13 there is an anti-satrapy that's induced and -- by the
14 faults or fractures, and DOE has now incorporated that
15 into their saturated zone flow water.
16 CHAIRMAN HORNBERGER: Phil?
17 MR. JUSTICE: Phil Justice, NRC staff.
18 DOE doesn't use a single fracture spacing in all of
19 its flow or transport models where fractures are
20 needed. And 20 meters, I haven't seen that one in a
21 while.
22 In the ECRB testing of facilities, for
23 example, such as alcove 8, niche 3 test, the spacing
24 in the middle non-lithologic -- lithoficile unit
25 that's being used is on the order of roughly 1.3

1 meters.

2 The question to us is not so much the
3 number, but the representativeness of the source of
4 data that allowed that generalization, and whether
5 that generalization for the particular test or portion
6 of the repository being evaluated is representative of
7 the entire repository system of interest.

8 CHAIRMAN HORNBERGER: Thanks.

9 Thanks very much, John.

10 MR. STAMATAKOS: Sure.

11 CHAIRMAN HORNBERGER: We have a
12 substitution, according to -- or a modification in the
13 original agenda, and I think Gustavo is going to go
14 next and talk about container life and source term.

15 MR. CRAGNOLINO: Okay. Good morning. My
16 name is Gustavo Cragnolino, and this is all of the
17 people that have made this presentation possible. And
18 I want to emphasize the name of our project element
19 manager at NRC, Tae Ahn.

20 My outline is, as you have seen before,
21 similar to the previous presentation, and I want to
22 emphasize this. And I am going to go directly to the
23 status of the CLST subissue resolution. The several
24 subissues, six in our case, are listed here. The
25 first one is effects of corrosion processes on the

1 lifetime of containers, and, as the other one, is
2 closed pending.
3 You can cover additional detail in the
4 last of my backup slides, what was presented before by
5 Brit, in terms of the scope of the CLST, the type --
6 the nature of the agreement with the DOE and what is
7 expected. And I'm not going to go into detail of
8 that.
9 Let me go to the main point that you are
10 interested to know about our view regarding what DOE
11 needs to provide before LA. And this is not only
12 analyzed in terms of specific subissues, but the text
13 in blue indicates precisely the main scope of the
14 subissues.
15 And this is relating particularly to the
16 case of subissue 2 and is what we consider the -- it's
17 necessary for part of the DOE event evaluation of
18 premature waste package failure, because this has an
19 important impact essentially in the problem of
20 criticality, in-package criticality, and we need a
21 reassessment of the probability of early failure
22 arising from an effectual defect, and, in particular,
23 closure welding and post-welding operations.
24 However, the subissue where we have a
25 special concern is what is reflected in subissue

1 number 1, and what we need is a better technical basis
2 to resolve uncertainty in container life prediction.
3 And the point -- and I'm not reflecting exactly the
4 agreement. There are 17 agreements here, but I'm
5 focusing on what are the important ones because seven
6 of the agreements are subsidiaries to this.
7 And one is the definition of the aqueous
8 environment in contact with the waste package, and
9 this is an issue that Bobby Pabalan is going to deal
10 with.
11 What we have is -- providing alternative
12 measure for passive corrosion rates. Data and
13 modeling support to establish that you have really
14 long-term stability of the passive film, because this
15 is the main issue in which you would like to have
16 long-term container life.
17 Here is an issue that in some way is an
18 answer to the question which arose before regarding
19 something that has scientific relevance and is in the
20 study of this. We think that the repassivation
21 potential is the basic criteria for the decision if
22 you have a container that is susceptible or not for
23 localized corrosion.
24 By that other point of view, in the
25 scientific community, in the corrosion community, and

1 this discussion -- and DOE favors this type of
2 context. This is an issue that has to be resolved.
3 And they are dealing -- but we need a more technically
4 accepted criteria for the selection of their
5 initiation potential for localized corrosion.
6 And this is very important, because we can
7 talk in theory about the behavior of the material, but
8 when you start to fabricate a container you have
9 potential problems related to welding, post-welding,
10 and this is important on corrosion and stress
11 corrosion cracking.
12 And to illustrate the point, this is
13 experimental data showing that this repassivation
14 potential has some sort of threshold potential for the
15 initiation of localized corrosion in our criteria,
16 because it's a lower bond, decreased significantly is
17 the material, alloy 22, and this solution is heat-
18 treated at 870 degrees Celsius for only five minutes.
19 And this is something that would happen
20 during the processing, with the slow cooling from the
21 annealing temperature, the fabrication of post-welding
22 treatment. Therefore, if you have corrosion potential
23 values in this range you have the potential for the
24 localized corrosion of the container material.
25 Defective welding appeared to be less

1 pronounced, but we need additional data in which the
2 defective welding plus this type of treatment is
3 evaluated. And this is a matter of concern, and this
4 is something that we expect that we've solved.
5 For the other subissues, -- we need a
6 better estimation of the rate of radinuclides released
7 from the waste, but this is essentially related and
8 focused on what is the definition of the in-package
9 aqueous environment. And what is the impact of this
10 environment of corrosion or stress corrosion cracking
11 because, as you know, DOE put a lot of emphasis and
12 gave a lot of credit to the container.
13 Finally, this is an issue that concerns
14 us, too, because it has to do with the role of the
15 titanium drip shield, and we believe that DOE should
16 provide more data on stress corrosion cracking
17 testing, technical basis for the choice of the
18 hydrogen pickup fraction, and also justification for
19 this value that they have adopted.
20 They can move from 400 ppl to 1,000. I
21 think that they are moving in the right direction, but
22 not with this quote, because this could have an impact
23 in the evaluation as has been shown very clear in this
24 figure.
25 A slight increase in the fluoride

1 concentration to 10^{-3}, increased the anodic current
2 density, and, therefore, the corrosion rate by three
3 orders of magnitude, and this rate, obviously,
4 significantly reduces the lifetime of the drip shield
5 and was, even if you have sulfate and nitrate or
6 nitrate plus sulfate, you cannot inhibit the
7 detrimental effect of fluoride.
8 And this is a point of concern that DOE
9 will need to progress.
10 What we should do to go and move ahead in
11 this path flow, and try to find resolution of these
12 issues that I mentioned. What I am talking about is
13 that we should very closely monitor the DOE progress,
14 because it is all viewed as a risk progress, and this
15 has to be very clearly emphasized.
16 They say that movement in the right
17 direction from the part of the DOE, and we need to
18 review and respond to the revised AMRs and the dated
19 information.
20 And although this is a mechanism that we
21 find more appropriate, this is related to what I
22 mentioned before regarding the importance of
23 publication process, and virtually any change in the
24 design, and we have to be prepared to assess.
25 And this is a range of uncertainty because

1 even though everything looks fine, we can have
2 surprises. Obviously, we need to do in order to be
3 able to tackle what is shown before now with an
4 independent evaluation of issues and we will focus
5 experimental program and the model program.
6 And this is the approach, and I don't need
7 to insist, but we have two other areas; uncertainly
8 that still exists in the environment, and the site and
9 component fabrication, material procurement, closure
10 welding and post-welding treatments. And I forget to
11 say that you can interrupt me at any time to ask
12 questions.
13 When we come down and what we have done in
14 this previous year, and we prepared Revision 3 of the
15 CLST IRSR, and that was the basis of our input to the
16 Revision 0 of the Integrated IRSR, and essentially in
17 the area of engineering environment, and where we
18 provide input also to other of the different type of
19 model areas of the differing -- presented by breaking
20 -- regarding engineering, too, that is degradation by
21 mechanical disruption, or the ones related to the
22 direct contact of the radioactive ash as a result of
23 organic eruption.
24 But participating in several technical
25 change, and this is what we have been doing all this

1 time through different types of reports and
2 publication and addressing pending issues on corrosion
3 of Alloy 22, and Titanium Grade 7, with the purpose of
4 evaluating the accuracy of the DOE data, and the
5 methodology for predicting early failures.
6 And we have been trying to follow very
7 closely any advances that have been done in the
8 evaluation of the source model, and this is a
9 secondary activity, but also was important for us to
10 support the evaluation of in-package criticality for
11 Navy spent fuel.
12 Finally, this is something that we have
13 paid attention to, and something that we have been
14 pushing forward because we consider the assessment of
15 the approach and the methodology for waste package,
16 and engineering barriers performance confirmation is
17 something that has to be kept in mind for the
18 evolution of this program.
19 We initiated a effort culminating, and
20 very soon we are going to have a report for the
21 evolution of natural industrial analog for Alloy 22,
22 and obviously we would like to support as much as
23 possible you, and the Nuclear Waste Chemical Review
24 Board, and participating in several meetings.
25 This will be our work plan for 2002. It

1 is important to conduct our independent evaluation of
2 the DOE status and follow all the information that we
3 will receive, and we will provide input for the model
4 abstractions of TPA Version 5.0 in our two related
5 modules for EBSFAIL and EBSREL release.
6 And as I mentioned before, we have
7 completed practically this, and continued activities
8 related to performance confirmation. Now, this is
9 what I wanted to call your special attention to.
10 We believe that the activities of the DOE
11 in order to obtain resolution of the issue has a broad
12 scope, and that in some ways is good, but there is not
13 clear prioritization.
14 And this is not our own words. This is
15 one of the reasons why the waste package proponent was
16 called by the DOE, and to help them to define the
17 product decision of the work.
18 And to follow in some cases a very
19 aggressive schedule, and may not have sufficient
20 resources. It is not my problem, the resources, and
21 I can't throw away the last one, but I give you
22 something to think about.
23 An evaluation of the radionuclide release
24 continued to be affected by significant uncertainties
25 in the definition of the aqueous environments, but

there is important progress there.

Finally, after many years the focus is very clear and we expect to have more research. These affect corrosion of the waste package and drift shield.

By the way, in the black and white copies that I have drift instead of drip, and I clarify that, and knowing the design, I don't want to cover a drift with a shield, and maybe wood, but I would not want to do it.

And this is a problem for radionuclide release because the cladding corrosion is still an issue. And DOE knows this very well. This is an important point.

If you look in the SSPA, there are significant modifications in the model abstraction, but they base it in very insufficient data, and this is where we have to be concerned.

If there is a modification that has an implication for a substantive reduction in the dose because it is less concerned about drip, but has no basis. And I don't want to dwell on the example, but I can give it if you want.

And this is what we need in terms of performance confirmation. We think that this is an

1 integral part of the program, and can be considered of
2 something to be done in the future, because
3 performance confirmation planning is integral to
4 design. And this is experience in any important and
5 significant industry that has had failures.
6 In summary, performance estimates are
7 affected by uncertainty in container life predictions,
8 including effects of fabrication and welding. This is
9 very important.
10 And a good evaluation of premature waste
11 package failure, and always as we mentioned before, we
12 have some uncertainty in the package embridlement that
13 has to be solved, and the drip shield case.
14 And I think from our part that active
15 monitoring of DOE progress, and I emphasize again
16 there are clear progress in the resolution of
17 agreements is needed to close all the pending
18 subissues at the time of the proposed license
19 application. And this finishes my presentation, and
20 I am open to any questions.
21 CHAIRMAN HORNBERGER: Thank you very much,
22 Gustavo. Raymond, do you want to start?
23 VICE CHAIRMAN WYMER: What I am going to
24 ask you, you have included by implication, Gustavo,
25 but you have not addressed it exclusively. A big deal

1 in recent years has been the effect of trace
2 impurities, such as lead, mercury, and things like
3 this.
4 What have you come up with recently, or
5 what are you planning to do, or where do you stand on
6 it?
7 MR. CRAGNOLINO: Well, we are exploring
8 these. We had difficulties in the study, for
9 instance, and one impurity that has been claimed that
10 is very important, and that is lead, to obtain
11 reproducible conditions to do these experiments.
12 And the preliminary work that we have done
13 up until now doesn't indicate a potential risk unless
14 you have extraordinarily high concentration of leads.
15 It is preliminary, but this is what we
16 think. I think we have to look more in the range of
17 comparison of environment that DOE is exploring now,
18 and going beyond the famous or infamous high
19 concentrations type of environment, and looking to the
20 variation that tends to go to the alkaline side or a
21 little bit to the acidic side.
22 But we are looking at the effect of trace
23 impurities, but my opinion, and the opinion that we
24 have, is that we are going to continue looking for
25 that mostly important period to be before. And this

1 is our preliminary type of conclusion.

2 VICE CHAIRMAN WYMER: Okay. I have one

3 additional question. On your next to the last view-

4 graph, you say prior experience with sensors and

5 monitoring devices in further or in other applications

6 reveals an extensive development and prolonged periods

7 of testing and verification, perhaps for many years,

8 are necessary.

9 Just how troublesome will that be with

10 respect to approving a license application?

11 MR. CRAGNOLINO: Well, it is not

12 troubling, but for the time of the license as a part

13 of Part 63, it is very clear that there has to be a

14 plan, a performance confirmation plan, and this plan

15 cannot be a series of generalities.

16 It should include provisions for these

17 types of issues, because this is an indication that

18 any type of potential problem that arises, there is

19 the advice or the sense of an approach to take over

20 and resolve the problem, or at least the possibility

21 to attack the problem.

22 And for this reason, it is not necessary

23 for us to be completely solved at the time of the

24 license, but you know there has to be a plan, and

25 there has to be a clear indication -- as a part of

1 this program, and certain experience in this type of
2 sense.
3 VICE CHAIRMAN WYMER: Well, if those
4 periods are necessary, and then the carrying out of
5 those extensive tests, to discover that the
6 performance that was assumed isn't there, that is bad
7 news isn't it?
8 MR. CRAGNOLINO: I guess so.
9 CHAIRMAN HORNBERGER: This is Tae Ahn of
10 NRC staff. I believe we have a dual purpose for
11 pursuing these types of testings. One is as Gustavo
12 stated, to be prepared to evaluate DOE's confirmation
13 plan in the licensing application.
14 They will attach the performance
15 confirmation plan. That is one purpose. The other
16 purpose is these tests will validate to a certain
17 extent the elaborate testing that we are conducting
18 right now. Most of these were being done on the
19 capacity condition with rock block and so forth.
20 And so we probably have two different
21 purposes for doing this type of testing.
22 VICE CHAIRMAN WYMER: So the implication
23 is that by the time of the license application, you
24 would have progressed far enough down the road in
25 verification that you have reasonable expectations

1 that there are not going to be any clinkers. Okay.
2 Thanks.
3 CHAIRMAN HORNBERGER: I am not sure that
4 I followed your question or your comment. I mean, a
5 performance confirmation plan is a plan isn't it?
6 MR. CRAGNOLINO: It is a plan,yes.
7 CHAIRMAN HORNBERGER: It does not require
8 that you have the results.
9 MR. AHN: That's what I added, and that we
10 have another purpose; to validate the lab testing
11 result in the real posture environment.
12 MR. CRAGNOLINO: This -- let me give you
13 a simple example for your satisfaction. It is very
14 simple. That product has nothing to do, and the plan
15 cannot say that we are going to measure corrosion
16 potential. No way.
17 We have to say that in order to measure
18 corrosion potential, if this is an issue, we have
19 decided or we know that there is a potential problem,
20 and the way to address this is to develop the specific
21 instrument that can be prepared in such a time, in
22 five years, and we have a plan for this. This is the
23 response.
24 What is important, too, and this is part
25 of the plan for my confirmation, has to be a clear

1 indication that in the confirmation period will be a
2 verification basis for continuation of the type of
3 tests they have been doing now.
4 And even we have a provision in the
5 agreement, specific agreement, that said that in order
6 to complete, for instance, this type of information
7 that we are requesting here in the measure methods for
8 possible corrosion rate, or even this, that this
9 information will be provided during the course of the
10 eventual license application, because this is
11 information that will take time.
12 But we have to make sure that at the time
13 of the license -- and I am correcting you. You said
14 six months of testing, and they have far more than six
15 months.
16 VICE CHAIRMAN WYMER: I was biased.
17 MR. CRAGNOLINO: They have several years
18 of testing.
19 VICE CHAIRMAN WYMER: I know that, yes.
20 MR. CRAGNOLINO: And this is important,
21 but we are going to gain more confidence if they have
22 a clear plan to continue this, because this is one
23 table in which all these types of clarifications
24 should appear in order to evaluate the license.
25 We need sufficient data, but a clear plan

1 as to what are they and different times.

2 VICE CHAIRMAN WYMER: I just wanted to be

3 sure that we brought out the clarification of that

4 point, and so we fully understood it.

5 CHAIRMAN HORNBERGER: Yes, and I would

6 make one comment on that. I think the words on your

7 slide give a little bit of a false impression that

8 they are generic, and you refer to all monitoring and

9 measuring, and my home, the thermal couples in my

10 furnace, are 45 years old, and still functioning very

11 well.

12 And if you are talking about sophisticated

13 instrumentation to measure corrosion films, you are

14 right. But I don't think it is correct to use the

15 general thing that all monitoring and sensing

16 instruments need development. There is a lot of

17 things that function very well for long times. But --

18 MEMBER LEVENSON: And to make one further

19 question --

20 CHAIRMAN HORNBERGER: Please go ahead.

21 MR. CRAGNOLINO: I have to review my --

22 well, I have to put the condition as closed there and

23 say that not thermal couples, but a few others. But

24 for simplification, you need this type of thing.

25 MEMBER LEVENSON: Yes. Well, the generic

1 statement of sensors and monitoring devices, and other
2 application is much too broad.
3 MR. CRAGNOLINO: Well, you know, my
4 manager told me that I have to remove the application
5 that I have in mind, and one of them is a RST
6 generator in a nuclear power plant; and the other one
7 is reactor core.
8 MEMBER LEVENSON: I have one question, and
9 that is in doing your studies on release source term
10 from inside the canister, how many of the types of
11 things that will be -- that are scheduled or might be
12 there, are included in your review?
13 I mean, we have the spent fuel, and there
14 is the vitrified waste from Savannah River, the two
15 obvious ones. Did you also look at -- and I don't
16 know if this month it is in or out, but the Cannon Can
17 Program for disposing of weapons grade plutonium by
18 putting massive amounts of plutonium in the middle of
19 vitrified logs, and then the aluminum waste program
20 from Savannah River?
21 MR. CRAGNOLINO: No. We don't look in
22 that detail, but we have looked precisely in Navy
23 fuel, and release from Navy Fuel, and all the
24 potential problems.
25 We have been looking at the way that DOE

1 has characterized in general the different types of --
2 because there is a large number of spent fuel as you
3 know that has been used in many different applications
4 for certain reactors, and that belong in many States
5 and so on that have been put together, and are going
6 to be disposed of.
7 And we have been looking in great detail,
8 but we have a clear understanding of the most
9 important type of fuel and the way that they are going
10 to be disposed by.
11 MEMBER LEVENSON: Well, it is not clear to
12 me that massive amounts of almost pure plutonium in
13 the middle of a vitrified log is a less significant
14 source than the fuel.
15 MR. CRAGNOLINO: I am sorry to interrupt.
16 The point is that we evaluate what DOE presents to us
17 in a document, and we cannot move forward to some
18 potential scenario related to something else.
19 What my concern is that there could be
20 design changes as you mentioned of this nature. We
21 are not in the condition of evaluating now until the
22 DOE puts this in the table.
23 But it is this type of thing happening and
24 in the event of putting us in the situation that it
25 would be difficult to complete certain aspects of the

1 evaluation and the documentation.

2 And therefore we will prepare in the same

3 way for the license, but this is something that should

4 be evaluated, depending upon the nature of the

5 problem.

6 I agree with you, but you have to realize,

7 too, that this is mostly is commensurate with spent

8 nuclear fuel and this is not our concern, because it

9 mainly contributes to the goal, and this is what we

10 are putting a lot of our resources to evaluate.

11 CHAIRMAN HORNBERGER: I don't think we

12 want to try to resolve all possible design changes

13 here.

14 MEMBER LEVENSON: No, no, no.

15 CHAIRMAN HORNBERGER: The real question is

16 where do we stand with KTIs.

17 MR. AHN: I would like to add what Gustavo

18 explained to you, the force and theory of TSPA, as

19 well as the NRC TPA. We concede that there are three

20 different types of inventory.

21 The first one is the commercial spent

22 nuclear fuel. The second one is the high level waste

23 clad. The third one is the 270 different types of

24 fuels, and that is called DOE owned-spent nuclear

25 fuel, including Navy fuel, and plutonium disposition

1 fuel as you mentioned.

2 The third type of category has a very

3 small amount of inventory compared with the first two.

4 Therefore, it does not directly affect the dose,

5 except for the criticality.

6 And as you mentioned in the criticality

7 assessment, there are fissile material in plutonium

8 glass contributes to that. That is separately

9 treated, and in Subissue 5.

10 So therefore we believe that we consider

11 also in actually the assessment that DOE uses

12 artificially and very conservatively in this scenario.

13 The actual radionuclide release is based

14 therefore on the solubility limits. We even did not

15 discuss about their approach because they chose the

16 very conservative approach in the last package

17 changes.

18 CHAIRMAN HORNBERGER: Okay.

19 VICE CHAIRMAN WYMER: I wanted to say one

20 other thing. I think this whole issue of container

21 life and source term is probably the most complex of

22 all of the issues involved in the repository. It

23 certainly is extremely complex.

24 MR. CRAGNOLINO: Yes, I would say so.

25 CHAIRMAN HORNBERGER: And I want to say

1 that I think the center is doing an outstanding job in
2 dealing with all these issues considering the
3 complexity of them. I just wanted to be sure that I
4 didn't give the wrong flavor to my discussion.
5 CHAIRMAN HORNBERGER: John.
6 MEMBER GARRICK: On your status table,
7 Viewgraph Number 3, I guess it is. Would you comment
8 on which of these subissues gives you the greatest
9 concern, or which 2 or 3, in terms of resolution?
10 MR. CRAGNOLINO: I would say that this is
11 the one that has the most significant impact.
12 CHAIRMAN HORNBERGER: That tallies with
13 what Bret presented, because that is the one that you
14 had major, and you had 2 through 5 being moderate to
15 major. And you had number six being minor.
16 MEMBER GARRICK: Right. Right.
17 MR. CRAGNOLINO: In the way that we relate
18 it, because originally we decided this subissue --
19 that there were more options in the DOE program. Now
20 it is reduced to drip shield, and several since are
21 tackled together here.
22 But you are completely right. This is the
23 dominant one, and there are others that we have to
24 obviously keep track of. In this area, the DOE has
25 done very good work, and there is a lot of progress.