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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

520th MEETING

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THURSDAY, MARCH 3, 2005

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ROCKVILLE, MARYLAND

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The committee met at the Nuclear  
Regulatory Commission, Two White Flint North, Room T-  
2B3, 11545 Rockville Pike, at 8:30 a.m., Graham B.  
Wallis, Chairman, presiding.

COMMITTEE MEMBERS:

- GRAHAM B. WALLIS, Chairman
- WILLIAM J. SHACK, Vice Chairman
- GEORGE E. APOSTOLAKIS, Member
- MARIO V. BONACA, Member
- RICHARD S. DENNING, Member
- F. PETER FORD, Member
- THOMAS S. KRESS, Member
- DANA A. POWERS, Member
- VICTOR H. RANSOM, Member
- JOHN D. SIEBER, Member-At-Large

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2 JOHN T. LARKINS, Executive Director, ACRS/ACNW

3 SAM DURAISWAMY, Technical Assistant

4 MEDHAT EL-ZEFTAWY

5 MICHAEL SNODDERLY

6 PANELISTS:

7 GREG GRECHECK, Dominion Resources

8 WAYNE HARRISON, Chairman, Westinghouse Owners  
9 Group LBLOCA Redefinition Working Group

10 TONY PIETRANGELO, NEI

11 NRC STAFF:

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20 GARY HAMMER, NRR/DE

21 ALAN HISER, RES/DET/MEB

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23 JAY LEE, NRR

24 CLIFF MUNSON, NRR

25 JACK ROSENTHAL, NRR

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

8:27 a.m.

CHAIRMAN WALLIS: Good morning. The meeting will now come to order. This is the first day of the 520<sup>th</sup> meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting the Committee will consider the following, draft NUREG on Expert Elicitation on Large-Break LOCA Frequencies, proposed rule-making package for risk informing 10 CFR 50.46, draft safety evaluation report related to North Anna early site permit application, technical basis for potential revision of the pressurized thermal shock screening criteria in the PTS rule, and the preparation of ACRS reports.

Several of these are particularly significant items. And I think we're going to be quite busy. This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act.

Dr. John Larkins is the designated Federal Official for the initial portion of the meeting. We have received no written comments from members of the public regarding today's sessions.

We have received requests from Mr.

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1 Pietrangelo, NEI, and Mr. Harrison, Westinghouse  
2 Owners Group for time to make oral statements  
3 regarding risk informing 10 CFR 50.46.

4 A transcript of portions of the meeting is  
5 being kept. And it is requested that the speakers use  
6 one of the microphones, identify themselves, and speak  
7 with sufficient clarity and volume so that they can be  
8 readily heard.

9 Before we get started there are some items  
10 of current interest. In the handout of items of  
11 interest you'll note that there's an SRM that states  
12 that the ACRS or ACNW should continue to review major  
13 research projects addressing nuclear safety issues.

14 So we continue to do that with an SRM.  
15 And there's also, you'll note, a couple of  
16 presentations by Commissioner Merrifield in here.  
17 Now, you probably know that Mag Weston, who has been  
18 with the ACRS staff for five years, is retiring on  
19 April the 1<sup>st</sup>.

20 And, on behalf of the Committee, I'd like  
21 to thank her for her outstanding technical support of  
22 the Committee in reviewing several technical issues,  
23 including reactor vessel penetration cracking, reactor  
24 vessel head degradation, reactor oversight process,  
25 the mitigating systems performance index program, and

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1 construction authorization requests for the MOX fuel  
2 fabrication facility.

3 She was also responsible for coordinating  
4 the preparation of the ACR's action plan and the  
5 subsequent revision. I note that she also did several  
6 other things not listed here.

7 Thank you Mag, and good luck in your  
8 future endeavors. Also, I believe you all know that  
9 this is the last meeting of the ACRS that Peter Ford  
10 will attend as a member.

11 I'd like to express our appreciation of  
12 his contributions to the Committee and our pleasure  
13 having him as colleague. Thank you Peter. Now we  
14 will proceed with the meeting.

15 And the first item, Draft NUREG on Expert  
16 Elicitation on Large-Break LOCA Frequencies, I'll ask  
17 Professor Apoltolakis to take us through that, please.

18 MEMBER APOSTOLAKIS: Thank you Mr.  
19 Chairman. The purpose of our meeting today is to  
20 review the revised draft NUREG report on estimating  
21 LOCA frequencies through the expert opinion  
22 elicitation process.

23 And, of course, this report was developed  
24 in support of the risk-informed revision to emergency  
25 core coolant system requirements 50.46. We issued --

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1 we reviewed the version dated November 4<sup>th</sup>, 2004 of  
2 the report.

3 And we issued a letter in December,  
4 December 10<sup>th</sup> of last year. We received an EDO  
5 response on February 4<sup>th</sup>. There were four, I would  
6 say, major -- although they're not all of the same  
7 significance -- issues that we raised in our report of  
8 December 10<sup>th</sup>.

9 The first one had to do with our  
10 explanation of what the objective of the expert  
11 opinion elicitation was, what -- we saw the word  
12 genetic frequency a lot, and, in particular, whether  
13 plant-to-plant variability was considered in the  
14 estimates.

15 The second comment in our report had to do  
16 with whether all the experts understood the questions  
17 that were posed to them. And there appear to be some  
18 confusion from some of the experts that were present  
19 in our deliberations here regarding the flow rate.

20 The third one appears to still be a point  
21 of disagreement between the authors of the report and  
22 at least some members of the Committee. And it has to  
23 do with the averaging method -- the method that is  
24 used to average the individual member opinions and  
25 estimates.

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1           And the final comment, the fourth comment,  
2           had to do with our request that the authors of the  
3           report state clearly, if they could, that the  
4           distribution they developed, based on all the  
5           sensitivity studies they did, that that distribution  
6           of the frequency of LOCAs represented the expert  
7           community's views and not just that annex.

8           Because, this Agency makes decisions based  
9           on the state of the art, not on what six people think,  
10          even though these six people might think very  
11          prominent.

12          I was looking again at the revised draft  
13          rule -- this morning in fact. And it seems to me that  
14          even though we may disagree on several things that the  
15          report does, the overall contribution to the revision  
16          of 50.46 is good in the sense that the proposed  
17          transition break size in the revised rule is greater  
18          than the sizes that correspond to 10 to the minus five  
19          frequency that you get in the report independently of  
20          what method you use.

21          In other words, what the Staff is going  
22          with is the conservative estimate of TBS. So, on the  
23          one had, we might say there is a positive contribution  
24          of the report in the sense that now we know that, no  
25          matter how one process the information from the

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1 experts, the regulatory staff is proposing a break  
2 size that is higher.

3 So that's good to know. On the other  
4 hand, given that this report might be used in the  
5 future by other people and so on, one would have to be  
6 more careful about the methods that are used and what  
7 is proposed.

8 So, the disagreements then have to be  
9 resolved. So, with these happy notes and  
10 observations, I'd like to turn the meeting over the  
11 Staff.

12 And I understand Dr. Alan Hiser wants to  
13 make a few comments first, please.

14 DR. HISER: Good morning, Dr. Apostolakis  
15 and Committee members. My name is Alan Hiser. I'm  
16 the Chief of the Component Integrity Section of the  
17 Office of Research.

18 As you described, we are here to discuss  
19 our revised draft NUREG. I guess what I would note is  
20 that this would be, over the last twelve months, our  
21 sixth briefing of either sub-committee or the full  
22 committee.

23 This report has been reviewed by ACRS.  
24 We've had two external peer reviewers, NRC internal  
25 peer review. We are here today to discuss two parts

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1 of the NUREG.

2 One are the changes that we've made since  
3 the Committee last reviewed the report and also to  
4 discuss our responses to the ACRS letter. At the end  
5 of our presentation we'll be seeking to release the  
6 NUREG for public comment.

7 And we'll request a letter from ACRS to  
8 that effect. With that, we look forward to a  
9 constructive dialogue this morning. And I'll turn it  
10 over to Rob.

11 MR. TREGONING: Thanks Alan. Good morning  
12 audience and Dr. Apostolakis and the rest of the ACRS.  
13 I wanted to thank you for providing us the opportunity  
14 to come in front of you today and, further,  
15 additionally discuss some of the, I'll say, remaining  
16 issues that we may have to try to resolve prior to,  
17 hopefully, our release of this document for public  
18 comment.

19 I'm just repeating the objectives I think  
20 George and Alan really summarized pretty well. But  
21 the objectives of this presentation, one, as Dr.  
22 Apostolakis mentioned, you have reviewed a preliminary  
23 version of the draft that was dated November of '04.

24 We want to walk you through what the major  
25 changes in this latest version is so that when you do

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1 your subsequent review this hopefully will allow you  
2 just to focus on pertinent areas.

3 So, the first thing we want to do is just  
4 very systematically walk you through what's different,  
5 the major things that are different. And then  
6 probably the more meteor portion of the talk is going  
7 to be the discussion of the ACRS comments that we  
8 received in your letter dated December 10<sup>th</sup>, and then  
9 our subsequent response to those comments in the  
10 letter as Dr. Apostolakis mentioned, dated February  
11 4<sup>th</sup>.

12 And, as Dr. Hiser mentioned, we are here.  
13 And the ultimate objective is to hopefully we can come  
14 to a successful resolution of these differences or at  
15 least an agreement on the best path forward so that we  
16 can move forward with releasing this document for  
17 public comment.

18 I think Dr. Hiser mentioned this, that  
19 we've been in front of ACRS numerous times throughout  
20 the elicitation process. It has been our goal to keep  
21 ACRS fully informed as we -- not only as we develop  
22 the process, but as we started to work through it.

23 So, this is just a continuing dialogue  
24 that we've tried to maintain with ACRS throughout the  
25 whole process. And, because of that, we're really

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1 just, you know, don't want to revisit old ground here.

2 I think we've discussed a lot of these  
3 issues fairly extensively. And we just want to focus  
4 on -- I'll say there's really only a few areas of  
5 disagreement that we have right now.

6 Now, since we were last in here, you see  
7 about the bottom of the slide, I just wanted to  
8 indicate what we've done with respect to the program  
9 and what milestones we've completed since we were last  
10 in here in December.

11 We have completed the draft NUREG that we  
12 supplied to you for review prior to this meeting.  
13 And, in this draft NUREG, we incorporated revisions in  
14 an attempt to address comments that we received in the  
15 December 10<sup>th</sup> letter from ACRS.

16 And we submitted that revised draft NUREG  
17 for both NRR and ACRS. I just want to -- I'm going to  
18 mention the comments that we got in the letter up  
19 front.

20 And then I'm going to walk you through the  
21 major changes. And the reason for mentioning these up  
22 front is, when we look at the changes, we'll say this  
23 change was to address ACR comment whatever.

24 So I just wanted to enumerate what those  
25 comments were. Again, Dr. Apostolakis stated these

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1 comments already. But I just want to make sure that  
2 we're clear what we're talking about today.

3 The first comment was that the report  
4 should include a better explanation of what a generic  
5 frequency value for the plants means, and to what  
6 extent plant-to-plant variability affected the  
7 results.

8 The second comment in the letter was that  
9 the report should state clearly what the understanding  
10 of the experts was when they answered questions about  
11 LOCA size categories.

12 The third comment was this practice and  
13 the practice that was being discussed is geometric  
14 averaging as it varies with the methods employed in  
15 references five through seven.

16 And those references are NUREG 11.50, the  
17 EPRI document on the seismic PRA, the hazard  
18 determination, and then also a companion report that  
19 talks about expert elicitation procedures with respect  
20 to the seismic hazard curve analysis.

21 So, the practice is at odds with those  
22 references. And all of those references used an  
23 arithmetic type averaging method to construct  
24 probability distributions of expert opinion.

25 And then the fourth comment was that the

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1 final distribution reported in the executive summary  
2 should be the composite distribution that the analyst  
3 -- and by analysts they mean authors of the report --  
4 based on the sensitivity analyses, believe represents  
5 the expert community's current state of knowledge  
6 regarding LOCA frequencies.

7 So, these were the four comments. And,  
8 again, Dr. Apostolakis has already indicated what they  
9 are, has already summarized these. So, the next few  
10 slides will just walk you through what changes we've  
11 had.

12 And this first slide really deals with the  
13 areas that we have really minimal changes. The first  
14 bullets up there just is -- you know, this is probably  
15 a nuisance point.

16 But we've re-lettered all the sections.  
17 So we had executive summary previously lettered as  
18 section A. Well, that's up front now. So then all  
19 the sections go up one.

20 If you were comparing section H  
21 previously, which was quantitative results, that's  
22 section G now. So we apologize for that nuisance.  
23 And hopefully it hasn't caused too much consternation.

24 I just wanted to make that clear. Most of  
25 the sections in the report we -- you know, between the

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1 11/04 draft and the draft that you've recently  
2 received, there's really no changes.

3 Or I would categorize them as minor  
4 editorial type changes. And that includes the  
5 background section, the objective and scope section,  
6 the base stage results section, the qualitative  
7 results and discussion section, and then the section  
8 where we talk about ongoing work.

9 So those chapters of the draft NUREG are  
10 essentially unchanged. Now, section C, which is the  
11 section on elicitation approach, we did go back in and  
12 add some clarification specifically to address the  
13 second comment which was, you know, understanding that  
14 the experts were -- what were they providing answers  
15 to with respect to break sizes.

16 So, we added some discussion, and  
17 specifically in section C7, which deals with the  
18 development of the flow rate correlations and how they  
19 were used within the elicitation.

20 So, when you review that section, you  
21 should -- I mean, this should be clear. And that new  
22 language is in there to make sure it's very clear how  
23 the elicitation was structured.

24 Now, later one, we're going to  
25 specifically address the ACRS comments. And I'll go

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1 into what exact language we use. Right now I'm just  
2 trying to provide an overview.

3 CHAIRMAN WALLIS: This flow rate thing  
4 always seemed to me backwards. These are experts in  
5 pipe rupture, aren't they? And the question they're  
6 going to ask is will this pipe break?

7 They're not going to ask, will I get  
8 10,000 gallons per minute. That means nothing to  
9 them.

10 MR. TREGONING: Of course.

11 CHAIRMAN WALLIS: So it seems very strange  
12 to define the problem in terms of flow rate. The  
13 problem is in terms of -- should be defined in terms  
14 of will a pipe break, how will it break, and what kind  
15 of a hole are you going to get when it does break?

16 MR. TREGONING: Right. And when we define  
17 the LOCA categories, realizing there's a lot of  
18 historical context involved in how LOCA categories  
19 have been defined.

20 They've been historically defined on a  
21 flow rate basis because the flow rate distinction is  
22 more important because it has implications in terms of  
23 what system performance is required.

24 You know, are you going to need HPIS, LPIS  
25 pumps? You know, what the system response is going to

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1 be. So, when we define the elicitation category, we  
2 stuck with those historical definitions, expanded them  
3 somewhat so that we could more definitively evaluate  
4 large break LOCAs, I'll say, with a finer -- a larger  
5 amount of categories.

6 But we certainly realize that the experts  
7 that we had, they are experts in degradation  
8 mechanisms. There were no plant systems expertise  
9 with respect to thermal hydraulic response for  
10 mitigating breaks.

11 So that's why we needed to develop the  
12 correlations and relate those categories to effective  
13 break sizes that the experts then took and used in  
14 their elicitation.

15 CHAIRMAN WALLIS: And then the peculiar  
16 thing --

17 MR. TREGONING: But we did want to tie  
18 them back to those historical definitions.

19 CHAIRMAN WALLIS: You converted them to  
20 single-ended breaks, as if the pipe is going to break  
21 and only have one end. It seems, again, a very odd  
22 thing to do.

23 MR. TREGONING: No, it's not.

24 CHAIRMAN WALLIS: Most --

25 MR. TREGONING: It's not a single-ended

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1 break. It's, again, the way the correlations were  
2 developed is the initial definitions were based on  
3 flow rate.

4 We related the flow rate to pipe to break  
5 areas. And then all we did is we took those areas and  
6 calculated and effective break diameter.

7 CHAIRMAN WALLIS: For a single --

8 MR. TREGONING: Assuming that those areas  
9 are --

10 CHAIRMAN WALLIS: For a single --

11 MR. TREGONING: It's an effective break  
12 hole.

13 CHAIRMAN WALLIS: One hole?

14 MR. TREGONING: One hole.

15 MEMBER APOSTOLAKIS: Yes, in fact -- are  
16 you coming back to it?

17 MR. TREGONING: Yes.

18 MEMBER APOSTOLAKIS: To this issue later?

19 MR. TREGONING: Yes, I'll talk exactly  
20 about the language we use.

21 MEMBER APOSTOLAKIS: Because I, in the EDO  
22 response of February 4<sup>th</sup>, we I suspect you guys have  
23 something to do with, there is a sentence that is not  
24 clear to me.

25 Thus the LOCA frequency associated with

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1 each LOCA size category relates to the cumulative  
2 frequency of a single-ended break of the site's size,  
3 and all larger breaks, including double-ended breaks  
4 of that size and larger pipe.

5 I'm having a problem understanding this.  
6 What does that mean?

7 MR. TREGONING: Well, again, realizing how  
8 the categories were defined in the elicitation, we  
9 were asking for frequency contributions for that size  
10 and height. So, the frequency --

11 MEMBER APOSTOLAKIS: Independently of  
12 whether it's double break or -- it's just a size.

13 MR. TREGONING: It's a size.

14 MEMBER APOSTOLAKIS: It's a size, okay.

15 MR. TREGONING: It's a size. So, if you  
16 look, let's say, you know, category 3, which was a  
17 flow rate of 5,000 GPMs --

18 MEMBER APOSTOLAKIS: Right.

19 MR. TREGONING: We're looking for -- and  
20 it's greater than 5,000 GPM flows. So we're -- I  
21 think we, for PWRs, that ended up being a three to  
22 four inch break size.

23 So, we're looking for frequency  
24 contributions for breaks of that effective diameter  
25 and higher. So that's what's meant by that statement,

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1 that it incorporates not only -- so, if you had a  
2 reactor.

3 Let's go to the biggest category, category  
4 6, which is essentially -- to get to the biggest  
5 category you need to have some failure in the main  
6 recirculation piping.

7 Okay, so when you go to category 6, that  
8 would incorporate not only, I'll say, a single hole --  
9 let me put it that way -- a single hole in the reactor  
10 piping, but it would also incorporate a double ended  
11 guillotine break as well. So that's what was meant.

12 MEMBER APOSTOLAKIS: Of smaller size?

13 MR. TREGONING: Of a larger size. Well --

14 MEMBER APOSTOLAKIS: Oh, a larger size?

15 MR. TREGONING: Yes.

16 VICE CHAIRMAN SHACK: That's a cumulative  
17 distribution rather than a density distribution.

18 MR. TREGONING: Right.

19 MEMBER APOSTOLAKIS: But, if all pipes  
20 broke with two ends, and you said -- used your method,  
21 it seems to me you'd always be displacing the  
22 coordinates by a factor of two in terms of size  
23 because you wouldn't have a single-ended break.

24 So your single-ended break area would have  
25 nothing there. It would have bigger things, which the

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1 first point would be twice as big. But that would be  
2 plotted as if it were the single-ended break.

3 So all the points would be displaced by  
4 this factor of two when your --

5 MR. TREGONING: I'm having trouble seeing  
6 that. Because, if you had -- look, the type of break  
7 -- if you truly had a double-ended guillotine break,  
8 you know, depending on the system, that would -- you  
9 could get dramatically different --

10 MEMBER APOSTOLAKIS: Suppose that you have  
11 5,000 gallons and that corresponds to a five inch  
12 pipe, one end broke. And they asked the question,  
13 what's the frequency of pipe breaks of that size or  
14 bigger?

15 That's your question. Well, suppose that  
16 when five inch pipes break they only break with double  
17 ends. Then there's no point of five inch. The first  
18 point is at twice that. Well, you could plot it as if  
19 --

20 MR. TREGONING: You could have --

21 MEMBER APOSTOLAKIS: -- it were the single  
22 end. You see what I mean?

23 MR. TREGONING: Right. You could have --  
24 you could potential -- and this is a George question.  
25 You could potentially have smaller pipes that --

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1 MEMBER APOSTOLAKIS: Had two ends.

2 MR. TREGONING: That had double ended  
3 breaks that would be --

4 MEMBER APOSTOLAKIS: So you might have  
5 some real points as well.

6 MR. TREGONING: As well.

7 VICE CHAIRMAN SHACK: Or you could have a  
8 large crack in a larger diameter pipe.

9 MR. TREGONING: That's right. So it  
10 includes partial breaks as well.

11 MEMBER APOSTOLAKIS: I understand that.  
12 It's just that, this isn't how you do this. This  
13 isn't independent of the way in which pipes actual  
14 break.

15 And the way in which pipes actually break  
16 has a potentiality to move things around a bit.

17 MR. TREGONING: Yes. No, that's exactly  
18 right.

19 MEMBER BONACA: I think it's the way that  
20 the break is selected in the rule that gives that  
21 sense, that you're bounding -- you're really -- you're  
22 taking, for example, the largest pipe attached, so,  
23 for example the -- and so, it gives you the sense that  
24 you have a double ended, but in reality, that's not  
25 the case.

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1                   MEMBER APOSTOLAKIS: They do say in the  
2 revised rule that they consider the largest pipe  
3 attached, which is from the pressurizer, right? They  
4 say they consider only one side.

5                   MEMBER BONACA: They consider only one  
6 side?

7                   MEMBER APOSTOLAKIS: One side. Because  
8 that's what matters from the hot --

9                   MR. BISHOP: Excuse me, this is Bruce  
10 Bishop from Westinghouse. I was a member of expert  
11 panel. And I just want to reinforce something that  
12 Dr. Shack just said to contradict an impression that  
13 was stated earlier.

14                   And that was the probabilities of having  
15 double ended break are very, very small for all pipe  
16 sizes, except the very small pipe sizes due to,  
17 typically, vibration of socket welds.

18                   The probability primarily come from small  
19 slits in bigger pipes. And those are much more  
20 probable. Again, they are very small. But they are  
21 still much more probable than a double ended break.

22                   And, at least for the PFM team members,  
23 and we shared our results, okay, with the other teams  
24 also. And there is no database -- in the database  
25 there are no double ended breaks.

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1           Okay, there are lots of leaks. So, even  
2           the people that were, you know, the experts on the  
3           database, had to make some transition from leaks, the  
4           probabilities of having leaks, or big leaks, to  
5           breaks.

6           Again, I think that point is very  
7           important. A primary contributor is the small slits  
8           much less than -- again, to get -- maybe like you were  
9           talking about a 5,000 GPM leak rate.

10           In a reactor coolant system piping you may  
11           only need a flaw that's ten percent of the  
12           circumference to give you that flow rate. And the  
13           probability of having that flaw is much larger than  
14           having a double ended break, even of a six inch pipe  
15           or something like that.

16           The other point is that one of the things  
17           that the expert panel was asked to take out to  
18           consider is how many pipes of a given size contribute  
19           to that overall leak rate because that also factors  
20           into that cumulative that Rob was talking about.

21           It's not just one pipe. You may have  
22           multiple pipes that could break. And so, the  
23           probabilities have to add up. And so, you have to  
24           start excluding certain pipe sizes as you go up in  
25           size.

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1           And I think a number of us, that's where  
2           the double break sort of got -- that's the way you  
3           could exclude a pipe size. If physically the leak  
4           rate was greater than that of a double ended break  
5           then you didn't have to consider that pipe size as  
6           being a contributor.

7           You could exclude that from the cumulative  
8           numbers you had to add up. Now, that's a lot of  
9           things to keep in your mind. But those were just some  
10          of the considerations that I know were discussed with  
11          all the panel members.

12          Now, I can't say that everybody agreed  
13          with that. But at least we all discussed that  
14          together and talked about that. So I think we were  
15          all sort of aware of that.

16          CHAIRMAN WALLIS: That was very helpful to  
17          me, thank you.

18          MR. TREGONING: Thank you Bruce. So, this  
19          next slide deals with -- we're starting to deal with  
20          the sections that we have more substantive changes  
21          since the November '04 draft report.

22          This slide deals with section E. And that  
23          section deals with the analysis of the elicitation  
24          responses. We really had two types of changes that we  
25          have here.

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1           The 11/04 draft, we had some  
2 inconsistencies between the description in section E  
3 and the 11/04 document and what was actually done and  
4 presented in the quantitative results section.

5           So, it was just -- we had some  
6 inconsistencies that we have to fix. And that's  
7 represented by these first changes made in these first  
8 three sections, sections E34, E341, E341, on summing  
9 distributions, calculating means, and the calculation  
10 of the variance and percentiles that we subsequently  
11 present in the quantitative results section, section  
12 G.

13           We also added some new sections which  
14 describe either additional or modified sensitivity  
15 analyses that we also have the result of in section G.

16           And those sections which were either  
17 modified or added include sections on the mean  
18 determination, correlation structure, the aggregation  
19 parameters, and the mixture distribution aggregation.

20           Again, we're not -- we hadn't planned to  
21 go over the changes today. Some of them are  
22 relatively minor. Some of them are more substantive.

23           But, I just wanted to alert you as you do  
24 your review what sections possibly to focus on.  
25 Section G, the quantitative results section, as I

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1 mentioned previously, the results that we provided you  
2 in 11/04 did previously reflect the current analysis  
3 methodology.

4 So, there's no change in the results that  
5 we presented between 11/04 and the draft NUREG that  
6 you've got in front of you now. We did, in keeping  
7 with sections that were added or modified in section  
8 E to reflect either additional or modified sensitivity  
9 analysis, we have corollary sections in section G that  
10 we've either added or modified on mean determination  
11 correlation structure, mixture distribution  
12 aggregation, and a new section on summary results.

13 We also added a new section, the summary  
14 results section. And this was in response to ACRS  
15 comment 4 to provide a recommendation as to what we  
16 thought, I'll say, the best encapsulation of the  
17 elicitation results were.

18 We've added a section called summary  
19 results, which are based on the overconfidence  
20 adjustment using the error factor scheme, however,  
21 aggregated currently with the geometric mean approach.

22 So, I know we're at odds with you on that.  
23 And, again, our opinion is those are the best or the  
24 improved group LOCA frequency estimates. We also  
25 highlighted these summary results in the executive

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1 summary.

2 Those are the results that we use in the  
3 new report. And all the comparisons with historical  
4 results that we make in section G are with respect to  
5 those summary results.

6 So, there's consistency at least there  
7 between what's in the executive summary, comparisons  
8 with historical results, and then this summary results  
9 section that's in section G.

10 MEMBER APOSTOLAKIS: So the baseline  
11 results do not have any adjustment for overconfidence  
12 or anything? And you are not reporting them in the  
13 executive summary?

14 (No verbal response.)

15 MEMBER APOSTOLAKIS: Okay. What you  
16 report there is what you believe after the whole thing  
17 is the current distribution of the frequency.

18 MR. TREGONING: That's exactly correct.  
19 And I should have made that point. So I'm glad that  
20 you made it for me.

21 MEMBER APOSTOLAKIS: And the  
22 overconfidence adjustment has to do only with the  
23 lower part of the distributions, right?

24 MR. TREGONING: Well, again, just to  
25 refresh your memory on how we did those -- how we did

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1 that adjustment, we looked at all the error factors  
2 associated with each category that we were trying to  
3 get quantitative results for.

4 And we calculated -- so we had, let's say,  
5 eight or nine experts that weighed in on a given  
6 question. We determined the mean error factor from  
7 those eight or nine experts.

8 And then experts which were below the  
9 mean, we adjusted their error factor only, not their  
10 middle response, but their error factor.

11 MEMBER APOSTOLAKIS: And you brought them  
12 up to the mean.

13 MR. TREGONING: We increased their  
14 uncertainty. We brought it up to the mean.

15 MEMBER APOSTOLAKIS: Okay.

16 MR. TREGONING: But those that were above  
17 the mean, we just left them there. We didn't correct  
18 them down.

19 MEMBER APOSTOLAKIS: Right. And the  
20 reason was that you felt that the guys with the lower  
21 error factor were overconfident?

22 MR. TREGONING: Yes. Based on -- and Lee  
23 may want to weigh in here. But, based on a lot of  
24 elicitation work, overconfidence adjustment is a well-  
25 known phenomenon.

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1           And, as I mentioned earlier, we have  
2 initially planned on doing some sort of correction for  
3 everybody on overconfidence. When we started to look  
4 at some of the uncertainty regions that we had for  
5 some experts, it became clear to us that they may not  
6 have actually been overconfident.

7           In some ways, many of them could have  
8 actually been under-confident. But, we didn't decide  
9 to correct back that way.

10           MEMBER APOSTOLAKIS: Do you remember how  
11 many experts were overconfident? I mean, according to  
12 this.

13           MR. TREGONING: Well, by definition, I  
14 mean, if you had eight experts and you calculated mean  
15 --

16           MEMBER APOSTOLAKIS: Because you went with  
17 the --

18           MR. TREGONING: You'd have four that you'd  
19 correct with, approximately four.

20           MEMBER APOSTOLAKIS: Do you remember what  
21 their affiliation was?

22           MR. TREGONING: There was no --

23           (Laughter.)

24           MR. TREGONING: You know, I don't think it  
25 asks this question. I did ask this question quite

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1 often. Did we notice any, I'll say, organizational  
2 effect on either the mean results or the uncertainty  
3 results?

4 And I will say usually no. If I looked at  
5 all the experts, there was no systematic differences  
6 between organizations. The only thing I will say is  
7 with respect to the uncertainty analysis.

8 There was probably a weak correlation that  
9 the industry participants probably tended to be a  
10 little more confident than some of the rest. But,  
11 it's a very weak correlation.

12 I wouldn't read too much into that  
13 comment.

14 MEMBER APOSTOLAKIS: Confident in the  
15 sense that they are giving you --

16 MR. TREGONING: That they --

17 MEMBER APOSTOLAKIS: -- tighter  
18 distributions.

19 MR. TREGONING: Yes. So it's not -- so,  
20 again, just realizing for each question we ask for  
21 their mid-value responses and then their uncertainty  
22 about the response.

23 So, it wasn't that there was any clear  
24 difference in mid-value responses as a function of  
25 organization on the expert panel. There was a

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1 stronger correlation, again, albeit, it was still  
2 relatively weak between their uncertainty associated  
3 with that value.

4 MEMBER APOSTOLAKIS: But, again, if you  
5 look only at the error factor, you really don't care  
6 where the distribution is, right? The error factor is  
7 a ratio for the square root of the 95<sup>th</sup> to the 5<sup>th</sup>.

8 And I wonder -- I mean, this is another  
9 example of, you know, the hundreds of ways that one  
10 can process this information. Because, you might say,  
11 yes, a guy was over-confident.

12 He gave a narrow error factor in that  
13 sense. But he placed the distribution way up there,  
14 you know. He was very conservative of where he put  
15 it.

16 So, by adjusting his error factor, I do  
17 not know, maybe you're doing some injustice to his  
18 estimates. In other words, overconfidence has to  
19 include some measure of location too, where the  
20 distribution --

21 MR. TREGONING: That's --

22 MEMBER APOSTOLAKIS: Not just the spread  
23 of the --

24 MR. TREGONING: That's a valid point. And  
25 that's one of the reasons why we settled on the

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1 approach that we did. We looked at some of the more,  
2 I'll say, classical ways to do overconfidence  
3 correction. This is not a classical way.

4 MEMBER APOSTOLAKIS: Yes.

5 MR. TREGONING: That was a -- that's a  
6 point that, you know, we had some -- because what  
7 happens, your median doesn't shift, but your mean can  
8 shift dramatically.

9 MEMBER APOSTOLAKIS: Exactly.

10 MR. TREGONING: Based on overconfidence.

11 MEMBER APOSTOLAKIS: The abstract.

12 MR. TREGONING: And, when we did some of  
13 these corrections, the mean shifted, because they had  
14 been conservatively placed, to frequencies which just  
15 weren't physically supportable.

16 And I think, you know, we've had past ACRS  
17 meetings where we talked about some of the reasons for  
18 that and what some of the ramifications were.

19 MEMBER APOSTOLAKIS: Okay.

20 MR. TREGONING: And that's another reason  
21 that we ended up doing this particular error factor  
22 correction.

23 MEMBER APOSTOLAKIS: As long as we  
24 recognize that, you know, overconfidence must be  
25 related to the location of the distribution, the

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1 estimate too, not just the spread.

2 MR. TREGONING: Right.

3 MEMBER APOSTOLAKIS: Lee?

4 MR. ABRAMSON: Dr. Apostolakis -- Lee  
5 Abramson. One thing that we could do, as suggested by  
6 your remarks, is we could investigate other  
7 sensitivity studies, sensitivity analyses, considering  
8 other modifications.

9 We investigate, as you know, a number of  
10 possible ways to do the overconfidence adjustment.  
11 However, as far as the error factor correction is  
12 concerned, we didn't try to investigate any  
13 modifications to this.

14 But this is certainly possible to do. And  
15 I do not know how this would turn out. We could, for  
16 example, say one way of suggestion is consider  
17 modifying this when it's going to drastically change  
18 the location of the distribution.

19 So, these are things that could be done to  
20 see what affect this particular, say, form the  
21 overconfidence adjustment was. The reason that we  
22 used the error factor adjustment was it was a more or  
23 less objective way to do it.

24 We didn't have to make any particular  
25 judgments about the level of the overconfidence

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1 adjustment that we did. That was some of the things  
2 that we did investigate from the targeted and the  
3 adjusted ones.

4 This was an overconfidence adjustment in  
5 which the experts themselves determined how much they  
6 had to be adjusted by virtue of their relation to the  
7 error factors of the other experts.

8 So, certainly, we could do some  
9 sensitivity analyses, which we haven't done yet.

10 MR. TREGONING: I'm going to maybe  
11 slightly disagree with one of my co-authors on that.  
12 I think one of the things we have to keep in mind with  
13 this error factor overconfidence correction is, you  
14 know, when we did that we did look at the location.

15 We sort of plot it out. And we have some  
16 box and -- plots that we show in the report that shows  
17 how specific points move. And the thing we have to  
18 keep in mind here is it's a relatively modest  
19 correction in the grand scheme of things.

20 Usually factor of two in the mean  
21 frequencies or less. So, you know, I think there's a  
22 lot of interesting ways, like you had said, that we  
23 could look at evaluating and processing these results.

24 But, you know, to me -- and I think we  
25 tried to do that by looking at -- we looked at three

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1 or four different overconfidence adjustment schemes.  
2 And I think, by that sensitivity analysis, we've  
3 really bounded pretty well the amount of, I'll say,  
4 results perturbation that you could do to account for  
5 overconfidence.

6 I don't really know that we, you know,  
7 given that we're talking about factors of two or less,  
8 that any further perturbation in the error factor  
9 scheme is really going to be justified at this point.

10 MR. BISHOP: Dr. Apostolakis, in the NRC  
11 SER for the risk informed ISI method, Dr. Fred Simonen  
12 at the Pacific Northwest Laboratory did some studies  
13 on the variability in the PFM results, some expected  
14 variabilities.

15 And I know several of the PFM members used  
16 that because it seemed to make sense. And what it  
17 showed was is that for the very high frequencies where  
18 you typically have failure data or something like that  
19 driving your failure probability predictions, the  
20 variability is fairly small.

21 But, when you start getting down to very  
22 low numbers like 10 to the minus six, 10 to the minus  
23 eight where you have very little or no data, the  
24 relative uncertainties can be very large, several  
25 orders of magnitude.

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1           However, you're talking about whether it's  
2           10 to the minus six, 10 to the minus eight, or 10 to  
3           the minus 10<sup>th</sup>. And so, in an absolute sense, if you  
4           were using arithmetic mean, that probably wouldn't  
5           have much effect.

6           But, if you were using a geometric mean,  
7           it could have more of an effect because the relative  
8           uncertainties are higher.

9           MEMBER APOSTOLAKIS: Coming back to the  
10          composite, one of the major conclusions of this other  
11          study that you guys refuse to consult --

12          MR. TREGONING: No, no.

13          MEMBER APOSTOLAKIS: That was EPRI, DOE,  
14          and NRC, reviewed by the National Academy of Sciences.  
15          One of the major conclusions there was that precisely  
16          because one can do a lot of -- implement a lot of  
17          mathematical schemes to process individual estimates,  
18          group estimates, and so on, as we just discussed, the  
19          ultimate distribution has to come from the experts, a  
20          consensus process, from a consensus process.

21                 Did you ask the experts to bless your  
22          final distribution, or is it yours, the authors of the  
23          report?

24                 (No verbal response.)

25          MEMBER APOSTOLAKIS: Whose distribution is

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1 it, the one that you report in the executive summary?

2 (No verbal response.)

3 MEMBER APOSTOLAKIS: You had eight  
4 experts, right?

5 (No verbal response.)

6 MEMBER APOSTOLAKIS: Did these eight  
7 experts look at what you said, finally this is the  
8 distribution? And they said, yes, we agree or I don't  
9 violently disagree?

10 (No verbal response.)

11 MEMBER APOSTOLAKIS: Or, is it Abramson's  
12 and Rob's?

13 MR. TREGONING: Okay. Yes, we --

14 MEMBER APOSTOLAKIS: That doesn't mean it  
15 is bad if it's yours. But I want to understand whose  
16 it is.

17 MR. TREGONING: Yes, you want to  
18 understand the process, right. And the way the  
19 process works, or the way the process worked, is we  
20 got results from the experts, which we went around  
21 with the experts individually to make sure they were  
22 satisfied with their individual results. There was a  
23 lot of back and forth.

24 MEMBER APOSTOLAKIS: The individuals?

25 MR. TREGONING: Individually.

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1 MEMBER APOSTOLAKIS: Yes.

2 MR. TREGONING: Individually. Then we met  
3 last -- about a year ago last February or so where we  
4 presented all the results, all the individual results  
5 and outlined our aggregation schemes to the experts.

6 We had a lot of discussion then about what  
7 was appropriate and was not appropriate. And then we  
8 went off, we finalized the aggregation schemes, and we  
9 reported those aggregation schemes.

10 And, in last July we had another two, two  
11 and a half day meeting with all of the experts where  
12 we presented the results of the various aggregation  
13 schemes.

14 Now, we hadn't done the mixture  
15 distribution aggregation yet, which is -- I'll take  
16 issue with the fact when you say we didn't consult the  
17 work.

18 I think we consulted that work quite  
19 extensively. And the mixture distribution is in line  
20 with what some of the prior work would recommend.

21 We didn't have that distribution.  
22 However, we had the arithmetic mean type of  
23 aggregation, which is pretty similar. You get pretty  
24 similar results to what you do with the mixture  
25 distribution creation.

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1           And we had some discussions among the  
2 expert panel. And I will say that probably some of  
3 the violent discussions among the expert panel. And,  
4 as far as the expert panel, they were -- those that  
5 were -- I don't want to speak for everyone, but we  
6 heard several people in violent opposition to using  
7 the arithmetic mean type of averaging schemes because  
8 of the reason they didn't think it represented a  
9 consensus type distribution for this elicitation.

10           MEMBER APOSTOLAKIS: Well, but -- two  
11 questions. First, did they agree that your  
12 distribution is representative?

13           (No verbal response.)

14           MEMBER APOSTOLAKIS: Because, you keep  
15 talking about the scheme. Well, it's one thing to  
16 talk about the method, and quite another to say, guys,  
17 this is it.

18           This is what we're going with. Did they  
19 have a chance to say, yes, this is fine?

20           MR. TREGONING: Sure. During that meeting  
21 they had a chance to weigh in on which aggregation  
22 scheme they proposed. Although, you know, we took  
23 their recommendation with somewhat of a grain of salt  
24 because, again, these are experts in -- these aren't  
25 experts in elicitation or aggregation of expert

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1 results.

2 So, we certainly wanted their input. But,  
3 I think Lee and I, you know, we wanted to withhold  
4 final judgment to do what we thought was right as  
5 well.

6 But, in all honesty, the experts largely  
7 agreed with the scheme that we were recommending at  
8 the time, the geometric mean aggregation was the most  
9 acceptable one that we presented.

10 The other thing they were violently  
11 opposed to was overconfidence correction. And that's  
12 a good thing. They should have been violently opposed  
13 to that.

14 MEMBER APOSTOLAKIS: But you did it  
15 anyway?

16 MR. TREGONING: We did some anyway, sure.

17 MEMBER APOSTOLAKIS: So, you could have  
18 done the same thing with the aggregation scheme?

19 MEMBER APOSTOLAKIS: We could have done  
20 the same, of course. Look, that's the role of the  
21 integrative facilitator, of course. But, I'm going to  
22 mention this later.

23 We were sort of clear throughout all the  
24 elicitation that we were looking to develop consensus  
25 type estimates. And that's something --

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1 MEMBER APOSTOLAKIS: When the experts  
2 agreed with the distribution that you presented, what  
3 was their view? What kind of distribution -- whose  
4 opinion did this represent?

5 Just the group's? Or did they feel that it  
6 represented that of the community at large?

7 MR. TREGONING: Just the group's.

8 MEMBER APOSTOLAKIS: Does this Agency make  
9 decisions based on a group of eight people?

10 MR. TREGONING: It was a group of 12  
11 experts.

12 MEMBER APOSTOLAKIS: Twelve people, 20  
13 people. We never do that. We are based on the state  
14 of the art. So, the experts should have told us, this  
15 is -- if you go out, you know, this is what the  
16 community thinks.

17 MR. TREGONING: We're going to get to this  
18 point later.

19 MEMBER APOSTOLAKIS: Okay.

20 MR. TREGONING: And, I understand where  
21 you're coming from. I think this is state of the art,  
22 to be honest. And we'll get to --

23 MEMBER APOSTOLAKIS: That's not what your  
24 response says. And that's not what the report says.  
25 The report says that its' impossible to say what the

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1 state of the art is.

2 Which I -- if I were a Commissioner I  
3 would be really very upset.

4 MR. TREGONING: No. I don't think the  
5 report says that. The report says it's impossible to  
6 say what the expert community -- what the community at  
7 large thinks.

8 MEMBER APOSTOLAKIS: Yes. Because, if I  
9 select the experts carefully -- which I think you did,  
10 you did do it carefully -- I should be able to figure  
11 out from those experts, if I ask the right questions,  
12 what the community at large thinks.

13 MR. TREGONING: Well, let's --

14 MEMBER APOSTOLAKIS: Yes, we'll come to  
15 that. Okay.

16 MR. TREGONING: We'll come to that. And  
17 I think my -- this may be -- you know, I'm going to be  
18 optimistic here. This may be a semantic thing as much  
19 as -- what you're calling the expert community and  
20 what we're saying, you know, we think our panel  
21 represents.

22 So, we're going to discuss that more fully  
23 later.

24 MEMBER APOSTOLAKIS: All right. Keep  
25 going.

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1 MR. TREGONING: Okay. So, changes to the  
2 draft NUREG abstract conclusion, executive summary  
3 statement. I think I mentioned a lot of these  
4 already.

5 The table and figures now reflect the  
6 revised summary results. And this was in --

7 MEMBER APOSTOLAKIS: Yes, I have another  
8 -- there were two issues. One is with what we just  
9 discussed, the community at large.

10 MR. TREGONING: Yes.

11 MEMBER APOSTOLAKIS: But there is the  
12 other statement that you keep making the report. And  
13 maybe we need to clarify that as well. The key  
14 requirement for aggregation is that the group opinion  
15 must be somewhere in the middle of the group.

16 I don't understand that. I really don't.  
17 Are you going to -- maybe when we talk about the  
18 expert community --

19 MR. TREGONING: Yes, we'll talk about  
20 that.

21 MEMBER APOSTOLAKIS: All right. Fine,  
22 let's go.

23 MR. TREGONING: Okay, so the executive  
24 summary again. The table and the figures in the  
25 summary now reflect these revised summary results.

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1 And this is our recommendation that you requested that  
2 we do an ACRS comment number for.

3 We tried to clarify in the executive  
4 summary what we meant by generic frequencies. Again,  
5 I'm going to specifically tell you what we did here in  
6 the next slide.

7 That was ACRS comment number one. We  
8 tried to summarize a rationale for using the geometric  
9 mean again and why, at least in the author's opinion,  
10 the mixture distribution aggregation is not  
11 appropriate, at least for the revised summary results.

12 And that's your ACRS comment number three.  
13 And, again, tried to clarify our opinion that the  
14 study results are designed to best represent the  
15 expert panel state of knowledge regarding LOCA  
16 frequencies.

17 Now, we still have this issue of, does the  
18 expert panel represent the community at large. And  
19 then the abstract and conclusions have been revised to  
20 make everything consistent with the executive summary.

21 So, let's get into specifically what we  
22 did. And then I think we'll be -- this will lead  
23 obviously to the conclusions discussion about the  
24 expert community and some of the other issues that Dr.  
25 Apostolakis has raised.

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1           But, let's get -- we wanted to get through  
2           the first couple of comments first because I thought  
3           hopefully we had pretty good agreement that we've  
4           handled those correctly now here.

5           Comment number one, you'd asked -- again,  
6           just to refresh your memory -- better explanation of  
7           what the generic frequency means. And this was the  
8           staff response to the letter as well as we've tried to  
9           clarify the executive summary to make this clear.

10          We had instructed the expert panel to  
11          develop generic or average type values. However, they  
12          did consider the service history. The service history  
13          comes from all plants.

14          So, by definition, the service history has  
15          information about plant specific variability. But,  
16          because we asked them to give us the average, really,  
17          the only factors that influence a large number of  
18          plants, you would expect to significantly influence  
19          the average.

20          And that's why we had given the panels  
21          clear instructions to only account for very broad  
22          plant specific factors and not specific individual  
23          plant to plant variability.

24          So, by broad plant specific factors,  
25          you're looking at factors which may affect a handful

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1 of plants, five to ten plants. You get into things  
2 like design differences, vendor differences, some of  
3 the bigger grosser distinguishing characteristics of  
4 plants.

5 But, you didn't get down to the level of  
6 a specific environment or operating history of one  
7 specific plant. And, again, we clarified the  
8 executive summary to reflect this understanding.

9 MEMBER APOSTOLAKIS: Is that how we  
10 regulate?

11 (No verbal response.)

12 MEMBER APOSTOLAKIS: Are the regulations  
13 intended to address the average plant? It's unclear  
14 to me.

15 MR. TREGONING: LOCA frequencies have  
16 always been developed historically with that in mind,  
17 yes. And that was another reason that we tried to be  
18 very clear there.

19 We wanted to be consistent with how LOCA  
20 frequencies have been developed and utilized in the  
21 past.

22 MEMBER FORD: Could I follow upon that  
23 Rob?

24 MR. TREGONING: Sure.

25 MEMBER FORD: So far we have been having

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1 a very useful discussion on the process of how we  
2 ascribe to various uncertainties in how the decisions  
3 were made.

4 Much bigger uncertainty, however, is the  
5 specifics over the degradation mechanisms. As you  
6 know, there's been a whole range of these. And  
7 there's going to be a big distribution of what's the  
8 likelihood of a crack, for instance, what's the  
9 likelihood of various cracking mechanisms?

10 And these are not taken into account,  
11 because you are looking at the generic plant, generic  
12 BWR, generic PWR. These are not taken into account.

13 Those specific degradation uncertainties  
14 are not taken into account. Brian Sheron at the last  
15 meeting -- I forget -- the last full meeting, resolved  
16 that problem for me by saying that, yes, the TBS that  
17 you come up with is the average.

18 But, plant specific issues, such as a BWR  
19 on different water chemistry, PWR at different  
20 temperatures and things of this nature, if they have  
21 a pipe or component lodged in the TBS, then they have  
22 to, still in a plant specific basis, apply a 1174 to  
23 show that the risk is not going to be -- for that  
24 specific plant.

25 Is that -- did I hear Brian Sheron

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1 correctly?

2 (No verbal response.)

3 MEMBER FORD: Because that resolves my  
4 problem with all these discussions of uncertainty.

5 MR. TREGONING: Yes, I don't want to  
6 interpret what Brian said. But, he's here, so maybe  
7 he would feel so compelled to --

8 MEMBER FORD: Do I understand this  
9 correctly? There's a back -- to this, a plant  
10 specific basis, if you have a BWR operating under  
11 something like this, then they can make the  
12 appropriate case for the larger pipe sizes and TBS to  
13 locate? Is that what you said?

14 MR. SHERON: In other words -- I'm trying  
15 to understand what --

16 MEMBER FORD: The problem I have is that  
17 you're defining a TBS for a generic plant.

18 MR. SHERON: Right.

19 MEMBER FORD: And anything above that you  
20 get exemptions. But, the problem is that if you have  
21 a plant which is operating under different water  
22 chemistry conditions, for that specific plant they  
23 have to make the safety case for those larger pipes or  
24 components. I think that's what you said.

25 MR. SHERON: For plants -- let's put it

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1 this way, we selected a transition break size, which  
2 is a generic number, okay, or a generic one. And it's  
3 based on the largest attached pipe to the primary  
4 system.

5 MEMBER FORD: Right.

6 MR. SHERON: So, that is a bit of a plant  
7 specific factor. We have said that if a plant, for  
8 example, proposes to run at conditions -- I think we  
9 used, like for an example, at an up-rated power level,  
10 where you might have higher vibration levels, higher  
11 temperatures and so forth.

12 They would have to provide a  
13 rationalization for continuing to use that -- in other  
14 words, to show that the transition break size hasn't  
15 been adversely affected from a probabilistic  
16 standpoint by running at these higher conditions.

17 MEMBER FORD: Right.

18 MR. SHERON: Does that make sense? That's  
19 what I was, I think, trying to get across at the  
20 meeting, that we were not just given a blanket okay,  
21 you know.

22 The parameters that were used in the study  
23 had to be consistent with the parameters licensees  
24 running their plant at.

25 MEMBER FORD: Thank you. That's the --

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1                   MEMBER BONACA: So that you then would  
2 address plant to plant variability?

3                   MEMBER APOSTOLAKIS: Well, it is plant  
4 specific the way they specify. But that question  
5 should come up again.

6                   MEMBER BONACA: I think your question  
7 before about regulation was very valiant.

8                   MEMBER APOSTOLAKIS: I don't mean you, I  
9 mean the revised group.

10                  VICE CHAIRMAN SHACK: The plant  
11 specificity seems to have very little to do with  
12 degradation, you know, the size of your largest  
13 attached pipe has virtually no connection whatsoever  
14 with any degradation mechanism that you do have.

15                   On the other hand, it seems to me that I  
16 wouldn't blow this up too much. I mean, the way we  
17 run plants today, the variations in water chemistry  
18 from one BWR to another, you know, is almost at the  
19 limits of measurement of the water chemistry purity.

20                   The specifications are fairly tight.  
21 We're dealing with such a limited database. I mean,  
22 you know, we are extrapolating -- we're looking for  
23 probabilities of six inch holes when, you know, your  
24 database, you know, is largely on leaks of a few  
25 gallons once you get beyond steam generator tube

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1 ruptures.

2 As you consider the data and you consider  
3 the restrictions that these plants are operating in,  
4 I'm not sure how I would distinguish between my fleet  
5 variability and uncertainty and my plant to plant  
6 variability and uncertainty.

7 I think you're just slicing the bologna  
8 finer than you can make it, if you really think that  
9 you can get it any finer than that.

10 MR. TREGONING: But, just to follow-up, I  
11 mean.

12 MEMBER FORD: But all you need is one.

13 MEMBER APOSTOLAKIS: But remember also  
14 that the report claims that safety cultural is not  
15 important.

16 MR. TREGONING: No, the report does not  
17 claim that at all. That is not claimed --

18 MEMBER POWERS: An entirely accurate  
19 perception.

20 VICE CHAIRMAN SHACK: That's not what it  
21 says George. It says that the safety culture is not  
22 likely to change dramatically. They've built in an  
23 assumption about safety culture.

24 But they don't think it's going to be  
25 allowed to get worse. And that's very different.

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1                   MEMBER APOSTOLAKIS: But they also say, I  
2 think, that variability in safety culture could affect  
3 the results significantly.

4                   MR. TREGONING: For a given plant.

5                   MEMBER APOSTOLAKIS: Right.

6                   MR. TREGONING: By all means.

7                   MEMBER APOSTOLAKIS: Which makes it now  
8 plant specific. But that effect we are ignoring in  
9 this analysis.

10                  MR. TREGONING: Just to follow-up a little  
11 bit on what you had said. You know, when we had  
12 talked about degradation mechanisms, Dr. Ford, we did  
13 talk about the variability.

14                  For instance, PWSEC, we talked about the  
15 effect of temperature. And, I know when the -- so,  
16 even though we did generic considerations, a lot of  
17 the testimony that we go tended to make rather  
18 conservative assumptions for how they were estimating  
19 the rates of degradation and things like that based  
20 on, again, sort of a maybe a more conservative set of  
21 operating conditions.

22                  So, I know for PWSEC that was the way it  
23 turned out. For IGSEC, like you had mentioned, where  
24 we have a lot more knowledge, the more generic  
25 considerations probably held, a lot more knowledge and

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1 a lot more uniformity, as Dr. Shack had said.

2 MEMBER APOSTOLAKIS: I think we're falling  
3 behind. This issue will come up again in the next  
4 session. And I'd rather have the next session go  
5 overtime than --

6 MR. BISHOP: But let me just make a point.  
7 The point that was said, okay, is that plant to plant  
8 variability and so forth was not considered. That is  
9 not a true statement because we were asked to provide  
10 a best estimate value which was a medium value which  
11 -- to represent sort of like the fleet average if you  
12 want to call it that.

13 But we also asked to provide five and 95  
14 percent values. And those tend to catch both the high  
15 and the low outliers. That was specifically  
16 discussed.

17 Okay, that's why we were asked to do that,  
18 was to catch -- yes, not all plants are going to have,  
19 you know, welding fabrication problem or high residual  
20 stresses or, you know, forgot to stress relieve their  
21 welds, or whatever that problem may be.

22 But there is still is a chance that maybe  
23 happen. And that's why we were asked to estimate five  
24 95 percentiles also on all our estimates.

25 MEMBER APOSTOLAKIS: Okay. I think we're

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1 done with them.

2 MR. TREGONING: We discussed this comment.  
3 I don't think we need it. So, let's get into the --

4 MR. SNODDERLY: Yes, Rob, it's Mike  
5 Snodderly. So, we've got a half hour left. Because  
6 we really need to end this presentation at 10:00, and  
7 three comments to go. So, let's try to --

8 MR. TREGONING: Two comments to go.

9 MR. SNODDERLY: Two, great.

10 MEMBER APOSTOLAKIS: What do we have at  
11 10:00?

12 MR. SNODDERLY: A break at 10:15. Then we  
13 start the discussion which is going to be --

14 MEMBER APOSTOLAKIS: I thought you said  
15 industry presentation.

16 MR. SNODDERLY: That's why we need the  
17 extra time, for the next presentation.

18 CHAIRMAN WALLIS: Do we have an industry  
19 presentation on this topic.

20 MR. SNODDERLY: No, for the next topic,  
21 the Rule Making Package.

22 MEMBER APOSTOLAKIS: This topic will end  
23 at 10:00. So where are we now? Slide 11?

24 MR. TREGONING: Yes. So now we're at sort  
25 of the mead of the disagreement or the mead of the

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1 comments here.

2 MEMBER APOSTOLAKIS: Yes.

3 MR. ABRAMSON: Addressing your third  
4 comment on this, and just to -- as we stated again,  
5 this practiced geometric averaging is at variance with  
6 the methods employed previously in which the  
7 arithmetic averaging method is applied to the  
8 probability distribution of the experts.

9 And our response went along the following  
10 lines, first of all, fundamental consideration in the  
11 elicitation was to aggregate such that the final  
12 results represent the opinions of the panel as a  
13 whole.

14 And, let me just digress from this or just  
15 amplify this a little in response to your comment  
16 there about our statement that it's important in the  
17 report that the results represent the center of the  
18 group.

19 What we kept in mind at all times, of  
20 course, is this is an expert elicitation. And what's  
21 the rationale for doing this? Well, there's been a  
22 lot of experience with this, as you all know.

23 And the indication is -- or there's a lot  
24 of evidence that there's some wisdom in the group and  
25 that the experts each bring different perspectives,

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1 experience, intuition and so on and so forth, and that  
2 the group is better than any individual expert could  
3 be.

4 I should emphasize that the purpose the  
5 elicitation is not to try to identify one or two good  
6 experts. If we could do that we wouldn't have to have  
7 the elicitation in the first place.

8 Now, what do we mean by a group opinion?  
9 Well, it seems too axiomatic that a group opinion has  
10 got to be somewhere in the center of the group  
11 because, if it's near the high end for whatever  
12 reason, or the low end, then it's not a group opinion.

13 Most members of the group would not agree  
14 that this is a consensus opinion.

15 MEMBER APOSTOLAKIS: Are you talking about  
16 the point value now?

17 MR. ABRAMSON: I'm talking about if you're  
18 taking what he had -- we had, what, for BWRs we had  
19 eight, for PWRs we had nine experts who weighed in on  
20 this.

21 Say, for the eight, what we did for the  
22 purpose of the report for summary, we had them  
23 summarize these eight values or nine values so they --  
24 so, to replace them, to summarize them by a single  
25 point, a single value for whatever it was, for the

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1 mean, the median, the 5<sup>th</sup> percentile, whatever it was,  
2 and that this necessarily was, as a group opinion, had  
3 to be somewhere in the center of the group.

4 Because, if it was near the high end, it  
5 was like the 8<sup>th</sup> highest value or the 7<sup>th</sup> highest  
6 value, most members of the group would say, that's not  
7 a group opinion.

8 MEMBER APOSTOLAKIS: But that assumes that  
9 you have to work with the estimate, say, of the 95<sup>th</sup>  
10 percentile. Another way of looking at this is the  
11 consensus is sought at the distribution level.

12 MR. ABRAMSON: Well, we didn't choose to  
13 do this.

14 MEMBER APOSTOLAKIS: You did not?

15 MR. ABRAMSON: No. What we did is our  
16 emphasis in the report -- the parameters of interested  
17 --

18 MEMBER APOSTOLAKIS: Right.

19 MR. ABRAMSON: -- directly, specifically  
20 the mean, the median, the 5<sup>th</sup>, and the 95<sup>th</sup> percentile.  
21 And we did not try to estimate the distribution as a  
22 whole, just these particular parameters, which, you  
23 know, if you say in the report, are the ones that are  
24 used for regulatory decision making purposes.

25 MEMBER RANSOM: Part of the problem seems

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1 to be with what do you mean by center?

2 MR. ABRAMSON: Well, when I say center --

3 MEMBER RANSOM: I mean, the center of a  
4 log basis or what is --

5 MR. ABRAMSON: When I say center I mean  
6 center so that -- well, a center could be the median,  
7 for example.

8 MEMBER RANSOM: Right.

9 MR. ABRAMSON: It would be the halfway  
10 point.

11 MEMBER RANSOM: Or it could be the  
12 arithmetic average.

13 MR. ABRAMSON: Well, it depends. If you  
14 have -- in some cases we had where the difference  
15 between the low and the high value was several orders  
16 of magnitude.

17 The arithmetic mean would be between the  
18 highest and the next highest value. It would not be  
19 at the center of the group. And then, when I say the  
20 center of the group, it should represent in both from  
21 the point of view of the panel and also, of course,  
22 from the analyst, a group opinion, and not something  
23 that's skewed either high or low.

24 And what this should be would depend on  
25 the particular circumstances, I would say, of the

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1 situation.

2 MEMBER RANSOM: Well certainly, it would  
3 make a difference whether you considered the actual  
4 values or the log of the values, for example, to  
5 define the center.

6 MR. ABRAMSON: Well, what we did -- no, it  
7 wouldn't. It wouldn't because you're just making a  
8 monotonic transformation of the -- if you take the  
9 median and you take the logs, you're going to get the  
10 same value.

11 It doesn't make any difference. The  
12 median is the center whether it's spread out or it's  
13 compressed with the log scale. It makes absolutely no  
14 difference.

15 MEMBER RANSOM: You mean the mean or the  
16 median?

17 MR. ABRAMSON: Well --

18 MEMBER RANSOM: The median just divides  
19 half higher and half lower.

20 MR. ABRAMSON: Exactly. That's right.  
21 And by the center -- if you took the -- it depends on  
22 the value whether the arithmetic mean or the geometric  
23 mean, or some other kind of mean is going to be close  
24 to the median or not.

25 By the center of the group I mean

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1 something around the median.

2 MEMBER RANSOM: The median.

3 MR. ABRAMSON: Right.

4 MEMBER RANSOM: Okay.

5 MR. ABRAMSON: In the sense that you have  
6 -- well from a -- I guess from a mathematical point of  
7 view, it's one that I would say it's around the 50<sup>th</sup>,  
8 maybe the 60<sup>th</sup> percentile or the 40<sup>th</sup> percentile.

9 But it's not the 90<sup>th</sup> or the 95<sup>th</sup>  
10 percentile or the 5<sup>th</sup> percentile. That's point one.  
11 And point two is, of course, as Rob emphasizes, you  
12 all know we had extensive feedback and iteration with  
13 the experts.

14 It's one of the experts as a group should  
15 feel is a consensus opinion. And Rob already  
16 described how they weighed into this. I don't want to  
17 say that it's -- for example, we didn't use the median  
18 in our report, although we did in some of our  
19 preliminary evaluation, we did use the median because  
20 it was easy to calculate.

21 And we presented that to the experts. But  
22 we did not choose to use this as the final result.  
23 The median by definition is the center of the group.  
24 But we didn't use that.

25 But it should be something close to this

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1 for the purpose, again, of having this be accepted by  
2 the panel and also, obviously, by the analysts as a  
3 group opinion.

4 And that's the key in this. That's their  
5 assumption, that we want to get a group opinion. And  
6 this necessarily --

7 MEMBER APOSTOLAKIS: The fundamental  
8 difference.

9 MEMBER RANSOM: Wouldn't that affect what  
10 you consider to be the 95<sup>th</sup> percentile, for example?

11 MR. ABRAMSON: No. Because what we're  
12 doing -- remember what we're doing is we're estimating  
13 the 95<sup>th</sup> percentile. So we have 95<sup>th</sup> percentile from  
14 all eight or nine experts.

15 So, we want to know what is the group  
16 opinion about the 95<sup>th</sup> percentile. Well, we have  
17 these numbers here and we just take, you know, what we  
18 did, the geometric mean, whatever we did.

19 MEMBER RANSOM: Okay.

20 MR. ABRAMSON: Okay. So that's the  
21 fundamental philosophy behind. Now, the -- we  
22 outline, as I said, as Rob emphasized in the report,  
23 we took, you know, a lot of -- paid a lot of attention  
24 to explaining this to the experts, this philosophy.

25 We got what we call a consensus type

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1 estimate, which means the other center individual --

2 MEMBER APOSTOLAKIS: Let me -- it seems to  
3 me that, you know, as we have already said several  
4 times, given eight experts who are providing  
5 distributions, point values, or whatever, there are  
6 many, many ways that one can process that information.

7 So, what really should matter at the end  
8 is not whether one use a geometric or arithmetic and  
9 so on. In fact, as you guys did, doing a lot of  
10 sensitivity analysis informs the process.

11 So, what really matters at the end is, is  
12 the distribution that you guys are proposing in the  
13 executive summary a distribution that represents what  
14 we know now about the frequency of various size breaks  
15 so that the decision maker like the Staff or the  
16 Commission can base its decision on what you have  
17 produced?

18 That really should be the final thing  
19 because to argue whether we are in the middle -- I  
20 mean, you know, Lee has a point, maybe I have a point,  
21 somebody else has another point.

22 All these analyses, it seems to me, inform  
23 the process, and ultimately we form a judgment in our  
24 mind, and we say this is it. So, the final question  
25 really should be, the distribution that you are

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1 proposing in your exhibit, what does that represent?

2 And I think our disagreement is now  
3 whether it represents a community or just the eight  
4 experts.

5 MR. ABRAMSON: I'm going to come to this  
6 in a minute.

7 MEMBER APOSTOLAKIS: Okay. Why don't we  
8 focus on that, because we can discuss this forever.

9 MR. ABRAMSON: Okay.

10 MEMBER APOSTOLAKIS: I mean, this is just  
11 one way of doing it. You also did the mixture of  
12 distribution. I mean, I look at all these things. In  
13 my mind I form a distribution, right?

14 So the question is, at the end, can the  
15 Commission feel that, yes, if I look at this  
16 distribution, and we go with that the Staff proposes  
17 regarding the TBS we are concerned?

18 MR. ABRAMSON: Okay, let me skip then.

19 MEMBER APOSTOLAKIS: This much, because we  
20 are running out of time.

21 MR. ABRAMSON: Let's skip the next slide.  
22 The ACRS comment number 4, which is what you're  
23 saying, the final distribution should be the composite  
24 distribution of the analysts based on the sensitivity  
25 analysis, represents the expert community's current

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1 state of knowledge regarding local frequencies.

2 Okay. Our response is this, the main  
3 point, the first point is, the elicitation did not  
4 attempt to determine the state of knowledge of the  
5 expert community.

6 By that I mean we did not explicitly tell  
7 the -- I don't think so -- the experts that they were  
8 to -- obviously they all recognized they were a part  
9 of the expert community.

10 They wouldn't be there otherwise. But we  
11 didn't specifically ask them to try to tell us what  
12 the expert community to be a stand in or to their  
13 opinion what the expert community felt.

14 So, they were not there as representatives  
15 of the -- or as assessors of the expert community  
16 opinion. They were there for their own opinion. Now,  
17 again, saying the study represents the expert panel's  
18 current state of knowledge regarding LOCA frequencies.

19 So I would say, certainly everything we  
20 did was we tried to make sure that we fairly in an  
21 unbiased way as we possibly could, in as accurate a  
22 way as we possibly could, have the experts make sure  
23 that the results we got from the experts represented  
24 their opinion.

25 And then, of course, from the point of

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1 view of the aggregation, we tried to make sure that  
2 the -- tried to aggregate in such a way that the --  
3 what the results we finally came up with represented  
4 the panel as a whole.

5 So that's what we did. But we're talking  
6 about the expert panel. Now, because these -- the  
7 panel was not asked -- to ask as a stand in for the  
8 expert community, we certainly cannot claim the study  
9 represents the state of knowledge of the expert  
10 community.

11 We can't claim that. We have their  
12 personal opinions, but not their perception, the  
13 expert community's opinion.

14 MEMBER DENNING: Can we ask them --

15 MR. ABRAMSON: However -- okay, I'm sorry.

16 MEMBER DENNING: Maybe you're going to get  
17 there. Make your point.

18 MR. ABRAMSON: Okay. However, the panel  
19 -- this is of course very, very important. The panel  
20 selection was designed to represent broad  
21 organizational, experiential, and international  
22 differences within the community.

23 We very deliberately made that. This is  
24 not necessarily a -- we did not try to get a random  
25 sampling in any sense from the community. So we very

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1 carefully chose and obtained relevant diversity.

2 And, therefore, the diversity of the  
3 experts would tend to accomplish the full breath of  
4 views in the expert community. So we felt that we had  
5 the full breath from whatever in this industry,  
6 academia or the regulatory point of view of the expert  
7 community.

8 It's just that we did not explicitly  
9 identify them as representation or representative of  
10 the expert community. So, from that perspective, we  
11 can say that the results may very well represent the  
12 results of the expert community.

13 But, we didn't make that assessment. It's  
14 up, I think, to you and the Commission and so on in  
15 deciding to what extent these results are going to be  
16 relevant and valid.

17 MEMBER APOSTOLAKIS: But your words now  
18 are much more softer than what you have in the report.  
19 The report is absolute. No, we didn't do that.

20 Come on, you selected these guys, as you  
21 say, to represent the broad spectrum of use. You  
22 know, if I --

23 MR. ABRAMSON: I think these words are in  
24 the report. These particular words are in the report.

25 MEMBER APOSTOLAKIS: Yes, but, the report

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1 is big, right? They can be down here in --

2 MR. ABRAMSON: Certainly in the executive  
3 summary. I believe these words are taken from the  
4 executive summary or they are in the executive  
5 summary.

6 MEMBER APOSTOLAKIS: Well, let's see with  
7 Dr. Denning.

8 MEMBER DENNING: Well, I just think this  
9 is semantic. I think really that what you've done has  
10 really looked at the community that's out there and  
11 sampled.

12 You didn't go out intentionally to sample  
13 like that. But I think that the saying that it's not  
14 really representative is an over -- I mean, these  
15 words are okay here.

16 MR. ABRAMSON: I'd like to make another  
17 point. Maybe Rob was going to make this. I'll jump  
18 in. The community -- the expert community is a rather  
19 small community.

20 And, therefore, our petition is that this  
21 panel of 12 is a pretty good chunk. I do not know how  
22 big of a chunk, but a pretty good chunk of the expert  
23 community.

24 So, from that point of view, it's already  
25 fairly representative, although it's not necessarily

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1 a random sample.

2 WITNESS RICE: It doesn't have to be  
3 random. In fact, I wouldn't want it to be random. I  
4 want the best guys on the --

5 MR. ABRAMSON: Of course. And I would  
6 certainly oppose, you know --

7 MEMBER APOSTOLAKIS: But that's not --

8 MR. ABRAMSON: A random choice is not the  
9 one you want to make anyway.

10 MEMBER APOSTOLAKIS: Let me ask again. If  
11 the Commission bases its decision on what you guys  
12 propose in the executive summary, would they be basing  
13 their decision on the best state of the art right now  
14 regarding these frequencies?

15 MR. TREGONING: My opinion is yes.

16 MEMBER APOSTOLAKIS: So, why don't you say  
17 that in the executive summary? Why do you keep  
18 talking about random samples and this and that? I  
19 mean, just say it.

20 Okay, you made a mistake -- if you can  
21 call it a mistake -- in the sense that you didn't ask  
22 the experts to actually try to figure out the state of  
23 the art.

24 But, the care that went into selecting  
25 them, all this stuff, all these analyses, all this

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1 stuff, you're damn close, it seems to me. I mean,  
2 what else can we do right now?

3 You know, maybe form -- is it possible to  
4 have a review group of equally qualified experts that  
5 would look at your work and the expert opinions that  
6 you collected and come up with the expert community's  
7 distribution?

8 And would that be significantly different  
9 from what you already have? Especially on the high  
10 side, that's really what worries, I think, the  
11 regulator.

12 MR. TREGONING: Yes, if you formed another  
13 group, you would essentially be replicating the  
14 elicitation at that point.

15 MEMBER APOSTOLAKIS: No, I don't want to  
16 elicit again, I would have them review what you guys  
17 have done. But, do you think that is possible and  
18 would that give any results that would justify the  
19 expense drastically different?

20 MR. TREGONING: My opinion is no. And I  
21 think that's one of the reasons. The other way we're  
22 trying to tap into the expert community here as well  
23 is by going out for public comment, by doing the  
24 reviews of the NUREG that we've done with ACRS  
25 internally and otherwise.

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1           We're hoping to get some of that review  
2           and some of the comments and feedbacks that we've  
3           received. And, you know, when we went out for the  
4           external review panel, that was one of the objectives  
5           of that as well.

6           And I think, throughout this review  
7           process, we've received very valuable comments,  
8           including comments that we've received from ACRS that  
9           we're trying to use to inform us on how this report  
10          needs to be structured and presented.

11          And I think, just following up on your  
12          remarks, I think what reaction we'll take out of this  
13          is we're going to look at the executive summary yet  
14          again and make sure that we do, I'll say, in keeping  
15          with words that are on the slides here, to make sure  
16          that we, maybe more accurately and fairly represent  
17          what's been done here in a very concise manner.

18                   MEMBER APOSTOLAKIS: Yes, and --

19                   MR. TREGONING: To be consistent with some  
20                   of the concerns that you've raised.

21                   MEMBER BONACA: And I think, particularly  
22                   the second last paragraph, the way it's written, you  
23                   know, it says, you know, arguing about why the  
24                   geometric mean was chosen.

25                   It says mixed distribution aggregation can

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1 lead to significantly higher mean in 95<sup>th</sup> percentile  
2 estimates. And then you go into a long discussion to  
3 explain why you want to have that.

4 It almost seems as if you want to have a  
5 lower mean. But that's not really what they intend to  
6 do. And I think if there is some rewording here to  
7 reflect better this discussion, I think that should be  
8 appropriate.

9 MEMBER APOSTOLAKIS: Yes, exactly. The  
10 point is not which distribution gives me something or  
11 which method gives me something that I like. We do  
12 all the methods.

13 In fact, you did. What matters at the end  
14 is the group that I had, plus you, of course, because  
15 you are acting as the integrator. Having seen all  
16 these results, you know, if I do the arithmetic thing,  
17 I get this.

18 If I do the other thing, I get that. If  
19 I have error factor adjustment, I get something else.  
20 Having done all these, having looked at all this  
21 stuff, now, what do we think as a group?

22 And that's really what matters at the end.  
23 And it should be emphasized, not one method against  
24 the other. Maybe they decided at the end, you know,  
25 I looked at the arithmetic average, I think it's a

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1 little stretching it too much.

2 You know, so their consensus distribution  
3 did not really go close to that. But that's fine.  
4 That's up the experts.

5 CHAIRMAN WALLIS: George, it occurs to me  
6 there's something else here too. I mean, you can ask  
7 the experts for all these opinions and stuff and  
8 what's their best conclusion.

9 That's rather different than asking them  
10 what should the authority use as a distribution in  
11 order to make decisions. That might be a different  
12 question.

13 MEMBER APOSTOLAKIS: it's a very different  
14 question.

15 CHAIRMAN WALLIS: That's not the question  
16 being asked.

17 MEMBER APOSTOLAKIS: They should --

18 CHAIRMAN WALLIS: But I think that's the  
19 question you're trying to ask.

20 MEMBER APOSTOLAKIS: No. What I'm trying  
21 to answer is, is this the distribution of what the  
22 expert community -- that means what the state of the  
23 art is?

24 I don't want to have an expert who's  
25 working in some obscure laboratory somewhere in

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1 Germany come back and give us evidence that this  
2 distribution, for example, is optimistic.

3 I want to have this warm feeling that,  
4 yes, this distribution -- look, experts may disagree,  
5 you know, by a factor of two here and there.

6 But, by and large, we have captured what  
7 we know now as a community. And this is really what  
8 we should be using in regulatory decisions. Now, one  
9 way of doing that is to ask the experts at some point  
10 explicitly to consider the community.

11 Now, these guys admit they didn't do that.  
12 But now the next question is, are we really far off?  
13 And, you know, the selection of the experts and so on,  
14 I tend to agree with you that we really aren't because  
15 we were careful how we selected the experts.

16 We were careful, you know, with the  
17 process and so on. We did a lot of -- we, I mean you  
18 did a lot of sensitivity analysis and so on. But I'm  
19 not getting it at this stage into the question of how  
20 these results should be used.

21 No, this is up to different people who  
22 will come before us at 10:15.

23 CHAIRMAN WALLIS: No, but George, the  
24 thing is, for certain purposes you might want to use  
25 different distributions because there's a good reason

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1 for using that particular distribution for that  
2 purpose.

3 MR. TREGONING: And that's why we tried to  
4 be very clear. And that was one of the reasons we  
5 were hedging about having a set of summary results in  
6 the executive summary.

7 MEMBER APOSTOLAKIS: Well, yes. And, as  
8 you recall, in the draft of November they said, you  
9 know, you go and read the report and decide what you  
10 want to use. And we objected.

11 CHAIRMAN WALLIS: Well, George, can I ask  
12 you, you've asked all these questions, are you not  
13 satisfied that they have a reasonable cross section of  
14 the expert community?

15 MEMBER APOSTOLAKIS: I am.

16 CHAIRMAN WALLIS: That the expert  
17 community is rather small and they have a fairly good,  
18 you know, fraction of that community is being captured  
19 here, that it is sufficiently diverse and all that.  
20 Are you satisfied with all that?

21 MEMBER APOSTOLAKIS: Yes.

22 CHAIRMAN WALLIS: All those answers to  
23 those questions?

24 MEMBER APOSTOLAKIS: Yes.

25 MEMBER KRESS: Yes. I think he just says

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1 that it ought to say that in the report.

2 MEMBER APOSTOLAKIS: It's the words.

3 MEMBER KRESS: The words, yes.

4 MEMBER APOSTOLAKIS: Well, let me tell you  
5 what I think. First of all, if I combine this with  
6 what we're going to hear in the next session, the way  
7 the Staff is proposing to select TBS, I think what  
8 they have done is fine.

9 The stuff is going a little higher.  
10 That's fine. Now, if there is any discussion at some  
11 point of going to lower transition break size, lower  
12 than eight inches for PWRs, then you are entering now  
13 the range of sizes of the experts are giving me.

14 Then I would probably have to rethink  
15 about it. The thing that really bothers me is that we  
16 do not seem to be building on the work that this  
17 Agency has sponsored in the past.

18 In fact, if I look at the citations on the  
19 revised report, chapter E, section E, this joint  
20 effort by EPRI, NRC and DOE is not even close. And  
21 that bothers me.

22 Because, in the future I'm sure people  
23 will go to this report and say this is the latest on  
24 expert opinion and LOCAs and so on and they will use  
25 this.

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1           And the question of expert community, for  
2           example, I don't want it to disappear. I want in the  
3           future to be more aware of the fact that we're really  
4           after the expert community's distribution, not just  
5           the expert panels.

6           Okay? And that's what bothers me with it.  
7           But in terms of revising 50.46, I don't think there is  
8           a problem.

9           CHAIRMAN WALLIS: I do not know quite what  
10          you mean by expert community. Each of these  
11          communities is sort of a pyramid. And if you take  
12          your expert community and make it too big, they're no  
13          longer experts.

14          Your experts are usually fairly select  
15          group.

16          MEMBER APOSTOLAKIS: You know what I mean.  
17          I mean the state of the art.

18          CHAIRMAN WALLIS: Well, it's often behind  
19          the experts. The standards --

20          MEMBER APOSTOLAKIS: This --

21          CHAIRMAN WALLIS: -- used by engineers in  
22          the field is often way behind the expert knowledge in  
23          the field.

24          MEMBER APOSTOLAKIS: And it's interesting  
25          to me that yesterday, in fact, the whole methodology

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1 that these guys used was on the early -- was in fact  
2 based on this joint effort on expert opinion  
3 elicitation. Anyway, you have a slide 15?

4 CHAIRMAN WALLIS: George, you may a  
5 predictive statement, which was deterministic, which  
6 was that we will finish by ten o'clock.

7 MEMBER APOSTOLAKIS: We will.

8 MR. TREGONING: I certainly hear what you  
9 say. We're going to go back and look at the executive  
10 summary as well as some other areas to make sure.

11 It sounds like it is semantics that we're  
12 talking about in making sure that the semantics and  
13 the way we characterize the elicitation is clear with  
14 respect to the state of the art and what was done.

15 I mean, we're taking that as an action to  
16 go and do further revision at this point on the  
17 executive summary.

18 MEMBER APOSTOLAKIS: Are we going to see  
19 this report after the public comment period.

20 MR. TREGONING: Yes.

21 MEMBER APOSTOLAKIS: We will again?

22 MR. TREGONING: Certainly, yes.

23 MEMBER APOSTOLAKIS: Okay. Do you have  
24 any closing comments?

25 MR. TREGONING: Closing comments, again,

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1 the reason that we're here is we're requesting a  
2 letter from ACRS essentially allowing us or  
3 recommending that we proceed for public comment with  
4 the draft NUREG report.

5 MEMBER APOSTOLAKIS: Any comments,  
6 questions from the members?

7 (No verbal response.)

8 MEMBER APOSTOLAKIS: Anybody else?

9 (No verbal response.)

10 MEMBER APOSTOLAKIS: Well, Mr. Chairman,  
11 we finished six minutes earlier.

12 CHAIRMAN WALLIS: Very good. We'll expect  
13 this to be maintained, this performance George. Let  
14 us take a break until ten after ten.

15 MEMBER APOSTOLAKIS: No, 10:15.

16 CHAIRMAN WALLIS: I guess we can't stop --  
17 it's just I'm trying to leave enough space for the  
18 examination subject, which I think is going to take  
19 some time. Okay. We'll take a break until 10:15.

20 (Whereupon, the above-entitled matter  
21 went off the record at 9:50 a.m. and went  
22 back on the record at 10:10 a.m.)

23 CHAIRMAN WALLIS: Come back into session,  
24 please. The next topic is 50.46, and I'll hand it  
25 over to my colleague, Dr. Shack to get things going.

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1                   VICE CHAIRMAN SHACK: Okay. We're here  
2 today to review a proposed draft or a draft of the  
3 proposed revision to 50.46 to risk inform the rule.  
4 In December, we reviewed a previous draft of a  
5 proposed rule change.

6                   There have been a number of changes in  
7 this new rule that we're going to be seeing today.  
8 The three most important ones that I could identify is  
9 the transition break size now is a single-ended  
10 rupture of the largest attached pipe in the  
11 recirculation piping system.

12                   The previous rule prohibited bundling of  
13 unrelated changes when we were assessing essentially  
14 changes in risk when we were making changes here. Now  
15 the new rule will permit bundling of unrelated  
16 changes, so that's a substantial change in the rule.

17                   And they've also removed some of the  
18 detail from the acceptance criteria for changes under  
19 50.46. That is the sort of Reg Guide 1.174 stuff that  
20 was built into the rule has been now -- some of that  
21 has been removed and there's basically a number of  
22 high-level requirements left but some of the details  
23 have been gone. And I guess there's a suggestion  
24 there will be a regulatory guide that will provide  
25 more detail to that.

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1           The rule still requires that you be able  
2 to mitigate all breaks up to the DEGB. However, when  
3 you do that, you do not need to assume loss of  
4 off-site power for an independent single failure, and  
5 you can credit non-safety grade equipment. And,  
6 again, the requirement is that you maintain coolable  
7 geometry and provide long-term cooling. The notion  
8 will be that there will be somewhat relaxed limits on  
9 the amount of damage that it can tolerate. But,  
10 again, the requirement that you can only operate in  
11 configurations in which this capability has been  
12 analyzed and credited is still maintained in the rule.

13           And Richard Dudley will lead us through a  
14 more detailed discussion of some of these changes and  
15 the staff's reasoning behind the changes.

16           MR. DUDLEY: Good morning. I'm Richard  
17 Dudley. I'm the rulemaking project manager for the  
18 risk-informed 50.46 rule. Today, I'd like to  
19 accomplish two things. We'd like to accomplish two  
20 things in our talk. First, as Dr. Shack said, we'd  
21 like to update the ACRS on what we've done to change  
22 the rule since we were last here on the 2nd of  
23 December. And, secondly, we would like to ask the  
24 ACRS for a letter so that we can go forward with  
25 putting the proposed rule forward to the Commission.

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1 And we'd like the letter hopefully by March 11. And  
2 I'll show you later in our schedule why that's  
3 important to us.

4 When we were here last on December 2, we  
5 received a letter from the ACRS on the 17th with three  
6 major comments. The first comment was that we should  
7 maintain mitigation of accidents up to and including  
8 the largest double-ended break of a reactor coolant  
9 system pipe. The proposed rule had that mitigation,  
10 and the current rule has that mitigation, so we have  
11 made no changes in that area.

12 The second comment was that for the  
13 transition break size we should consider the  
14 single-ended break versus a double-ended break. As  
15 you have heard, we have looked into that and decided  
16 we should change the TBS to a single-ended break.

17 And the final comment from the ACRS was  
18 that we really hadn't done what's necessary to  
19 quantify the risk benefits of a smaller TBS and that  
20 additional studies and work would be necessary before  
21 that relationship was properly known. And so we're  
22 doing some studies on that that we'll talk to you  
23 about in a moment.

24 Again, the TBS now is a single-sided  
25 break. Gary Hammer, of our Mechanical Engineering

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1 Group, is going to talk to you in some detail about  
2 the changes that we've made to the TBS and why we've  
3 made those.

4 We've initiated thermal-hydraulic studies,  
5 both the NRC and the industry, to investigate the risk  
6 benefits of smaller technical break size. Ralph  
7 Landry, of our Reactor Systems Group, will talk to you  
8 in some detail about those studies and the parameters  
9 and the other things that we're looking at.

10 And also we've made a number of changes.  
11 In addition to changes to bundling, we've made some  
12 other changes in the risk assessment requirements that  
13 we had in the proposed rule. These would be the  
14 requirements that would be used to determine the  
15 acceptability of facility changes that are enabled by  
16 the revised 50.46 ECCS requirements.

17 CHAIRMAN WALLIS: I thought, Ralph, doing  
18 risk benefits a smaller break size, but, presumably,  
19 if you back off on the requirements for the large  
20 breaks, then the risk associated with large breaks  
21 goes up?

22 MR. DUDLEY: I guess that would be the  
23 case.

24 CHAIRMAN WALLIS: Are you looking at that  
25 risk at all?

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1 MR. DUDLEY: If you optimize your ECCS  
2 design for smaller breaks, which are more likely, you  
3 could have the net effect be the overall risk to go  
4 down.

5 CHAIRMAN WALLIS: You could, but you don't  
6 know. But you can't ignore the other effects on the  
7 larger breaks while you're doing that.

8 MR. DUDLEY: Yes, that's correct. You  
9 would have to factor that in and weigh that off  
10 against any increases. That's correct. Again, we're  
11 going to talk about that in a moment.

12 VICE CHAIRMAN SHACK: Again, on this 1.174  
13 type requirements, we make all sorts of decisions on  
14 changes to licensing basis using 1.174 now. Why do we  
15 have to have new requirements in the rule for these  
16 particular licensing basis changes?

17 MR. DUDLEY: I think Mike Tschiltz will go  
18 into that perhaps later on. My understanding is that  
19 we had Reg Guide 1.174. It had a number of  
20 recommended items of guidance in there. And in  
21 addition to that, as the staff went through the Reg  
22 Guide 1.174 review for risk-informed changes, there  
23 were additional things that the staff, I guess,  
24 performed or considered or looked at or there was a  
25 level of detail that perhaps wasn't in the reg guide

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1 that we used when we reviewed risk-informed changes.  
2 Again, I'm going to have to let --

3 VICE CHAIRMAN SHACK: Why these changes to  
4 the licensing basis deserve that consideration and  
5 other changes to the licensing basis are okay to get  
6 by with an inferior version of 1.174.

7 MR. DUDLEY: Well, the inferior version of  
8 Reg Guide 1.174 is not a requirement at all; it's just  
9 guidance.

10 VICE CHAIRMAN SHACK: But it's an  
11 acceptable way to make licensing changes.

12 MR. RUBIN: Well, if I could point out --  
13 this is Mark Rubin from the staff -- the base of 1.174  
14 was licensing changes that met all current regulatory  
15 requirements. Here we're making substantial changes  
16 to some of the fundamental safety requirements that  
17 were promulgated 20, 30 years ago. And so as a  
18 consequence, 1.174, the general approach to 1.174,  
19 while it's being significantly retained, it's being  
20 expanded to fill into the context of supporting a  
21 major regulatory change. As a consequence, some areas  
22 a little more detail is being provided to provide  
23 clarity and to ensure that adequate safety is  
24 maintained.

25 MEMBER APOSTOLAKIS: I thought part of the

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1 reason was that as long as it's a regulatory guide you  
2 really don't have to follow it. But if you put it in  
3 the rule --

4 VICE CHAIRMAN SHACK: Yes, but you have  
5 that problem with every licensing basis change. They  
6 don't have to use Reg Guide 1.174; they just do.

7 MR. RUBIN: But they have to either follow  
8 the regulatory guide or provide an alternate  
9 acceptable method. Here there are requirements in the  
10 rule that have to be satisfied, and there will be a  
11 regulatory guide that will provide one way of meeting  
12 those requirements.

13 VICE CHAIRMAN SHACK: Yes, because you've  
14 chosen to do that for these changes to the licensing  
15 basis.

16 MEMBER KRESS: I think part of the problem  
17 is that when you change this rule there are enumerable  
18 changes that can be made to the plant that changes the  
19 licensing basis as a result of the rule change. It's  
20 relatively impossible to a priori know how many plants  
21 will make how many of those changes. Therefore, to go  
22 up front and say, "Apply 1.174," it's not going to be  
23 very easy because you have to somehow make judgments  
24 about all of those changes that are going to be made  
25 and how each of them affects each plant. So I don't

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1 see how they can --

2 VICE CHAIRMAN SHACK: They can't make any  
3 change without coming in and presenting it.

4 MEMBER KRESS: Well, after the fact they  
5 will come in and use 1.174 to track the result of  
6 those changes. I think they're using it -- I don't  
7 think you can use it as a basis for judging the pipe  
8 size or the rule. You can use it as a control of the  
9 effect of the rule once it's in place.

10 VICE CHAIRMAN SHACK: The rule, as I  
11 understand it, will not change anything that's in  
12 place. If a plant wants to change anything in  
13 response to the new rule, they're going to have to  
14 come in and apply for a change to their licensing  
15 basis.

16 MEMBER KRESS: And I think they will use  
17 1.174 like criteria for that.

18 VICE CHAIRMAN SHACK: But why can't they  
19 just use 1.174?

20 MEMBER KRESS: They probably could have.  
21 Every plant would have had to come in and do it.

22 MR. DINSMORE: This is Steve Dinsmore from  
23 the staff. I think we couldn't just reference 1.174  
24 in the rule. We wanted to put enough in the rule to  
25 provide the framework with which we had to work with.

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1 And so that's why we actually put some of the 1.174  
2 criteria into the rule.

3 MEMBER APOSTOLAKIS: In other words, you  
4 don't people to propose an alternative approach.

5 (Laughter.)

6 If it's a regulatory guide, they can. Now  
7 you're putting it in the rule.

8 VICE CHAIRMAN SHACK: Now they will have  
9 no alternative.

10 MR. SHERON: Dr. Shack, if I could also  
11 add, if you remember that what the rule allows is  
12 beyond the transition break size, okay? There are a  
13 number of things that are currently regulatory  
14 requirements, for example, consideration of a single  
15 -- or assumption of a single act of failure occurring,  
16 picking parameters at their worst case conditions.  
17 For example, as I said, we assume infinite operation  
18 for decay heat along with the assumption of a maximum  
19 peaking factor which those two can't occur, basically,  
20 at the same time, yet those are requirements that  
21 currently exist.

22 If a licensee were to come in, you know,  
23 and as Mark said, the 1.174 is a risk-informed reg  
24 guide but licensees still have to meet the regulatory  
25 requirements that exist. What we're doing is we're

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1 changing the regulatory requirements in this case,  
2 okay? When we apply 1.174 to other situations,  
3 licensees still have to meet the regulations  
4 regardless.

5 In this case, if a licensee, for example,  
6 were to come in and say, "I want to change my ECCS  
7 analysis, and I want to use Reg Guide 1.174," unless  
8 they used, for example, infinite decay heat, 1.2 times  
9 ANS, et cetera, and the like, they would have to  
10 request an exemption from the regulation. They would  
11 still have to meet 50.46 requirements. That's the  
12 difference. And this is allowing that we are changing  
13 50.46 requirements. We're backing off from them, and  
14 what the 1.174 does --

15 VICE CHAIRMAN SHACK: But with the new  
16 rule in place, with 50.46(a) in place, why can't he  
17 now come in under 1.174 and say, "I want to change my  
18 diesel start time" and present an analysis with a  
19 1.174 analysis? He'll do exactly the same thing  
20 except the requirements are in the rule versus the reg  
21 guide. If we decide in our infinite wisdom sometime  
22 that we need to change 1.174, we now are faced with  
23 the fact that we'll have things built into the rule  
24 rather than the 1.174. So we're --

25 MR. SHERON: Well, again, the difference,

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1 I think, as Mark said, and that is that 50.46 is an  
2 enabling rule. We want to have that control,  
3 basically, over changes in risk, because we believe  
4 that if a license were to come in and propose changes  
5 under 50.46(a), they could result in substantial  
6 changes to public health and safety from reduction in  
7 risk.

8 As you said, 1.174 is merely -- it's a  
9 guide, it's an acceptable way to meet the Commission's  
10 rules and regulations. It's not the only way. That  
11 puts more of a burden on the staff from the standpoint  
12 is a licensee wants to deviate from 1.174 we have to  
13 consider it, we have to -- it basically becomes the  
14 burden is on us to say why something's not acceptable.  
15 I think the approach we're trying to promulgate here  
16 is to put some consistency in the regulatory process  
17 in how licensees come in and justify changes to their  
18 plants. We've probably beat this enough to death.

19 MR. DUDLEY: Well, you'll get another  
20 chance toward the end, and Mike Tschiltz, the Branch  
21 Chief of the Probablistic Assessment Branch, will be  
22 talking to you about the changes in the risk  
23 assessment that follows.

24 Now, I'd just like to talk about the  
25 schedule for issuing a proposed rule. We're at the

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1 point where we've just completed office concurrence  
2 and we've received concurrence or comments from a  
3 number of different offices. On March 10, our current  
4 internal schedule is to resolve any open issues  
5 associated with the concurrence or concurrence  
6 comments. And now I'd like to kind of go to the end  
7 of the schedule. On the March 31 date when we're  
8 supposed to have this proposed rule to the Commission,  
9 in order to do that, working backwards, we have to  
10 provide it to the EDO on March 23. And to get it to  
11 the EDO on that date, we have to start the concurrence  
12 process around the 17th or the 18th of March.

13 So it's important for us to get your  
14 letter somewhere very near March 11 because if it  
15 contains any items that we need to address, either in  
16 rule language or in the Federal Register notice, we  
17 will need to make those changes before we start the  
18 concurrence process. This is why we're asking for the  
19 letter by a particular date.

20 And the last two slides are on what we  
21 call a planning schedule. This gives you just an  
22 overall idea of how the schedule for the proposed rule  
23 and the final rule would go. The purpose of these  
24 slides is not to specify the schedule we'll actually  
25 use because it's all contingent on many things we have

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1 no control over, but the purpose of these slides is to  
2 show you that we'll be coming back to the ACRS on  
3 numerous occasions as we continue to go through this  
4 rulemaking process.

5 If we assume that the Commission is able  
6 to issue an SRM in two months, and that's just an  
7 assumption, that's a pretty optimistic assumption,  
8 quite honestly, but if that were the case, then we  
9 would issue the proposed rule somewhere around the  
10 middle of June. We're already working on the reg  
11 guide.

12 MEMBER APOSTOLAKIS: What SRM would that  
13 be?

14 MR. DUDLEY: We'll put forward the  
15 proposed rule to the Commission and if the Commission  
16 gives us an SRM that tells us to issue the proposed  
17 rule --

18 MEMBER APOSTOLAKIS: Oh.

19 MR. DUDLEY: -- towards the end of May,  
20 then we would publish the proposed rule in mid-June.

21 We're already working on the reg guide,  
22 and we have an internal date of the 30th of June to  
23 complete the first internal draft of that reg guide.  
24 So in the summer of 2005 we'll probably initiate  
25 discussions with the ACRS on the reg guide, most

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1 likely with the subcommittee. In late summer or early  
2 fall of 2005, we'll publish the reg guide for comment  
3 and it will be a 75-day comment period, the same  
4 comment period we believe that we'll use for -- that  
5 we know we'll use for the proposed rule, and we think  
6 we'll use the same period for the reg guide.

7 In September of 2005, the proposed rule  
8 comment period would end. Shortly after that, in the  
9 fall of 2005, the comment period on the reg guide  
10 would also end. In winter 2005-2006, we're looking to  
11 complete the final rule package in the reg guide, the  
12 final reg guide. So we'll probably meet with the ACRS  
13 at least one more time in the winter of 2006 to  
14 discuss the reg guide and the final rule, maybe in one  
15 meeting, maybe in separate meetings.

16 CHAIRMAN WALLIS: It's interesting that  
17 you're putting the reg guide and the rules together  
18 here; they go out as a package.

19 MR. DUDLEY: That's correct. That's our  
20 goal.

21 CHAIRMAN WALLIS: Whereas what we've got  
22 today to look at is a rule --

23 MR. DUDLEY: Right.

24 CHAIRMAN WALLIS: -- with great vagueness  
25 about what might be in the reg guide, I think

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1 deliberately because you haven't done it yet.

2 MR. DUDLEY: Yes.

3 CHAIRMAN WALLIS: It gives you freedom to  
4 put in what's appropriate. But we've only got one of  
5 those things today.

6 MR. DUDLEY: That's correct, yes. But you  
7 will be seeing the reg guide at least two more times.

8 And in the spring of 2006, we would be in  
9 a position to put the rule forward to the Commission.  
10 Again, I want to emphasize, and there's an asterisk on  
11 all the planning schedules, that these dates are not  
12 official dates. They're contingent on many things we  
13 have no control over. And they're just kind of for  
14 ballpark planning purposes only, and the elapsed times  
15 on the rulemaking items are based on typical  
16 rulemaking schedules for other goals, rules that we've  
17 worked with.

18 MR. SHERON: Dick, could I add one thing  
19 that I think Dick didn't cover? The industry has  
20 indicated their desire to develop let me call it an  
21 evaluation or an implementation guide document,  
22 perhaps similar to what they did for Generic Issue  
23 191. We have agreed that we think that's something we  
24 encourage them to do. I don't know their schedule  
25 right now. Maybe that's a question you might want to

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1 pose to them when they come up and speak, but the  
2 thought is is that somewhere down the road they will  
3 have their own guidance document which the staff will  
4 review, and presuming we find it acceptable we would  
5 then probably endorse it as another alternative method  
6 for implementing the 50.46(a) rule. We would endorse  
7 it through our reg guide. So that's another piece  
8 which you'll probably become involved in.

9 MR. DUDLEY: Now I'd like to introduce  
10 Gary Hammer from the Mechanical Engineering Branch,  
11 and he'll talk about the revised selection of the  
12 transition break size.

13 MR. HAMMER: Yes, good morning. In way of  
14 a little brief background on the selection of the TBS,  
15 as you remember, we were here in late 2004 on a couple  
16 of occasions to discuss this with you before where we  
17 outlined the basis for the TBS selection at that time,  
18 and we discussed that we had based that on several  
19 considerations, foremost the expert elicitation  
20 frequency estimates. Together, with that, we wanted  
21 to incorporate consideration of uncertainties and  
22 sensitivities that might need to be considered, and we  
23 also wanted to try to account for adjustments that  
24 might further need to be incorporated, such as any  
25 considerations due to heavy loads other than during

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1 normal operation or the sizes of actual attached pipes  
2 that are configured in the plants.

3           And as we discussed, ultimately, we based  
4 the size of the TBS on the size of the largest  
5 attached pipe in the RCS loop, and those size pipes  
6 roughly have the frequency of the 95 percentile of ten  
7 to the minus 5th per reactor year. Piping larger than  
8 that, larger than those attached pipes, tends to be  
9 quite a bit larger and has quite a bit of smaller  
10 frequency, such that you have this jump, if you will,  
11 which forms sort of a natural decision point, if you  
12 will.

13           At that time, we were postulating that the  
14 TBS be considered as double-ended since it was an  
15 actual broken pipe, and that it would be applied as a  
16 double-ended break at the limiting location; that is,  
17 it would have to be moved around in the main loop just  
18 to see where the limiting location was.

19           MEMBER APOSTOLAKIS: No, wait. Go back.  
20 Let's go back. I think the first sub-bullet under the  
21 first bullet is a little misleading. The frequency,  
22 actually -- eight inches I think is the smallest  
23 diameter, right?

24           MR. HAMMER: It would depend on how you  
25 aggregate the data. The aggregation had a big change

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1 --

2 MEMBER APOSTOLAKIS: No, no, no. The  
3 pipes attached to the RCS main loop, I think the  
4 smallest size is eight inches?

5 MR. HAMMER: Oh, yes.

6 MEMBER APOSTOLAKIS: Forget about the  
7 expert opinion. I'm talking about the plants now.

8 MR. HAMMER: Okay.

9 MEMBER APOSTOLAKIS: It's about eight. I  
10 think the frequency of the whole equivalent diameter  
11 of eight inches is much lower -- it's lower than ten  
12 to the minus five. It's not ten to the minus five, as  
13 this sub-bullet implies. And that was your choice is  
14 a little more conservative than this.

15 MR. HAMMER: I'm not sure --

16 MEMBER APOSTOLAKIS: Attached piping has  
17 95th percentile break frequency of about ten to the  
18 minus five?

19 MR. HAMMER: That's roughly --

20 MEMBER APOSTOLAKIS: It's not an accurate  
21 statement.

22 MR. HAMMER: It's not exact.

23 MEMBER APOSTOLAKIS: It's lower. The  
24 frequency is actually lower.

25 MR. HAMMER: Well, if you look at the 95th

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1 percentile, those numbers were of course a little  
2 bigger breaks. And if you look at the LOCA categories  
3 covered some range between LOCA Category 3 and LOCA  
4 Category 4 or 4 to 5. And so all of these pipes fell  
5 roughly in that range.

6 MEMBER APOSTOLAKIS: I think it's lower.

7 MR. HAMMER: Coupled with that, the next  
8 bullet, which is that the next larger pipe has a much  
9 lower frequency, so --

10 MEMBER APOSTOLAKIS: So what you're doing  
11 here, for my own benefit, if I go to the 95th  
12 percentile of the frequency failure, of the  
13 distribution of the frequency failure, then I have a  
14 bunch of expert opinions, right? Then I will also go  
15 to the 95th percentile of the expert opinion  
16 variability, and that's the ten to the minus five  
17 you're using?

18 MR. HAMMER: I'm not sure I understand  
19 what you're saying. We were only working with one  
20 curve, but the curves were aggregated in different  
21 ways.

22 MEMBER APOSTOLAKIS: But this one curve  
23 you are using is from the executive summary from the  
24 report? Is that what you're using? You say you're  
25 working with one curve. Where did that curve come

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1 from?

2 MR. HAMMER: Well, you mentioned 12  
3 experts, but the experts were aggregated into one  
4 curve. That's what I meant.

5 MEMBER APOSTOLAKIS: Right, from the  
6 executive summary.

7 MR. HAMMER: But there were several of  
8 those curves.

9 MEMBER APOSTOLAKIS: I know. And which  
10 one did you pick?

11 MR. HAMMER: We tried to consider that  
12 there was some sensitivity involved in which curve you  
13 picked, so we took that into consideration.

14 MEMBER APOSTOLAKIS: Did you pick the one  
15 that the previous speakers in the previous session  
16 feel is the best consensus curve or you picked another  
17 one?

18 MR. HAMMER: Actually, the base case was  
19 the geometric mean curve --

20 MEMBER APOSTOLAKIS: Yes.

21 MR. HAMMER: -- that you heard about  
22 earlier. There were also the aggregations of the  
23 mixture distribution or the arithmetic mean, and we  
24 looked at all of those and tended to pick whatever  
25 number came up as the larger of the group.

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1 MEMBER APOSTOLAKIS: Oh, okay.

2 MR. HAMMER: So this is -- realizing that  
3 there's not uniform agreement on the exact aggregation  
4 anyway and --

5 MEMBER APOSTOLAKIS: Okay.

6 MR. HAMMER: -- and we wanted to consider  
7 that.

8 MEMBER APOSTOLAKIS: So you went with the  
9 most conservative estimate that you could find.

10 MR. HAMMER: Well, yes. I mean of course  
11 95th percentile is arbitrary, so in some person's mind  
12 that might not be the most conservative.

13 MEMBER APOSTOLAKIS: But the point is that  
14 --

15 VICE CHAIRMAN SHACK: We're supposed to  
16 finish at 10:55.

17 MEMBER APOSTOLAKIS: But this is an  
18 important point. I don't know why the other guy  
19 hasn't bothered to come up with their best  
20 distribution.

21 VICE CHAIRMAN SHACK: Well, he's going to  
22 pick a different break size anyway. He's  
23 conservative, George.

24 MEMBER APOSTOLAKIS: I know he is. All  
25 right.

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1 VICE CHAIRMAN SHACK: Let's move on.

2 MEMBER RANSOM: Is there a slight  
3 disconnect here? They're focusing on attached piping,  
4 and I thought the elicitation was for cracks in piping  
5 and more or less of a continuous distribution.

6 VICE CHAIRMAN SHACK: This is the size.

7 MEMBER RANSOM: Right.

8 VICE CHAIRMAN SHACK: They're picking the  
9 size based on the sciences.

10 MEMBER RANSOM: But why pick it based on  
11 attached piping? Why not pick it based on just on the  
12 probability of occurrence regardless?

13 MR. HAMMER: Well, we looked at that. I  
14 mean you could have holes in the system of various  
15 configurations. We felt like one of the ways that --  
16 since the bigger pipes tend to be thicker and more  
17 robust, then there was a greater likelihood that if  
18 you had a break of a given size, it might be in the  
19 attached pipe. Because the wells are oriented in a  
20 circumferential fashion, so if you have a crack of a  
21 given length, it tends to affect you more that way  
22 than in some other way.

23 MEMBER RANSOM: But we heard from the  
24 elicitation that the double-ended or guillotine break  
25 was more unlikely than, say, cracks in piping and

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1 things like that, which might open up, which then  
2 leads you to a continuous distribution of sizes of the  
3 break, even though it's single-ended type of thing.  
4 And I would think that your choice of TBS would be  
5 based on the same type of consideration.

6 MR. HAMMER: Well, I heard the discussion  
7 earlier. I'm not sure I exactly agree with it, but we  
8 wanted to capture what we thought were the important  
9 things in terms of the actual configurations. And so  
10 we felt like the attached pipes were a major  
11 consideration.

12 VICE CHAIRMAN SHACK: But, again, this  
13 size does bound all those other holes that could  
14 appear in the system --

15 MR. HAMMER: Right.

16 VICE CHAIRMAN SHACK: -- which is  
17 consistent.

18 MR. HAMMER: Right. Right. And I'll get  
19 into that a little bit. We looked at how we might do  
20 something regarding varying the size of the break with  
21 regard to location, and I'll touch on that a little  
22 bit. We did investigate that.

23 After the last RCS meeting in December, we  
24 set about investigating ways that we might be able to  
25 better estimate the TBS, make it smaller or more

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1 accurately estimate it. We looked at primarily two  
2 issues. The first was could we vary the size of the  
3 TBS with respect to the location, and I think this  
4 gets into your question a little bit.

5 One of the things that we specifically  
6 wondered, and this is kind of maybe just one example,  
7 but we felt like it was an important one, on PWRs you  
8 have hot legs and cold legs that operate at slightly  
9 different temperatures. Might be 40 degrees F or 50,  
10 60 degrees F, whatever it is. Anyway, it's  
11 substantial, perhaps, in terms of the degradation  
12 mechanisms being somewhat different, at least  
13 theoretically.

14 So we thought -- and cold leg breaks tend  
15 to be limiting thermal-hydraulically in the analysis.  
16 So we thought, well, okay, we're basing this TBS on  
17 the largest attached pipe, which is actually the surge  
18 line, and the surge line is attached to the hot leg.  
19 Do we need to make that same size break in a cold leg?  
20 Maybe it doesn't logically follow.

21 So we went through that though process,  
22 and we said, well, can we further parse or subdivide  
23 some of the information that was in the elicitation  
24 data, in some of those estimates, and see if we could  
25 come up with some difference like that or some better

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1 estimate, which might be beneficial in terms of making  
2 the break somewhat smaller in the cold leg?

3 But when we started to do that we found  
4 that we really couldn't adequately quantify such  
5 difference, because the elicitation responses were in  
6 terms of overall frequencies of a certain size  
7 aggregated over a significant population. So if you  
8 start to break that data out in that way, it really --  
9 you're doing something and it really wasn't generated  
10 for, we didn't feel like. So we felt like we're  
11 introducing a lot of additional uncertainty in trying  
12 to make that type of formulation.

13 And so we felt like that what we would do  
14 is just stay with the size of the largest attached  
15 pipe and apply that from all locations. But --

16 MEMBER RANSOM: That's what you're  
17 intending to do, apply it in all locations.

18 MR. HAMMER: Right.

19 MEMBER RANSOM: Okay.

20 MR. HAMMER: Well, in all locations, but  
21 --

22 MEMBER RANSOM: In cold legs?

23 MR. HAMMER: Right. Right. Right. The  
24 other question we had was something that the -- yes?

25 VICE CHAIRMAN SHACK: Two minutes we'll

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1 finish up?

2 MR. HAMMER: Two?

3 VICE CHAIRMAN SHACK: Two.

4 MR. HAMMER: Okay. I'll run quick. All  
5 right. The other question was something that the ACRS  
6 had specifically asked about that we though was a good  
7 question, whether it needed to be modeled as a  
8 double-end. There's several considerations about  
9 that, and I've listed them there. Ultimately, we felt  
10 like -- I guess the most important bullet there is  
11 that the, as you heard this morning, expert  
12 elicitation really estimated frequencies of certain  
13 size holes in the system, and our further  
14 consideration of doubling that size hole was  
15 essentially double counting that would be  
16 inappropriate, in large part.

17 And even if you look at the full break of  
18 pressurizer surge line, which does simultaneously  
19 empty the pressurizer contents in addition to flow out  
20 of the hot leg, the primary effect is what's coming  
21 out of the hot leg, not what's coming out of the  
22 pressurizer. And so -- let me see if there's anything  
23 else there.

24 CHAIRMAN WALLIS: You had something about  
25 manways.

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1 MR. HAMMER: It's essentially bounded --

2 CHAIRMAN WALLIS: We were happy that the  
3 double-ended break sizes seem to bound the manway  
4 break, but the single-ended break probably does not  
5 bound the manway break anymore.

6 MR. HAMMER: I'm sorry, Dr. Wallis.

7 CHAIRMAN WALLIS: The manway and the steam  
8 generators and so on, if they come off, that area is  
9 I think equivalent to the double-ended break you had  
10 before. I think going with a single-ended break you  
11 no longer cover the manways.

12 MR. HAMMER: Because the manway itself  
13 would be bigger than this size, you mean --

14 CHAIRMAN WALLIS: Yes, right.

15 MR. HAMMER: Yes. But in looking at the  
16 manway failure, I think we felt like that was a lower  
17 frequency than what was being targeted here. You'd  
18 have to fail multiple bolts simultaneously.

19 CHAIRMAN WALLIS: It has a possible cause,  
20 which would be human error. That's why it's a little  
21 different from the other breaks. It has a possible  
22 cause, which is overtightening of bolts. Human error  
23 could lead to manway failure. That's why we like the  
24 idea in our letter that you were covering that, and  
25 now you're not. So I just noticed that in passing.

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1 MR. HAMMER: Okay. And for the proposed  
2 rule, I guess just to summarize, we're proposing that  
3 it be based on the largest attached pipe, similar to  
4 before, and that it would be applied at the limiting  
5 location, wherever that would be, and that it would be  
6 modeled as a single-ended break.

7 MEMBER BONACA: Since you're not using any  
8 more double-ended discharge, I mean to continue to  
9 link the transition break size to a pipe is  
10 misleading. I mean I understand and now I can see  
11 it's a single-ended, whatever, but by referring to  
12 break size it just raises the question. It seems as  
13 if we try to model a limiting break in real terms when  
14 we didn't. I mean, yes, it's a size of the  
15 pressurizer line but then we're only using one side of  
16 this charge. So it really is not related to that.  
17 Anyway, just a comment. I can live with that.

18 I think this linkage is a remnant of the  
19 previous version of the rule where we have  
20 double-ended discharge, and it stays in but it's  
21 unrealistic so therefore is not representative of what  
22 happens if you really had a double-ended break on  
23 that.

24 VICE CHAIRMAN SHACK: I think one of the  
25 conclusions of the elicitation process was that if you

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1 wanted to get an eight-inch hole, the way that you'd  
2 most likely get it would be a break of an eight-inch  
3 pipe rather than an eight-inch hole in a 24-inch line.

4 MEMBER BONACA: I understand.

5 VICE CHAIRMAN SHACK: So there is a  
6 logical connection, I think, between the pipe and the  
7 hole.

8 MR. HAMMER: And if you remember -- I  
9 didn't go back over all of this, remember we had  
10 initially just come up with a nice, big, fat, round  
11 number, 14-inch on PWRs, 20-inch on BWRs. But then we  
12 started to look at, well, if we're looking at pipes  
13 that break, they don't have those exact dimensions,  
14 and as a matter of fact those attached pipes vary from  
15 plant to plant, so shouldn't we customize it a little  
16 bit for that?

17 MEMBER BONACA: Okay.

18 MR. HAMMER: Okay.

19 MR. DUDLEY: Okay. Next, Ralph Landry  
20 will talk about the thermal-hydraulic calculations  
21 that we're having done.

22 MR. LANDRY: Okay. One of the interesting  
23 questions that has come up from the Subcommittee, the  
24 full Committee and our own internal discussions as  
25 we've gone about formulating this regulation is that

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1 what are some of the safety benefits, what are the  
2 changes in risk from a potential change in the rule of  
3 the break size?

4           Subsequent to the meeting which we had in  
5 December with the Committee, we met with the industry,  
6 the Westinghouse Owner's Group, which included  
7 Westinghouse, Framatome and General Electric, and  
8 discussed what could be a set of calculations which  
9 could be performed by both the industry and the NRC to  
10 try to define or determine in some way a risk-benefit.  
11 Now, this is not a definitive work, it is not  
12 all-encompassing. We due to time could only focus on  
13 one particular area, so we have defined, in  
14 conjunction with the Westinghouse Owner's Group, a set  
15 of calculations which are going to be done by the  
16 industry and in parallel by the NRC.

17           We are going to do reactor coolant system  
18 calculations, in other words, the LOCA calculations.  
19 The industry is going to perform these calculations,  
20 and the NRC is going to perform calculations. We're  
21 going to use a more or less generic model for the  
22 Westinghouse four-loop, 12-foot core plan. We're are  
23 going to use the same basic model for both the  
24 industry and the NRC so that we see how the different  
25 codes compare.

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1           We are going to do containment  
2 calculations, both the industry and the NRC, and the  
3 industry is going to take a plant-specific PRA and  
4 make modifications in the PRA based on the results of  
5 some of these thermal-hydraulic calculations and try  
6 to determine what is the change in risk from these  
7 operational changes that we're talking about.

8           Okay. The reactor coolant system  
9 calculations which we're going to perform are  
10 basically five break sizes. We're going to look at  
11 what has been traditionally the worst case, small  
12 break LOCA. We're going to look at a hot leg break of  
13 the pressurizer surge line, and we're going to look at  
14 the cold leg, taking the Accumulator/SI line, but  
15 we're going to place that break on the bottom of the  
16 pipe, which is traditionally the worst case to have a  
17 cold leg break. And then we're going to take that  
18 Accumulator/SI line break size and increase it by 20  
19 percent and decrease it by 20 percent, so that we can  
20 see if there's an effect from a slightly larger or  
21 slightly smaller break size.

22           These five breaks will then be run in two  
23 conditions. We're going to use the normal emergency  
24 diesel generator start time of ten seconds, and we're  
25 going to use a delay in the start time up to 60

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1 seconds, so that we can see is there a change in the  
2 thermal-hydraulic response due to a delay in the  
3 diesel generator start.

4 Now, when Wayne Harrison gets up from the  
5 industry, Wayne is going to talk more about how  
6 they're going to quantify the effect of change on the  
7 PRA and change of reliability --

8 CHAIRMAN WALLIS: You're expecting a  
9 safety benefit from this?

10 MR. LANDRY: Well, we want to see if there  
11 is. These calculations are being designed to tell us  
12 for an initial cut is there a change in risk from such  
13 things as changing the diesel generator start time?  
14 As I said, this is not an all-encompassing set of  
15 calculations. This was only one that we determined  
16 initially we could use as a starting point.

17 CHAIRMAN WALLIS: But you might look for  
18 an optimum start time would make some sense, wouldn't  
19 it?

20 MR. LANDRY: That's a possibility to  
21 optimize, to iterate or perturb the start time till  
22 you find what is the optimum tradeoff between change  
23 in thermal-hydraulics versus change in reliability.

24 We had to select an arbitrary set of  
25 conditions to get the calculations started, and that's

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1 why we've selected these as an arbitrary initial set,  
2 and we may vary other things at a later date.

3 CHAIRMAN WALLIS: Are you looking at risk  
4 here or are you looking at core damage?

5 MR. LANDRY: We're going to look at the  
6 change in the thermal-hydraulic conditions from a  
7 diesel generator delay. And then that change in start  
8 time can be translated into a change in reliability  
9 which can be then put into the PRA and determined from  
10 the PRA what is the change in risk.

11 MEMBER BONACA: Would the PRA model also  
12 the double-ended guillotine break with less capable  
13 PCCS system or less capable, I mean, simply with maybe  
14 single train rather than two?

15 MR. LANDRY: That would be an additional  
16 calculation for a later date. This is just -- as I  
17 said, this is the initial attempt to try to quantify  
18 a change in risk.

19 MR. SHERON: Mario, this is Brian Sheron.  
20 The PRAs I don't think go into that level of detail.  
21 And I'll have to turn to Mark or Steve here but my  
22 understanding is that, for example, they will have a  
23 success criteria that says if the thermal-hydraulic  
24 calculation says you mitigate, the event would say two  
25 accumulators or three accumulators, and your PRA says

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1 therefore for those scenarios it's success, it's not  
2 core melt. It doesn't get into the question of how  
3 much did I increase risk by decreasing margin. We  
4 just don't get down to that level.

5 MEMBER BONACA: In fact, you don't get  
6 into the issue as long as it's coolable.

7 MR. SHERON: Yes. The intent here is --  
8 I mean we have heard for a long time that these fast  
9 starts of diesels and the testing required actually  
10 may be causing more harm than good, and so the whole  
11 idea here is that if we can allow a longer start time  
12 for the diesels, there's I think a pretty obvious  
13 safety benefit in terms of reduced wear and tear on  
14 diesels, and that's what we're trying to see what that  
15 benefit is.

16 MEMBER KRESS: You have to come up with a  
17 new reliability number for the diesel?

18 MR. LANDRY: Wayne Harrison is going to  
19 talk about how the industry is approaching that.

20 MEMBER KRESS: Okay.

21 MR. LANDRY: And he presents after us.

22 Okay. We are also going to look at the  
23 containment response in a couple of ways. One is we  
24 are going to use a generic GOTHIC containment model  
25 for what we're calling a generic large dry

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1 containment. We're going to use that model to build  
2 a contained model also, so that we can look at GOTHIC  
3 and contained within the staff. The industry is using  
4 just GOTHIC.

5           And with the containment analyses, we want  
6 to use the mass energy releases we get from the  
7 thermal-hydraulic calculations and then look at  
8 varying the spray actuation time. Instead of using an  
9 automatic containment spray actuation, can we delay the  
10 spray actuation, and what is the effect on RWST to  
11 some switchover from changing the spray actuation  
12 time? What is the change in washed-out debris? What  
13 is the change in the effect on ECC pump and PSH from  
14 the sump from this delay?

15           CHAIRMAN WALLIS: It's interesting that  
16 you seem to be looking at the consequences of a  
17 decision to be made, and the decision's going to be  
18 made before your evaluation of the consequences is  
19 available.

20           MR. LANDRY: We plan on sharing the  
21 results of these analyses with the appropriate  
22 subcommittee as they become available.

23           CHAIRMAN WALLIS: That's very interesting.  
24 I think it's very interesting. I'm just interested in  
25 the fact that you're looking at the consequences of

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1 the decision, and yet your analysis isn't going to be  
2 available before the decision is made. It's just an  
3 interesting way to do business. It may be in this  
4 case very appropriate, I don't know.

5 MEMBER APOSTOLAKIS: When are the results  
6 of these analysis going to be made?

7 MR. LANDRY: That's my last slide.

8 MEMBER APOSTOLAKIS: Okay. Keep me in  
9 suspense.

10 CHAIRMAN WALLIS: Yes, we're a long way  
11 from the final rule. Maybe by the time we get to the  
12 final rule you will have this, and that would be very  
13 helpful.

14 MR. SHERON: Dr. Wallis, again, let me  
15 just reiterate, this is an enabling rule. It does not  
16 say that licensees will -- this rule allows licensees  
17 to go automatically off and do this. Even though we  
18 do these calculations, individual licensees are going  
19 to have to demonstrated, for example, if they want to  
20 go to manual action for the sprays, they're going to  
21 have to show why the timing, why the operators are  
22 trained, why this can be done reliably.

23 CHAIRMAN WALLIS: That's very important,  
24 I think. The rule doesn't allow all these things to  
25 happen automatically, and therefore the kind of thing

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1 that is being done here is going to be very helpful  
2 and you're assessing the applications from industry  
3 resulting from the rule.

4 MR. SHERON: Yes.

5 MR. LANDRY: The quick answer, George, is  
6 the spring.

7 MEMBER APOSTOLAKIS: Oh, that's fine.

8 MR. LANDRY: The PRA, which is being  
9 looked at by the industry, is going to look at  
10 multiple effects. As we talked about with EDG  
11 reliability changes, do the longer start times improve  
12 reliability is it less demanding on load sequencing,  
13 et cetera? Those effects can be looked at within the  
14 PRA. But with respect to the containment, as we  
15 already talked about, does changing this switchover  
16 time from RWST to sump affect the reliability of the  
17 human factor by giving the operator more time in which  
18 to make a switchover? Does it reserve water?

19 MEMBER APOSTOLAKIS: What kind of -- the  
20 change, what is it? Because if it's only a few  
21 minutes, I don't think you're going to see anything.

22 MR. LANDRY: We were talking about the  
23 spray actuation time could be changed on the order of  
24 hours.

25 MEMBER APOSTOLAKIS: Hours. Oh.

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1 MR. LANDRY: The initial discussions which  
2 we've had with industry indicate that this could be  
3 hours, more than 40 minutes.

4 MEMBER APOSTOLAKIS: Because, as you know,  
5 the human reliability models are not that sensitive to  
6 changes in time. But if you go to hours --

7 MR. LANDRY: That's what the staff had  
8 said when we started talking about this, that if it's  
9 only a matter of minutes, it's not going to make a  
10 change. If it's 40 minutes, an hour or more, then it  
11 may have an effect. We don't know that until we run  
12 the calculations.

13 MEMBER BONACA: And still maintain the  
14 capability to mitigate beyond TBS?

15 MR. LANDRY: Downstream. Another phase in  
16 this analysis work is that we are planning on doing  
17 work with our Office of Research looking at the  
18 effects of changes in mitigation strategies,  
19 mitigation requirements, what analyses can show --

20 MEMBER BONACA: The reason why I'm asking  
21 that question is that you want to delay the start of  
22 the spray as long as you can, but you still have  
23 constraints of mitigating beyond the transition break  
24 size which may impose some requirement. I don't know  
25 what it's going to be. So that's why there's a

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1 tradeoff there how much you can gain in the delay of  
2 the time.

3 MR. LANDRY: All right. That gets into a  
4 whole different area, because then you start weighing  
5 which plants have safety-grade air coolers, which  
6 don't. If they have safety-grade air coolers, they  
7 may not need sprays for a very long time. This  
8 becomes very plant-specific, but right now what we are  
9 doing is a first attempt at attempting to quantifying  
10 what are some of the risk changes, the safety  
11 benefits.

12 MEMBER BONACA: Yes. All I'm saying is  
13 that in quantifying the safety benefits you can't  
14 assume that you're going to have all latitude to  
15 change these things. You still have the constraints  
16 coming from the mitigation necessity beyond transition  
17 break size that will limit how much of this can be  
18 gained.

19 MR. LANDRY: Right. We're arbitrarily  
20 limited ourselves to the TBS, to the range that would  
21 still be the design basis accident, the range which  
22 would still require the conservative assumptions for  
23 the analysis, single failures, et cetera. We are not  
24 looking at the range beyond the TBS to the  
25 double-ended guillotine break where we would relax the

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1 requirements and say you could use full ECC, you don't  
2 have to take single failure or single failure, et  
3 cetera. That would be another stage in trying to  
4 study and quantify what the safety benefits are.

5 MEMBER BONACA: If that's true, then we're  
6 not independent.

7 MR. LANDRY: We realize that.

8 MR. DINSMORE: Dr. Bonaca, this is Steve  
9 Dinsmore. I think what you're asking is whether we're  
10 going to select a change and fully implement that  
11 change into the PRA so that all the plus and the  
12 negatives of this change are reflected in the results.  
13 And I believe that's the plan.

14 MEMBER BONACA: I'm only saying that if  
15 you say that I can delay my actuation of the spread by  
16 one hour, it's a great gain and all that kind of  
17 stuff, and then when I do the actual analysis I find  
18 that I can't do beyond ten minutes because I have to  
19 deal with still this defense-in-depth capability  
20 beyond transition break, then we get the wrong picture  
21 of the results. We get some results that give us  
22 comfort and they may not be correct. That's all I'm  
23 saying.

24 VICE CHAIRMAN SHACK: We have to finish up  
25 here in about a minute.

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1                   MEMBER BONACA: Understand that, but  
2                   that's important, I think. Otherwise we  
3                   mischaracterize the benefits of the change.

4                   MR. LANDRY: Okay. Our schedule is to  
5                   complete these calculations in May of 2005. We wanted  
6                   to have these calculations available to support the  
7                   development of the reg guide. So we're pressing to  
8                   have these calculations done in May and, again, we do  
9                   want to share the results with the appropriate  
10                  subcommittee. As the results are reviewed and we are  
11                  sure the results are right, we would like to come  
12                  forward with you all and share the results and discuss  
13                  them with you.

14                  VICE CHAIRMAN SHACK: Next is Mike  
15                  Tschiltz.

16                  MR. TSCHILTZ: Go ahead and go to the next  
17                  slide, please. Next slide, please. Thank you. This  
18                  slides provides a summary of the four significant  
19                  changes involving the risk assessment that have made  
20                  to the proposed rule since the staff last spoke with  
21                  the committee. Next slide. You'll get a chance. The  
22                  slide goes into them in detail.

23                  The first issue is late release frequency.  
24                  I'm trying to be sensitive to the time issue here.  
25                  The proposed rule has been changed to no longer

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1 provide a specific late release frequency acceptance  
2 criteria, although a later release frequency  
3 calculation will still be required for changes that  
4 have an impact on containment performance. It will be  
5 evaluated as part of the defense-in-depth assessment  
6 to ensure that a reasonable remains between core  
7 damage prevention, containment failure and constant  
8 mitigation.

9 Why did we make the change? The staff  
10 felt that the best place to evaluate the late release  
11 frequency was in the consideration of  
12 defense-in-depth. More specific guidance will be  
13 developed and provided in the associated reg guide,  
14 and guidance will provide for consideration of both  
15 qualitative and quantitative information.

16 We still need the calculation of late  
17 release frequency for changes to the facility where  
18 CDF and LERF metrics are not sensitive to the change,  
19 such as changes to the containment spray system.

20 If you recall, an inconsequential change  
21 has been defined as one when considered by itself and  
22 when considered in combination with all other  
23 inconsequential changes --

24 MEMBER APOSTOLAKIS: Let me understand  
25 something here. It seems to me when you say that LRF

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1 will be evaluated when considered in defense-in-depth,  
2 in essence what you're saying is we will leave it up  
3 to the judgment of the decision maker whether LRF  
4 plays any role or not. Is that true? I mean  
5 considering defense-in-depth is really a judgment  
6 call, and you are removing explicit criteria.

7 MR. TSCHILTZ: Yes. And I think there had  
8 been a great deal of work done in the early '90s on  
9 late release criteria, and I think it becomes very  
10 complicated as far as coming up with criteria that  
11 don't usurp the other criteria that are directly  
12 linked to the QHO, CDF and LERF. So I think that the  
13 judgment here was that this was a complicated enough  
14 metric that it needed to have a careful assessment as  
15 opposed to an arbitrary type of metric with a set  
16 limit, that we needed to consider a number of factors  
17 in the decision.

18 MR. SHERON: The other thing, Dr.  
19 Apostolakis, is that we looked and we said why is this  
20 unique to 50.46 as opposed to 1.174, in general? So  
21 I think the thought was is that at a future revision of  
22 1.174 we would consider a late release frequency in a  
23 more global context rather than just single it out for  
24 this rule change.

25 MR. TSCHILTZ: Okay. Back to the

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1 definition of the inconsequential change. It's one  
2 that when considered by itself and when considered in  
3 combination with all other inconsequential change  
4 remains insignificant. It does not become  
5 significant. For those type of changes that can be  
6 quantified, we've set the limit as one E to the minus  
7 seven CDF and one E to minus eight LERF, but we expect  
8 most inconsequential changes that are quantifiable  
9 will be much less than these limits.

10 Why did we make the change? The staff  
11 felt that requiring licensees to track the cumulative  
12 risk of inconsequential changes was overly burdensome  
13 and unnecessary and that there were other measures  
14 that remain that assure that the facility risk remains  
15 acceptably small.

16 Why is the change acceptable? The  
17 proposed rule requires submittal of a 24-month report  
18 by licensees that provides a list of all  
19 inconsequential changes. The staff will use this  
20 report to evaluate whether the provision for allowing  
21 inconsequential changes is being properly applied by  
22 licensees, and particularly it will allow us to  
23 identify inappropriate parsing of changes where  
24 numerous inconsequential changes are being made that  
25 should have been considered as one change.

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1           The proposed rule still requires the  
2           quantification of the inconsequential change where  
3           possible, although there are many changes that may not  
4           be quantifiable from a risk perspective. Next slide.

5           Okay. We reduced the level of detail in  
6           the rule that was basically a direct excerpt out of  
7           1.174. Why did we do this? Well, when we discussed  
8           this before, we felt that since Reg Guide 1.174 was  
9           guidance and not legally enforceable that some of it  
10          needed to be incorporated into the rule. I think our  
11          first attempt we basically directly excerpted sections  
12          from 1.174 into the rule. Upon further consideration  
13          we determined that this level of detail was not  
14          necessary or appropriate for the rule itself and that  
15          a lot of the guidance -- or a lot of the information  
16          could be incorporated in the associated reg guide.

17          Why is this acceptable? What remains in  
18          the proposed rule are what we consider to be the high  
19          level requirements that provide sufficient control for  
20          safety and risk. The requirements that remain in the  
21          rule that are related to Reg Guide 1.174 include,  
22          first, a requirement concerning the PRA scope and  
23          quality. The proposed rule requires that licensees  
24          quantitatively address risk from all sources that  
25          would affect the regulatory decision in a substantive

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1 manner. And for issues that are addressed  
2 qualitatively, the proposed rule requires that the  
3 analysis be conservative enough to provide a high  
4 confidence in the decision.

5 Second, a requirement that specifies the  
6 risk acceptance criteria. The proposed rule provides  
7 high-level criteria that will be spelled out in  
8 greater detail in the associated reg guide, and it  
9 requires that the risk from 50.46(a) change is small  
10 and that baseline risk to the facility remains  
11 relatively small.

12 And, third, a requirement that specifies  
13 that as a part of the PRA updates licensees must  
14 submit a report to the NRC when changes to a  
15 licensee's PRA result in either a greater than 20  
16 percent increase in the baseline risk or a greater  
17 than one E to the minus six CDF or one E to the minus  
18 7 LERF, respectively. Next slide.

19 Bundling. Changes that are enabled by  
20 50.46 or changes that are associated with ECCS  
21 performance or associated with the consequences of the  
22 LOCA, bundling will allow the tradeoff of risk  
23 reductions associated with unrelated changes with risk  
24 increases associated with changed enabled by 50.46(a).  
25 We only envision this to be necessary or useful in

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1 situations where the 50.46(a) changes, the cumulative  
2 effect of the changes exceed the acceptance criteria.  
3 In these cases, it provides licensees with the  
4 incentive to reduce the overall risk of the facility  
5 by making other unrelated changes.

6 MEMBER KRESS: Will you allow  
7 administrative changes to offset changes in hardware?

8 MR. TSCHILTZ: Administrative changes as  
9 far as -- I'm not seeing how an administrative change  
10 --

11 MEMBER KRESS: Some procedure on how an  
12 operator does.

13 MR. DINSMORE: This is Steve Dinsmore from  
14 the staff. Essentially, the way it's written out is  
15 that it would allow that. We'd have the opportunity  
16 to review each one individually, because these bundled  
17 ones have to come in for review.

18 MEMBER APOSTOLAKIS: So the  
19 defense-in-depth consideration, though, probably will  
20 veto it.

21 MR. RUBIN: Let me add that excessive use  
22 of programmatic methods is discouraged in 1.174, and  
23 we will carry that same philosophy through here. So  
24 if it relied heavily on a programmatic method for a  
25 significant risk reduction, it's likely we would not

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1 accept it for bundling.

2 MR. TSCHILTZ: This concept is allowed in  
3 1.174. It's described as an unrelated change in  
4 consideration of a combined change request. And,  
5 basically, 1.174 requires the reviewer to examine the  
6 relationships between the proposed changes. Where one  
7 proposed change may have a high degree of uncertainty  
8 associated with it, the reviewer is supposed to  
9 consider that in the decision. The same would apply  
10 here to the example, I think, that you gave.

11 MEMBER APOSTOLAKIS: No, but I think Mark  
12 is right. Excessive reliance on programmatic means is  
13 discouraged. And that will be part of the  
14 defense-in-depth evaluation, which is separate from  
15 the quantitative comparison with criteria.

16 MR. RUBIN: It will all be part of the  
17 decision process of whether that particular bundling  
18 package was acceptable.

19 MR. TSCHILTZ: Allowing bundling will  
20 result in changes that have a result and a net  
21 decrease in risk or smaller net increases than would  
22 occur if bundling weren't allowed. Next slide.

23 Limitations on bundling. One of the  
24 premises of risk-informed regulation is that  
25 facilities are built and operated in accordance with

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1 requirements. Therefore, if a change were necessary  
2 to bring a facility in compliance with NRC  
3 regulations, it could not be bundled with other  
4 changes. An example of this would be where a licensee  
5 discovered a section of piping that was required to be  
6 seismically qualified and they made the modifications  
7 to the plant that brought it in compliance and  
8 seismically qualified the pipe. There would be an  
9 associated risk reduction with that change. They  
10 could not bundle that with other 50.46(a) related  
11 changes in order to meet the risk criteria.

12 There's additional limitations on the use  
13 of bundling that have been derived directly from Reg  
14 Guide 1.174. Specifically, bundled changes must not  
15 increase risk from significant accident sequences,  
16 cause lower rank accidents to become more significant  
17 or create new significant accident sequences.

18 MEMBER KRESS: Do you have a  
19 quantification of the word, "significant?"

20 MR. TSCHILTZ: No. It's not quantified in  
21 1.174, as I'm sure you know, and it's not quantified  
22 here.

23 MEMBER KRESS: Yes, but we always have to  
24 ask this question.

25 MEMBER APOSTOLAKIS: You're using the

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1 language that -- I don't understand why do you have to  
2 say, "must not." Why don't you soften it and say that  
3 these considerations will be part of the  
4 defense-in-depth evaluation as well? In other words,  
5 it will be part of the judgment of the decision maker.  
6 That makes much more sense. Because you can have an  
7 increase in risk from significant accident sequences,  
8 but overall that's acceptable if you consider  
9 everything else.

10 MEMBER KRESS: In fact it's more likely.

11 MEMBER APOSTOLAKIS: Yes. I mean this  
12 "must not" is kind of too strong.

13 MR. TSCHILTZ: I don't know whether those  
14 words are taken directly out of 1.174 or not.

15 MEMBER APOSTOLAKIS: Well, you know, 1.174  
16 didn't come down from the mountain.

17 (Laughter.)

18 MR. DINSMORE: This is Steve Dinsmore.  
19 The "must" is from the rule because it was written in  
20 the rule like that. If we changed it to "should," I'm  
21 not sure how that affects the rule language.

22 MEMBER APOSTOLAKIS: From the rule. Which  
23 rule is that?

24 MR. DINSMORE: Well, the proposed rule.  
25 I think we have flexibility in defining "significant"

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1 and that kind of stuff, but -- I think we could change  
2 the rule, but I don't know the impact of that.

3 MR. RUBIN: I think the actual process is  
4 exactly what Dr. Apostolakis is asking for, is  
5 implying. But the word language I think was driven,  
6 as Steve said, by our attorneys. But we do of course  
7 have the flexibility of determining both significant,  
8 what the significant accident sequences are. These  
9 aren't defined in the ASME standard either, and that's  
10 an issue.

11 MR. SHERON: I was just going to say that  
12 we normally don't put "shoulds" in rules, okay? It's  
13 "must" or "shalls." Shoulds go to reg guides.

14 MEMBER APOSTOLAKIS: Couldn't you say,  
15 "must be considered in the defense-in-depth  
16 evaluation"? Then you still use "must."

17 MR. RUBIN: This isn't just  
18 defense-in-depth, this is directly impacting the risk  
19 profile.

20 MEMBER APOSTOLAKIS: Well, everything is  
21 defense-in-depth.

22 VICE CHAIRMAN SHACK: We need to move on,  
23 George.

24 MEMBER KRESS: Can I ask one more question  
25 of these guys? I was a little disturbed to hear that

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1 you backed off the late containment failure criteria.  
2 Does this mean you're now going to ignore total number  
3 of deaths and the total impact of land contamination  
4 in your criteria? Because those aren't really  
5 covered. Well, to some extent CDF addresses them, but  
6 they're not covered by the quantitative health  
7 objectives. Those are individual risks.

8 MR. TSCHILTZ: Well, I think the reason we  
9 want to have the late release frequency in there is  
10 because we recognize that a significant amount of the  
11 dose to the public from an accident would occur from  
12 a late release. That's why we're including it in our  
13 decision. The ability to come up with a meaningful  
14 metric that we could live with forever or close to  
15 forever in the time frame that we are developing this  
16 rule is a challenge.

17 MEMBER KRESS: I understand that, and it's  
18 a lot like the safety goals, and those were like  
19 pulling teeth. I suggest you give this some thought  
20 before the next revision of 1.174. I think that's  
21 something that is badly needed, some quantifiable risk  
22 acceptance metric that deals with societal risk.

23 MR. TSCHILTZ: I think we were already  
24 planning on doing that as part of our next review in  
25 Revision 1.174, because this -- when we were doing the

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1 work for this rule, we recognized that we could use  
2 additional guidance here.

3 MEMBER APOSTOLAKIS: Is it necessary to  
4 have the last bullet in the rule? Take it out. But  
5 if you have to use "must," then take the whole thing  
6 out. Nobody's forcing you to put that in the rule.

7 MR. DINSMORE: This is Steve Dinsmore.  
8 But then it --

9 MEMBER APOSTOLAKIS: Because this is  
10 awfully detailed. A minor increase in the risk from  
11 significant accident sequences must not. Leave it up  
12 to the decision maker to decide whether it's  
13 important.

14 MR. DINSMORE: This is Steve. But we have  
15 to have some reason to -- we have to have some  
16 authority to request that and to deny it based on this  
17 type of information.

18 MEMBER APOSTOLAKIS: They have a lot of  
19 freedom.

20 MR. DINSMORE: Yes, that's a lot of  
21 freedom, but it's also difficult to fully justify the  
22 -- but if we have this type of language in the rule,  
23 it's clear.

24 MEMBER APOSTOLAKIS: But what is a minor  
25 increase? This says, "must not increase," period.

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1 And the increase is ten to the minus ninth. This  
2 says, "must not."

3 MR. SHERON: I think you've raised a good  
4 point. We can look at the words. I mean I wouldn't  
5 want to use the word, "significant," twice in the same  
6 line, but we could say, "should not significantly  
7 increase the risk from significant accident  
8 sequences." I think that's what you mean, really.  
9 But you're right, there could very small increases  
10 that are inconsequential where "must" would -- and I  
11 think we've suffered with that with the NOED policy.

12 MR. SNODDERLY: Excuse me, Mike. Can I  
13 follow up on Dr. Kress' question about late release  
14 frequency? So is it correct to say then from the  
15 period early to, say, 24 hours the design basis of  
16 containment now would be driven by the transition  
17 break size? In other words, after early, say, two to  
18 four hours, to 24 hours, in that time period, what  
19 would be the design basis of containment? Would it be  
20 governed by the transition break size? I'm trying to  
21 figure out what --

22 MR. TSCHILTZ: Which is the most limiting?

23 MR. SNODDERLY: Right. What would be the  
24 design basis for containment? It no longer would be  
25 the double-ended guillotine break, right?

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1 MR. TSCHILTZ: Yes, but the containment  
2 would still need to withstand the double-ended  
3 guillotine break.

4 MR. SHERON: It still says they have to  
5 mitigate up through the double-ended guillotine  
6 rupture, which means that the containment has to  
7 remain in tact.

8 VICE CHAIRMAN SHACK: Yes, but if you take  
9 a transition break size with a design basis pressure,  
10 will that be more limiting with a large break with a  
11 realistic failure criteria? That's the question that  
12 Mike is after, if I can understand it.

13 MR. SHERON: The double-ended guillotine  
14 is going to produce the largest mass and energy  
15 release into the containment and will produce the  
16 largest challenge to the containment.

17 VICE CHAIRMAN SHACK: Right, but as I read  
18 it, you're going to have different -- you no longer  
19 can have the design basis pressure for the  
20 containment.

21 MR. SHERON: We said we would look. I  
22 think if I remember correctly we would look at whether  
23 or not it was acceptable to allow increases, say,  
24 above the appropriate ASME code service level. For  
25 example, if the containment design pressure is 55 psi

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1 and let's say a licensee comes in and proposes an  
2 uprate in power such that the mass energy release goes  
3 up to 60 psi, I think what we said -- help me, Gary,  
4 if you remember -- we said that we would take a look  
5 at that and as long as we were preserving substantial  
6 margin with that, then we would probably allow that.  
7 But we were not going to just give up on the design  
8 basis for the containment at all. Does that make  
9 sense?

10 MR. LANDRY: That's another one of those  
11 plant-specific calculations, because when we talk  
12 about the service levels for containment, it's for a  
13 particular containment design. The design pressure,  
14 the yield pressure and the ultimate pressure for a  
15 large dry are significantly different than from a  
16 freestanding shell. So that we have to be very  
17 careful when we talk about changing allowable pressure  
18 limits for a containment. What containment design are  
19 we talking about here before we start saying we can  
20 allow these changes.

21 VICE CHAIRMAN SHACK: Yes. I mean you're  
22 going to still have assurance of the containment  
23 integrity, but it's not clear to me that the design  
24 basis will always be the large-break LOCA, the DEGB.  
25 It may, it may not be; I just don't know.

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1 MR. LANDRY: The steam line break is still  
2 in the design basis. And the main steam line break on  
3 pressure is only slightly below the LOCA. It's only  
4 a couple psi less than a LOCA for pressurization. It  
5 is in virtually all cases the limiting event for  
6 temperature in all containments. So simply changing  
7 the LOCA requirement or LOCA limitations really isn't  
8 going to affect significantly the containment  
9 requirements.

10 VICE CHAIRMAN SHACK: We're going to have  
11 to move on now.

12 MEMBER SIEBER: Well, the leak rate would  
13 be higher with the larger break, which is also the  
14 design requirement. It's possible you may move to a  
15 different service level for containment.

16 MR. LANDRY: Leak rate is a function of  
17 service level and pressure.

18 MEMBER SIEBER: Right. Right.

19 MR. LANDRY: The leak rate doesn't go as  
20 a stop function with service level. It's a linear  
21 function.

22 MEMBER SIEBER: Right.

23 MR. LANDRY: As you go up in pressure, the  
24 leak rate is going to keep going up.

25 MEMBER SIEBER: It will go up with it,

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1 right.

2 MR. LANDRY: When you go from Service  
3 Level A to B, you don't have a step function change in  
4 leak.

5 MEMBER SIEBER: Right.

6 MR. DUDLEY: Dr. Shack, Brian Sheron has  
7 some concluding remarks he'd like to make.

8 MR. SHERON: Well, I just wanted to thank  
9 the Committee for allowing us to come down and make  
10 the presentation. I just want to point out we've  
11 worked kind of long and hard on this. If you counted  
12 the number of hours we agonized over this, this was  
13 not an easy rule. We think that based on the letter  
14 we got from the Committee I think last December, we've  
15 actually moved the rule closer to meeting your  
16 comments.

17 VICE CHAIRMAN SHACK: Except for  
18 containment failure.

19 MR. SHERON: I'm sorry?

20 VICE CHAIRMAN SHACK: Except for late  
21 containment failure.

22 MR. SHERON: Well, what we said, I think,  
23 is that we agree with you that -- and I agree with Tom  
24 that it's something that needs to be e considered. We  
25 need to do it in the context of 1.174. It's not a

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1 unique parameter or metric just for this rule, okay?  
2 And I think we've said that we would -- you know, as  
3 we go forward with 1.174, it is something we will  
4 explicitly consider. And to the extent that we change  
5 1.174, it would probably be retroactively applied to  
6 this rule as we go forward. But in the same sense, as  
7 you heard, we're not ignoring late containment failure  
8 considerations when we look at the risk analyses here.

9 I'm going to be mercenary and say we would  
10 love to get a positive letter so we could get this up  
11 to the Commission and like to go forward with it and  
12 at least get the public comment period started. So  
13 with that, I'll close.

14 MEMBER APOSTOLAKIS: So we're way ahead of  
15 time.

16 MR. HARRISON: You ready?

17 VICE CHAIRMAN SHACK: Yes.

18 MR. HARRISON: Well, I guess it's still  
19 morning. Good morning. I want to thank the ACRS for  
20 giving us this opportunity to status the industry's  
21 efforts at evaluating the proposed change to 10 CFR  
22 50.46. Ralph Landry covered a number of the things  
23 that I was going to discuss, so I will be brief.

24 The first slide was intended to put this  
25 work in context and I think we've discussed this to

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1 some extent. The point that I want to make here is  
2 that we view the proposed rule as a key part of the  
3 change in the regulatory structure that will serve the  
4 industry and the regulator for the long term. These  
5 are example safety benefits. They're not the primary  
6 purpose or necessary desired outcome of this proposed  
7 rule change.

8 And I'd like to also point out we think  
9 the proposed rule is the right thing. We believe that  
10 what we're seeing is that the proposed rule is safe,  
11 preserves the safety of the plants. It's consistent  
12 with the vision that's up here. It is an optional  
13 rule, we want to reiterate that, which makes it easier  
14 for the industry and to regulator to implement. And  
15 I think it establishes the environment for going  
16 forward to identify changes in the future.

17 I think as Ralph mentioned, we met with  
18 the staff in January and had a very effective  
19 discussion on how the evaluation should proceed and  
20 what kind of information the NRC would need from the  
21 industry in supporting their evaluation. And today,  
22 we focused on the two examples of safety benefits.

23 It says here we are supporting development  
24 of the implementation guidance. That's still in its  
25 very early conceptual stage, so I'm not going to spend

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1 any time on that today. And the discussion on the two  
2 examples is going to be qualitative because we don't  
3 have the final quantitative results that have been  
4 vetted through all our stakeholders.

5           Ralph discussed how we were doing the  
6 modeling with the diesel generator start requirements.  
7 We expect the longer start times to have an increase  
8 in diesel reliability, and we have been doing  
9 quantified evaluations of that. We've introduced  
10 station personnel that are familiar with diesel  
11 reliability. Their response has been very positive  
12 with regard to extending start times from the ten  
13 seconds to something like 30 seconds or a minute.

14           And we've also reviewed INPO EPIX data  
15 from diesel generators for the past eight years,  
16 about 800 diesel generator reports. And the  
17 preliminary results are showing a decrease in start  
18 failures, decrease in run-time failures due to the  
19 reduced wear and tear of fast starts and the potential  
20 for decrease corrective maintenance that you have to  
21 take to address those start run failures, which  
22 clearly affects the availability of the diesel.

23           We're taking those results and we're going  
24 to run those through several plants PRAs. As you  
25 would know, plants vary in their susceptibility or

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1 sensitivity to the loss of off-site power events.

2 MEMBER APOSTOLAKIS: What results are  
3 these, preliminary results? What results? I mean  
4 where do they come from? You said preliminary  
5 results?

6 MR. HARRISON: Preliminary results  
7 indicate we have started to take some of the -- we've  
8 begun to try to quantify the effect of this interview  
9 with the station personnel and --

10 MEMBER APOSTOLAKIS: So these are the  
11 results of interviews?

12 MR. HARRISON: Interviews and looking at  
13 these 600 cases up there on what effect were these  
14 cases attributable and how many of these case could be  
15 attributable to issues related to fast starts of the  
16 diesel.

17 MEMBER APOSTOLAKIS: Which is also a  
18 matter of judgment.

19 MR. HARRISON: Well, certainly, the  
20 evaluation of the individuals performing those  
21 evaluations, yes.

22 MEMBER APOSTOLAKIS: So you would say,  
23 let's say, from the 600, I don't know, 425 were due to  
24 the fact that we started within ten seconds.

25 MR. HARRISON: Or however many there are.

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1 MEMBER APOSTOLAKIS: So now if I didn't  
2 have to do that, what would you do? You would  
3 eliminate the 425 failures from the pool?

4 MR. HARRISON: You would evaluate whether  
5 that failure could be eliminated from that pool. I  
6 don't have the exact details on how they have  
7 addressed those values, and that would be part of our  
8 report.

9 MEMBER APOSTOLAKIS: Okay.

10 MR. HARRISON: The containment spray  
11 results, as Ralph has indicated, the changes that  
12 could affect the LOCA accident progression, as we  
13 mentioned before, are to reduce the potential for  
14 human error in performing the manual actions for going  
15 to recirc. And they minimize or eliminate major  
16 debris transport mechanism to the containment sump.  
17 Of those two, the one that we're quantifying is the  
18 first one, which is the potential for human error in  
19 performing the manual actions.

20 Also, for smaller LOCAs, you have the  
21 potential for using normal shutdown cooling as a  
22 long-term stable state to maximize that.

23 CHAIRMAN WALLIS: I think it would be very  
24 good for the industry if you could show that this rule  
25 would enable you to do something about the containment

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1 sump.

2 MR. HARRISON: Well, I think qualitatively  
3 just looking at what we have to do to the models on  
4 that is right now the models are based on the existing  
5 sump size assumptions and failure probabilities. And  
6 you would say, okay, then if I now assume I don't have  
7 to initiate containment spray, this is a change that  
8 we wouldn't have to make to the model. We haven't  
9 really looked at how we would quantify that, so this  
10 has just been a qualitative assessment at this point.

11 MEMBER SIEBER: With respect to debris  
12 generation and transport, have you tried to estimate  
13 how much debris generation and transport comes from  
14 the actual jet impingement of the break as opposed to  
15 the effective containment spray, which typically has  
16 much less energy content?

17 MR. HARRISON: I think there have been --  
18 I'm sure there might be some people who can address  
19 what the -- and you all have probably heard the  
20 discussions on the modeling that has been done. My  
21 understanding is that the containment spray transport  
22 is a lot of what washes down from loose stuff inside  
23 the containment.

24 MEMBER SIEBER: Lose all the dust.

25 MR. HARRISON: But it also adds to the

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1 volume and velocity that goes into the sumps. And the  
2 other detriment that containment spray provides here  
3 is the water that's used for containment spray can't  
4 be used to inject into the core. So you're competing  
5 with safety injection on core cooling.

6 MEMBER SIEBER: Well, I'm struck by the  
7 word about halfway down there, "eliminate major debris  
8 transport." If you have a break, you're going to have  
9 debris transport.

10 MR. DUDLEY: You'll have debris transport,  
11 but the way it's currently done, Jack, it really is a  
12 contributing factor to the amount that makes it to the  
13 sump.

14 MEMBER SIEBER: I agree with that.

15 MR. DUDLEY: Yes.

16 CHAIRMAN WALLIS: I don't think he's  
17 eliminating debris transport. He's eliminating one of  
18 the major mechanisms.

19 MR. HARRISON: Right. That's correct.

20 VICE CHAIRMAN SHACK: It's a major debris  
21 transport mechanism.

22 MR. HARRISON: That's my understanding, it  
23 is a major contributor.

24 VICE CHAIRMAN SHACK: Now, you're going to  
25 still address Dr. Bonaca's question of how much of

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1 this benefit you can get and still mitigate.

2 MR. HARRISON: Well, that's true, and I'm  
3 glad you asked it. That was one of the comments that  
4 I wanted to make, and I'll go ahead and make it now.  
5 We had the question, does the risk from the  
6 large-break LOCA increase, and I'd point out that  
7 there certainly is no change until a licensee actually  
8 makes a change to their plans. That's the first thing  
9 I'll point out.

10 For the standby diesel generator, I'd  
11 comment that it probably -- changes, it probably makes  
12 no difference in the core damage frequency because the  
13 ten-second assumption, remind you, is an arbitrary  
14 deterministic time, and we don't -- within the PRAs we  
15 don't say that you have a loss offsite power at the  
16 time of the break. So I would anticipate that there  
17 will be no change in the core damage failure  
18 probability for the larger breaks.

19 MEMBER BONACA: My question was a  
20 different kind. I just simply said that you do not  
21 have freedom in modifying your parameters, such as  
22 price set points and things like this. It's too bound  
23 by some requirements that comes from the beyond  
24 transition break, and you don't know what they are  
25 yet.

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1 MR. HARRISON: Right. Now, when you go --  
2 on sprays, that's a good point. We've always made  
3 that statement that -- diesel improvements, I think,  
4 are more applicable across the board to more people.  
5 And like I said, it varies with your sensitivity to  
6 loss of offsite power scenarios. Containment spray is  
7 more plant-specific. It varies a lot with the design  
8 of the plant, the size of the containment, what you  
9 depend upon sprays for, whether you have  
10 safety-related reactor containment fan coolers and so  
11 forth.

12 So whether you would change the  
13 contribution for the larger breaks for containment  
14 spray is going to depend upon your plant design, and  
15 it may vary from essentially none for a plant like  
16 South Texas, I think we would probably see no change  
17 where containment spray is not a contributor to core  
18 damage frequency, to other plants, smaller plants  
19 where containment spray is credited and they would not  
20 see the same benefit. In any case, I think it's going  
21 to be zero to very, very small.

22 MEMBER POWERS: Do you run into a Part 100  
23 problem to laying the spray?

24 MR. HARRISON: I think the short answer to  
25 that is no. The source term would already be

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1 addressed by, what is it, 50.67, the source term.  
2 There may be, I think, opportunities to use the source  
3 term in conjunction with this rule, the alternate  
4 source term. If you still have to assume a --  
5 certainly, for Part 100 in consideration of offsite  
6 dose, you'd still have to consider a deterministic  
7 source term.

8 MEMBER POWERS: I guess I don't  
9 understand. Your worst two-hour concentration is  
10 guaranteed to be higher, isn't it?

11 MR. HARRISON: I'm sorry?

12 MEMBER POWERS: Your worst two-hour  
13 concentration of suspended radioactivity in the  
14 containment atmosphere is guaranteed to be higher if  
15 you delay the spray.

16 MR. HARRISON: That is right, and that's  
17 why I'm saying you may need to credit alternate source  
18 term.

19 MEMBER POWERS: I don't think that will  
20 give you any advantage at all, because the amount of  
21 particulate that you're going to have in the  
22 atmosphere is going to be pretty significant if you  
23 don't have that spray operating. Two hours you've  
24 gotten everything that you're going to get out of the  
25 --

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1 MR. HARRISON: I can only cite the  
2 initial results that we have been able to do in South  
3 Texas. The initial results that we have at South  
4 Texas suggests that with the -- that we do not -- with  
5 the alternate source term, we will not need  
6 containment spray for dose. Again, I would stress  
7 that this is a plant-specific analysis. It may be  
8 that not everyone can use the same results or achieve  
9 the same results.

10 MR. PIETRANGELO: But that's one of the  
11 limiting factors we talked about before, I think.

12 MR. HARRISON: Right.

13 MR. PIETRANGELO: You have to meet that.  
14 You cannot get out of that by doing this.

15 MR. HARRISON: I think I made all the  
16 points I was going to make on that one.

17 The summary I'll stress that the  
18 preliminary results are positive, that the valuations  
19 for both examples are showing a safety benefit. I  
20 stress again the results are going to be  
21 plant-specific.

22 And, again, just for context purposes,  
23 that these are example cases, and we're really looking  
24 for the rule to establish the framework to identify  
25 additional safety benefits for future applications --

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1 operational benefits.

2 CHAIRMAN WALLIS: So there are some  
3 benefits, but I didn't see you speaking as if they  
4 were spectacular or so you're saying that they're  
5 wonderful benefits and that -- they are benefits.

6 MR. HARRISON: They are benefits. I think  
7 of the two that the diesel generator reliability will  
8 be the more significant of the two benefits. I think  
9 that's implied, if not almost specifically stated  
10 here.

11 CHAIRMAN WALLIS: Is there some way to  
12 quantify that benefit so we know how big it is? How  
13 big is it?

14 MR. HARRISON: We're in the process of  
15 quantifying that. Again, that's not been -- we don't  
16 have the final results, but it will be --

17 CHAIRMAN WALLIS: How big is it likely to  
18 be? I mean you must have some idea of the order of  
19 magnitude.

20 MR. HARRISON: I'm not even going to try  
21 to --

22 MEMBER APOSTOLAKIS: Let me understand  
23 this. To what extent a statement like that depends on  
24 our ability to quantify these things?

25 MR. HARRISON: Well, it depends upon the

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1 --

2 MEMBER APOSTOLAKIS: I mean I question  
3 where we are --

4 MR. HARRISON: You need to be able to  
5 quantify and make the relationship between the data --

6 MEMBER APOSTOLAKIS: Sure.

7 MR. HARRISON: -- that we're evaluating.  
8 In other words, if we say, "Well, we're going to  
9 increase diesel generator reliability by five percent  
10 or ten percent," then we need to be able to use the  
11 data that we have to say that these data support that  
12 change in diesel generator reliability. We can make  
13 that relationship between those data.

14 MEMBER APOSTOLAKIS: Right. It seems to  
15 me in both cases there will be a considerable use of  
16 judgment just to the impact on the safety benefit. On  
17 the one hand, as we said earlier, we have to decide  
18 which failures of the diesels that have been reported  
19 were actually due to the fast start time.

20 MR. HARRISON: Right.

21 MEMBER APOSTOLAKIS: And then use some  
22 judgment to say, "If I didn't have that, something  
23 would happen." And with the human reliability, as we  
24 discussed with the staff earlier, unless you go to  
25 hours, the current models really will not be able to

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1 tell you, "Boy, this is really better, because you  
2 increased it by 15 minutes."

3 MR. HARRISON: Well, as they're saying, 15  
4 minutes doesn't help very much, but if you increase it  
5 by an hour, you could probably increase human  
6 reliability by maybe a factor of five or an order of  
7 magnitude, perhaps. And that can help some plants.

8 MEMBER APOSTOLAKIS: So you think the main  
9 benefit is the diesel reliability.

10 MR. HARRISON: That's my judgment. And  
11 the reason I say that is because I think that it would  
12 be more broadly applicable to more plants.

13 MEMBER APOSTOLAKIS: Oh, I see. I see.  
14 Thank you.

15 MR. HARRISON: And that concludes my  
16 discussion. If you have any questions --

17 MR. DUDLEY: May I ask a question?  
18 Obviously, we're interested in things that are  
19 potential safety benefits. As far as the economic  
20 benefits are concerned, is it obvious to you which  
21 things you would go after now? I mean is it clear if  
22 this is enacted that you're going to go and ask for  
23 some changes to the plant that would involve very  
24 small increases for economic purposes?

25 MR. HARRISON: We have a pilot plant

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1 that's ready to make an application. I think that we  
2 have quantified some business cases for this. We've  
3 looked at, for instance, some of the testing  
4 requirements on the diesel generators. We think it's  
5 an advantage to us. One of the things that the jury's  
6 still a little bit -- still out on is the analytical  
7 savings that we would see from not having to do  
8 detailed large-break LOCA analysis to the same degree  
9 we had. So one of the goals of the implementation  
10 guidance is that we don't create a process where we  
11 have to do a risk-informed beyond design basis  
12 evaluation that looks and has the same impact that the  
13 current large-break LOCA does. But I think we're  
14 seeing certainly some potential savings in that area.

15           The fuel savings that we've talked about,  
16 that's going to be plant-specific. It depends on  
17 whether you're large-break LOCA limited. If you're  
18 large-break LOCA limited on peaking, you may have an  
19 opportunity there, but I think we all recognize that  
20 there are other fuel design limits that may give you  
21 a challenge, like DNB or actual offset anomaly or what  
22 have you.

23           So, again, I want to say that we're  
24 establishing a framework here that will remove what's  
25 been a barrier so that as we move forward in time that

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1 we can gain some of these additional benefits.

2 CHAIRMAN WALLIS: I think my colleague  
3 asked you about economic benefits, and the regulatory  
4 analysis that we saw came up with a major benefit  
5 being the potential for power uprate. Is that  
6 something that you see from your perspective to be a  
7 major benefit?

8 MR. HARRISON: My personal view is this  
9 will facilitate power uprates. Power uprates  
10 obviously require a lot of other analytical things  
11 that you have to consider. I think that this will at  
12 least make the large-break LOCA evaluation certainly  
13 simpler and much less of an obstacle for a power  
14 uprate.

15 MR. SNODDERLY: Excuse me, Mr. Harrison?  
16 Mike Snodderly back here.

17 MR. HARRISON: Oh, Mike.

18 MR. SNODDERLY: The staff told us they  
19 anticipated completing their analyses in May 2005 and  
20 their reg guide by June 30, 2005 and then initiating  
21 discussions with us in the summer of 2005. Can you  
22 give us some idea of your schedule or if you think it  
23 will be compatible with the staff's? In other words  
24 -- because I think when we review the staff's analyses  
25 and their reg guide, we'd ideally like to be able to

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1 compare it to what you've developed.

2 MR. HARRISON: We're working with the  
3 staff's schedule, so our intent and plan is to support  
4 the staff's schedule with our evaluations and actually  
5 to give them -- perhaps if we can to even precede  
6 their schedule so they'll have something to look at  
7 ahead of time.

8 MR. SNODDERLY: Okay.

9 VICE CHAIRMAN SHACK: Tony?

10 MR. PIETRANGELO: Before I get into some  
11 perspective on the proposed rulemaking and some of the  
12 other stuff, I did want to offer a few remarks on  
13 behalf of the BWR Boiling Water Reactor Owner's Group.  
14 They couldn't be here today but they did send me some  
15 stuff to ask me to include in the remarks here, and I  
16 did want to do that.

17 Obviously, we haven't seen what's in the  
18 proposed rulemaking package with regard to the  
19 specific rule language. The first version of the rule  
20 specified the 14-inch and 20-inch for BWR double-ended  
21 break. I believe, if I could surmise correctly, that  
22 the current version says something like single-sided  
23 of the largest attached pipe.

24 In the case of the BWRs, that doesn't do  
25 them much good, because it's still 20 inches with

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1 their recirc piping and their RHR lines. So from  
2 terms of enabling anything with regard to boiling  
3 water reactors, this rule does not do that. And,  
4 again, on behalf of the boilers, they do think that  
5 there is in the neighborhood of something less than 14  
6 inches, consistent with the expert elicitation  
7 results, would allow them to accrue the same types of  
8 safety benefits as well as other benefits that they  
9 could get with their current topical report that was  
10 submitted last year on the separation of loss of  
11 offsite power from the large-break LOCA.

12 Now, that's been in the staff. That's  
13 been deferred because of this rulemaking plan, but  
14 this rulemaking, given that the GDCs don't apply  
15 beyond the transition break size, could accomplish the  
16 same purpose that the boiling water reactors were  
17 included in the ruling.

18 So in terms of being enabling, it doesn't  
19 do it for the boilers. They did submit comments to  
20 the staff in September as part of the regulatory  
21 analysis input following the workshop late last  
22 summer. I know it's too late for the staff to do  
23 anything with the current package and probably even  
24 for the Commission to do anything at this point, so  
25 this is obviously something that's going to be

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1 commented on in the proposed rule stage, but I'd ask  
2 you to -- I'm planting that seed now because we're  
3 going to come back to this point when we have further  
4 deliberations.

5           So the boilers think there's a case to be  
6 made for their inclusion as being enabling in this  
7 rule with regard to break size, and there's lots of  
8 benefits like the ones that Wayne talked about diesel  
9 generator reliability, on optimized DCCS performance  
10 on enhanced decay removal capability as well as  
11 simplifying some of the text spec surveillance  
12 requirements. The same kind of safety benefits we're  
13 trying to quantify here we could do the same thing now  
14 if the boilers could play in the sandbox, if you will.  
15 So I just wanted to offer that on their behalf.

16           Okay. Turning to the -- let me start at  
17 a really high level. Why are we doing this  
18 rulemaking? What is the purpose of this rulemaking?  
19 What are the success criteria for this rulemaking?  
20 What do you really want to get out of it? And I guess  
21 I could go around and poll each ACRS member, but let  
22 me just suggest one to save time.

23           If at the end of the day this rule doesn't  
24 provide the option at least to get licensees and the  
25 NRC to focus more on safety-significant matters, it's

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1 a failure. It will be perceived as a failure. I mean  
2 that is the intent. That goes back all the way to the  
3 definition of risk-informed regulation. Focus on  
4 things more that matter, more of the stuff that  
5 doesn't matter or that's less significant. So that's  
6 what this has to achieve at the end of the day.

7 Now, we just talked about enabling  
8 beneficial changes. That to me is a sub-tier. It has  
9 to -- if you can't do anything that's beneficial as a  
10 result of the rule, it's a failure. It's just out  
11 there, people won't pick it up. If we go through all  
12 this work, staff went through all this work, industry  
13 went through all this work, nobody picks it up, it's  
14 a failure. So it has to enable beneficial changes.  
15 I think that's why the boilers want to be included in  
16 this.

17 CHAIRMAN WALLIS: I noticed you said  
18 safety-significant matters were beneficial, but how  
19 about the power uprates? There are benefits which are  
20 not related to safety.

21 MR. PIETRANGELO: There are.

22 CHAIRMAN WALLIS: That are enabled by this  
23 rule.

24 MR. PIETRANGELO: There are. There are.  
25 But at the end of the day, you still have to be able

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1 to make a case that you're focused on safety more than  
2 you were before. I you can get some economic benefits  
3 out of that and do the same thing, great.

4 Now, there's another element of this, and  
5 I think consistent with the history of risk-informed  
6 regulation you see this, and that is, well, how do you  
7 control the potential changes that this thing enables?  
8 And I think that's where a lot of that part of the  
9 rule that the staff worked on comes from. And I  
10 understand that. From a regulatory perspective, you  
11 don't want to enable something that could have a  
12 significant increase in the risk profile or decrease  
13 safety at the plant. So I perfectly understand that.

14 My point is that at the end you have to  
15 have a balance, okay, that you can't burden licensees  
16 on looking at things that are inconsequential or  
17 burden the NRC staff with amendment requests on things  
18 that are inconsequential or review of things that are  
19 inconsequential, because if you do that, you won't  
20 meet the higher-level purpose of focusing on things  
21 that matter more. So there's a balance that has to be  
22 achieved there. I understand the regulatory  
23 perspective, but there's an attention and resources  
24 perspective that also has to be balanced.

25 CHAIRMAN WALLIS: Well, that's what I'm

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1 waiting for really is the consequential things. I  
2 think that there are a lot of inconsequential things.  
3 I'm not really interested in those. But if you can  
4 show there are some really consequential changes which  
5 matter, then that will be great. I don't think we've  
6 got to that point yet.

7 MR. PIETRANGELO: I'll get to that in a  
8 second. To me there's three basic issues wrapped up  
9 in this rulemaking, okay? The first has been the  
10 focus on the break size. A lot of -- that's the whole  
11 expert elicitation, three years worth and even before  
12 that talking about it has been focused on this expert  
13 elicitation. So when that effort's over, I mean  
14 you've looked at it six times now, you're going to get  
15 a seventh shot at it later, I think we're going to  
16 have a pretty sound rationale for saying this is it.  
17 And it will be reflective of the expert community.

18 Part of the safety benefits calculations  
19 that Wayne talked about and that Ralph Landry talked  
20 about before are really aimed, I think, at trying to  
21 give us some more confidence that when you put the TBS  
22 at a certain spot consistent with that expert  
23 elicitation, you can in fact enable beneficial  
24 changes. You don't want to set it so high that it  
25 doesn't enable anything. So those calculations, those

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1 quantifications will help to inform that.

2 But I've got to tell you, I don't need a  
3 PRA calculation that tells me if I increase the diesel  
4 start time from ten seconds to 60 seconds, I don't  
5 need a calculation to tell me that's better.

6 CHAIRMAN WALLIS: It's better, but how  
7 consequential is it?

8 MR. PIETRANGELO: Doesn't matter. Doesn't  
9 matter. Doesn't matter.

10 CHAIRMAN WALLIS: But you said you used --

11 MR. PIETRANGELO: I don't need to have it  
12 quantified.

13 CHAIRMAN WALLIS: Don't want it to be an  
14 inconsequential thing.

15 MR. PIETRANGELO: Why? I know, and I  
16 think the qualitative data will tell you that it's  
17 better. To delay containment spray, and Dr. Powers  
18 brought up the part about the Part 100, I mean we  
19 already have to assume that you have a degraded core  
20 in order to scrub the containment spray. But in  
21 delaying containment spray it doesn't mean that there  
22 can't be some operator actions that look at actual  
23 radioactivity levels in the containment post-accident  
24 or have interlocks with radiation monitors that would  
25 actuate containment spray versus let's just assume it

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1 is per the current design basis and just flood the  
2 containment with all that containment spray, bypass  
3 the core, wash all that debris down in the screens.

4 I mean, intuitively, I know that it's  
5 better if we do it smart, and we can quantify what the  
6 delay and emptying the RWST is and the delay to switch  
7 over and how much that will improve the reliability in  
8 doing that. And we'll do it. But I don't have to do  
9 it to know that it's better. And there's thousands of  
10 examples like that. I don't have to know that if the  
11 diesel starts in 11 seconds instead of 10 today I've  
12 got to tear the diesel down and go fix something to  
13 get it to start at ten seconds. That takes the diesel  
14 out of service. It's unavailable, okay? Is that good  
15 for safety?

16 MEMBER RANSOM: But the real question is  
17 is 60 seconds any better?

18 MR. PIETRANGELO: Right.

19 MEMBER RANSOM: Significantly better.

20 MR. PIETRANGELO: Right.

21 MEMBER RANSOM: Because starting a diesel  
22 engine it takes maybe an hour to bring it up to  
23 thermal --

24 MR. PIETRANGELO: Right. But even beyond  
25 just the diesel itself there's the sequencing of the

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1 loads, and most of these are done right up to the max  
2 of what those buses can handle. So I think by  
3 allowing those loads to come on more gradually, okay,  
4 that you can actually improve the reliability of the  
5 whole ECCS. And we don't have time to go do  
6 calculations on all that different stuff, but,  
7 intuitively, and I think if we apply expert opinion  
8 and judgment to this, we can say it's better. So  
9 we're going to do the quantifications and I hope to  
10 get some of the other owners' groups in on this  
11 because I think there are benefits associated with  
12 this and it makes a strong safety case. Again, the  
13 rule has to enable that.

14 The second part of the issues or the  
15 second issue to me that's important with this  
16 rulemaking is this demonstration of mitigation  
17 capability, and that's what Dr. Bonaca raised before.  
18 You're going to change the design basis of the  
19 facility from this double-ended largest break in the  
20 RCS to something smaller, the TBS, all right? To me,  
21 a big part of the defense-in-depth is this mitigation  
22 capability all the way up to that largest break. We  
23 still have to demonstrate that.

24 There's been next to no discussion, even  
25 in the industry or with the NRC staff, on what's good

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1 enough or that demonstrating of the mitigation  
2 capability. And I won't be able to answer Dr.  
3 Bonaca's question sufficiently until I know what's  
4 good enough there, because then I'll know what leeway  
5 I have between my new design basis and what's good  
6 enough for this demonstration of mitigation  
7 capability.

8 At least from my perspective, this is  
9 probably the most important part of this rule, because  
10 that's what's different. If I'm a licensee and I'm  
11 going to opt for the new 50.46, okay, for up to my TBS  
12 I'm going to use the same method, same rule, same  
13 requirements that I was using before; nothing changes.  
14 What changes is I've got this other thing, this  
15 demonstration of mitigating capability. I don't know  
16 whether the staff wants to review and approve it, I  
17 don't know what to do for current code. There hasn't  
18 been any discussion on that. So we need to have that.

19 But if the licensee ops, I'm guessing that  
20 staff's going to be interested in what their  
21 mitigating capability is, because that's going to be  
22 part of the license. It won't be the design basis,  
23 but it will be part of the licensing basis. And  
24 you're going to be asked to maintain that going  
25 forward. So that's a significant piece.

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1 MEMBER BONACA: I'm sorry, I thought,  
2 however, reading the statement of consideration, that  
3 there is a significant intent or an accession. I mean  
4 there is a lot of concessions being done. Now,  
5 clearly, it's not fully defined yet in the reg guide.

6 MR. PIETRANGELO: Right. Right. And that  
7 to me is the focus of the rule, should be the focus of  
8 the reg guide, all that stuff.

9 MEMBER BONACA: Yes. But I'm saying that  
10 on that issue the door is open, it seems to me.

11 MR. PIETRANGELO: I hope so, yes. I hope  
12 it's open. Yes, because we haven't had any  
13 discussion, we haven't see that. So I'm glad to hear  
14 you say that.

15 MEMBER BONACA: Oh, okay.

16 MR. PIETRANGELO: I haven't seen it.  
17 Okay.

18 Now, the third issue wrapped up in this is  
19 one I alluded to before, this kind of change control.  
20 Now, one of the kind of principles we've always used  
21 in risk-informed regulation is we try to build on the  
22 existing regulatory framework before you invent  
23 something new. And if you're going to invent  
24 something new, you'd better have a really good reason  
25 why you've got to go it differently than what the

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1 current framework tells you to do.

2 So what do we do today for change control?  
3 Well, we've got 50.59. Been in place since the  
4 mid-60s. It was significantly improved, I think, in  
5 the late 1990s. Licensees have been using it every  
6 day. Every change that's for something that's  
7 described in the FSAR and even some that's not  
8 described in the FSAR are run through this 50.59  
9 process. The SAR's updated as appropriate, the safety  
10 analysis report. These changes are reported to the  
11 NRC periodically. And you don't have to do any risk  
12 assessment on any of these changes. You don't.  
13 That's what we have in place today.

14 Now, we're going to do this new TBS for  
15 the 50.46. Was PRA used as the basis for this change?  
16 I don't see any. I do know that any change I make  
17 going forward I still have to meet the current design  
18 basis, the SAR analysis up to that transition break  
19 size. I still have to demonstrate that I have the  
20 mitigating capability for up to the double-ended -- so  
21 we will have change control in place with the current  
22 framework.

23 Now, a lot of the talk has been about we  
24 have to do more than 1.174 and this and that. Well,  
25 those are for risk-informed license amendments, when

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1 you have to come into the staff, and even in 50.59.  
2 We give examples in the deterministic guide to what a  
3 more than minimal increase in risk is or consequences.  
4 That's when you have to come in. But 1.174 has a  
5 similar threshold about what's small and very small.  
6 But all 1.174 is is a broad framework for  
7 risk-informed decision making on amendment requests  
8 and changes to the current licensing basis. And it  
9 tells you you've got to look at all the sources of  
10 risk. And it tells you how to input defense-in-depth  
11 and safety margins and risk insights. And it's worked  
12 pretty darn well, I think.

13 And a lot of the changes I think that the  
14 staff's concerned about are things that are  
15 necessarily going to involve amendment requests. You  
16 can't do a power uprate without coming into the NRC.  
17 You can't change your technical specifications without  
18 coming into the NRC. And I'm hard pressed to think of  
19 any of the changes the staff would be concerned about  
20 that wouldn't drive an amendment request. And in that  
21 case, we have guidance on submitting amendment  
22 requests. And even if the licensee doesn't use a risk  
23 argument as part of that amendment request, the staff  
24 has the leeway to ask for risk information if they  
25 think it's important to that amendment request.

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1           So at least from perspective, the  
2 framework's in place to handle this already, without  
3 trying to redo it as part of this rule.

4           CHAIRMAN WALLIS: Are you saying we don't  
5 need a rule at all?

6           MR. PIETRANGELO: Well, this is supposed  
7 to be an enabling rule that incorporates this insight  
8 about big pipes don't break as often as little pipes.  
9 And that's the insight, okay without any of the  
10 quantification and all this other stuff. And it's not  
11 -- at least it wasn't our intent when we began  
12 deliberations with the staff to turn this into the  
13 configuration control change we'd use in risk and  
14 codify all that in the rule. Now, it's evident from  
15 the staff's presentation --

16           CHAIRMAN WALLIS: Tony, I want to ask my  
17 question again.

18           MR. PIETRANGELO: Okay.

19           CHAIRMAN WALLIS: You seem to be saying  
20 quite eloquently that we've got a lot of stuff in  
21 place already, 50.59 --

22           MR. PIETRANGELO: Right.

23           CHAIRMAN WALLIS: -- and 1.174. And you  
24 seem to be questioning whether we need any rule at  
25 all. That seems to be where you're going.

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1 MR. PIETRANGELO: No, I didn't say we  
2 don't need a rule at all. I'm talking about this  
3 portion that deals with change control.

4 MEMBER APOSTOLAKIS: The 1.174 part of the  
5 rule.

6 CHAIRMAN WALLIS: Oh, that part. It's  
7 that part.

8 MR. PIETRANGELO: That part. That part.

9 CHAIRMAN WALLIS: Okay.

10 MEMBER APOSTOLAKIS: Tony, what you're  
11 saying is that that is not needed at all.

12 MR. PIETRANGELO: Well, we haven't had a  
13 lot of discussion with the staff on this. I really  
14 haven't heard a case yet that tells me why I need this  
15 all other stuff in the rule. I think the changes that  
16 the staff are concerned about are things that are in  
17 the current license, that are in tech specs, that  
18 you've got to come in with an amendment request  
19 anyway.

20 MEMBER APOSTOLAKIS: Why does it bother  
21 you that it's in the rule? I mean it's just  
22 redundant.

23 MR. PIETRANGELO: If it's in the rule?  
24 Why add extraneous stuff? I mean that's just a bad  
25 practice.

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1                   MEMBER APOSTOLAKIS: I mean is it just the  
2 beauty of the rule?

3                   MR. PIETRANGELO: No. To me the rule was  
4 supposed to be about enabling beneficial changes and  
5 getting focused on safety significance. This it  
6 doesn't. Look at the staff lines about  
7 inconsequential changes and reporting all that and  
8 bundling. Is that what the rule was supposed to be  
9 about? It's supposed to make you focus on the more  
10 safety-significant things. And I don't want to  
11 reinvent a process that's worked, whether it's 50.59  
12 or 1.174.

13                  MEMBER APOSTOLAKIS: But isn't the  
14 inconsequential part the equivalent of 50.59? I mean  
15 that's what they're trying to do. They're trying say,  
16 "Well, look, we don't want to review everything."

17                  MR. PIETRANGELO: No. Well, they just  
18 told you to report them all. And if they're  
19 quantifiable, you should do it and put it in your risk  
20 model. Now, I'm not saying that's a bad practice at  
21 all. I already report all my changes, whether they're  
22 inconsequential or not, under 50.59.

23                  MEMBER APOSTOLAKIS: That's what I'm  
24 saying.

25                  MR. PIETRANGELO: So why do I have to

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1 repeat it in this rule?

2 MEMBER APOSTOLAKIS: So it's really the  
3 elegance of the rule that bothers you.

4 MR. PIETRANGELO: No, it's not the  
5 elegance. It's people see -- they're used to a  
6 certain way of doing it, and if you're not intending  
7 anything differently, don't create something new that  
8 makes them do the same thing, because they'll read the  
9 words differently, they'll intend something  
10 differently, and I already talked about developing  
11 additional regulatory guidance

12 And any specific application like whether  
13 it's power uprate or even some of these tech spec  
14 things typically what we do is we do  
15 application-specific regulatory guidance, especially  
16 if it's a risk-informed one. What parts of the PRA am  
17 I going to tinker with to show the delta CDF, the  
18 delta LERF, late release, whatever? It will be on an  
19 application-specific basis. We'll probably develop  
20 the guidance and ask the staff to endorse it. We'll  
21 even clip it to make sure that everybody does it in a  
22 template that the staff's familiar with and facilitate  
23 the changes.

24 So it's hard to say at the outset of this  
25 rule how many of those I'm going to need or try to

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1 guess on what I need to put in the rule to cover all  
2 those things. I understand the urge to do it, I'm  
3 just not convinced that the basis is there to do it  
4 yet, because no one's shown me that the current  
5 framework won't work.

6 Now, again, I know that's not going to be  
7 changed in the current version. We will comment on it  
8 when it comes out. I'm not trying to delay the  
9 current thing, but we will have this discussion again  
10 some day, and I just want to get on record our  
11 concerns. And it's obvious there's been movement  
12 since the last time. Evidently, the staff took a lot  
13 of the prescriptive stuff that was in 1.174 and in  
14 this rule and taken it out, so I think it's a step in  
15 the right direction. That's a good thing.

16 One last piece about -- I think I've  
17 covered it. I've probably said enough. Thanks.

18 CHAIRMAN WALLIS: Could I comment on what  
19 you said, Tony?

20 MR. PIETRANGELO: Sure.

21 CHAIRMAN WALLIS: Listening to you, a  
22 great deal of what you said, not all of it, but a  
23 great deal of what you said I felt could have been  
24 said by an ACRS member. We have the same sorts of  
25 questions and concerns that you have. You maybe are

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1 freer to be more outspoken and eloquent in expressing  
2 it, but I was struck by the fact that a lot of these  
3 concerns really are things we've mulled over too.

4 MR. PIETRANGELO: I'm sorry that you feel  
5 constrained to speak your mind in here, Dr. Wallis.  
6 That wouldn't have been one of the attributes I  
7 thought was yours.

8 (Laughter.)

9 MEMBER APOSTOLAKIS: I don't pay attention  
10 to that. I don't feel constrained.

11 MEMBER SIEBER: Thinking is a protected  
12 activity.

13 MR. PIETRANGELO: Well, I'm glad to hear  
14 that.

15 CHAIRMAN WALLIS: The problem is, you see,  
16 if I say something that's too outspoken, you will get  
17 criticize it, and it will get in the newspaper, but  
18 you can say anything you like and I can't criticize  
19 you quite the same way.

20 (Laughter.)

21 MR. PIETRANGELO: I think the discussion  
22 -- this Committee is absolutely essential to this  
23 activity.

24 CHAIRMAN WALLIS: I think it was very good  
25 to have your input, and maybe I'm not speaking for the

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1 Committee at all, but personally I felt a lot of the  
2 things -- the questions you raised are ones that we  
3 have raised ourselves and mulled over too.

4 MEMBER APOSTOLAKIS: I'm looking forward  
5 to debating the last point that you made, because I  
6 still think you worry about elegance.

7 MR. PIETRANGELO: No, it's no.

8 MEMBER APOSTOLAKIS: Well, you're  
9 concerned that maybe these new requirements, which  
10 really are intended to be the same as before but now  
11 they're qualified in the rule, they might be  
12 misinterpreted by people who are already doing this  
13 work. Isn't that what you said?

14 MR. PIETRANGELO: Again, I haven't seen  
15 what's in the -- I'm --

16 MEMBER APOSTOLAKIS: No, I understand  
17 that.

18 MR. PIETRANGELO: Yes. And there may be  
19 a need to put something in the rule. But we've  
20 already got -- even if it just points you to the  
21 existing framework, that's better than trying to  
22 repeat a lot of the other stuff.

23 MEMBER APOSTOLAKIS: Okay. That's a good  
24 statement. But you are not -- I mean the final  
25 conclusion from your speech is that you are not

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1 objecting, based on what you've heard, to having this  
2 released for public comment. In fact you are looking  
3 forward to submitting --

4 MR. PIETRANGELO: Because of the schedule  
5 there's been precious little opportunity for  
6 interaction, and maybe once the proposed rule's out  
7 that we can actually engage on what should be in the  
8 regulatory guide and that kind of thing. So we want  
9 to get on with it. There are certain things that,  
10 again, I haven't seen it, that we might want  
11 differently --

12 MEMBER APOSTOLAKIS: Very good.

13 MR. PIETRANGELO: -- in the proposed rule,  
14 but I know, trying to be practical, that trying to  
15 change it now isn't going to speed up this process at  
16 all. But I would hope that we keep open mind to  
17 changes to the proposed rule once everybody can really  
18 engage and weigh in.

19 VICE CHAIRMAN SHACK: Any more comments or  
20 questions from the Committee? Turn it back to you,  
21 Mr. Chairman.

22 CHAIRMAN WALLIS: Thank you. I was trying  
23 to finish on time but we just missed. We will now  
24 take a break for lunch until 1:15, and I'd like to  
25 thank all those who contributed to our discussions

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1 this morning. Thank you.

2 (Whereupon, the foregoing matter went off  
3 the record at 12:12 p.m. and went back on  
4 the record at 1:11 p.m.)

5 CHAIRMAN WALLIS: The topic we will  
6 consider now is the draft safety evaluation report for  
7 the North Anna early site permit application.

8 I'll turn to my colleague, Dana Powers, to  
9 lead us through this one.

10 \*\* MEMBER POWERS: "Lead" may be too strong  
11 of a term.

12 We're going to talk about an early site  
13 permit. As most of you are aware, approval of early  
14 site permits is a statutory obligation of the  
15 committee. All of this playing around on pressurized  
16 thermal shock, that's a sidelight. This is the real  
17 line business.

18 This is the first of the early site  
19 permits that come in, and for those of you that  
20 thought we would get it for enough time to study it,  
21 to devise procedures, to test procedures and whatnot,  
22 I'm going to have to apologize. The subcommittee was  
23 mean enough on yesterday's subcommittee meeting that  
24 Laura Dudes promised that she would get even by  
25 inflicting about three of these on us at two-month

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1 schedules, and that any further obstreperousness on  
2 our part, she would invent four or five more to  
3 inflict on us.

4 What we're going to hear is a synopsis of  
5 discussions that were presented at a subcommittee  
6 meeting yesterday. All of the speakers had promised  
7 to attenuate the use of geological jargon in their  
8 presentations, though they equally promised that if  
9 we're too obstreperous they will lapse back into  
10 "geologicese."

11 What the staff has done is receive the  
12 application and prepared a draft safety evaluation  
13 report, following a review standard that has been  
14 developed, and they're asking from us for an interim  
15 letter which would be rather similar to the interim  
16 letters that we prepare in connection with design  
17 certification.

18 There are still a few outstanding open  
19 items and discussions of conditions on the license  
20 that are going on. Apparently there was a meeting  
21 today.

22 MR. GRECHECK: There will be a letter sent  
23 in today.

24 MEMBER POWERS: And so things are going  
25 on, but by and large, I would say that the safety

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1 evaluation report and the application are pretty  
2 complete and pretty well done.

3 The rules are fairly prescriptive for what  
4 the staff has to do once they receive these  
5 applications. It is prescriptive on what the  
6 application should contain, and consequently fairly  
7 prescriptive sense of analyses, and it looks to me  
8 like they're pretty well through all of that process.  
9 So it's more of a mopping up operation than were made  
10 to be done.

11 So unless any of the members of the  
12 subcommittee have points to add, and I don't see any,  
13 let us start with a presentation from Dominion by the  
14 Vice President, Gene Grecheck.

15 \*\* MR. GRECHECK: Good afternoon. I'm Gene  
16 Grecheck, Vice President of Nuclear Support Services  
17 for Dominion.

18 And what I'm going to do in the next few  
19 minutes is just to try to give you a quick overview of  
20 what the ESP application is and then also a little bit  
21 more about the North Anna site if you're not familiar  
22 with it.

23 First, the reason that we made the  
24 application to start with was to determine the  
25 suitability of a potential site without having gotten

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1 to the point of determining a specific technology that  
2 we would like to deploy there. The benefit of the ESP  
3 process, at least in theory, is that you can resolve  
4 the siting issues early, before you have spent a great  
5 deal of resources trying to finish the design of a  
6 particular technology.

7 So that's what we're doing. We've been  
8 working with the staff for about the last year and a  
9 half on the site itself, and we still have not made a  
10 decision or a final decision on a technology or  
11 whether we would submit a COL application for this  
12 particular site, but at least we're working through  
13 the siting options.

14 The next slide.

15 Just a little bit about the North Anna  
16 Power Station. The site that we are proposing is  
17 within the North Anna site boundary. North Anna was  
18 originally planned as a four unit site back in the  
19 1970s. Two units were Westinghouse three-loop PWRs.  
20 Those were licensed in 1978 and 1980.

21 Adjacent to that construction permits were  
22 issued for two additional BNW units. The construction  
23 had actually started. There was actually the steel  
24 frame for the containment buildings were actually  
25 erected at both of those, when first Unit 3 and

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1 then -- well, first Unit 4 and then Unit 3 were  
2 canceled, one of those in the last '70s and then Unit  
3 3 was canceled in the post TMI contraction.

4 All of the above ground hardware that was  
5 installed as part of that construction effort was  
6 removed. The base mats for the containment are still  
7 there down at the bottom of the pit somewhere, and  
8 you'll see on the picture shortly that the intake and  
9 discharge structures for those plants still exist, and  
10 we are studying whether to use those existing  
11 structures as part of a proposed additional unit.

12 The next slide is a 50-mile overview of  
13 the North Anna site. North Anna is in western central  
14 Virginia south of Washington here. You can see right  
15 at the center is Lake Anna. Lake Anna was formed by  
16 damming the North Anna River in the early '70s. That  
17 dam was built for the purpose of constructing a  
18 cooling water lake for the plant.

19 Within this 50-mile circle, you can see  
20 off to the west Charlottesville is about 40 miles or  
21 so due west. Richmond is to the southeast about 45  
22 miles or so.

23 CHAIRMAN WALLIS: What is it, South Anna?

24 MR. GRECHECK: South Anna?

25 PARTICIPANT: Another river.

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1 MR. GRECHECK: There's a North Anna River  
2 and a South Anna River.

3 CHAIRMAN WALLIS: I thought you said  
4 "nuke."

5 MR. GRECHECK: Oh, NUG, N-U-G, that's a  
6 non-utility generator. There's an independent  
7 merchant power plant there.

8 CHAIRMAN WALLIS: It's not N-U-C.

9 MR. GRECHECK: No.

10 All right. The next slide is a little bit  
11 closer view. This is a ten-mile view of the site.  
12 You can now see the lake. Down at the very bottom  
13 there where you see the North Anna River designation,  
14 that's where the dam is, and you can see that the Town  
15 of Mineral is about seven miles or so from the site.

16 The Town of Mineral, I think, at the  
17 latest population estimates were about 400 people.

18 MEMBER SIEBER: It has a post office.

19 MR. GRECHECK: Yes, it does.

20 The lake is quite popular for recreation  
21 use over the years since the plant was installed. You  
22 can see just to the northwest of the plant is a state  
23 park, Lake Anna State Park, that has a large,  
24 transient population of boaters and water skiers that  
25 come in through there.

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1           And also there has been a significant  
2 amount of residential development around both shores  
3 of the lake.

4           The next slide is zeroing in on the site  
5 itself. This is the exclusion boundary of the site.  
6 Right in the middle where you see the red X, that is  
7 North Anna or Unit 1. The exclusion boundary is  
8 measured as a 5,000 foot radius around that, and then  
9 off to the left there, that cross-hatched area is the  
10 ESP site. That is the site that is being examined for  
11 the application.

12           The area that is right in the center  
13 immediately to the left of the two plants where -- as  
14 a matter of fact, where the words "Unit 2 Containment"  
15 are -- that is the location of the previously proposed  
16 and started construction of Units 3 and 4.

17           We extended the site a little bit off to  
18 the west there to provide room for the cooling tower.

19           CHAIRMAN WALLIS: Now, the center of that  
20 circle is not at the red X.

21           MR. GRECHECK: It's intended to be. Okay.

22           MEMBER POWERS: It may not be germane  
23 either.

24           (Laughter.)

25           MR. GRECHECK: And the next slide is a

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1 close-up of the proposed early site permit slide.  
2 Again, the rectangular, roughly rectangular space  
3 right in the middle of the figure is where North Anna  
4 3 and 4 were, and it is most likely the location of  
5 the units if we were to proceed with building them,  
6 and then off to the left is a large open area that  
7 would be the location of cooling towers if they were  
8 to be built.

9           Next slide is a photograph. This is a  
10 photograph of Units 1 and 2. You can see immediately  
11 to the left of Units 1 and 2 is a pit. That pit is  
12 where the Unit 3 and 4 construction was. Actually  
13 there was another construction project, and as a  
14 matter of fact, you can see some concrete there at the  
15 bottom of that pit. There was a rad waste handling  
16 facility that construction had begun in the mid-'80s,  
17 and then that project was also terminated. So that  
18 area has had several stops and starts, but that would  
19 be the area.

20           But one of the things I wanted to point  
21 out on this picture is you can look in this area here.  
22 This area right in that area is where the Units 3 and  
23 4 intake is. You can see that there's a cofferdam or  
24 a, you know, embankment that's been built there to  
25 keep the lake out of that pit, but that would be

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1 removed, and that would be the intake for Units 3 and  
2 4.

3 And the discharge for Units 3 and 4 is up  
4 here on the right that would discharge into the  
5 existing discharge canal that comes out.

6 MEMBER KRESS: Are there any dry storage  
7 on the site?

8 MR. GRECHECK: Yes, there are, and that is  
9 about right here.

10 And the final picture in this set is just  
11 a very conceptual idea of a generic plant built on  
12 that site. That's not intended to represent any  
13 design that you might be able to recognize.

14 All right. The next slide.

15 This is a little bit about the chronology  
16 of the application that was submitted in September of  
17 2003. We have submitted three formal revisions to the  
18 application as you can see on those dates. Revision  
19 2 was primarily an environmental, responding to  
20 various environmental requests for additional  
21 information. Revision 3 was mostly answers to the  
22 various safety related questions.

23 The Revision 2 is also significant because  
24 we did modify in that revision the cooling design of  
25 Unit 4, and I'll get to that a little bit later, but

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1 that was where we officially change the design.

2 NRC issued the draft SER in December of  
3 2004. That's what the staff will be discussing with  
4 you, and later this afternoon, we will submit the  
5 response to all of those open items but one. So we  
6 will pretty much have all of those open items resolved  
7 today.

8 There are a few items I just wanted to  
9 point out to you. I'm sure if you've read the  
10 application you've seen that we used something called  
11 the plant parameter envelope. This is just a way to  
12 represent a potential unit without having specifics  
13 about what that unit looks like.

14 What we have proposed is two 4,300  
15 megawatt conceptual units that could be built at this  
16 site, and that envelope envelopes six different  
17 reactor technology designs.

18 CHAIRMAN WALLIS: Is this allowed to be  
19 built now? That seems to be awfully big in  
20 megawattage.

21 MR. GRECHECK: Yes, they would be allowed  
22 to be built.

23 CHAIRMAN WALLIS: I thought there was a  
24 limit.

25 MR. GRECHECK: We had that discussion

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1 yesterday, and we're not aware of any --

2 CHAIRMAN WALLIS: I wasn't here.

3 MR. GRECHECK: I mean, I think there  
4 perhaps was some de facto limit based on the plants  
5 that were being built at the time, but most of the  
6 advanced designs, if you look at the G.E. BWR, for  
7 example or, as a matter of fact, Framatome is  
8 currently marketing the EPR; all of those units are  
9 significantly larger than the previous one.

10 CHAIRMAN WALLIS: You're actually very  
11 specific when you say 4,300.

12 MR. GRECHECK: Well, that was based on the  
13 plant parameter envelope of the designs that were  
14 provided.

15 MEMBER SIEBER: These are megawatts  
16 thermal.

17 MR. GRECHECK: That's correct.

18 MEMBER SIEBER: So you basically divide by  
19 three to get electric.

20 MR. GRECHECK: In general we're looking at  
21 about 1,400, 1,450 megawatt electric plants.

22 And when you look at the conceptual units,  
23 include the designs, for example, of a pebble bed or  
24 a gas turbine GTMHR, which means that these units as  
25 defined as 4,300 megawatt thermal could be composed of

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1 multiple modules of smaller units and --

2 CHAIRMAN WALLIS: Would they be put in?

3 MR. GRECHECK: Yes, they would.

4 CHAIRMAN WALLIS: It would be an awful lot  
5 of pebble beds to get 4,300.

6 MR. GRECHECK: There would be, but the  
7 site does accommodate that, and that site boundary, we  
8 have a layout that shows how they could fit on that  
9 particular site.

10 Finally, there have been several issues  
11 during the review. Again, we believe that all of the  
12 remaining issues that the staff will discuss from the  
13 draft safety evaluation report are resolvable, but  
14 there has been a tremendous amount of discussion about  
15 seismic issues, and I know that we've promised not to  
16 talk about that too much, but it has been the first  
17 application or the first time we've used the revised  
18 NRC guidance that came out during the 1990s about  
19 using a different methodology for approaching the  
20 design seismic of a plant, and it has been a learning  
21 experience, I think, for all parties trying to work  
22 through that.

23 I did want to make a point that one of the  
24 issues that is resolved or discussed during an early  
25 site permit process is the emergency planning or major

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1 features of emergency planning. Clearly, we do have  
2 two existing units here, and we have referenced that  
3 existing emergency plan and would use all of the  
4 features of that existing emergency plan if these  
5 units were built.

6 And finally, Lake Anna water usage has  
7 been an issue here because as we indicated, the lake  
8 was originally built for four units, and if you go  
9 back and look at the licensing history of Units 3 and  
10 4, there was some uncertainty about the overall effect  
11 of four large units on this lake, and there were some  
12 questions that were left open during the construction  
13 permit phase.

14 As we went through that process for these  
15 units, we did make a determination that we would use  
16 the lake as cooling for a proposed Unit 3, but for  
17 Unit 4, the issues of both thermal effects on the  
18 lake, but even more importantly than thermal effects  
19 would be water consumption and thereby water level of  
20 the lake. Those issues seemed a bit steep for Unit 4.

21 So in the application we do propose the  
22 use of a dry atmospheric cooling tower for Unit 4. So  
23 Unit 4 does not use any water from the lake other than  
24 for miscellaneous make-up.

25 Again, I look forward to the discussion,

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1 and if there are question I can answer, I'd be happy  
2 to do that, but I think that just gives you a good  
3 overview of what the application looks like.

4 CHAIRMAN WALLIS: How do you consumer  
5 water from the lake if you're not having cooling  
6 towers and things? You don't consume much of it. It  
7 doesn't disappear.

8 MEMBER SIEBER: Evaporation.

9 MR. GRECHECK: Well, the majority of the  
10 water leaving the lake is by evaporation. If you had  
11 a cooling tower you have to make up to the cooling  
12 tower, and that is a significant drop in --

13 CHAIRMAN WALLIS: Why is it so much?

14 MR. GRECHECK: It's actually more usage  
15 than a once through cooling system.

16 MEMBER SIEBER: And a dry cooling tower,  
17 so to speak, would have to have a tremendous amount of  
18 surface in order to operate a unit.

19 MR. GRECHECK: It would require a great  
20 deal of surface. It would also require motive force  
21 with fans.

22 CHAIRMAN WALLIS: With fans, yeah.

23 MEMBER SIEBER: Yeah.

24 MR. GRECHECK: And it would be a rather  
25 significant use of electricity in order to make that

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1 happen. So our thought is that it is not likely that  
2 a lightwater reactor would be built on this site using  
3 that cooling system, but there are other reactor  
4 technologies included within the PPE that have much  
5 less thermal effect, and if one of those were ever  
6 built on this site, it's more likely that that would  
7 be the way we would go.

8 MEMBER SIEBER: Well, my question is:  
9 have you looked at the size of the site to accommodate  
10 such a cooling --

11 MR. GRECHECK: Yes. That large area that  
12 I showed you on the diagram will accommodate that.

13 MEMBER SIEBER: Yes, okay. Thank you.

14 CHAIRMAN WALLIS: They'd have less cooling  
15 effect because they're more efficient?

16 MR. GRECHECK: Well, they don't use a  
17 water exchange as the cooling medium. The heat  
18 rejection is to the air directly.

19 CHAIRMAN WALLIS: But it would still have  
20 to reject it.

21 MR. GRECHECK: Yes, but it's rejected to  
22 the atmosphere.

23 CHAIRMAN WALLIS: So it would still have  
24 to take the same mass of air through something.

25 MR. GRECHECK: That is correct.

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1 CHAIRMAN WALLIS: So you would still have  
2 to have fans and all of that.

3 MR. GRECHECK: Yes. But I think what I'm  
4 saying is that with other reactor technologies, their  
5 thermal discharge to the environment is less because  
6 they're more thermally efficient.

7 CHAIRMAN WALLIS: That's correct. So you  
8 would have less heat to reject and there would be a  
9 smaller cooling tower as a result.

10 MEMBER POWERS: Of the many elements of  
11 the application, which did you find the most difficult  
12 to do?

13 MR. GRECHECK: Again, I would have to say  
14 seismic because I think that was --

15 MEMBER POWERS: It was seismic?

16 MR. GRECHECK: What has happened with  
17 seismic is that many -- and we had some of these  
18 discussions yesterday -- many of the paradigms and the  
19 rules that many of us remember from many years ago  
20 about what a design basis or what an SSE is and how  
21 you select that acceleration, much of that has  
22 changed, and as a result of that, it's a learning  
23 process to understand what's significant and what  
24 isn't and how do you define that SSE and how do you  
25 define what geological features are significant and

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1 how do you handle those.

2 And I'm sure that even once we complete  
3 the ESP process, should we get into a COL process at  
4 a later date, I'm sure many of those questions will  
5 come up again.

6 MEMBER POWERS: Which of the many elements  
7 were you frustrated the most with?

8 MR. GRECHECK: I think for us it was  
9 probably most surprising and what was most frustrating  
10 was the review of emergency planning. As I indicated,  
11 we did reference an acceptable in-place emergency plan  
12 that's been in place for many, many years, which is  
13 periodically exercised and inspected and verified, and  
14 verified not only by the NRC, but also by FEMA for the  
15 off-site processes.

16 And I think we were a bit surprised to  
17 find that the review standard as it's currently in  
18 place seems to require a detailed re-examination of  
19 many, many things in that plan which, you know, down  
20 to the level of -- as a matter of fact, we had  
21 requests for additional information talking about how  
22 many hospital beds are available in various hospitals  
23 and how the equipment in various state and county  
24 emergency centers is configured, and some of that  
25 seemed to be, first, misplaced in terms of timing,

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1 given that the plant would be built many years from  
2 now, but in addition to that, again, we're talking  
3 about existing plans that would not have to be  
4 appreciably modified for the additional units, and yet  
5 there was this extensive review required.

6 And I think I would certainly suggest that  
7 as part of any lessons learned process that would come  
8 out of this, we would have to take a look as to why  
9 does that seem to be necessary in this review.

10 MEMBER POWERS: Which of the sections do  
11 you think you did the best job on?

12 MR. GRECHECK: Well, I wouldn't want to  
13 make any --

14 MEMBER POWERS: Oh, come on.

15 MR. GRECHECK: I wouldn't want to make  
16 anybody feel they --

17 MEMBER POWERS: Well, you did an excellent  
18 job on all of them. Now, which one is a little more  
19 excellent than the others.

20 PARTICIPANT: First among equals.

21 MR. GRECHECK: Right. Well, I think going  
22 into the application, I think we suspected that there  
23 would be lake usage issues, and I think we spent a lot  
24 of time on that and a lot of effort, and I'm rather  
25 proud of the work that was done in terms of

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1 reconstructing the thermal models that existed from  
2 the previous applications and then updating those and  
3 making some sense of all of that.

4 So I think that was probably a significant  
5 work that we're proud of.

6 CHAIRMAN WALLIS: You have about a three-  
7 page theses on geology.

8 MR. GRECHECK: Yes.

9 MEMBER POWERS: That's actually required  
10 explicitly in the requirement, in the regulations.  
11 They had no choice but to.

12 CHAIRMAN WALLIS: Can't you go back  
13 billions of years and everything?

14 MEMBER POWERS: Well, that's a feature of  
15 geology, is it goes back billions of years.

16 Any other questions?

17 (No response.)

18 MEMBER POWERS: Okay. Let's turn to the  
19 staff. Ms. Dobbs --

20 MS. DUDES: Dudes.

21 MEMBER POWERS: -- are you going to give  
22 an introduction or are we going to go straight to  
23 beating on Mike?

24 MS. DUDES: Well, I'd like my introduction  
25 to include beating on Mike, but I'd like to just do an

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1 introduction, and I know I did this with the  
2 subcommittee yesterday. So I'll try and make it  
3 brief.

4 MEMBER POWERS: So you should be  
5 practiced, right?

6 \*\* MS. DUDES: Yeah, yeah. We'll change it  
7 up a little bit.

8 First and foremost, my name is Laura  
9 Dudes. I'm the Section Chief for New Reactors. I  
10 wanted to introduce Michael Scott, the Senior Project  
11 Manager. I'm probably introducing him for the last  
12 time as a New Reactor staff member, but I'm sure  
13 you'll all get used to seeing Mike around here  
14 shortly.

15 So that's the bad news for us, good news  
16 for the ACRS. The good news for the North Anna  
17 project is Ms. Belkys Sosa will be taking over as the  
18 Senior Project Manager for the North Anna ESP.

19 MEMBER POWERS: They might want to check  
20 with the Canadians before they celebrate too much.

21 MS. DUDES: Well, I think regardless, the  
22 Canadians were pretty happy, and I know ACRS was  
23 pretty complimentary of her work for our pre-  
24 application review on that. So we're very lucky to  
25 have her step in at this critical time in this

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1 project.

2 And I say "critical" because the early  
3 site permits are first of a kind projects. We have  
4 come to an interim milestone, which is the completion  
5 of the draft safety evaluation report, which we have  
6 provided to all of you, and I must say the  
7 introductory remarks were correct. They do plan on  
8 bringing two more of those to you in two-month  
9 intervals.

10 MEMBER POWERS: What did we do to you?

11 MS. DUDES: Nothing, but I was thinking of  
12 a mitigative strategy last night in terms of if we  
13 step back a little bit and look at some of the  
14 activities that are going on nationally in Congress  
15 and other things, we are now planning and looking at  
16 a much higher level of new reactor activities,  
17 including combined license applications.

18 Another design certification is expected  
19 in June, and more early site permits. So I think one  
20 thing that we can do to maybe help the committee, and  
21 you'll have a pretty good support system with Mr.  
22 Scott next week, and we'll be able to maybe figure out  
23 with him how we can get you more information in a  
24 timely manner is once we docket these applications,  
25 the applications are 2,000 pages. They're big.

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1           The staff review is slightly smaller. So  
2 we could probably get you the applications much sooner  
3 and try and condense and point out some critical areas  
4 so that we're not waiting until the last minute when  
5 we're handing you the draft safety evaluation report.

6           So as I said, the Clinton Exelon  
7 application should be -- these applications were all  
8 received within about a month of one another in 2003.  
9 We staggered the reviews by two months to make  
10 efficient use of resource teams because we just  
11 physically couldn't review all of them simultaneously,  
12 and I think we're learning lessons as we go through  
13 this.

14           So Mike is going to go through the North  
15 Anna ESER now. Two months later we'll see Clinton and  
16 then two months after that Grand Gulf, and then just  
17 in case, you know, you're afraid that we're going to  
18 let you have a little bit of a breather, we'll be back  
19 again to do the final safety evaluation for North  
20 Anna.

21           MEMBER KRESS: One question.

22           MS. DUDES: Yes.

23           MEMBER KRESS: Did you guys, the same  
24 group, review the environmental impact statement or is  
25 that a different group?

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1 MS. DUDES: We're within the same division  
2 in NRR, but it's a different section, yes, that does  
3 the environmental impact statement.

4 MEMBER KRESS: Should we be hearing from  
5 them also on these?

6 MR. SCOTT: I don't believe so because the  
7 statutory charter that was mentioned earlier is that  
8 you all report on safety aspects of the application.

9 MEMBER KRESS: And there are no safety  
10 aspects in the environmental impact statement?

11 MEMBER POWERS: Well, the questions you  
12 were asking, Dr. Kress, about the severe accident and  
13 doses, whatnot, is all in the environmental part of  
14 it, and as portrayed yesterday, it's all there. And  
15 as portrayed yesterday, the potential dose to the  
16 public is all dominated by the existing reactors. New  
17 reactors have very low core damage frequencies.

18 MEMBER KRESS: I think that's a good  
19 think, yeah, as long as the constraints are there that  
20 says these have to be one of the new reactors.

21 \*\* MR. SCOTT: If we can get started, I'd  
22 like to, first of all, defend my lengthy slide show.  
23 I have taken some comments already before we even  
24 started on it, but I would ask you all to be a little  
25 patient with me. There are really only 21 slides here

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1 and the rest are all back-up, and some of the 21  
2 slides we should be able to get through quickly  
3 because they are somewhat repetitive either to what  
4 Laura said or what Dominion said earlier.

5 In addition to the slide package, you have  
6 two individual pieces of paper there. One of them is  
7 a brightly colored map of the area and another one is  
8 the seismic source zone map. Those are also in your  
9 slide show as the very last two pages, but I was a  
10 little concerned that there might be a vision test  
11 issue with those. So the separate copies are just  
12 larger font so that you would be able to see them if  
13 you wish.

14 And I don't plan, unless you all have a  
15 particular question on any of the back-up material to  
16 get into that back-up material. We discussed it with  
17 the subcommittee yesterday.

18 So moving into the presentation, the  
19 purpose, of course, is to brief the committee on the  
20 draft safety evaluation report and support your view  
21 and the ultimate issuance of an interim letter to the  
22 Commission.

23 Next slide is the agenda, which I'm  
24 anticipating we would spend approximately 30 minutes  
25 on.

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1 Slide No. 4, as was mentioned earlier,  
2 Subpart A to 10 CFR 52, Part 52 governs what we're  
3 doing here, and Part 52, of course, references Part  
4 100, and we talked about the ACRS does have a  
5 statutory role in this, and Laura mentioned already  
6 this is the first one you're getting. So we can move  
7 right on.

8 The subcommittee asked us to come back  
9 with the purpose of an early site permit, and Dominion  
10 came back with the purpose from their perspective, and  
11 we developed a slide here that shows the purpose of an  
12 early site permit, more generically speaking. It  
13 separates to the extent feasible; ideally it would be  
14 completely feasible to separate, but it turns out that  
15 there are some cases where it's a little difficult to  
16 draw the line, as we discussed with the subcommittee  
17 yesterday.

18 In any event, the intention is to separate  
19 the review of the site from the review of the design,  
20 and that allows the resolution of site related issues  
21 before the applicant has spent significant resources  
22 either developing the design or actually constructing  
23 the plant.

24 And it allows the early site permit holder  
25 who is successful to bank the site for up to 20 years

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1 for future use. So if the applicant anticipates they  
2 may want to build a nuclear power plant but isn't in  
3 an immediate rush to build one right now, then the  
4 early site permit could facilitate a step-wise review  
5 for them to reach the finish line.

6 Next slide.

7 Dominion talked about the past milestones.  
8 I'd like to talk a little bit about the future  
9 milestones. Laura, of course, referred to some of  
10 these.

11 Our schedule assumes an interim letter  
12 from the ACRS this month. Staff provides the final  
13 SER to you in late May. It will be in close to final  
14 form, and then we will issue the FSER, the final  
15 safety evaluation report, in the middle of June.  
16 Hope to have a letter from you all, your final letter,  
17 in July. We have a nominal date here, but of course,  
18 just some time in July.

19 And then we will incorporate the ACRS  
20 letter and issue the final safety evaluation report as  
21 a NUREG, and that schedule date is August 29th, '05.

22 Once the SER is issued and the EIS, the  
23 final EIS is issued, and the ACRS letter is received,  
24 then that will trigger the remaining events that will  
25 take us to a mandatory hearing, which we assume will

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1 begin in the fall of 2005.

2 There will be a contested hearing, as we  
3 discussed with the subcommittee, because there is  
4 currently one environmental contention that is before  
5 the Board, and of course, the Atomic Safety and  
6 Licensing Board keeps its own schedule. So these are  
7 only assumptions on our part as to when the hearing  
8 would actually occur.

9 And also have an assumption, as you see in  
10 the bottom bulleted slide that the Commission would  
11 make its decision in mid-2006, but that's, again, just  
12 a staff assumption.

13 Slide 7, this has largely been covered by  
14 Dominion. I'd just mention here they are seeking  
15 authorization for limited work in accordance with 10  
16 CFR 52.17. The applicant for this early site permit  
17 is a company that, like Virginia Power, is owned by  
18 Dominion Resources, Incorporated, but the applicant is  
19 not the same identical entity as the one that owns  
20 North Anna Power Station. That has some import in the  
21 review that's discussed in the safety evaluation  
22 report.

23 Slide 8. Dominion talked about what  
24 they're asking for capacity-wise. They mentioned the  
25 fact that a unit might be one large reactor or

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1 multiple smaller reactors. They mentioned the fact  
2 that they have submitted a plant parameter envelope.

3 The point that we would make there is that  
4 when an applicant submits a plant parameter envelope,  
5 they are retaining additional flexibility that they  
6 might want to choose their reactor design later  
7 instead of choosing it at the early site permit stage.

8 The down side to that is that we do not  
9 issue -- if we do issue an early site permit to an  
10 applicant who submits a PPE, that permit will not  
11 speak to any particular reactor being approved, and  
12 our review of the PPE values at the early site permit  
13 stage will be limited to whether they are reasonable  
14 or not.

15 And then the combined license applicant is  
16 burdened with showing that their actual chosen design  
17 falls within the PPE. For cases where it does not,  
18 then the issue needs to be reevaluated at combined  
19 license.

20 Slide 9, this is additional information  
21 that we provided in response to a request from the  
22 subcommittee. Of course, this is a rock site. There  
23 are regional geologic faults and the very colorful  
24 drawing that you have there that I mentioned that's  
25 separate shows the faults in the vicinity, and

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1 Dominion did develop their application ultimately for  
2 the seismic hazard using Regulatory Guide 1.165 method  
3 and the low and high frequency earthquakes that are  
4 noted there.

5 Should you be interested, the drawing that  
6 shows the resulting safe shutdown earthquake is in the  
7 back-up slides on page 27 -- I'm sorry -- 26.

8 CHAIRMAN WALLIS: This earthquake M7.2 is  
9 Charleston, is it?

10 MR. MUNSON: Yes, that's correct.

11 MR. SCOTT: That was Cliff Munson speaking  
12 for the staff.

13 Next slide.

14 I believe Dominion talked about their  
15 cooling system. I won't address that again. They do  
16 plan if they elect to place a unit on the site that  
17 requires an ultimate heat sink, they plan to provide  
18 an underground ultimate heat sink which also has had  
19 some import on the review as is discussed in one or  
20 two of the staff's open items.

21 Slide 11. Talked about the draft safety  
22 evaluation. Of course, this is the first of a kind.  
23 It has, therefore, been an interesting review for the  
24 staff, just as I'm sure that it was interesting and  
25 challenging for the applicant in developing a first of

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1 a kind early site permit application.

2 We did have a generic issue resolution  
3 process that we used prior to the receipt of any early  
4 site permit applications to attempt to resolve as many  
5 generic issues as we could identify before the  
6 applications came in.

7 As you can imagine, while we were  
8 successful in identifying a number of issues, others  
9 popped up. We actually got to look at an application,  
10 and so some of those, a few of those are being  
11 resolved as part of what's going on with the review of  
12 these three applications, and I'll speak briefly to  
13 that in a minute.

14 Slide 12 shows the review areas for the  
15 safety review and the staff reviewers. As you can see  
16 there, we have an able group of reviewers, many of  
17 whom you all have previously interacted with. We also  
18 have some very important contract and consulting  
19 support in the hydrology area. We received contract  
20 support from Pacific Northwest Laboratory. They also  
21 supported the site hazards review. Geology and  
22 seismology we were assisted by the U.S. Geologic  
23 Survey, and in the emergency planning area, the staff  
24 consulted extensively with the Federal Emergency  
25 Management Agency.

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1 Next slide.

2 I'd like to talk briefly about a few  
3 issues that came up during the review of the early  
4 site permit application for North Anna. Some of these  
5 are more generic in nature, but of course, we do have  
6 the three applications before us. So they affect  
7 those applications.

8 The first one is regarding emergency  
9 planning. Of course, Gene Grecheck referred to their  
10 concerns regarding emergency planning, and we have  
11 accumulated some lessons learned from the review in  
12 this area.

13 Dominion, like the other two applicants  
14 has elected to seek acceptance of major features,  
15 which is authorized by 10 CFR 52. The concept,  
16 however, is not to find in detail, and when we got  
17 into the review of these three applications, we ended  
18 up having discussions regarding what is finality when  
19 you have limited information presented to you on a  
20 given subject.

21 And what we've concluded is that the  
22 staff, of course, must be able to make its required  
23 findings at the combined license stage. So if we  
24 receive information on a major feature, we can approve  
25 and provide finality for the review of that major

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1 feature, the description of the major feature at a  
2 high level.

3           However, the implementation details  
4 underneath that major feature are open to additional  
5 valuation at the combined license stage. And this, as  
6 was mentioned, perhaps, was not what was expected  
7 going in. So this has been a bit thorny.

8           Slide 14, I mentioned in an earlier --  
9 yes?

10           MEMBER POWERS: Let's come back to this.  
11 As I read the regulations, which, I mean, doesn't say  
12 very much, but I get the impression that what they  
13 were looking for on the emergency plans was a much  
14 more high level sort of thing than what hospital beds.  
15 I mean, they were looking at are there any changes  
16 that are going to change the evacuation routes that  
17 are going to be a problem, not the more microscopic  
18 features in the emergency plan.

19           Am I wrong in reading it that way?

20           MR. SCOTT: Oh, no. You are correct. I  
21 believe that, again, Gene Grecheck referred to that.  
22 This applicant and -- well, let's just say this  
23 applicant -- Dominion did submit emergency planning  
24 information that included a reference to the existing  
25 emergency plan and the evacuation time estimate for

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1 the North Anna Power Station.

2 The staff had previously dealt generically  
3 with the question of what do we do with submittal of  
4 preexisting information, information previously  
5 submitted to the NRC, and we absolutely communicated  
6 with the Commission on that in the approval of RS002,  
7 their early site permit review standard.

8 When we got into the reviews, the staff  
9 did choose to do a review in some detail of both the  
10 on-site and off-site emergency plans and the  
11 evacuation time estimate, and as we remarked to the  
12 subcommittee yesterday, that is an area in which we  
13 have accumulated some lessons learned that perhaps  
14 next time it will be different.

15 MEMBER POWERS: As long as we're going  
16 back, at the subcommittee we did not go into much of  
17 the detail on population projections. Safe to say  
18 that you did them. Could you talk a little bit about  
19 population projections?

20 MR. SCOTT: Population projections figure  
21 into the safety side review both in the emergency  
22 planning area and in the Part 100 area, and there are,  
23 as we mentioned yesterday, there are some regulatory  
24 guides that provide a methodology for determining  
25 actually whether population density is adequate or not

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1 or excessive or not.

2 The review standard provides guidance on  
3 doing a population projection, and as we mentioned,  
4 the population projections that were done run out to  
5 a total of 60 years, which would be the 20-year  
6 assumed period for the early site permit, and then  
7 assuming an application is submitted towards the end  
8 of that period and a plant is built, then we assumed  
9 another 40 years on top of that.

10 And when we looked at the and when the  
11 applicant looked at the resulting population density  
12 figures, they were all the way out to 2065, I believe  
13 is the end year. They were within the criteria for a  
14 population density that the regulatory guides provide.

15 If you want details on what the numbers  
16 are in the regulatory guides, I have somebody here who  
17 can answer that.

18 MEMBER POWERS: I'm more interested in the  
19 resources available to make those projections.

20 MR. SCOTT: Can you clarify, please?

21 MEMBER POWERS: Yeah, how do you know? I  
22 mean, have you got a crystal ball that --

23 MR. SCOTT: What's the basis of the  
24 projections?

25 MEMBER POWERS: Count the number of women?

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1 MR. SCOTT: Okay. The first place I'll go  
2 to ask that question is the tech staff over here. Jay  
3 Lee, can you speak to that? Yeah, that would be your  
4 area, I believe.

5 Did you understand the question?

6 MR. LEE: Yeah, yeah, I do. Perhaps maybe  
7 applicant can address that better than I can. They  
8 use the special formula they developed projecting  
9 future population distribution.

10 MR. SCOTT: And we looked at their method  
11 and found it to be acceptable.

12 MR. LEE: Right.

13 MR. SCOTT: Okay. I don't know if  
14 Dominion would have anybody here that could address  
15 that question. Do you happen to have?

16 PARTICIPANT: We don't have a way to do  
17 that in detail, but it was --

18 MR. SCOTT: It's documented in the  
19 application, I believe.

20 MEMBER POWERS: There's a lot written on  
21 it.

22 MR. SCOTT: Marvin Smith, I believe, from  
23 Dominion wants to say something.

24 MR. SMITH: It's Marvin Smith from  
25 Dominion.

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1           It is documented in the application as to  
2           how that was done, but use the 2000 census as a basis  
3           point and then you have formulas that project  
4           population trends over time that were applied to the  
5           population and the area around the early site permit  
6           site.

7           But, again, the details would be, I think,  
8           pretty well described in the application.

9           MR. SCOTT: And referenced in the safety  
10          evaluation report.

11          Jay, what section of the SER is that? Is  
12          that 2.1.3?

13          MR. LEE: Correct, yes.

14          MR. SCOTT: So that information is, we  
15          believe, contained in there.

16          MEMBER POWERS: There was an ulterior  
17          motive.

18          MR. SCOTT: Okay.

19          MEMBER POWERS: And it is you can project  
20          on population, but you don't project on weather.

21          MR. SCOTT: That's correct.

22          MEMBER POWERS: They would seem equally  
23          challenging to me.

24          MR. SCOTT: I'm going to have to say that  
25          we have no new information for you on the subject of

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1 forecasting the weather based on what was said  
2 yesterday.

3 MEMBER KRESS: Point of clarification on  
4 the siting rules on population density.

5 MR. SCOTT: Yes.

6 MEMBER KRESS: There's a number in there,  
7 I guess, a certain number of people per square mile,  
8 right?

9 MR. SCOTT: Well, there's --

10 MEMBER KRESS: A limit.

11 MR. SCOTT: -- a population center  
12 distance and there is a number per square mile taken  
13 out to certain radiuses, yes.

14 MEMBER KRESS: Now, my question about that  
15 one, that part of it.

16 MR. LEE: Right. Population density  
17 guidance is 500 persons per square mile.

18 MEMBER KRESS: How is that determined? Do  
19 you take a ten-mile limit and get the area and divide  
20 by the number of people, divide that into the number  
21 of people in there?

22 MR. LEE: No, no. We use 20 miles from  
23 the site.

24 MEMBER KRESS: But you use the full area  
25 of the 20 and the total number of people?

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1 MR. LEE: Right, average, average.

2 MEMBER KRESS: And the number of people  
3 there?

4 MR. LEE: But average population density.

5 MEMBER KRESS: Okay. It doesn't involve  
6 the wind rows or bunches of people at given spots in  
7 that 20 miles?

8 MR. LEE: Well, that's included, transient  
9 population, as well.

10 MEMBER KRESS: But that's an average in  
11 the full 20 miles?

12 MR. LEE: Right. Twenty miles. So you  
13 have the area and then you project so many population  
14 including weighing the transient population. Then you  
15 divided that number by area.

16 MEMBER KRESS: That's what I thought.

17 MR. LEE: To come up with --

18 MEMBER KRESS: Thank you. That's what I  
19 thought it was.

20 MR. SCOTT: It's concentric rings, right?

21 MR. LEE: Right.

22 MR. SCOTT: Are we ready to move on?

23 Slide 14. We did identify some issues in  
24 the seismic area. As was mentioned earlier, Dominion  
25 ultimately used the NRC approved method in Regulatory

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1 Guide 1.165. They had come in with a performance  
2 based approach, which is a new approach the NRC has  
3 not yet evaluated, and therefore, we informed the  
4 applicant that use of this performance based approach  
5 would likely result in a delay in completion of the  
6 review, and so the applicant revised its application  
7 to --

8 MEMBER POWERS: But it would seem to me  
9 they'd still use the EPRI-1, but they just noted that  
10 it bounded the Reg. Guide 1.165.

11 MR. SCOTT: Well, that's correct. If we  
12 can flip back to Slide 27, please, or 26 rather. Can  
13 you take us there?

14 If you used the NRC approved method, you  
15 come up with an SSE that's addressed by taking the  
16 higher of the blue and the red lines that you see on  
17 this figure. When the applicant used their  
18 performance based approach, they came up with a line  
19 that exceeds or is equal to those blue -- the higher  
20 blue and red curves throughout.

21 So the NRC found it acceptable because by  
22 our standards it's conservative, but they could have  
23 chosen another number and used another method, and it  
24 still would have been conservative.

25 So while we accept their choice of SSE, we

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1 did not accept it on the basis of a review of the  
2 performance based approach.

3 As we mentioned yesterday, the second of  
4 these applications you're going to see from Entergy,  
5 they have chosen to retain a performance based  
6 approach, and so the staff is reviewing that. So  
7 you'll hear considerably more about the performance  
8 based approach next time around.

9 MEMBER POWERS: I have to admit that that  
10 is the most confusing language. I mean, the idea of  
11 a performance based approach, I think, I could imagine  
12 somebody in Japan coming to me and saying, "Well, I've  
13 got a performance based approach to earthquakes," but  
14 the East Coast of the United States?

15 MR. SCOTT: Cliff Munson can correct if  
16 I'm wrong here. I believe that the performance based  
17 approach refers to other aspects of the methodology,  
18 doesn't it?

19 MR. MUNSON: It refers to the performance  
20 of systems, structures, and components undergoing  
21 ground motion.

22 MR. SCOTT: Which is not the way we've  
23 done these evaluations in the past. So I think that's  
24 what they had in mind rather than it's based on a  
25 large series of earthquakes and what happens to

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1 equipment, you know, in that kind of thing.

2 Let's see here. Okay. The bottom bullet  
3 here, another issue that's come up, and this will end  
4 up being a combined licensed item to be addressed. As  
5 I mentioned, North Anna is a rock site. So the site,  
6 safe shutdown earthquake exceeds the design safe  
7 shutdown earthquake for the applications that have  
8 been either certified or submitted for certification  
9 to date.

10 That is depicted graphically on Slide No.  
11 27, if you're interested in looking at that, and we  
12 fixed Slide 27, by the way. The legend was backwards  
13 yesterday. It's now on straight.

14 So that issue, the applicant has defined  
15 a safe shutdown earthquake and once the open items are  
16 all addressed, if presumably the staff finds it  
17 acceptable, then that will be adequate for the early  
18 site permit.

19 And then the comparison of that safe  
20 shutdown earthquake with the design will be a function  
21 that we'll need to happen to the COL.

22 Slide 15.

23 MEMBER POWERS: I mean, it still raises  
24 the question of once again we run into this finality  
25 issue that now if you open up the design, the

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1 certified design to say, okay, you've got to X this  
2 thing in order to put it on this site. How much do  
3 you open it up?

4 MR. SCOTT: Well, I guess I don't see that  
5 as the same thing as some of these other  
6 considerations. The SSE as specified for the site  
7 will be final, subject to the provisions of 10 CFR  
8 52.39, and the design SSE is a design issue, and our  
9 purpose here is not to resolve design issues at the  
10 ESP stage.

11 So I don't see that as a finality issue so  
12 much as an item of matching the site and the design,  
13 and in the perfect world, you would have those two  
14 match up. The site would fully bound the design, and  
15 so at combined license, the applicants' task would be  
16 easier, but because that's not the case here, if they  
17 don't come in with the design that is bounded by the  
18 site at that stage, then they're going to have to  
19 demonstrate that the design can be safely put on the  
20 site, and that will be subject to all full  
21 consideration at combined license.

22 Slide 15 speaks to another question that's  
23 come up, site characteristics versus design inputs.  
24 We have given Dominion credit in our SER for  
25 appropriate consideration of the most severe and

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1 natural phenomena that have been reported for the site  
2 with allowance for margin and uncertainties, which is,  
3 of course, the language that they will ultimately need  
4 to comply with in General Design Criterion II,  
5 although GDC II largely does not apply at the ESP  
6 stage.

7           The staff was of the objective that if the  
8 applicant has been able to partially demonstrate  
9 compliance with a rule that will apply at combined  
10 license, we should give them credit for that, and we  
11 did where appropriate.

12           However, Dominion was concerned about the  
13 language in our safety evaluation report that refers  
14 to design bases, and they wanted to clarify that site  
15 characteristics are not necessarily the design bases.  
16 Site characteristics are the minimum design bases, and  
17 an applicant can always choose to use more  
18 conservative design bases for their actual design, and  
19 the staff is all right with that.

20           Slide 16. I mentioned earlier that the  
21 interface between site and design, which we would like  
22 to separate the review of the site and the design to  
23 the extent we can because that, of course, is the  
24 purpose of the step-wise process in Part 52. There  
25 are some cases where it's not quite clear how we do

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1 that, and some of the examples that we've come up  
2 against in this evaluation you see in front of you.

3 For most of these we have worked through  
4 it and determined a site characteristic that can be  
5 suitable for addressing the issues involved. The one  
6 that we're still under discussion with in the staff is  
7 potential interferences between new and existing  
8 plants.

9 The subject who actually brought this up  
10 was the fact that the normal service water discharge  
11 for the new plants will run underneath the safety  
12 related service water piping going to and from the  
13 ultimate heat sink for the existing plants, and we  
14 have wrestled with how do we insure that the impact of  
15 the construction of the new plants is appropriately  
16 addressed.

17 The applicant believes that that should be  
18 addressed under Part 50, that it's not necessary to be  
19 part of the ESP considerations, and the staff is still  
20 evaluating that.

21 Now, other examples of these are discussed  
22 in the back-up slides, but I don't propose to address  
23 them today unless the committee would like to discuss  
24 any particular one of them.

25 MEMBER POWERS: Let's go through the

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1 frazil and anchor iced again.

2 MR. SCOTT: Okay. The issue there --  
3 well, I'll tell you what. Rather than me go through  
4 it, I'll just get Goutam to come up here. Goutam, are  
5 you back there?

6 Would you please speak to the open item  
7 regarding frazil ice and anchor ice?

8 MR. BAGCHI: The staff was looking for  
9 some kind of criterion to insure that frazil and  
10 anchor ice is considered as a characteristic of the  
11 site that would be incorporated in the future design  
12 of the intake and the screen and so forth.

13 MR. SCOTT: And what we ended up  
14 concluding the right thing to do at this stage is to  
15 have a site characteristic simply that there are  
16 conditions that could arise at the site that would  
17 cause frazil or anchor ice to occur.

18 There was not, to the best of we could  
19 determine, a site characteristic that we could rely on  
20 that would say this is what will bring about frazil  
21 ice because there's a combination of conditions, and  
22 so what we are simply stating is that at ESP frazil  
23 and anchor ice could occur, and that will mean that  
24 when we stated that, that the combined license  
25 applicant will need to provide appropriate design

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1 features to deal with that.

2 CHAIRMAN WALLIS: Have you got frazil ice  
3 in lakes, do you?

4 MR. SCOTT: Yes.

5 CHAIRMAN WALLIS: I've seen it in rivers.  
6 It just floats around in a lake?

7 MR. BAGCHI: Well, in the application  
8 itself they accept that it can occur in lakes, lakes  
9 and rivers, yes.

10 CHAIRMAN WALLIS: But rivers, it's moved  
11 by the river. So it's mixed up with the water in the  
12 river. In the lake I would think it would float to  
13 the surface.

14 MEMBER POWERS: Well, the application  
15 itself defines a turbulent condition to get the  
16 necessary mixing.

17 MR. SCOTT: The actual combinations of  
18 conditions that would result in that occurring at Lake  
19 Anna, Virginia are not going to be common.

20 MEMBER POWERS: Yeah, basically, as I  
21 interpret the argument, it is that if the Units 1 and  
22 2 are operating, you don't get cold enough to get ice.  
23 If they're not operating then there's not enough  
24 turbulence to mix any ice up, and so that it's a  
25 relatively rare occurrence.

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1 MR. SCOTT: As I recall, the issue could  
2 emerge if you've had a large number or say all of the  
3 units shut down and now you're getting ready to start  
4 one up. The cold water is there, and now you have the  
5 turbulence.

6 MEMBER POWERS: But you handle it just by  
7 saying, yeah, it can occur.

8 MR. SCOTT: It can occur, and so the COL  
9 applicant is going to need to provide design measures  
10 to deal with it, and that is not something that's  
11 unprecedented.

12 MEMBER POWERS: Oh, yeah, yeah.

13 MR. SCOTT: And this was one of those kind  
14 of lessons learned again. Do we ask the applicant at  
15 the early site permit stage to show us what design  
16 feasibility is out there?

17 And ultimately we concluded that that's  
18 not the role of an early site permit review.

19 MEMBER POWERS: Yeah, because I mean if  
20 nobody had ever had frazil ice before in the world,  
21 you might well want to look at that for feasibility,  
22 but since Wolf Creek, we're all attuned into frazil  
23 ice. You know, there are ways of handling it.

24 MR. SCOTT: Right. Slide 17 just speaks  
25 to largely the collection of items that we've given to

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1 you in the back-up slides. We do have some open  
2 items. There are about 30 of them. Twenty of them  
3 are in the emergency planning area and half of those  
4 are related to the fact that some of the requests for  
5 additional information responses came in late.

6 And then there are another ten or 15 that  
7 are related to various site issues, and as Gene  
8 Grecheck mentioned, we are working through those, and  
9 the applicant expects to provide most of that  
10 information today.

11 So we're anticipating that, and we'll have  
12 the staff reviewers looking hard at how the applicant,  
13 how Dominion is resolving those.

14 MEMBER POWERS: You tantalized us by  
15 saying all save one. Do you happen to know what the  
16 one is?

17 MR. SCOTT: The issue is, yes -- let me  
18 see if I can find it.

19 MEMBER POWERS: He's a dirty guy. He  
20 leaves me curious for long periods of time. I know he  
21 did it deliberately. He's grinning back there.

22 MR. SCOTT: A whole lot more credit than  
23 it's due.

24 CHAIRMAN WALLIS: Are you going to revisit  
25 seismic or are you going to go to the end?

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1 MR. SCOTT: Well, actually as it happen,  
2 the item that they're going to be a little late on is  
3 seismic. If we could -- say again? -- go to page 35,  
4 actually I'm going to say it's 36.

5 Thirty-six is open item 2.5.2, which is to  
6 incorporate site specific geologic properties and  
7 their uncertainties into the determination of the SSE.  
8 Dominion has provided their method for determining the  
9 SSE at a hypothetical rock outcrop, which is  
10 consistent with NRC guidance on the subject, and as  
11 noted on the slide here, the staff has no questions on  
12 it, but the actual results of the method will not be  
13 provided to us until the end of this month.

14 CHAIRMAN WALLIS: Now, this is a rock  
15 site.

16 MR. SCOTT: It is a rock site, yes.

17 CHAIRMAN WALLIS: Yet you have concerns  
18 with the liquefaction in the --

19 MEMBER SIEBER: Yes.

20 CHAIRMAN WALLIS: How does that come  
21 about?

22 MR. MUNSON: This is Cliff Munson.

23 They have a thin layer of soil. It's  
24 considered a rock site. There is a thin layer of soil  
25 at the top. This will be removed when they build a

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1 reactor. It will be excavated and removed, but they  
2 did do a liquefaction analysis propagating the ground  
3 motion up through the site, and that included this  
4 weak soil layer

5 CHAIRMAN WALLIS: That's going to be  
6 removed?

7 MR. MUNSON: Right.

8 CHAIRMAN WALLIS: So liquefaction issue  
9 goes away?

10 MR. MUNSON: Right.

11 MR. SCOTT: That's a permit condition,  
12 too, that we're planning to propose.

13 MEMBER SIEBER: Actually they're going to  
14 do a couple of things. They're going to improve the  
15 soil that's located not under safety related  
16 structures.

17 MR. SCOTT: Right.

18 MEMBER SIEBER: And remove the soil where  
19 safety related structures would be. So there's a lot  
20 of shoveling.

21 CHAIRMAN WALLIS: Now, do these pipes go  
22 through the rock or through the soil?

23 MR. SCOTT: Are you speaking of the  
24 service water piping?

25 CHAIRMAN WALLIS: Yes. Do they go through

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1 the rock or through the soil?

2 MR. SCOTT: As I think Mr. Grecheck  
3 mentioned, Dominion is planning to use the existing  
4 service water structure to the extent possible. I  
5 don't know. Cliff, can you speak to whether it's in  
6 the rock?

7 MR. MUNSON: I have no idea.

8 CHAIRMAN WALLIS: Presumably, it's a  
9 seismic response of the piping?

10 MR. SCOTT: Dominion, do you have any  
11 insight on this?

12 CHAIRMAN WALLIS: It depends on what it's  
13 in?

14 MR. GRECHECK: First, the piping that's  
15 being referenced --

16 MR. SCOTT: That's Gene Grecheck.

17 MR. GRECHECK: Yes, this is Gene Grecheck.

18 The piping that's being referenced here is  
19 the circ water piping for condenser cooling. That's  
20 non-safety related, and that's the large cooling  
21 structure. That is through soil. That is not.

22 But this soil at this site is a mixture of  
23 soil and then something called saprolite, which is a  
24 crumbled rock type material, but the excavation --and  
25 part of the reason that we are seriously looking at

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1 using this existing piping is because all of this  
2 excavation in construction was done some years ago,  
3 and if we can reuse that, there's no reason to do all  
4 of that again.

5 But the rock layer, the safety related  
6 structures are founded on the bedrock underneath all  
7 of that. So when we're talking about what we'd do is  
8 remove that cover material, found the structures on  
9 rock, and then refill it, and much of the discussion  
10 that we have about seismic response is the response of  
11 that fill material and how that interacts with the  
12 structure.

13 MEMBER POWERS: And as I read your  
14 application, you had agreed to backfill not with the  
15 existing soil but with a different soil.

16 MR. GRECHECK: And with an improved  
17 material.

18 CHAIRMAN WALLIS: You have safety related  
19 pipes. You have an ultimate heat sink and things like  
20 that. Presumably you have safety related pipes that  
21 go through this soil.

22 MR. SCOTT: If they use an ultimate heat  
23 sink.

24 CHAIRMAN WALLIS: Do you do a seismic  
25 analysis of these pipes then?

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1 MR. SCOTT: Not at this stage.

2 MR. GRECHECK: For the existing station,  
3 for North Anna 1 and 2, there is safety related piping  
4 that does run through the soil, but that piping is  
5 anchored at various points, and there is a seismic  
6 analysis that discusses how that would response.

7 MR. SCOTT: But that would be outside our  
8 scope here.

9 In addition to the open items, there is a  
10 confirmatory item. Just briefly, it's regarding use  
11 of the Internet for information supporting safety  
12 related analyses, and the applicant addressed that,  
13 and the staff has inspected it and has no additional  
14 questions on it.

15 COL action items. There are a number of  
16 items which, again, are in the back-up slides here.  
17 There are items that are site related, but for various  
18 reasons the staff believes will more appropriately be  
19 addressed at the combined license stage.

20 Just as an aside, as part of reviewing the  
21 responses to the open items discussing these issues  
22 with the applicant, the staff has considered and  
23 there's some chance that some of these combined  
24 license action items may be revised or deleted by the  
25 time we're complete with the final safety evaluation

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1 report.

2 For example, we have one speaking to this  
3 separation distance, and it doesn't make sense given  
4 the actual physical condition or configuration of the  
5 site.

6 Finally, we have a number of permit  
7 conditions. Again, these are in the back-up slides as  
8 well. These are items that we believe are applicable  
9 to the ESP holder, and there will be constraints on  
10 the ESP holder if an ESP is issued for the site.

11 CHAIRMAN WALLIS: To go back to seismic,  
12 what's the effect of seismic on the dam that retains  
13 the lake?

14 CHAIRMAN WALLIS: Okay. Again, the lake  
15 is not the safety related ultimate heat sink for the  
16 site, for the early site permit site.

17 CHAIRMAN WALLIS: They don't need the  
18 lake.

19 MEMBER SIEBER: No.

20 CHAIRMAN WALLIS: For safety purposes.

21 MR. SCOTT: That's correct.

22 CHAIRMAN WALLIS: So if you lost the lake,  
23 it wouldn't matter.

24 MR. SCOTT: Well, it wouldn't be good.

25 MR. BAGCHI: Well, that's right.

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1 This is Goutam Bagchi.

2 We did look at that for availability of  
3 water, and the dam failure is postulated.

4 MEMBER SIEBER: On the other hand, the  
5 ultimate heat sink is that big pond.

6 MR. SCOTT: That's correct.

7 CHAIRMAN WALLIS: No, no.

8 MR. SCOTT: Well, there's an underground  
9 facility if they use one, correct, Goutam?

10 MEMBER SIEBER: That's for the new.

11 MR. SCOTT: The new ones, yes, as opposed  
12 to the old ones.

13 MR. GRECHECK: Again, this is Gene  
14 Grecheck.

15 Just to clarify that, remember on the  
16 picture there was that pond. That is the service  
17 water reservoir, and that is the ultimate heat sink  
18 for Units 1 and 2. For the ESP units, we are  
19 proposing if an external ultimate heat sink is  
20 required, then it would be an underground width band.

21 CHAIRMAN WALLIS: I wonder if it's  
22 underground what do you do. You have welds or  
23 something? Is that what you mean?

24 MR. SCOTT: No, the make-up would come  
25 from the lake.

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1 CHAIRMAN WALLIS: But the lake is gone in  
2 my scenario.

3 MEMBER SIEBER: Well, you fill it first.

4 CHAIRMAN WALLIS: You fill it first. It's  
5 an underground pond. Is that what it is, rather than  
6 groundwater? It's actually underground reservoir?

7 MR. BAGCHI: It's a very large tank. It's  
8 230 feet by some 100 feet by 50 feet.

9 CHAIRMAN WALLIS: So it's an actual tank.

10 MR. BAGCHI: It's an actual tank buried  
11 inside the ground.

12 MEMBER SIEBER: Big.

13 MR. BAGCHI: Very big.

14 MR. SCOTT: The next slide, Slide 18,  
15 please.

16 CHAIRMAN WALLIS: -- from the tank on the  
17 surface. It's just a tank of water.

18 MR. SCOTT: Yes. The DSER, being the  
19 first cut at the safety evaluation report and having  
20 open items associated with it, defers general  
21 regulatory conclusions regarding site safety and  
22 suitability to the final safety evaluation report,  
23 which I mentioned we will plan to issue in June.

24 However, there are some sections of the  
25 report for which there are no open items, and in those

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1 sections we have reached conclusions that are shown  
2 here. As you will note, the applicant has provided  
3 appropriate quality assurance measures equivalent to  
4 those in 10 CFR 50, Appendix B.

5 Part 52 does not require compliance with  
6 Appendix B, but the staff has clearly stated to the  
7 applicants that we need for the ability to have  
8 confidence in the review findings, that the measures  
9 the applicant applies be equivalent in substance to  
10 those in Appendix B, and Dominion has done so, and the  
11 staff has accepted that.

12 Site characteristics are such that  
13 adequate security plans and measures can be developed.  
14 As I understand, the committee is not evaluating  
15 security. So we'll move on from that one.

16 CHAIRMAN WALLIS: We just note that it is  
17 on a lake.

18 MR. SCOTT: It is on a lake.

19 MEMBER POWERS: Our specific charter is to  
20 look at the items related to safety, and the  
21 Commission has expressed no interest in advising them  
22 on security issues with regard to these early site  
23 permits. So we've kind of said, okay, we won't do  
24 that.

25 I think we have enough to do without it.

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1 MR. SCOTT: Additional conclusions. We  
2 talked about this earlier. The population center  
3 distance is defined in 10 CFR 100.3. Meets the  
4 criteria for being one and a third times the distance  
5 from the reactor to the outer boundary of the low  
6 population zone, and is compliant with the applicable  
7 regulations.

8 The applicant has also established  
9 appropriate atmospheric dispersion characteristics to  
10 support its radiological calculations, radiological  
11 dose consequence evaluations.

12 And based on that information, as well as  
13 the PPE value --

14 CHAIRMAN WALLIS: I'm curious about this  
15 population center distance. How do you decide what  
16 the distance is? Is it the outer boundary of the  
17 population center or is it the center of the -- if  
18 it's a big area, how do you decide how to measure the  
19 distance?

20 MR. SCOTT: Jay, can you speak to that,  
21 please?

22 MEMBER POWERS: It's mineral.

23 MR. LEE: The distance is from the  
24 reactor.

25 CHAIRMAN WALLIS: That's easy to define,

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1 but what's the other end of the distance?

2 MR. LEE: That's the one and one-third  
3 times --

4 CHAIRMAN WALLIS: Yeah, but what's the --

5 MR. LEE: -- the distance to the LPG,  
6 which is 6.8 miles.

7 CHAIRMAN WALLIS: I understand.

8 MR. SCOTT: I think he's asking what the  
9 population center is.

10 CHAIRMAN WALLIS: What is the location of  
11 the population center? Is it the outer boundary or  
12 what? We have a city. Is it the distance to the  
13 first suburb or is it the distance to the city limits,  
14 City Hall?

15 MR. SCOTT: What is the definition of a  
16 population center is where he's going.

17 MR. LEE: I don't think we defined that.

18 CHAIRMAN WALLIS: It seems to me important  
19 because the city could be bigger than one and one-  
20 third times the distance.

21 MR. SCOTT: I think it is dispersed.

22 MEMBER POWERS: It could be, but it's  
23 Mineral, Virginia. So --

24 MEMBER SIEBER: Yeah, Mineral is not --

25 MEMBER POWERS: You could take either one

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1 of them. It's the same distance.

2 CHAIRMAN WALLIS: It's like a small town  
3 in Vermont.

4 MEMBER POWERS: It's not quite that big.

5 MR. SCOTT: There are criteria for this  
6 and we can get back to you on that as to what those  
7 criteria are. I mean, there is a method for doing  
8 this that we went through in this evaluation.

9 MEMBER POWERS: Well, the first population  
10 center has to have a population of less than 25,000,  
11 and unless it's an extremely peculiar 25,000 city,  
12 there's not going to be a huge amount of distance  
13 between the outer limits and the town center.

14 CHAIRMAN WALLIS: Well --

15 MEMBER POWERS: A town of 25,000?

16 PARTICIPANT: Oak Ridge would be a huge  
17 area.

18 MEMBER POWERS: Unless it's extremely  
19 unusual. I excluded that. There's a possibility on  
20 the off chance you might bring up Oak Ridge, which by  
21 definition is a very eccentric place.

22 PARTICIPANT: You're right.

23 MR. SCOTT: The nearest relatively large  
24 town in the vicinity of this site, as Mr. Grecheck  
25 mentioned is over 30 miles away.

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1 Slide 20. The staff also concluded that  
2 potential hazards associated with nearby  
3 transportation routes, industrial-military facilities  
4 pose no undue risk to a facility that might be  
5 constructed on the site. In other words, we evaluated  
6 the hazards in the area, and did not find issues  
7 related to significant hazards, off-site hazards.

8 Slide 21. This is just a wrap-up on the  
9 presentation. The staff has, of course, issued a  
10 first of a kind DSER. We expect today to have open  
11 item responses for most of them. We are working  
12 through some issues that we've talked to you about.

13 We're looking forward to seeing the  
14 interim ACRS letter and to coming back -- well, to  
15 Belkys coming back in July and bringing you again on  
16 the final safety evaluation report.

17 And we are identifying a number of lessons  
18 learned related to these three reviews. As you can  
19 imagine, first of a kind, it's fertile ground for  
20 identifying things that you didn't expect to identify,  
21 and we plan to revise our guidance in the future to  
22 address these lessons learned and that which supports  
23 review of any future early site permit applications  
24 that might be submitted.

25 And there is some industry discussion that

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1 there may be additional early site permits, although  
2 we do not currently have a commitment letter from any  
3 particular entity for seeking one.

4 MEMBER POWERS: I think we'd be interested  
5 in working with you on that, the lessons learned  
6 activities. We can help you provide input from our  
7 perspective, but not to -- you know, if it's not too  
8 terribly much of an imposition on you, once you get  
9 your thoughts together, maybe come down and give us a  
10 chat, and we can give some feedback, and maybe we can  
11 put something together kind of jointly on this.

12 MR. SCOTT: We would appreciate your  
13 input.

14 MEMBER POWERS: You know, I mean, in the  
15 spirit of what is efficient and good guidance and is  
16 efficient or review is possible and things like that.  
17 So I think we'd be interested in working with you on  
18 that.

19 MR. SCOTT: Thank you.

20 CHAIRMAN WALLIS: That would be very  
21 useful. It would help us to know what to focus on  
22 next time around and that sort of thing.

23 MR. SCOTT: Sure. That concludes --

24 MEMBER POWERS: I think it's going to be  
25 possible. I mean, it sounds like they're going to

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1 exercise us pretty good on this, and if we're just  
2 careful on keeping track of where we find rough spots  
3 and things like that, and then we get together with  
4 them and get their notes and where they found rough  
5 spots and we might be able to put together a pretty  
6 good story here.

7 I'm quite sure the Commission is very  
8 anxious for us to work like that, in a, you know,  
9 cooperative fashion like that.

10 Similarly, I would invite comments, Gene,  
11 from your crowd, too, just you know, some input on  
12 what you found easy, difficult, hard, and things like  
13 that, and confusing or whatever. I just think it  
14 would be useful.

15 MR. SCOTT: That concludes my prepared  
16 remarks, subject to your questions.

17 MEMBER POWERS: Do you have any questions  
18 for the speaker?

19 (No response.)

20 MEMBER POWERS: Well, for those of you who  
21 have not had a chance to look at the massive  
22 documentation sent to us primarily, I think, in  
23 electronic format, it's actually -- the application is  
24 impressive, but the SER is a fairly readable document,  
25 and if take a chance to look at it if you haven't.

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1                   Now, are there any questions the members  
2 have of either set of speakers?

3                   (No response.)

4                   MEMBER POWERS: And I'm not aware of  
5 anybody from the public wanting to make comments. So  
6 I'll thank you.

7                   MR. SCOTT: Thank you.

8                   MEMBER POWERS: And welcome aboard, Mike.

9                   MR. SCOTT: Thank you.

10                  MEMBER POWERS: And thank all of the  
11 speakers and turn it back to you, Mr. Chair.

12                  CHAIRMAN WALLIS: Thank you.

13                  So we have gained some time, but we can't  
14 use it because we're not allowed to start until three  
15 o'clock. So we will take a break until three o'clock.

16                  (Whereupon, the foregoing matter went off  
17 the record at 2:24 p.m. and went back on  
18 the record at 2:56 p.m.)

19                  CHAIRMAN WALLIS: Let's come back into  
20 session.

21                  We're going to hear about pressurized  
22 thermal shock rule. We're very much looking forward  
23 to what we hope will be the end or almost the end of  
24 this process. I will hand the chair over to Bill  
25 Shack to get things going.

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1       \*\*               VICE CHAIRMAN SHACK:   Okay.  You know,  
2       we've had a number of meetings to discuss pressurized  
3       thermal shock.  At our last meeting since we reviewed  
4       much of the documentation which really provides the  
5       technical basis for pressurized thermal shock, and we  
6       said, you know, this project was out to develop the  
7       technical basis.  It really comes down to the reports  
8       that were available.

9                       And today we'll be talking about another  
10       one of those reports covering the thermal hydraulic  
11       evaluation of thermal shock.  And again, you know,  
12       there's a PRA part.  There's a thermal hydraulic part,  
13       and a probabilistic fracture mechanics to PTS.

14                      The thermal hydraulic calculations have  
15       been done with RELAP, and being a structures guy, I  
16       never understand exactly how this works when you do  
17       these things with RELAP.

18                      CHAIRMAN WALLIS:  It's magic.

19                      VICE CHAIRMAN SHACK:  Its magic.  They  
20       used 2D models with their axial azimuthal segments  
21       here.  We deactivate the momentum flux in the  
22       downcomer because otherwise we get unrealistic  
23       circulations, but --

24                      MEMBER POWERS:  And that part is wrong  
25       anyway, right?

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1                   VICE CHAIRMAN SHACK: Six azimuthal  
2 regions. We looked at NUREG 1806 last time. There  
3 are comparisons with experiments in NUREG 1806, and  
4 they focused on comparisons of the pressure and the  
5 fluid temperature in the downcomer in experiments and  
6 RELAP calculations. Those were fairly good.

7                   However, there were no comparisons of the  
8 wall temperature or the heat transfer coefficient H,  
9 and in reality it's really the wall temperature that  
10 controls the pressurized thermal shock.

11                   There was some sensitivity studies that  
12 showed that the downcomer fluid temperature is  
13 relatively insensitive to H, and again, that's not  
14 totally unexpected, but it's really the wall  
15 temperature that we're worried about. RELAP uses the  
16 maximum of the Churchill-Chu or the Dittus-Bolter  
17 correlations to compute age for the baseline  
18 calculations, and they use plus or minus 30 percent on  
19 those values for an uncertainty analysis.

20                   MEMBER POWERS: Why 30 percent?

21                   VICE CHAIRMAN SHACK: Well, we'll let them  
22 discuss that.

23                   In 1806, they did some sensitivity  
24 studies, Petcherkoff-Galinski, with the Swanson-Catton  
25 multiplier for buoyancy opposed mixed convection, and

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1 when they did those calculations, they got a through  
2 wall cracking frequency for the 12 transients they did  
3 increase or change by factors ranging from .4 to 1,  
4 with an average of about five.

5 And so if you take a simple minded point  
6 of view, you might say that if you use those  
7 correlations you would increase the through all  
8 cracking frequencies you were getting by something on  
9 the order of a factor of five.

10 Now, that's interesting. That would still  
11 leave a significant margin for plants at the end of  
12 license renewal. So it's not the end of the world,  
13 but it certainly would be different than the kind of  
14 values that we've had.

15 We have a new report now, NUREG 1809  
16 that's intended to provide further information on the  
17 comparison of RELAP with experiments. One of the  
18 things that I'd like to get out of this discussion is  
19 the basis that we should find acceptable either way of  
20 calculating age that we use, either the conventional  
21 baseline RELAP calculations or the Petcherkoff-  
22 Galinski with Swanson-Catton multiplier.

23 And so what evidence do we have that  
24 either one of those provides a realistic value of H?  
25 Which H correlation should we be using? The baseline

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1 calculations have been done with one. We have an  
2 alternative sensitivity calculation with another, and,  
3 again, any more insight on how much difference it  
4 really makes.

5 And I believe Jack Rosenthal wants to.

6 \*\* MR. ROSENTHAL: Thank you.

7 I'm Jack Rosenthal. I'm the Branch Chief  
8 of the Advanced Reactor and Regulatory Effectiveness  
9 Branch in the office of Nuclear Regulatory Research.

10 I've been given the opportunity to provide  
11 some opening remarks.

12 This February we provided our report,  
13 NUREG 1809, entitled "Thermal Hydraulic Evaluation of  
14 Pressurized Thermal Shock," and that was intended to  
15 summarize our work and answer questions. Dr. Bessette  
16 is our principal spokesman today to summarize the  
17 report of which he's really the author and to respond  
18 to questions.

19 Dr. Kirk also is at the table. He's from  
20 Materials Engineering Branch, and he will actually  
21 start the discussion to try to put what we have to say  
22 in perspective.

23 Roy Woods is in the room, and he's from  
24 the Probabilistic Risk Analysis Branch should  
25 questions arise.

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1           And Professor Griffith and Professor  
2 DiMarzo, who are consultants to the staff, are next to  
3 me to answer questions should they arise.

4           We've been doing thermal hydraulic work  
5 for over four years in this area, and we've had an  
6 extensive analytic effort and experimental program,  
7 and we think that we've made significant progress over  
8 what we knew 20 years ago, in part due to increased  
9 understanding and in part due to the fact that we now  
10 have computers that just allow us to do multiple,  
11 multiple calculations.

12           We have performed assessment of our code  
13 against experiments, and find it surprisingly predicts  
14 rather well, and you'll hear an explanation of why.

15           Using the tools we've performed hundreds  
16 of calculations to examine a spectrum of transients  
17 and accidents relevant to PTS, ranging from a stuck  
18 open safety valve which subsequently receives to a  
19 large break loss of coolant accident.

20           We've performed extensive sensitivity  
21 studies of the thermal hydraulic aspects alone, as  
22 well as coupling the thermal hydraulics and the  
23 fracture mechanics, and the body of work provides  
24 confidence that we've addressed what we believe are  
25 the significant issues.

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1                   We've had the benefit of peer review both  
2 by the ACRS and an independent peer review committee  
3 in which we spent days going over the details and  
4 have had the benefit of their wisdom, and I believe  
5 that we've addressed their comments.

6                   I believe our effort at this point is  
7 complete. While questions may exist and you can  
8 always make refinements, we believe that the work is  
9 now technically robust and provide the technical basis  
10 to move forward with rulemaking.

11                   With this, Mark.

12                   MR. EricksonKIRK: Okay.

13                   CHAIRMAN WALLIS: Could I say something  
14 here?

15                   MR. EricksonKIRK: Sure.

16                   CHAIRMAN WALLIS: Yes, we've heard a lot  
17 about your calculations and the effect on each and  
18 temperature distributions and all of that sort of  
19 thing. The bottom line is: how does this affect PTS?

20                   And you know, seeing temperature  
21 distributions in the wall is very interesting, but if  
22 they have no effect on PTS, there's no useful  
23 conclusion.

24                   So I'd like us to eventually get to that  
25 bottom line, as what is the effect on all this stuff,

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1 on crack initiation growth and the real sort of issue  
2 with PTS.

3 \*\* MR. EricksonKIRK: Okay. Well, I've got  
4 the easy part here because I've only been asked to  
5 explain one slide and then Dave gets all of the hard  
6 questions.

7 CHAIRMAN WALLIS: You're not going to show  
8 us that big scatter plot again, are you?

9 MR. EricksonKIRK: I'm going to make a big  
10 copy of that for your wall at home, but I'll be here  
11 to answer, you know, questions about fracture  
12 mechanics calculations and so on.

13 But just to orient people, and I think  
14 this is all fairly familiar in terms of overall how we  
15 conduct the analysis. We begin with a PRA and then  
16 sequence analysis, and that defines for us both the  
17 sequences of things that could go wrong that would  
18 lead to an overcooling event, perhaps with  
19 repressurization, perhaps not, and also the frequency  
20 with which those events would occur.

21 Those sequences of bad things would then  
22 be passed to the thermal hydraulics code RELAP, which  
23 would then -- and since I'm a structural analyst, I  
24 don't understand what goes on in there either. So I  
25 have some sympathy for Dr. Shack, but something

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1 happens inside and out comes pressure, temperature,  
2 and heat transfer coefficient, all varying versus  
3 time.

4 That is then passed to our probabilistic  
5 fracture mechanics code, which takes that information  
6 in combination with information on the vessel material  
7 properties, the flow distribution within the vessel,  
8 refuence, and out of that code comes a conditional  
9 probability of through wall cracking, and it's called  
10 conditional because it's conditioned on or premised on  
11 the fact or the assumption that a certain transient  
12 has occurred.

13 Of course, those transients occur with  
14 certain frequencies or probabilities. So the last  
15 step in the calculation is to actually multiply the  
16 frequency with which we believe these events occur  
17 with the probability of generating a through wall  
18 crack, presuming that they occur, and that gives us  
19 our yearly frequency of through wall crack.

20 And we then perform those analyses for a  
21 number of different plants at a number of different  
22 embrittlement levels, and use that information to  
23 develop proposals for materials based screening  
24 limits, and we would then recommend to our colleagues  
25 in NRR for their use.

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1           So that's the overall scope of the  
2 calculation, and now we're going to focus in on the  
3 thermal hydraulics part.

4           CHAIRMAN WALLIS: Can we also at some time  
5 discuss the effect of uncertainties, fluctuations and  
6 so on in the thermal hydraulics on the favor code?  
7 How robust is the favor code when fed uncertainties in  
8 the thermal hydraulics? Can we address that at some  
9 time?

10          MR. EricksonKIRK: Yeah, I can. I think  
11 that will come up, but I can take a shot at it just  
12 right off the top.

13          I think if we were asking Favor to analyze  
14 the response of the probability of a vessel failing  
15 relative to one specified transient, then these small  
16 differences that Dave will show you between what RELAP  
17 predicts and what reality is could, in fact, be very  
18 troublesome, and I can just give you some thought  
19 experiments to tell you why.

20          For example, you'll see figures like RELAP  
21 is off or can be off by ten degrees C. Is ten degrees  
22 C. a big difference? Well, it could be a very big  
23 difference if, say, the -- and, again, these are  
24 comments restricted to analysis of a particular  
25 transient and its effect on the vessel.

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1           If RELAP predicted values that were  
2 systematically ten degrees C. too high so that the  
3 real transient was ten degrees C. lower and,  
4 therefore, the fracture toughness was lower and the  
5 thermal stress was higher, and so in the real  
6 transient you actually got a failure probability, but  
7 in the analyzed transient the driving force was too  
8 low and the resistance was too high and you didn't get  
9 a failure probability. You'd then have a difference  
10 between reality when you actually have some finite,  
11 albeit small, failure probability and the analysis or  
12 representation of reality where you calculate a zero,  
13 and that's obviously --

14           CHAIRMAN WALLIS: Because you have a  
15 critical event. You're either above it or not.

16           MR. EricksonKIRK: That's right. That's  
17 right.

18           CHAIRMAN WALLIS: And thus your  
19 uncertainties begin to really matter.

20           MR. EricksonKIRK: That's right, and  
21 that's just a natural consequence of the material.

22           But all of those comments were with  
23 regards to one particular transient, whereas in the PT  
24 analysis coming out of the PRA are sequences of events  
25 where we analyze anywhere between 30 and 100 different

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1 events for their PTS significance.

2 And what the assessment results that  
3 you've seen before and Dave will summarize again show  
4 is that, you know, yes, RELAP can be a bit off by  
5 something of the order of ten degrees C. and similarly  
6 small values in pressure. But it's neither  
7 systematically high nor low. Sometimes it's high;  
8 sometimes it's low.

9 And you know, I can't give you a proof  
10 that this is so, but the fact that it's sometimes  
11 high, sometimes low gives me, you know, as the guy  
12 that's sitting in the third blue box a reasonable  
13 degree of confidence that since we're analyzing a  
14 family of different events that are sometimes going to  
15 be predicted high with respect to reality, sometimes  
16 predicted low, that on average my results out the end  
17 will be a reasonable representation of reality.

18 If we were in the other situation where I  
19 was asked to analyze one particular transient, then I  
20 must admit I'd be getting much more wrapped around the  
21 axle about these small differences.

22 CHAIRMAN WALLIS: But that's okay for  
23 temperature. Now, when we talk about heat transfer  
24 coefficient, I think you would agree if heat transfer  
25 coefficient is big enough it doesn't matter what it

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1 is, and the question then would be, well, suppose it's  
2 infinite. Does it really make a difference whether  
3 it's 3,000 or any --

4 MR. EricksonKIRK: I think in concert the  
5 same comments apply to heat transfer coefficient in  
6 that if RELAP is systematically always one way or the  
7 other relative to the reality of heat transfer  
8 coefficient, that's a bad thing.

9 CHAIRMAN WALLIS: Is it a bad thing or  
10 does it matter if it's big enough?

11 MR. EricksonKIRK: If it's big enough, it  
12 doesn't matter, but I think now we're getting into the  
13 point where --

14 CHAIRMAN WALLIS: It does make a  
15 difference. He's going to tell us it does matter.

16 MR. EricksonKIRK: Yes.

17 DR. ROSENTHAL: I think now we're starting  
18 to get ahead of ourselves. We'll bring it up again in  
19 about Slide 8, and then we'll bring it up again when  
20 we talk about the heat transfer coefficient, and I  
21 would remind you that you have to think it through,  
22 the transients, the small break LOCAs, the large break  
23 LOCAs because what's important changes, and of course,  
24 the commensurate frequency.

25 CHAIRMAN WALLIS: The reason I'm asking

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1 these questions is that the draft report we have from  
2 Dave has a lot of thermal hydraulics in it, has very  
3 little of the coupling of that to the fracture  
4 mechanics, and that's why I'm asking questions now  
5 about that coupling.

6 MR. EricksonKIRK: I'm just going over  
7 there to be comfortable.

8 CHAIRMAN WALLIS: Perhaps we'll come back  
9 to that later.

10 MR. EricksonKIRK: Yeah.

11 CHAIRMAN WALLIS: That's the bottom line  
12 really.

13 MR. EricksonKIRK: Well, yes, that's the  
14 bottom line, but it's also true that even before you  
15 get to that bottom line you need to, you know, we all  
16 need to convince ourselves that the thermal hydraulics  
17 models are either right or adequate.

18 CHAIRMAN WALLIS: Or it doesn't matter.

19 MR. EricksonKIRK: But I would  
20 respectfully disagree because the sensitivity or  
21 insensitivity of a result coming out of a fracture  
22 mechanics code to input says nothing about whether the  
23 input is right or wrong. I think we have to start by  
24 saying that we believe what's going in.

25 VICE CHAIRMAN SHACK: Well, would you

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1 agree with my sort of extrapolation from the  
2 sensitivity results you do present in 1806 that if we  
3 change the heat transfer correlation, we would be  
4 talking about changing --

5 MR. EricksonKIRK: Yes.

6 VICE CHAIRMAN SHACK: -- the failure rate  
7 by something like a --

8 MR. EricksonKIRK: Yes, yes, yes.

9 VICE CHAIRMAN SHACK: -- factor of five?

10 MR. EricksonKIRK: Yes.

11 VICE CHAIRMAN SHACK: And would that  
12 bother you?

13 MR. EricksonKIRK: A factor of five would  
14 turn into something like 20 degrees on the screening  
15 limit, and yes, that would bother me. So yes. But I  
16 think before we get into saying it's a factor of five,  
17 we need to first qualify that and say what has  
18 produced the factor of five, and is the difference  
19 between the base calculation and the sensitivity, are  
20 those both credible models?

21 If those are, indeed, both credible  
22 models, then we need to worry about the factor of  
23 five. If either of those models is incredible, then  
24 the factor of five is meaningless, and that's the  
25 thing that I think is important for the thermal

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1       hydraulists to establish before we get into structural  
2       mechanics.

3                   CHAIRMAN WALLIS: There's nothing  
4       universal about this factor of five. If you have a  
5       long, slow transient as we have seen in some of the  
6       reports where things happen on the scale of 50 minutes  
7       or 3,000 seconds, then the wall sort of cools down  
8       with the water and nothing much happens. So the heat  
9       transfer coefficient doesn't become important.

10                   If it's a long, slow transient, you don't  
11       care too much about age I think you'll find.

12                   MR. EricksonKIRK: Well, if it's a long,  
13       slow transient, I don't care much about it anyway.

14                   CHAIRMAN WALLIS: If somebody quenched the  
15       wall, a double ended guillotine break, things happen  
16       very quickly. Then that H assumes a much bigger role.  
17       So I think we have to be careful about sort of a  
18       factor of five being bandied around. It may be that  
19       for certain transients the factor is much bigger. For  
20       certain other transients it doesn't matter what H is.

21                   That was, again, not too clear from the  
22       report. Maybe it will be made clearer today.

23                   MR. EricksonKIRK: Okay.

24                   CHAIRMAN WALLIS: I'm sorry to hold you  
25       up, Dave. I'm sure you're eager to go.

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1 DR. BESSETTE: Take up the whole two hours  
2 if you like.

3 (Laughter.)

4 \*\* DR. BESSETTE: I have about 15 viewgraphs  
5 to go through.

6 So where we were in December is described  
7 the assessment performed to determine the ability of  
8 RELAP to predict pressure, downcomer temperature, and  
9 part of the presentation was devoted to showing that  
10 plumes would not be an issue.

11 It also showed results of a sensitivity  
12 study we did prior to the start of the current PTS  
13 reevaluation that showed that even if plumes did  
14 exist, they did not materially affect the --

15 CHAIRMAN WALLIS: Now, were these plumes  
16 with 100 degrees of subcooling that you got in the  
17 cold leg or are they -- that's a much bigger, stronger  
18 plume than no plume.

19 DR. BESSETTE: Are you speaking of the  
20 sensitivity?

21 CHAIRMAN WALLIS: I'm saying if plumes did  
22 exist in fact it was negligible. How strong were  
23 those plumes?

24 DR. BESSETTE: They were 40 degrees C. and  
25 80 degrees C.

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1 CHAIRMAN WALLIS: Because you've got over  
2 100 degrees C. stratification in the cold leg.

3 DR. BESSETTE: Yes.

4 CHAIRMAN WALLIS: So you didn't look at  
5 the worst plume.

6 DR. BESSETTE: Well, I think there's no  
7 evidence that any experiments or modeling -

8 CHAIRMAN WALLIS: I know.

9 DR. BESSETTE: -- that you can get such  
10 plumes.

11 CHAIRMAN WALLIS: But if you're going to  
12 make this categorical statement if they exist, the  
13 effect is negligible, you're not looking at the worst  
14 case. You're looking at something more realistic.

15 DR. BESSETTE: I am looking at something  
16 more realistic, but it was --

17 CHAIRMAN WALLIS: The first thing you  
18 might do is look at the extreme case, and if nothing  
19 matters, then forget about it.

20 DR. BESSETTE: What we looked at in that  
21 study was conservative to everything we knew at the  
22 time. And the 40 degree case was conservative, and  
23 then we did twice that at 80 degrees and still could  
24 not see an effect.

25 So today I've got to --

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1 CHAIRMAN WALLIS: And you concluded that  
2 the plumes are no stronger than ten degrees, I think,  
3 from the experiments.

4 DR. BESSETTE: Yes.

5 CHAIRMAN WALLIS: You haven't seen any  
6 plume stronger than ten degrees.

7 DR. BESSETTE: Not in any integral system  
8 test, no.

9 CHAIRMAN WALLIS: Except on the inner call  
10 and the QRA (phonetic) test.

11 DR. BESSETTE: Yeah. So today I was going  
12 to just go over those results quickly. So at the  
13 December meeting, I think the main questions that were  
14 lingering regarded RELAP's -- the adequacy of RELAP's  
15 modeling in the downcomer heat transfer, particularly  
16 suggested that RELAP could be nonconservative and what  
17 would be the effect.

18 CHAIRMAN WALLIS: Could we get it  
19 absolutely straight at the beginning what RELAP you're  
20 talking about? Because there's 1D RELAPs mentioned  
21 very often in your report, but the downcomer modeling  
22 is 2D always, right?

23 DR. BESSETTE: Well, when I spoke of RELAP  
24 as 1D, I spoke of it in terms of the formulation of  
25 the transport equation.

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1 CHAIRMAN WALLIS: When it's 2B, it gets  
2 you circulation patterns which are much stronger than  
3 the average.

4 DR. BESSETTE: But for all of our analyses  
5 and assessment, we use a consistent two dimensional  
6 downcomer.

7 CHAIRMAN WALLIS: And what do you do for  
8 an H then? Because in the circulation pattern, you've  
9 got various losses in various places. So what do you  
10 say is the H?

11 DR. BESSETTE: Well, the H is dependent on  
12 if you're a free conduction regime, velocity doesn't  
13 come into it.

14 CHAIRMAN WALLIS: Yeah, but when you have  
15 circulation patterns in the downcomer --

16 DR. BESSETTE: Yes.

17 CHAIRMAN WALLIS: -- there are some places  
18 where there's no velocity, and there's some places  
19 where it's up four and a half meters a second. What  
20 do you use for the velocity to calculate H? Do you  
21 vary H around the thing or what do you do?

22 DR. BESSETTE: Well, the way RELAP works  
23 is it takes the maximum of free convection and force  
24 convection.

25 CHAIRMAN WALLIS: It takes the maximum H.

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1 DR. BESSETTE: The maximum free. So if  
2 velocity dropped to zero, heat transfer does not drop  
3 to zero. It drops to a free convection number.

4 CHAIRMAN WALLIS: Yeah, but when it has  
5 got force conduction cells, it takes the maximum H  
6 from the force conduction?

7 DR. BESSETTE: For each cell, it looks at  
8 the velocity within that cell and takes the maximum of  
9 free and forced convection.

10 CHAIRMAN WALLIS: I think these are  
11 important details I didn't get from your report.  
12 Maybe they were buried somewhere or maybe they weren't  
13 there.

14 DR. BESSETTE: Well, maybe it's another  
15 level of detail that I didn't go to.

16 CHAIRMAN WALLIS: But it's important.

17 DR. BESSETTE: Yeah. So it's not like if  
18 you had a zero velocity heat transfer drops to zero.

19 CHAIRMAN WALLIS: It's very important to  
20 know what you're using in this to get age. It's very  
21 important to specify clearly so that the reader knows.

22 DR. BESSETTE: It is in there. I'll give  
23 you the page number.

24 CHAIRMAN WALLIS: This is the document  
25 that's going out to the world about how to calculate

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1 PTS and how to calculate --

2 DR. BESSETTE: Yeah, my only thing is  
3 definitely without -- the balance is in there with the  
4 equations.

5 MEMBER RANSOM: And that 2D representation  
6 of the downcomer, I gather you had to turn off  
7 momentum flux in order to avoid these artificial  
8 recirculations?

9 DR. BESSETTE: Well, let's say 98 percent  
10 of the time, for 98 out of 100 transients we analyze,  
11 it wasn't a factor.

12 MEMBER RANSOM: Oh, only once in a while?

13 DR. BESSETTE: Only once in a while did it  
14 turn up as a factor.

15 MEMBER RANSOM: And I guess you're using  
16 a cross-flow approximation to the 2D effects in the  
17 downcomer?

18 DR. BESSETTE: That's correct. You know,  
19 it's parallel channels with cross-ros (phonetic)  
20 junctions.

21 MEMBER RANSOM: Now, one thing, the volume  
22 average velocity in that case is only an axial average  
23 of the velocities computed at the top and bottom, more  
24 or less, of the volumes, aren't they?

25 DR. BESSETTE: I think that's correct,

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1 too.

2 MEMBER RANSOM: And that's what goes into  
3 the heat transfer correlation.

4 DR. BESSETTE: Yeah, but like I say, you  
5 get quite a significant amount of heat transfer in  
6 free convection. It doesn't drop to a low value.

7 MEMBER RANSOM: And that's just based on  
8 a Grashoff number correlation.

9 DR. BESSETTE: Yeah. So that I think the  
10 residual questions were mainly focused on the heat  
11 transfer because at that time we did not have  
12 integrated assessment results of RELAP against  
13 experimental data. Since then we performed additional  
14 assessment based on data from UPTF, APEX, and we also  
15 looked at CREARE.

16 The comparisons indicated that RELAP heat  
17 transfer modeling is appropriate, and secondly,  
18 there's another issue that was still lingering in  
19 December, was the question of whether we get down to  
20 low enough --

21 CHAIRMAN WALLIS: Can we look back at the  
22 CREARE tests where they have a plot? It's in your  
23 report, a Dittus-Bolter versus the actual measure of  
24 each. Do you remember that?

25 DR. BESSETTE: Yes.

1 CHAIRMAN WALLIS: They had to take the  
2 average velocity and multiply it by 20 to get all of  
3 that stuff.

4 DR. BESSETTE: Yes.

5 CHAIRMAN WALLIS: There is an error there,  
6 a factor of about two even there, I think, in that  
7 box, but this factor of 20, that comes from the two  
8 dimensional RELAP calculation?

9 DR. BESSETTE: No, the factor of 20 comes  
10 from the experiments.

11 CHAIRMAN WALLIS: But it must also come  
12 from RELAP. Otherwise RELAP isn't a useful tool.

13 DR. BESSETTE: Well, yes. RELAP comes out  
14 with a consistent -- with a factor of 20 that's --

15 CHAIRMAN WALLIS: That also predicts the  
16 factor of 20?

17 DR. BESSETTE: Yeah, but the when I quote  
18 a factor of 20 and a half and it flows, it's from the  
19 experimental data with measurements of flow  
20 velocities.

21 CHAIRMAN WALLIS: But you have to also  
22 convince us that RELAP with the momentum flux  
23 suppression and all of that is realistic enough to  
24 predict the right circulation velocity.

25 MR. ROSENTHAL: Yeah, and when we compared

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1 RELAP with the data, it was consistent velocities.

2 CHAIRMAN WALLIS: It also had the 20 times  
3 or something close, but not necessarily in the same  
4 place.

5 DR. BESSETTE: If you take a certain point  
6 in the vessel, it could be off, but overall obviously  
7 it's probably time and spatial varying.

8 MR. ROSENTHAL: I think that we're  
9 discussing what's about Slide 15, and if we let Dave  
10 rapidly go through the beginning, it will set the  
11 stage, and then we can dwell on the phenomenological  
12 issues which are the real reason that we're here.

13 CHAIRMAN WALLIS: So you think you've  
14 required a little more?

15 MR. ROSENTHAL: Can we just give Dave five  
16 minutes?

17 CHAIRMAN WALLIS: Well, we can probably  
18 skip this slide.

19 DR. BESSETTE: So I just show this just to  
20 list the six reports that we've written, and this is  
21 in addition to the ESR. I just show this just to  
22 remind you.

23 So when we talk about the main  
24 contributors to uncertainty, the thermal hydraulic  
25 issues can basically be distilled into how good a

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1 predictive tool is RELAP, and from that governing  
2 issue, the main subissues included experimental  
3 evidence for plumes and the heat transfer modeling in  
4 RELAP. I was going to talk about that today.

5 This is along the lines what Mark was  
6 talking about earlier. The overall determination of  
7 uncertainties includes contributions from PRA,  
8 fracture mechanics, and thermal hydraulics. The  
9 bottom line risk number incorporates each of these  
10 three sources of uncertainty, and each needs to be  
11 considered within the context of the overall analysis.

12 The PRA uncertainty is reflected in the  
13 estimates that have been frequency, which is shown in  
14 the left-most histogram. The bin frequency is an  
15 estimate of the total frequency of all the individual  
16 event sequences that comprise a bin. For example, the  
17 medium break LOCA bin includes all of this spectrum of  
18 break sizes from four inches to eight inches,  
19 different break locations, different decay heat levels  
20 either coming out of full power operation or shutdown,  
21 winter or summer ECC conditions, and so on.

22 The middle histogram illustrates the  
23 resulting range of behavior that can occur within a  
24 given PRA bin so that each PRA bin has a certain  
25 family of 100 to 1,000 sequences in it, and you have

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1 a variation, an outcome within that bin. We  
2 characterize the range of that behavior for the  
3 various bins by analyzing a number of sequences or  
4 scenarios within each bin that are using RELAP.

5 In the last histogram, these tended to be  
6 qualitatively indicating the actual uncertainty.

7 CHAIRMAN WALLIS: Those are temperatures  
8 and impression.

9 DR. BESSETTE: Yeah. It represents the  
10 uncertainty in the RELAP code itself. It's the  
11 physical models in the code. So it says heat transfer  
12 and natural circulation.

13 CHAIRMAN WALLIS: Well, your message is  
14 that the thermal hydraulic uncertainties, perhaps  
15 because it's scaled this way, are smaller than the  
16 uncertainties in defining the event itself.

17 DR. BESSETTE: Well, I think, yeah, that's  
18 the correct conclusion.

19 CHAIRMAN WALLIS: So as in so many of  
20 these things, the uncertainties in the PRA dominate  
21 the uncertainties in the physics.

22 DR. BESSETTE: Believe it or not, the  
23 thermal hydraulics code is rather exact compared to  
24 the other uncertainties.

25 CHAIRMAN WALLIS: With the PRA, yeah.

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1 DR. BESSETTE: Yeah.

2 MEMBER APOSTOLAKIS: Taking advantage of  
3 the fact that I came late --

4 (Laughter.)

5 CHAIRMAN WALLIS: Did you say something,  
6 George?

7 DR. BESSETTE: The main contributors to  
8 hydraulic uncertainties are actually --

9 PARTICIPANT: Next slide.

10 DR. BESSETTE: I hit at the button and it  
11 didn't go. Wrong button this way. Human factors  
12 problem.

13 The main contributors to thermal hydraulic  
14 uncertainty is the boundary conditions. The range of  
15 thermal hydraulic response in a given PRA bin is large  
16 compared to the predicted capability of RELAP. So,  
17 therefore --

18 CHAIRMAN WALLIS: Could you remind us  
19 which of these sequences is most important in  
20 determining the fracture potential? It seems to have  
21 changed with time over the evolution of this project.

22 MR. ROSENTHAL: Mark, you explained that  
23 to me yesterday, you know, what was important and it  
24 depended on what time of life, how much irradiation.  
25 Why don't you take that?

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1 MR. EricksonKIRK: The general answer  
2 that's true at any point in the embrittlement life of  
3 the vessel is the primary side events way dominate  
4 over secondary side events, irrespective of  
5 embrittlement level.

6 At the next level of refinement, you'd  
7 have to say that at levels of embrittlement that are  
8 characteristic of the plants that we have operating  
9 today, when you take them out at either the end of  
10 their current 40-year license or even the end of  
11 license extension at 60 years, it's the stuck open  
12 valves that reclose later, and this is sort of a  
13 general statement, that would dominate for --

14 CHAIRMAN WALLIS: So it's the pressurized  
15 thermal shock.

16 MR. EricksonKIRK: It's the pressurized  
17 thermal shock. When you get down to the lower levels  
18 of embrittlement, the mild thermal shock that comes  
19 from the stuck open valve, which is equivalent to  
20 punching like a two to three inch hole in the primary  
21 is enough to initiate the cracks, but to get it all  
22 the way through the vessel, you need that late stage  
23 repressurization.

24 As you get out to the levels of  
25 embrittlement that are characteristic of our more

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1 embrittled vessels at the end of the 20-year license  
2 extension, at the end of 60 years, then you're  
3 starting to get into a mode where the medium and large  
4 pipe breaks on the primary side are starting to be  
5 like 50-50 contributors relative to the stuck open  
6 valves with late stage reclosure.

7 CHAIRMAN WALLIS: And that's with no  
8 pressurization presumably.

9 MR. EricksonKIRK: Yeah, the pressure is  
10 what it is, and it's not much when you put that big a  
11 hole in the vessel.

12 DR. BESSETTE: So, by list, the main  
13 contributors of the medium and large breaks and the  
14 stuck open SRV.

15 So in terms of the thermal hydraulic  
16 response of the plant for these bins, the outcome is  
17 mainly a function of the boundary conditions. For  
18 LOCA the most important factor is the break size.  
19 This affects both the energy removal from the RCS and  
20 the rate at which you add cold water to the ECC  
21 system.

22 For stuck open SRV scenarios, the  
23 important factor is whether the valve recloses or not,  
24 and if it did, how long did it stay open, and when it  
25 does close whether the operator throttles HPI to

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1 prevent the RCS from going water solid?

2 MEMBER APOSTOLAKIS: So the size of the  
3 break is a random variable?

4 DR. BESSETTE: Well, it's not known a  
5 priori. So you analyze the whole break spectrum.

6 MEMBER APOSTOLAKIS: But you're saying  
7 that it's a random variable that can be anywhere from  
8 1.4 inch to 24 inches?

9 DR. BESSETTE: Yes.

10 VICE CHAIRMAN SHACK: But they have  
11 different frequencies.

12 DR. BESSETTE: They have different  
13 frequencies, yes. So it's not conclusive or anything.  
14 It's not a uniform distribution, but you don't know  
15 the size of the break a priori.

16 MEMBER APOSTOLAKIS: And if you had 100 of  
17 these, you would get 100 different break sizes.  
18 That's what they're saying.

19 DR. BESSETTE: Yes, yes.

20 MEMBER APOSTOLAKIS: Because it's random.

21 DR. BESSETTE: Yes. It may not be  
22 completely random, but because of certain pipe sizes  
23 you --

24 MEMBER APOSTOLAKIS: Essentially it would  
25 be random.

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1 DR. BESSETTE: But it's essentially  
2 random.

3 VICE CHAIRMAN SHACK: One of the things  
4 that bothered me in the 1809 report is that your  
5 measure for the effect is the downcomer fluid  
6 temperature, whereas the thing I'm really worried  
7 about is the downcomer wall temperature or the vessel  
8 wall temperature, and I'm sort of worried whether  
9 you're underestimating the effect of the heat transfer  
10 coefficient in these calculations because I'll agree  
11 that the heat transfer coefficient doesn't do much to  
12 the downcomer fluid temperature, but it may have a  
13 rather more significant effect on the vessel wall  
14 temperature.

15 And so the measure that you have chosen  
16 for much of this on whether something is important or  
17 not is the fluid temperature when the reality the  
18 thing that drives the rest of this problem is the wall  
19 temperature.

20 DR. BESSETTE: Well, I'll try to show that  
21 if you have to choose a single variable in which in  
22 this case we had to choose a single variable, fluid  
23 temperature is the thing to choose. I mean the wall  
24 temperature reflects the fluid temperature and the  
25 heat transfer, but so you could choose like a heat

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1 flux number, let's say, that would incorporate both --

2 VICE CHAIRMAN SHACK: I could just choose  
3 a wall temperature.

4 DR. BESSETTE: Or wall temperature.

5 MEMBER RANSOM: Well, certainly it seems  
6 like the most uncertain parameter in this is the heat  
7 transfer coefficient itself. You know, the pressure  
8 and the temperature are pretty much global or  
9 macroscopic variables that their accuracies are more  
10 easily determined, I would guess.

11 But the thing that I think derives thermal  
12 stress on the wall is the gradient of temperature at  
13 the wall, and the boundary condition that is in force  
14 is the heat transfer coefficient times the wall delta  
15 T equal to minus K times the gradient of temperature  
16 in the wall.

17 It's the gradient that drives the thermal  
18 stress.

19 DR. BESSETTE: But I think though that  
20 we'll try to show that the fluid temperature, and  
21 average, an average downcomer fluid temperature is a  
22 suitable or the most is a good indicator of the  
23 severity of any given transient or comparing one  
24 transient to another and comparing the effect of  
25 different -- if you're trying to do sensitivity

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1 studies to look at the importance of different  
2 boundary conditions or physical models in the code,  
3 it's the best indicator or certainly there's no better  
4 indicator for our purpose than just simply choosing  
5 the downcomer fluid.

6 MEMBER RANSOM: Well, I don't doubt that  
7 the fluid temperature -- certainly that's important  
8 because that's the heat transfer to the wall, but in  
9 terms of uncertainty and, you know, trusting the  
10 system calculations, the one that I believe probably  
11 has the greatest uncertainty would be the heat  
12 transfer coefficient itself.

13 DR. BESSETTE: I'll try to show the  
14 uncertainty in the heat transfer coefficient is  
15 similar to the uncertainty effect of the downcomer  
16 fluid temperature.

17 CHAIRMAN WALLIS: The preferred  
18 temperature is the key thing. It must mean that the  
19 heat transfer is effective because if the heat  
20 transfer were very poor, the wall would not follow the  
21 fluid.

22 And it's really significant that what the  
23 heat transfer coefficient was, but you're telling me  
24 the fluid temperature matters the most. That seems to  
25 indicate to me that the heat transfer coefficient is

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1 big enough that it doesn't exert much influence.

2 DR. BESSETTE: Well, you could have a  
3 transient with a fluid temperature that went to 300  
4 F., and it does what -- the heat transfer doesn't  
5 matter because the vessel doesn't get cold enough. So  
6 the key indicator is --

7 CHAIRMAN WALLIS: It doesn't get cold  
8 enough?

9 DR. BESSETTE: Essentially, no. Three  
10 hundred F. is not --

11 CHAIRMAN WALLIS: How could that be a  
12 measure of what's happening then if the vessel doesn't  
13 respond?

14 Well, maybe you're going to go ahead.

15 DR. BESSETTE: Well, I'll try to proceed  
16 and see if I answer the question.

17 So for a stuck open SRV scenario, the  
18 important factor is what -- oh, I went through that.

19 So anyway, these boundary conditions don't  
20 involve the physical modeling capability of the code.  
21 They're all associated with the input model of the  
22 code.

23 This is an example of the medium break  
24 LOCA bin for Palisades, where I plotted the risk  
25 significant transients that fall into the medium break

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1 LOCA bin, and you can see the family of curves here in  
2 terms of pressure and temperature, and I hope we can  
3 make it out.

4           These are the error bars or uncertainty  
5 bars on the RELAP predictions of pressure and  
6 temperature, and the idea, this illustrates that the  
7 RELAP uncertainty in predicting these parameters is  
8 small compared to the range of behavior, the family of  
9 curves that characterize a range of behavior in this  
10 particular PRA bin.

11           VICE CHAIRMAN SHACK: Now, that RELAP  
12 uncertainty is what you're getting when you're varying  
13 the break flow model uncertainty and the heat transfer  
14 coefficient uncertainty?

15           DR. BESSETTE: No, this is the uncertainty  
16 we determined. Well, I guess when I say "RELAP," it's  
17 experimental data. So this is the code data  
18 comparisons for a bunch of experiments.

19           CHAIRMAN WALLIS: And just to put this in  
20 perspective, the response time of the wall is  
21 something like 50 minutes or 3,000 seconds in terms of  
22 the wall.

23           DR. BESSETTE: Yeah, it's about 1,000  
24 seconds or so, or more.

25           So from here on I'll get more into the

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1 RELAP modeling issues. I hope this shows that the  
2 basic idea is that the uncertainty from RELAP itself  
3 is small compared to what we're trying to measure with  
4 RELAP, what we're trying to characterize with RELAP,  
5 which is a good thing. Otherwise, it would be a  
6 problem.

7 MEMBER RANSOM: That's true of PNT, but  
8 I'm not sure it's true of H.

9 DR. BESSETTE: Well, we'll get into that.

10 MEMBER RANSOM: Which you can't measure.

11 DR. BESSETTE: I'll discuss that.

12 Well, we can measure it.

13 CHAIRMAN WALLIS: So your approach to this  
14 is not to say analyzing the system, the important  
15 dimensionless parameters are the Froude number, the  
16 BO number, the this and the that, and we're going to  
17 make sure that we cover a range of these variables.

18 You're going to say you have integral  
19 system tests representative of transients and because  
20 the facilities have been properly scaled, these cover  
21 the range of interests. That's your argument, rather  
22 than a dimensionless group sort of scaling thing.  
23 You're going to say all of these experiments suitably  
24 scaled, the range of transients we're interested in.  
25 That's your --

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1 DR. BESSETTE: Yeah, in a sense, that's  
2 kind of --

3 CHAIRMAN WALLIS: That needs to come  
4 across.

5 DR. BESSETTE: -- a short circuit way of  
6 saying it, yeah.

7 CHAIRMAN WALLIS: -- in the report, too.

8 DR. BESSETTE: Yeah.

9 CHAIRMAN WALLIS: How you assured yourself  
10 that the experiments covered the field of interest.

11 DR. BESSETTE: Well, we knew, of course,  
12 what the dominant bins were, or at least early on we  
13 had some indication what the dominant bins are going  
14 to be, and they turn out to be medium break LOCAs.

15 CHAIRMAN WALLIS: See, if you read your  
16 report, there's the one page where it will say the  
17 only Froude number of interest is .05, and then you  
18 have the table where it goes to 60, and then there's  
19 no indication in any of these experiments what the  
20 Froude number really was, and the reader is left  
21 saying, "Well, now what Froude number is he really  
22 interested in?"

23 DR. BESSETTE: Well, in fact, I did look  
24 at the Froude numbers for the cold legs. I thought it  
25 was --

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1 CHAIRMAN WALLIS: Well, you see the  
2 problem the reader has here, but you actually say the  
3 Froude number is an important variable, and you give  
4 conflicting values for what it should be, and it's  
5 never related to these experiments, and the reader  
6 says, well, you know, "What's going on here?" There's  
7 something important which never seems to be tied  
8 together with the experiments.

9 DR. BESSETTE: I'm pretty sure it's  
10 discussed in the report, but we show that the Froude  
11 number -- obviously the Froude numbers in the cold  
12 legs indicate stratification for the experiments and  
13 for the plant, and indeed for all --

14 CHAIRMAN WALLIS: Well, what are they in  
15 reality? Are they always low?

16 DR. BESSETTE: They're always low.

17 CHAIRMAN WALLIS: They're always much less  
18 than one?

19 DR. BESSETTE: Yes.

20 CHAIRMAN WALLIS: I didn't get that from  
21 the report because I have a table which has it going  
22 up to 60.

23 DR. BESSETTE: Well, I sent you a  
24 correction to that. There was a --

25 CHAIRMAN WALLIS: Yeah, but you see it

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1 doesn't tell me what really happens. You have table  
2 going up to 60. It doesn't tell me which of those  
3 numbers in that table are realistic and which are just  
4 academic.

5 MEMBER POWERS: I'm shocked that you would  
6 use such a term.

7 DR. BESSETTE: So one of the -- this is  
8 how we obtained the uncertainty values with RELAP. So  
9 what are the objectives for determining the  
10 uncertainty due to the physical modeling in the code?

11 To do so, we assess RELAP against both  
12 integral and separate effects tests, and then integral  
13 tests were used to assess the code's ability to  
14 predict temperature or pressure and heat transfer. We  
15 included 12 experiments from UPTF, LOFT, ROSA, APEX  
16 and MIST, and these facilities cover a range of scales  
17 up to full scale. Their geometrical representations  
18 included all three vendor designs, and LOFT and ROSA  
19 were based on Westinghouse, APEX on Combustion  
20 Engineering; and MIST on Babcock & Wilcox.

21 So one scaling factor common to all was  
22 the power-to-volume, which was the basis of all the  
23 LOCA integral system test programs that we performed.

24 Now, the PTS PERT was used to guide the  
25 assessment of RELAP in terms of important phenomena.

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1 The overall conclusion from all this was that the code  
2 compared well with the data.

3 CHAIRMAN WALLIS: Now, can I ask you about  
4 that? That's a qualitative sort of statement, and  
5 somewhere here I've got an APEX result where RELAP  
6 starts off doing fairly well, but ends up being off by  
7 20 degrees in downcomer temperature. Is that good  
8 enough or not?

9 I mean I don't know what you mean by  
10 "compared well." How good does it have to be is  
11 perhaps the question.

12 CHAIRMAN WALLIS: Well, all I can say is,  
13 you know, we generated the uncertainties using the  
14 whole set of experiments, but the answer of how good  
15 does it have to be goes back to the question that was  
16 posed to Mark a little earlier.

17 I can tell you how good it is, and I can  
18 tell you --

19 CHAIRMAN WALLIS: I think your  
20 measurements of goodness are qualitative statements,  
21 aren't they, in your report?

22 DR. BESSETTE: In terms of comparisons  
23 with a separate effects phenomena, I used qualitative  
24 indications. In terms of an integral system test,  
25 we're actually generating statistics for the pressure

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1 and temperature as well as looking in detail comparing  
2 phenomena to make sure that we're in the right --

3 CHAIRMAN WALLIS: You see, I've got here  
4 a curve which compares RELAP with APEX CE tests, and  
5 after a while it's off by 20 degrees or more, and the  
6 APEX is colder than RELAP is predicting.

7 So that would mean that RELAP is not being  
8 conservative. I just wonder if that's important or  
9 not.

10 DR. BESSETTE: Well, like I say, you have  
11 to look -- I mean, I've said the one uncertainty in  
12 RELAP for temperature is ten degrees C., meaning five  
13 percent of the time it's going to be more than 20  
14 degrees C. high or low.

15 CHAIRMAN WALLIS: I don't know if it  
16 matters. You see, if you're very close to fracturing  
17 the wall, 20 degrees might make a big difference. I  
18 don't know.

19 VICE CHAIRMAN SHACK: Because if you come  
20 back again to his Slide 8 where he's showing his RELAP  
21 uncertainty --

22 CHAIRMAN WALLIS: It's very small.

23 VICE CHAIRMAN SHACK: -- with all of the  
24 variations that he gets from his boundary condition,  
25 I mean, he does have three orders of magnitude of

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1 scatter in the through wall cracking results. I mean,  
2 there's no question there's large uncertainty in the  
3 prediction of the frequencies, but you know, his  
4 answers here do seem to be dominated by these  
5 uncertainties in the boundary conditions.

6 DR. BESSETTE: And in fact, I think that  
7 particular what you're referring to, if I remember, is  
8 the fact that we had suppressed circulation in the  
9 cold legs. So we constrained the mixing volume that  
10 RELAP was using, you know, in terms of a remix type of  
11 approach. The mixing volume includes all of the cold  
12 legs at a downcomer in the lower plenum.

13 By suppressing circulation in the RELAP  
14 model in the cold leg to prevent circulating flow, we  
15 truncated the mixing volume, and I think that was the  
16 explanation for that divergence.

17 CHAIRMAN WALLIS: So the bottom line here  
18 is that your 12 integral system tests --

19 DR. BESSETTE: They were chosen to --

20 CHAIRMAN WALLIS: -- offered enough of a  
21 feel that you really covered everything of interest --

22 DR. BESSETTE: I think so.

23 CHAIRMAN WALLIS: -- from the smallest  
24 break to the largest break?

25 DR. BESSETTE: We covered small breaks,

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1 medium breaks, large breaks, like open SRVs, main  
2 steam line breaks. The idea was to choose from the  
3 best facilities that we had for the same transients  
4 that showed up as being risk significant in the PTS  
5 analyses.

6 CHAIRMAN WALLIS: So that what you  
7 actually could cite in your report are the significant  
8 transients or just some typical transients?

9 DR. BESSETTE: I cited all transients that  
10 we did assessments for.

11 CHAIRMAN WALLIS: But only in one to two  
12 cases did you ever get to the point of giving us any  
13 information about whether or not a crack would form.

14 DR. BESSETTE: Well, in my report I didn't  
15 get into the combined analysis. I focus on the  
16 thermal hydraulic validation of RELAP.

17 CHAIRMAN WALLIS: So you didn't get to  
18 what's my bottom line here.

19 DR. BESSETTE: That wasn't really the  
20 intent. The intent was to show the validity of RELAP  
21 for the PTS analysis.

22 MR. EricksonKIRK: I think I'd like to  
23 just interject a thought experiment here. I really  
24 think we need to -- and if the committee wants to see  
25 effects on the bottom line, that's a reasonable

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1 question, and I think clearly we haven't come prepared  
2 to answer that today, but I do think we need to  
3 structure the discussion in terms of first  
4 establishing what do the relevant topical area experts  
5 feel is a credible model and then assess the effect of  
6 variations between potential credible models on the  
7 bottom line.

8 And I'll just, you know, throw out this  
9 question as a thought experiment, and this applies to  
10 any part of the calculation.

11 Would the committee be prepared to accept  
12 a completely ludicrous model as part of the whole if  
13 I could show you that it had no effect on the bottom  
14 line? For instance, would Dr. Ford let me get away  
15 with an embrittlement model that says as I embrittle  
16 the material it becomes -- as I irradiate the  
17 material, the fracture toughness goes up, if I could  
18 show him that it had no effect on the model?

19 Certainly it wouldn't because it's absurd,  
20 and so I think that the focus of Dave's paper and what  
21 we need to focus on today is to say: is the heat  
22 transfer coefficient model credible? Are there  
23 potential alternative credible models that we need to  
24 investigate? You know, are plumes credible or not?

25 And once we establish those answers, then

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1 we'll be prepared to move on and say, "Okay. Here's  
2 our baseline model. Here are the potential credible  
3 alternatives," be they slight variations in heat  
4 transfer coefficient, slight existence of plumes or  
5 not, and then we can crank those things through the  
6 fracture mechanics analysis to see what the effect of  
7 potential credible variations is on the bottom line.

8 CHAIRMAN WALLIS: You see, the reason I  
9 keep saying this is I like figures like Figure 420,  
10 where you've got a KR versus time versus various Hs,  
11 and then there's a statement in the text that if KR  
12 gets above one, then you have to worry.

13 Well, it's quite clear that by varying H  
14 by a little bit, you can make KR go above one or not,  
15 and so this tells me I'd better get H right.

16 And that's to me being a much more  
17 important message than seeing a whole lot of Hs  
18 predicted by RELAP maybe or maybe not agreeing with  
19 data. That tells me how well I have to get my H  
20 right. I think that's a very important part of the  
21 report.

22 MR. EricksonKIRK: Yes, it is, but you  
23 also have to remember that the bottom line that we  
24 keep talking about is not the through wall cracking  
25 frequency or the conditional probability of failure

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1 associated with one particular transient.

2 If we were trying to predict with high  
3 accuracy the response of the vessel to one particular  
4 transient, I'd go find myself another job because I  
5 know we can't do it.

6 CHAIRMAN WALLIS: Yeah.

7 MR. EricksonKIRK: But, I mean, because of  
8 the uncertainties and the systematic biases in all of  
9 the parts of this analysis, but because we're trying  
10 to predict the response of the vessel to a series of  
11 different postulated transients, and again, you know,  
12 the assessment results showed, some of which are high,  
13 some of which are low, and they're not off by that  
14 much. You know, I think we can get a reasonable  
15 result that can be used in an engineering analysis to  
16 set a screening criteria.

17 CHAIRMAN WALLIS: Go back to the argument.  
18 Because we're so uncertain about the PRA results we  
19 can be really sloppy about the thermal hydraulics.

20 MR. EricksonKIRK: I'm not sure I want to  
21 agree with that.

22 MEMBER RANSOM: I thought the report did  
23 quite a good job though of pointing out that you can  
24 screen out many of these transients because if you  
25 don't have any pressure on the vessel, you're

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1 certainly not going to contribute to the stress.

2 So there is a selected break size of  
3 importance, and a set of scenarios and pretty much  
4 need to just focus on those.

5 In terms of the heat transfer coefficient,  
6 too, I suspect again you can probably show it's not  
7 very important because these are very low flow type  
8 situations that are not going to result in high  
9 convective heat transfer.

10 So I thought it did a pretty reasonable  
11 job of leading you through all of that for us.

12 DR. BESSETTE: And I'm planning to go  
13 through that story today.

14 This is sort of the bottom line in a way  
15 that shows that the statistical results obtained for  
16 comparing RELAP with the 12 experiments from the five  
17 facilities I mentioned. As you can see, RELAP had a  
18 bias of 13 psi in pressure with a standard deviation  
19 of 46 psi.

20 These differences, these numbers are  
21 equivalent to about one to two percent of the vessel,  
22 the pressure during normal operation. It's less than  
23 one percent of the yield stress. So obviously these  
24 are small numbers. So these uncertainties are not  
25 important.

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1 MEMBER POWERS: When you do a comparison  
2 of the code against the experiments and you look at  
3 what might be called residuals between the  
4 experimental measurements and the "could" predictions,  
5 do you try to characterize the distribution of those  
6 residuals?

7 DR. BESSETTE: I'm not --

8 MEMBER POWERS: Well, you've used the  
9 language here as though you saw these residuals as  
10 normally distributed, and that's not uncommon. Most  
11 people do that. But I wondered if you actually went  
12 and tried to verify that, in fact, those residuals  
13 came from a normal population.

14 DR. BESSETTE: I don't think we looked at  
15 that.

16 Is Bill here? We didn't look -- no. No,  
17 we did not.

18 MEMBER POWERS: Is it important to do  
19 that?

20 DR. BESSETTE: Well, I don't think so. I  
21 think this first order numbers are adequate for what  
22 we're trying to do.

23 You can see with respect to temperature  
24 RELAP had essentially no bias. That's one degree C.,  
25 and the standard deviation of one sigma was ten

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1 degrees C. Heat transfer --

2 CHAIRMAN WALLIS: This temperature is the  
3 downcomer?

4 DR. BESSETTE: Downcomer temperature,  
5 yeah.

6 The heat transfer, the integral system  
7 assessments that we performed showed RELAP to be  
8 realistic or conservative.

9 CHAIRMAN WALLIS: Now, is there some  
10 evidence for that? And what you mean by conservative  
11 is that the heat transfer in the experiment is always  
12 less than what you predicted. Is that what you mean  
13 by that?

14 DR. BESSETTE: The heat transfer  
15 coefficient in RELAP, that would be derived from RELAP  
16 was higher than the experiment.

17 CHAIRMAN WALLIS: In every case?

18 DR. BESSETTE: The cases we looked at. We  
19 didn't --

20 CHAIRMAN WALLIS: The CREARE tests, you  
21 got that factor of 20, and Dittus-Bolter. The  
22 experimental points are above the predicted.

23 DR. BESSETTE: Yeah, well, the Dittus --  
24 we didn't actually try to calculate Dittus-Bolter. We  
25 calculated APEX and -- I mean, we didn't try to

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1 calculate CREARE. We tried to -- we calculated UPTF  
2 and APEX.

3 CHAIRMAN WALLIS: But you see, that's the  
4 problem, again, I have with parts of the report. You  
5 make this statement, and then I look at that figure  
6 from CREARE, and the data are all about a factor of  
7 two above the predictions.

8 DR. BESSETTE: Well, it's about 50 percent  
9 higher.

10 CHAIRMAN WALLIS: Well, at least it's not  
11 conservative.

12 DR. BESSETTE: Yeah, it's consistent with  
13 Dittus-Bolter, but lying above the line.

14 CHAIRMAN WALLIS: The problem I have,  
15 again, sort of reading bits of the report, we say,  
16 well, is this evidence compatible with the conclusion  
17 or not?

18 DR. BESSETTE: The evidence that it does  
19 match -- it does follow Dittus-Bolter with a 1.5  
20 multiplier --

21 CHAIRMAN WALLIS: It never reached a  
22 conclusion like that. It's a very strong conclusion  
23 really, and I think you ought to be careful that there  
24 isn't something else in the report that's inconsistent  
25 with it.

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1 DR. BESSETTE: Well, we chose UPTV, and  
2 see CREARE has, let's say, what you might call an  
3 atypical geometry. It has a thermal shield in it, and  
4 the measurements that were taken that led to where  
5 those data came from were just slightly downstream  
6 from the entrance to the thermal shield region, and we  
7 weren't sure how valid or how applicable those data  
8 were.

9 So we concentrated on APEX and UPTF  
10 instead.

11 VICE CHAIRMAN SHACK: Now, as I read the  
12 APEX though, there were only a very limited number of  
13 tests in which you actually made the wall temperature  
14 measurements.

15 DR. BESSETTE: Well, they're there for all  
16 of the tests, but we had just --

17 VICE CHAIRMAN SHACK: But you only  
18 presented them --

19 DR. BESSETTE: We only did one test. We  
20 only picked one test.

21 VICE CHAIRMAN SHACK: Oh, so you only made  
22 the comparison for one test.

23 DR. BESSETTE: Yeah.

24 VICE CHAIRMAN SHACK: So for that test it  
25 was okay, and you, therefore --

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1 DR. BESSETTE: We looked at the APEX, at  
2 the APEX and UPTF, and they both produced similar  
3 results.

4 CHAIRMAN WALLIS: So that's another thing,  
5 is were you extrapolating some very limited results  
6 from one test to make a general conclusion about all  
7 conditions.

8 DR. BESSETTE: Well, what I said is for  
9 the test we looked at and we compared against data  
10 from UPTF and Apex under conditions of loop flow  
11 stagnation, and for these tests the code was realistic  
12 or conservative.

13 CHAIRMAN WALLIS: And do you generalize  
14 this conclusion to all conditions of interest in that?

15 DR. BESSETTE: No, I don't think I say  
16 that.

17 CHAIRMAN WALLIS: But you have this  
18 conclusion to your report that each is predictive  
19 conservatively by RELAP, and I just wanted to find out  
20 how broad a base of evidence you have for that  
21 conclusion.

22 DR. BESSETTE: Well, I mean, that's why I  
23 didn't go as far as to try to generate statistics and  
24 whatnot, is because I figured I didn't have a large  
25 enough database to be definitive that in all cases

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1 this would be true, but all I can say is we had a  
2 short time to do it. We looked at the best data we  
3 could find at least from two facilities, and from what  
4 we looked at, the code looked okay.

5 CHAIRMAN WALLIS: Well, I would still ask  
6 the question if it's a very limited data set, is it  
7 one extreme or the other? If it's for a very slow  
8 transient, maybe you don't care what H is anyway and  
9 the fact that it's conservative or that's unimportant.

10 DR. BESSETTE: Yes.

11 CHAIRMAN WALLIS: But maybe it's for a  
12 rapid transient where you do really care about it, and  
13 in that case it's conservative. So when it really  
14 matters, you've got some evidence that it's  
15 conservative.

16 DR. BESSETTE: Yes.

17 CHAIRMAN WALLIS: I can't put it in  
18 perspective if it's just one test, and I don't know  
19 which one it is.

20 DR. BESSETTE: I'm going to get into that  
21 later.

22 CHAIRMAN WALLIS: Okay.

23 DR. BESSETTE: A few slides later.

24 So I'm going to talk about impact of these  
25 uncertainties first in terms of pressure, then

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1 temperature and then heat transfer.

2 So by itself, the uncertainty in the RELAP  
3 prediction approach was small compared to the range of  
4 conditions found in the various PRA bins, and without  
5 uncertainty value was considered in terms of the  
6 contribution of vessel wall stress. The effect also  
7 seemed to be small, as well.

8 For example, I said the uncertainty in the  
9 RELAP calculation of pressure amounts to approximately  
10 two percent of the normal operating stress.

11 CHAIRMAN WALLIS: No problem.

12 DR. BESSETTE: So off the table.

13 Now, for stuck open SRV scenarios, the  
14 pressure at the time of vessel failure, for predicted  
15 vessel failure is determined by the set point of the  
16 SRVs themselves, and not by the thermal hydraulic  
17 uncertainties. So the most important factor is the  
18 timing of reclosure, which is a boundary condition.

19 Now, with respect to temperature, the heat  
20 flux is a function of the downcomer temperature and  
21 the heat transfer combined, and from these two  
22 parameters the favor calculates the temperature  
23 distribution and vessel walls as a function of time.  
24 And the vessel temperature distribution, of course,  
25 determines both thermal stress and the local fracture

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1 toughness.

2 Therefore, temperature enters twice into  
3 the equation and determines the vessel failure  
4 probability.

5 So it showed RELAP calculates temperature  
6 with no bias, while the standard deviation is ten  
7 degrees C. This standard deviation number of ten  
8 degrees C., while it seems small, can still affect the  
9 probability of vessel failure, as I think we've been  
10 discussing.

11 However, in context, this ten degrees is  
12 small compared to the absolute change in temperature,  
13 which gets back to why we chose average downcomer  
14 temperature, which during these risk significant  
15 transients, the absolute change in temperature is  
16 about 200 degrees C.

17 So the uncertainty of ten degrees compared  
18 to the absolute change is about five percent.

19 CHAIRMAN WALLIS: That's okay unless  
20 there's no crack growth until you get to 200 C., and  
21 if you get to 210 degrees C. maybe it makes a big  
22 difference. I mean, again, I don't know.

23 DR. BESSETTE: That's why I say it can't  
24 be dismissed.

25 CHAIRMAN WALLIS: I think this is rather

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1 a cliff sort of thing. It's not a continuum where you  
2 can say five percent doesn't matter.

3 DR. BESSETTE: No.

4 MS. DUDES: It's like going through a  
5 door. If you're six feet, six, you go through a door.  
6 If you're six foot, nine you hit your head. I mean  
7 just the fact that it's a small percent change doesn't  
8 really help you.

9 DR. BESSETTE: It depends where you are.

10 But secondly, it's small in comparison to  
11 the range of behavior that characterizes a given PRA  
12 bin, which is typically 50 degrees C. to 150 degrees  
13 C. or so.

14 Now, the impact of the heat transfer  
15 coefficient.

16 So I think the situation is probably clear  
17 with pressure and temperature. Now, we turn to the  
18 heat transfer coefficient. Now, the change in the  
19 heat transfer coefficient has a similar effect to a  
20 change in the downcomer temperature as the heat fluxes  
21 a combination of the two.

22 So the impact of an uncertainty in heat  
23 transfer depends on a transient, of course, and like  
24 I've said, the faster the transient, the greater is  
25 the wall to fluid temperature difference. So fast

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1 transient has got to be sensitive to uncertainty in  
2 heat transfer than slow transients.

3 So a small break LOCA is slow transients  
4 obviously. For slow transients, a downcomer wall  
5 attracts the fluid temperature quite closely with a  
6 small delta T, and a large break LOCA is fast  
7 transients, and the downcomer cools quickly. The  
8 fluid cools quickly, and you build up more of a lag  
9 between the wall temperature and the fluid  
10 temperature.

11 CHAIRMAN WALLIS: This is one of my  
12 questions again. You chose to show only one figure of  
13 the effect of H on a pressurized thermal shock  
14 parameter, such as K sub R, and that was for a  
15 transient of 30 minutes tau, which is much longer than  
16 the large break that you show here.

17 And so my immediate sort of curiosity is,  
18 well, suppose you had shown some other curves for a  
19 shorter transient. What would it have looked like?

20 DR. BESSETTE: Well, I didn't choose that.  
21 I was taking a historical document and --

22 CHAIRMAN WALLIS: But you see, it  
23 immediately raises the question by the reader: why  
24 did he predict this long, slow transient which really  
25 isn't that much of a threat to the vessel? I'm more

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1 interested in the other ones.

2 DR. BESSETTE: Yeah.

3 CHAIRMAN WALLIS: So I'd like to see more  
4 figures like 420 for other --

5 DR. BESSETTE: Yeah, I'll try to address  
6 that to some extent today at least.

7 CHAIRMAN WALLIS: I notice this difference  
8 in this large break, the big temperature uncertainties  
9 here. Anyway, when you get this 29 degrees C. and  
10 you've talked about ten degrees C. not mattering,  
11 being where things don't matter, it immediately raises  
12 a flag.

13 DR. BESSETTE: Well, it goes back to  
14 putting things in context and showing where things  
15 might matter and where things might not matter.

16 CHAIRMAN WALLIS: That's good, that's  
17 good.

18 DR. BESSETTE: So you get some things off  
19 the table and you concentrate on the other things.

20 MEMBER SIEBER: Yeah, now when you did the  
21 through wall cracking sensitivity study with the other  
22 heat transfer coefficient, four of the 16 inch hot leg  
23 break, you increase by a factor of an order of a  
24 magnitude.

25 DR. BESSETTE: Yes.

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1 PARTICIPANT: So, you know, it was  
2 sensitive to --

3 CHAIRMAN WALLIS: It was significant. It  
4 would have been good to bring that out more in the  
5 report.

6 DR. BESSETTE: So you can see here --

7 CHAIRMAN WALLIS: Well, the results are  
8 pretty reasoned, but you can see that for a large  
9 break it would be double the heat transfer  
10 coefficient. This is equivalent to decreasing the  
11 fluid temperature roughly by 20 to 30 degrees C.

12 So even though a large break is a fast  
13 cool-down, you can still boost the heat transfer even  
14 more.

15 MEMBER SIEBER: Yeah, but you can't get  
16 the pressure back up, right?

17 MR. GRIFFITH: Peter Griffith.

18 I think you should mention here that the  
19 probability of those three breaks is not the same.

20 CHAIRMAN WALLIS: That's right.

21 MR. GRIFFITH: But you could have another  
22 column over there which showed the --

23 CHAIRMAN WALLIS: That's what he has on  
24 the bottom.

25 MR. GRIFFITH: That's right. The event

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1 frequency for large break is very low to begin with.

2 So --

3 CHAIRMAN WALLIS: But it might dominate  
4 the risk because it might lead much more frequently to  
5 disaster, and so I understand that when you go to high  
6 levels of embrittlement, this large break LOCA becomes  
7 a more dominant thing. So if you're going to come up  
8 with a number for probable failure, but if the large  
9 break LOCA, even though very unlikely is the dominant  
10 sequence.

11 DR. BESSETTE: So you can see from the  
12 previous slide that --

13 CHAIRMAN WALLIS: Then you can't just  
14 dismiss it because its event frequency is low to begin  
15 with.

16 MEMBER SIEBER: Well, let me understand.  
17 If you have a large break and you get a rapid cool  
18 down, because you have the break, you can't  
19 repressurize, and so you can't put stress.

20 CHAIRMAN WALLIS: That's right.

21 DR. BESSETTE: So there's no pressure.  
22 That's right.

23 CHAIRMAN WALLIS: So it breaks from the  
24 thermal stress alone.

25 MEMBER SIEBER: So why worry about that.

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1 CHAIRMAN WALLIS: The thermal stress alone  
2 can break the vessel.

3 MEMBER SIEBER: That's true, but whether  
4 it breaks or not, you know.

5 CHAIRMAN WALLIS: You can do the  
6 experiment by taking a glass.

7 MEMBER SIEBER: I've done that.

8 MR. EricksonKIRK: You're getting into the  
9 question of consequence after the break.

10 MEMBER SIEBER: Right. You've got a  
11 messed up plant. On the other hand, the consequence  
12 from a public health and safety standpoint really  
13 doesn't change.

14 MR. ROSENTHAL: Actually -- Jack Rosenthal  
15 -- actually it does.

16 MEMBER SIEBER: Okay.

17 MR. ROSENTHAL: Let's just take this in  
18 pieces.

19 MEMBER SIEBER: All right.

20 MR. ROSENTHAL: We have a large break  
21 LOCA. ECCS works or doesn't work.

22 MEMBER SIEBER: Right.

23 MR. ROSENTHAL: If ECCS doesn't work, then  
24 it's a severe accident, and we're in a different  
25 regime and discussion.

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1 MEMBER SIEBER: Yeah.

2 MR. ROSENTHAL: We're talking about large  
3 break LOCA in which ECCS does work. You reflood the  
4 core. You don't melt the core or you reflood the  
5 vessel and you don't melt the core.

6 Now, let's say -- and in your event tree,  
7 you would write okay at the far right. Now if you do  
8 crack the vessel, then you have the initiating event.  
9 ECCS did work, but the vessel, should the vessel have  
10 cracked, now I may not be able to maintain a covered  
11 core, and so I may have a sequence in which even  
12 though I had my LOCA and ECCS worked, I'm still in  
13 trouble.

14 So it is a relevant consideration, and the  
15 argument would be that it's unlikely that you're going  
16 to fail the vessel, even with injecting cold water and  
17 successfully mitigating the LOCA.

18 DR. BESSETTE: So where heat transfer is -  
19 - where the outcome is most sensitive to heat  
20 transfers for large breaks, and we're dealing with the  
21 run frequencies. Current numbers are like ten to the  
22 minus seven. It brings it --

23 CHAIRMAN WALLIS: So we might as well not  
24 consider them at all.

25 DR. BESSETTE: So even if they're

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1 sensitive to heat transfer, it's still, you know.

2 VICE CHAIRMAN SHACK: Although again,  
3 we'll come back to the sensitivity study, I just keep  
4 looking at the numbers here. The one that I have the  
5 biggest thing tacked on gives me a factor of 30  
6 increase in through wall failure frequency, and that's  
7 a two-inch break.

8 MR. EricksonKIRK: At the risk of  
9 contradicting my colleague, the fact remains that  
10 large breaks are an important to PTS risk. So you can  
11 say that it's a low event frequency, which is true,  
12 but when you roll all of the calculations together,  
13 they show that medium to large breaks are important  
14 contributors at high levels of embrittlement. You're  
15 not going to get rid of it.

16 CHAIRMAN WALLIS: They're important  
17 contributors, but the total risk is still very small.

18 MR. EricksonKIRK: Yes, that's absolutely  
19 true, and that's a true statement across the board.  
20 You can say that about anything we discuss today.

21 CHAIRMAN WALLIS: So what about this  
22 sensitivity factor of 30 that my colleague Bill Shack  
23 is raising here?

24 VICE CHAIRMAN SHACK: I'm just looking at  
25 another case with a two inch line break which does

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1 occur more frequently, and it's got a factor of 30  
2 increase with a change in the age, and that actually  
3 strikes me as somewhat plausible, but you know, if I  
4 only have a small thermal insult, the question of  
5 whether I get that thermal insult from the fluid to  
6 the wall is kind of a critical question.

7 So, you know, with a large break LOCA, the  
8 insult is so big it almost doesn't matter what I --  
9 you know, it's going to get to the wall and do me in  
10 anyway, but I'd sort of worry about medium and small  
11 breaks where, you know, how much I get to the wall  
12 really starts to become important.

13 MR. EricksonKIRK: At the risk of beating  
14 a dead horse because I've tried this twice and we keep  
15 veering off --

16 (Laughter.)

17 MR. EricksonKIRK: I think it's  
18 extraordinarily important because you know, the nice  
19 thing about calculations is you can make them tell you  
20 anything that you want.

21 I think it's exceedingly important to  
22 first establish what the technical area experts  
23 consider to be credible variations in the heat  
24 transfer coefficient or any other parameter we want to  
25 examine, and then we'll do the sensitivity studies.

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1 It isn't at all clear to me that --

2 VICE CHAIRMAN SHACK: Well, we were just  
3 studying impact of heat transfer coefficient.

4 MR. EricksonKIRK: Yes, yes, and it's big.  
5 It can be big, sure.

6 VICE CHAIRMAN SHACK: Okay.

7 MR. EricksonKIRK: So the question really  
8 is back to we need to reach some consensus between the  
9 review committee and the staff as to what a credible  
10 baseline model is and what credible perturbations are,  
11 and then we can do sensitivity studies with meaning.

12 CHAIRMAN WALLIS: But the sensitivity  
13 studies help to define the requirements for the  
14 accuracy of the thermal hydraulics. If it was a  
15 factor of 30 in your predictions by getting an error  
16 in new transfer coefficients, then it seems to me you  
17 would say, "Well, go back and get the heat transfer  
18 coefficient more accurately."

19 I don't think you can just look at how  
20 good thermal hydraulics is without asking what are you  
21 going to use it for. Then you're not being an  
22 engineer.

23 DR. BESSETTE: What I'm trying to show  
24 here is, you know, that your question is concerned  
25 with heat flux, and the heat flux is temperature and

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1 heat transfer coefficient. If the effect of a factor  
2 of two change in heat transfer coefficient is within  
3 the uncertainty as to how well you know the  
4 temperature, so it's not a uniquely important problem.  
5 It's not more important than how well you know the  
6 fluid temperature, and we know the fluid temperature  
7 to with --

8 VICE CHAIRMAN SHACK: Well, unless there's  
9 a systematic.

10 DR. BESSETTE: Yeah, and we don't see a  
11 systematic -- we haven't seen a systematic error or  
12 bias in fluid temperature or in a more limited  
13 assessment we did, a heat transfer.

14 MR. EricksonKIRK: To return to Dr.  
15 Wallis' last point, isn't there a question of state of  
16 the art? And I'll get this in something that the  
17 materials people can understand so that I have a  
18 chance.

19 The uncertainty in fracture toughness data  
20 is what it is, and that's the plot with the gas leak  
21 scatter that you keep referring to, and members, you  
22 know, Shack and Ford cannot like that degree of  
23 uncertainty, but it's controlled by physics. I can't  
24 make it any better. So we just simply have to deal  
25 with it, and can't a similar -- can't an analogous

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1 point be raised here regarding the overall fidelity of  
2 the thermal hydraulics model? I mean there has to be  
3 a question of practical state of the art that puts in  
4 that maybe we don't know the heat transfer  
5 coefficient better than plus or minus 20 percent.

6 If that's the consensus of the technical  
7 community, then that's what we need to feed through  
8 our analysis, but I don't think we've gotten there  
9 yet.

10 I mean, certainly, yes, you're absolutely  
11 right. You need to understand the sensitivity of your  
12 results on your input, but I'm seeing that we've gone  
13 quite a bit further than that and that we're letting  
14 the results, be they sensitive or insensitive drive  
15 our acceptance of models that either may be at state  
16 of the art or may be completely ludicrous.

17 CHAIRMAN WALLIS: I understand your point,  
18 and I think it's a very good one, but inevitably when  
19 we look at the results that they present, we sort of  
20 say, "What does it matter?" We can't help asking  
21 ourselves that question.

22 DR. BESSETTE: And you know, when you look  
23 at a sensitivity studies plot, sometimes it doesn't  
24 make any difference. Sometimes you can find a factor  
25 of 30, and you just have to look at the bottom line

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1 and just put everything in context.

2 In fact, you can see we're dealing with --  
3 you can see the order of magnitude in terms of the  
4 frequency estimates in the last column between the 5th  
5 and the 95th percentiles. So within that kind of  
6 context, a factor of 30 is certainly within that  
7 range.

8 So one of probably the key issues raised  
9 during the peer review that we had of the PTS work was  
10 with respect to the buoyancy opposed mixed convection.  
11 So if flow velocities were to be sufficiently low, one  
12 could get an enhancement in heat transfer over that  
13 predicted by the three or fourth convection models in  
14 RELAP.

15 Sine the December meeting, we looked at  
16 data from UPTF, APEX and CREARE, the same data we've  
17 just been discussing, that provide flow velocity  
18 measurements in a downcomer.

19 CHAIRMAN WALLIS: These are the maximum  
20 velocities reported?

21 DR. BESSETTE: I reported the range. What  
22 i have here, this one third to -- we saw velocities.  
23 The total range of velocities we saw amongst the three  
24 experiments was between one-third of a meter, one foot  
25 a second and four or five feet a second.

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1 CHAIRMAN WALLIS: Our cells are probably  
2 some places where there's at least some of the time no  
3 velocity at all. So you may not --

4 DR. BESSETTE: That zero velocity, that  
5 stagnation point is probably changing the design in  
6 space.

7 CHAIRMAN WALLIS: And probably their  
8 velocity meter measured fluctuating velocity, no?

9 DR. BESSETTE: Well, these velocities, of  
10 course, they're measured at fixed locations, a certain  
11 number of fixed locations, and --

12 CHAIRMAN WALLIS: It did vary with time  
13 presumably.

14 DR. BESSETTE: You see, of course, noisy  
15 data.

16 CHAIRMAN WALLIS: I think was it APEX.  
17 The heat transfer coefficient fluctuated by a factor  
18 of about five. So something is certainly going on  
19 there.

20 DR. BESSETTE: Yeah. Well, certainly if  
21 you look, for example, if you look at either velocity  
22 data or temperature data, you see fluctuations.  
23 That's like the passage of eddies or whatnot.

24 CHAIRMAN WALLIS: Right. So what you mean  
25 here is the maximum velocity when you talk about

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1 downcomer velocity?

2 DR. BESSETTE: What I'm talking about here  
3 is the velocities that we saw fell within this range.  
4 Sometimes there would be -- it was all within this  
5 range. I didn't see anything lower than about a foot  
6 a second.

7 CHAIRMAN WALLIS: So which one are you  
8 going to use? You're going to use the maximum one for  
9 your heat transfer predictions?

10 DR. BESSETTE: No, I'm just saying --

11 CHAIRMAN WALLIS: No?

12 DR. BESSETTE: What we did, I said this is  
13 their range of velocities. Well, the point on this  
14 viewgraph is the to say for these kind of velocities,  
15 you're well outside the range of buoyancy opposed  
16 mixed convection.

17 CHAIRMAN WALLIS: It's Reynolds number  
18 dominated.

19 DR. BESSETTE: This is Reynolds number  
20 dominated.

21 CHAIRMAN WALLIS: So you want to get the  
22 velocity right.

23 DR. BESSETTE: So, I mean, for these  
24 velocities, what we get is downcomer reynolds numbers  
25 of 500,000 to three million. So the idea is that this

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1 whole issue of buoyancy opposed mixed convection was  
2 something of a red herring.

3 VICE CHAIRMAN SHACK: On this, I noticed  
4 on the staff replied review comment number 65, no  
5 experiments of measured velocity in the downcomer.

6 DR. BESSETTE: Well, I was pretty ignorant  
7 when I wrote that.

8 (Laughter.)

9 DR. BESSETTE: I looked harder and found  
10 data.

11 VICE CHAIRMAN SHACK: Ah, you looked  
12 harder. Okay. That solves that problem.

13 DR. BESSETTE: Anybody can be wrong in  
14 this, but there's always a chance for reforming.

15 CHAIRMAN WALLIS: That business of  
16 centimeters, it's just a typo. Centimeters in the  
17 second one is a typo.

18 DR. BESSETTE: That's supposed to be --  
19 that was a typo. That's meters.

20 CHAIRMAN WALLIS: So RELAP is predicting  
21 similar velocities at the maximum, although the cells  
22 are not quite the same, and you think that's good  
23 enough to give a characteristic velocity on which to  
24 base age.

25 DR. BESSETTE: I think what we can say is

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1 that RELAP velocities are consistent with these  
2 experiments.

3 CHAIRMAN WALLIS: See, 2D RELAP without  
4 momentum flux is not a very good tool, is it, in  
5 general?

6 DR. BESSETTE: The 2D RELAP with momentum  
7 flux off aid these same range of velocities that we  
8 saw in the experiments.

9 MEMBER RANSOM: Well, when they emit the  
10 momentum flux, they're not emitting all the other  
11 forces, you know, pressure driven forces and that kind  
12 of buoyancy and gravitational. So those forces are  
13 still included.

14 If you're in a constant area passage and  
15 an incompressible fluid, you don't have any real  
16 change in momentum flux.

17 DR. BESSETTE: But you may be seeing to do  
18 is disable a potential demiracle (phonetic) effect.

19 CHAIRMAN WALLIS: Right. So a user who  
20 runs RELAP 2D form in the downcomer for this problem  
21 is not going to encounter erratic, whimsical, large  
22 velocities, unrealistic just due to the numerics and  
23 the running of the code under any circumstance?

24 DR. BESSETTE: We ran hundreds of  
25 calculations. We looked at the output of every

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1 calculation and checked for downcomer velocities just  
2 to make sure we weren't getting anything.

3 CHAIRMAN WALLIS: And they were all --

4 DR. BESSETTE: They were like typically --

5 CHAIRMAN WALLIS: Erratic ones only come  
6 in when you put in some momentum flux terms.

7 DR. BESSETTE: Yeah, it's like for the  
8 whole set of Oconee transients, there's only one  
9 transient. When we ran a whole set of 75 Oconee  
10 transients with momentum flux on or off, only one out  
11 of those 75 was affected.

12 CHAIRMAN WALLIS: So we're trying to  
13 establish a MOX requirement in this, the state of the  
14 art. The state of the art is the RELAP can predict  
15 this thing, and it can predict it well enough on some  
16 basis?

17 DR. BESSETTE: I think the state of the  
18 art is, I think, reflected in these ten degrees C. and  
19 the fact that if you change heat transfer by a factor  
20 of two, the effect is similar. It's within this ten  
21 degrees C. uncertainty.

22 CHAIRMAN WALLIS: This factor of 20 is  
23 also 20 in RELAP or in 16 or 25?

24 DR. BESSETTE: Yes. Without that factor  
25 of 20, you just have flow creeping along at about an

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1 inch a second in downcomer instead of what we see of  
2 one to --

3 CHAIRMAN WALLIS: But the story has  
4 changed here. The old story I heard was that the  
5 reason you get good mixing is because you have flow-  
6 through there which is mixing injected flow.

7 It's not that at all. It's that the  
8 injected flow itself sets up cells.

9 DR. BESSETTE: That's correct, yeah. I  
10 think we characterized it as mysterious last time,  
11 but --

12 (Laughter.)\_

13 DR. BESSETTE: So this is the issue of,  
14 say, temperature distribution in the downcomer, and we  
15 looked at the same body of integral system test data  
16 that I have been talking about, these 12 experiments,  
17 and we looked at the temperature measurements both  
18 axially and azimuthally and couldn't find any plumes  
19 in any of the integral system test data. I'm speaking  
20 of a plume now. I'm speaking of any temperature  
21 differences beyond ten degrees C., but typically we  
22 didn't even find anything close to ten degrees.

23 CHAIRMAN WALLIS: All because the  
24 stratified flow coming out of the cold leg in some way  
25 fixes with about ten times as much fluid and 140

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1 degrees certification becomes ten degrees.

2 DR. BESSETTE: That's right if you have a  
3 mixing --

4 CHAIRMAN WALLIS: But not insight as to  
5 what that mixing process is.

6 DR. BESSETTE: They have a mixing ratio of  
7 ten. Then the 100 degrees becomes ten.

8 CHAIRMAN WALLIS: There's an awful lot to  
9 happen at that one place instantaneously. I agree  
10 there's a lot of evidence, but it seems a very  
11 strange, extraordinary amount of mixing in one place.

12 DR. BESSETTE: Well, I think what we --

13 CHAIRMAN WALLIS: If you look at pictures  
14 of salt plumes, they don't show all stirring around  
15 and so on.

16 DR. BESSETTE: Well, I think maybe a part  
17 of that is, you know, you see these salt plumes in  
18 these separate effects tests. I think there are  
19 additional mixing processes going on.

20 The other thing --

21 CHAIRMAN WALLIS: My instinct would be  
22 that if you had a low Froude number, you'd simply be  
23 pouring the stuff down the wall like pouring maple  
24 syrup out of a container, and it's running down the  
25 container into of onto your plate, and it doesn't mix

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1 at all. This stuff would just ooze out and run down  
2 the wall. There's no reason for it to mix.

3 It jumps the gap and impinges on the wall  
4 and spreads out, and that's great.

5 DR. BESSETTE: Well, the CREARE data --

6 CHAIRMAN WALLIS: The Froude number must  
7 have something to do with this.

8 DR. BESSETTE: The CREARE data, for  
9 example, flows up the gap.

10 CHAIRMAN WALLIS: Then that would be a  
11 mechanism for it spreading and getting a lot of  
12 mixing.

13 DR. BESSETTE: Yeah.

14 CHAIRMAN WALLIS: But that would depend on  
15 the Froude number.

16 DR. BESSETTE: Yeah.

17 CHAIRMAN WALLIS: And does the Froude  
18 number vary a lot between plants? Well, it did  
19 between CE plants and Westinghouse.

20 DR. BESSETTE: Well, see, I think the  
21 injection Froude number varies a lot. I mean, CE and  
22 Westinghouse have low injection Froude numbers and BNW  
23 high, but no matter what --

24 CHAIRMAN WALLIS: How high is high for  
25 BNW?

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1 DR. BESSETTE: Like any of the velocities,  
2 I can't remember the exact numbers. CE and  
3 Westinghouse flow comes in at about a foot a second or  
4 so, and BNW comes in at 20 feet a second. So in  
5 Westinghouse, let's say the flow comes in, drops to  
6 the bottom of the cold leg, and then it spreads out.  
7 There's some mixing in the cold leg obviously.

8 CHAIRMAN WALLIS: It's extraordinary to  
9 me. It's not just low velocity. It's being squirted  
10 in I thought very rapidly in order to save the core.  
11 In fact, it was just dribbling in.

12 DR. BESSETTE: Well, I'm talking about  
13 high pressure injection flow rates, and everything is  
14 coming in through the same pipe. So each --

15 CHAIRMAN WALLIS: High pressure would  
16 presumably create high velocity.

17 DR. BESSETTE: Well, no. High pressure --

18 CHAIRMAN WALLIS: It goes through a  
19 throttle valve or something?

20 DR. BESSETTE: No, no.

21 MEMBER SIEBER: Everything is high  
22 pressure.

23 CHAIRMAN WALLIS: But it's into low  
24 pressure once the pressure drops down in the system.

25 DR. BESSETTE: the low pressure pumps a

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1 high capacity. High pressure pumps a low capacity.

2 CHAIRMAN WALLIS: Well, this is part of  
3 the report I thought could b improved, where you talk  
4 about Froude number being so important, and clearly it  
5 does affect some of these phenomena, and yet you don't  
6 then tell us what it is for various plants and various  
7 conditions. So we don't have a perspective as to, you  
8 know, why it's important, what its range is, whether  
9 you've covered the range and all of that.

10 So maybe you could do that for us when you  
11 rewrite the report.

12 DR. BESSETTE: I will try to clarify it.  
13 I thought it was in there. Obviously I'll take  
14 another look at it.

15 Well, about the these dye tests, of  
16 course, you know, it's qualitative indications.

17 CHAIRMAN WALLIS: And also the salt tests  
18 at APEX I guess have been thrown out because if you  
19 look at them they're quite anomalous.

20 DR. BESSETTE: I think the uncertainties  
21 are so high it's best not to draw anything more than  
22 some qualitative indications.

23 So at any rate I already talked about the  
24 sensitivity studies. Earlier we talked about the  
25 sensitivities we did on plumes before we started this

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1 whole reanalysis, and we used plumes of 40 degrees C.  
2 and 80 degrees C., and so almost no effect on the  
3 probability of vessel failure.

4           Nevertheless, we thought it was one of the  
5 key reasons we did the whole APEX program, was to make  
6 sure that our understanding that plumes were not  
7 important was, indeed true, and I think APEX certainly  
8 bore that out. We ran more than 20 different tests,  
9 and I looked at data from every test we ran, and  
10 typically the axial or azimuthal temperature  
11 variations were less than five degrees C. Generally  
12 they're unobservable.

13           So in conclusion what I tried to show is  
14 that the most important thermal hydraulic uncertainty,  
15 and I don't even know if you can call it thermal  
16 hydraulic uncertainty. It's the range of variations  
17 that characterize any given PRA bin. Within that  
18 range the actual physical model uncertainty  
19 contributed by RELAP --

20           CHAIRMAN WALLIS: -- analogy. It's like  
21 the break size. You can argue about what model you  
22 should use for critical flow out the break, but if the  
23 break itself is uncertain over a huge a range, it's  
24 not so important that you get your model right.

25           DR. BESSETTE: Yeah, the break flow

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1 uncertainty may be 20 percent, but when you double  
2 the size of the break you don't care about the  
3 uncertainty, and that's the whole bottom line.

4           So since the RELAP modeling uncertainty is  
5 small compared to the bin uncertainty, the method we  
6 use to characterize the variations within a bin by  
7 running a set of RELAP calculations that cover the  
8 range of the bin was sufficient to represent the  
9 behavior of that bin, the map of the behavior of that  
10 bin.

11           We established the accuracy and  
12 uncertainty of RELAP, assessing it against a body of  
13 experimental data, and it was also assessed against  
14 additional separate effects data for important  
15 phenomena identified by the PTS PERT, and I think  
16 particularly with pressure and temperature, the  
17 agreement is very good, and it can be attributed to  
18 the integral nature of temperature and pressure as a  
19 measure of energy and inventory, conservation of  
20 energy and inventory.

21           And I think we've addressed the issues of  
22 fluid temperature distribution and downcomer and of  
23 mixed convection and have showed these two to be  
24 resolved or unimportant.

25           CHAIRMAN WALLIS: There you say RELAP

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1 compared well to data. That doesn't mean anything to  
2 me. A well comparison in fracture mechanics, I think  
3 I know what that is.

4 DR. BESSETTE: It's qualitative, but  
5 you've got to say something.

6 CHAIRMAN WALLIS: Yeah, but I think you --

7 VICE CHAIRMAN SHACK: Well, but you do  
8 have uncertainties.

9 CHAIRMAN WALLIS: You have uncertainties.  
10 You have real numbers.

11 DR. BESSETTE: And quantify the  
12 uncertainties to the extent we can.

13 VICE CHAIRMAN SHACK: I have the same  
14 problem with this slide that I do with your report,  
15 and that is bullet three really seems to me to be  
16 bullet one. You know, the report should have been  
17 organized to tell me that RELAP agrees well with  
18 experiments, and I can sort of believe RELAP  
19 predictions.

20 Then you can go on and tell me how you can  
21 deal with the uncertainties, and the last thing I  
22 should hear about is the argument that maybe H  
23 variations aren't so important because when you start  
24 out with and I start to get to discuss variations on  
25 H, then I can run to my sensitivity calculations and

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1 I come up with factors of 30, and it sure is hard to  
2 convince me that H is unimportant until you've  
3 convinced me that I'm using the wrong H.

4 DR. BESSETTE: I'll schedule a dry run  
5 with you next time.

6 (Laughter.)

7 VICE CHAIRMAN SHACK: Well, you know, I  
8 should have read the report backwards.

9 CHAIRMAN WALLIS: No, you shouldn't have  
10 done that. You shouldn't have done that because where  
11 is the section? There's a section called "Sensitivity  
12 of Probabilistic Fracture Mechanics Analysis to  
13 Thermal Hydraulic Variations," which I thought was one  
14 of the bottom lines, is one page, and there's nothing  
15 there or almost nothing there.

16 Now, this is one of -- it seems to me it's  
17 one of the key questions.

18 DR. BESSETTE: Do you want to handle that  
19 again, Mark? Do you want to go for it?

20 MR. EricksonKIRK: No, I believe I would  
21 say the same thing again. Comments with regards to the  
22 organization of the report notwithstanding, I mean,  
23 you're right. That's an important part of the story,  
24 and I think the comments we've received from the  
25 committee suggest that some reorganization of the

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1 report and perhaps an additional --

2 CHAIRMAN WALLIS: I think that might be in  
3 order. I think that generally speaking you've got  
4 enough here to make a case.

5 VICE CHAIRMAN SHACK: And review that  
6 section on the ratio of K applied and K fracture  
7 mechanics so that it isn't a stress.

8 MR. EricksonKIRK: That section will be  
9 removed.

10 VICE CHAIRMAN SHACK: Good.

11 MR. EricksonKIRK: Because that's not a  
12 bottom line.

13 VICE CHAIRMAN SHACK: Well, it's also  
14 wrong.

15 MR. EricksonKIRK: Yes. Minor issue.

16 VICE CHAIRMAN SHACK: Minor issue.

17 MR. EricksonKIRK: That's why it's easy to  
18 remove it.

19 MEMBER SIEBER: So it makes no difference.

20 CHAIRMAN WALLIS: So if we were to suggest  
21 that you rewrite the report, what would be the  
22 mechanics of it and the time line and so on?

23 MR. ELTAWILA: this is Farouk Eltawila  
24 from the (unintelligible) staff.

25 I think we really appreciate the comments

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1 that we got from the committee here, and we definitely  
2 need to sharpen our message, and reorganize the  
3 report, but I think it should not be germane for the  
4 committee to write its own report to the Commission  
5 about that we have enough information to proceed with  
6 the rulemaking so that we can transfer the report to  
7 NRR so they can work on it.

8 So having said that, we definitely are  
9 going to go and reorganize the report, and we're  
10 putting the message to put more clarity in it, and all  
11 the recommendations that you made, we'll incorporate  
12 them.

13 But again, it should not be any conditions  
14 for the --

15 CHAIRMAN WALLIS: And remember that the  
16 report doesn't just go to NRR. It goes out in the  
17 world.

18 MR. ELTAWILA: Absolutely.

19 CHAIRMAN WALLIS: Other countries, other  
20 experts are very much interested in this problem. You  
21 have to make your case clear so that they can  
22 understand it.

23 MR. ELTAWILA: No doubt about it, but the  
24 NRR needs to know now that we have enough technical  
25 basis to support a rulemaking, and they can put that

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1 into their schedule and they can work on the process,  
2 and we will be working on modifying the report, and we  
3 can do that in the next few months.

4 CHAIRMAN WALLIS: And the rule goes out  
5 for public comment in time to --

6 MR. EricksonKIRK: Oh, yes.

7 CHAIRMAN WALLIS: -- really get the report  
8 in shape before the rule is finalized.

9 MR. ELTAWILA: That's correct.

10 VICE CHAIRMAN SHACK: Don't forget to  
11 change Comment 65.

12 (Laughter.)

13 DR. BESSETTE: I'll make a note.

14 MR. EricksonKIRK: Would you like self-  
15 consistency?

16 CHAIRMAN WALLIS: How are we for time?

17 MEMBER POWERS: We're just about right on  
18 it.

19 CHAIRMAN WALLIS: We've been on time all  
20 day.

21 VICE CHAIRMAN SHACK: This is  
22 unbelievable. I'll turn it back to you, Mr. Chairman.

23 CHAIRMAN WALLIS: Thank you.

24 Are there any comments from the other  
25 members of the committee? Now is your chance.

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1 (No response.)

2 MR. EricksonKIRK: Are we -- I'm going to  
3 ask my management a pointed question. What are we  
4 asking of the committee at this time?

5 MR. ELTAWILA: I think we are asking for  
6 a letter, that the staff has sufficient information to  
7 support change to the rule, and whatever additional  
8 comments the committee will want to make, that's their  
9 prerogative, but we're asking for a letter right now.

10 CHAIRMAN WALLIS: Okay. So we are ahead  
11 of time again. But this time, gentlemen, we don't  
12 have something that we have to come back for on time.  
13 We can come back early and do our work.

14 So thank you very much, Mark and Dave. I  
15 think you did a good job under --

16 MEMBER KRESS: Duress.

17 CHAIRMAN WALLIS: No, under appropriate  
18 examination.

19 (Laughter.)

20 VICE CHAIRMAN SHACK: Just remember  
21 Professor Wallis is always restrained when he has to  
22 make his comments at the ACRS.

23 CHAIRMAN WALLIS: I have to be very  
24 careful.

25 VICE CHAIRMAN SHACK: We'll bring the NEI

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1 guys in next time to give you a hard time.

2 (Laughter.)

3 CHAIRMAN WALLIS: We will then take a  
4 break until five o'clock, and then we'll go to work.

5 Thank you.

6 (Whereupon, at 4:36 p.m., the committee  
7 meeting was concluded.)

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