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1 UNITED STATES OF AMERICA  
2 NUCLEAR REGULATORY COMMITTEE

3 + + + + +

4 479TH MEETING

5 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

6 (ACRS)

7 + + + + +

8 THURSDAY

9 FEBRUARY 1, 2001

10 + + + + +

11 ROCKVILLE, MARYLAND

12 + + + + +

13 The Advisory Committee met at the Nuclear  
14 Regulatory Commission, Two White Flint North, Room  
15 T2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. George  
16 Apostolakis, Chairman, presiding.

17 COMMITTEE MEMBERS:

18 GEORGE APOSTOLAKIS, Chairman

19 MARIO V. BONACA, Vice Chairman

20 DR. THOMAS S. KRESS, Member

21 GRAHAM S. LEITCH, Member

22 DR. DANA A. POWERS, Member

23 DR. ROBERT L. SEARLE, Member

24 DR. WILLIAM J. SHACK, Member

25 JOHN D. SIEBER, Member

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1 COMMITTEE MEMBERS: (CONT.)

2 ROBERT E. UHRIG, Member

3 GRAHAM B. WALLIS, Member

4  
5 ACRS STAFF PRESENT:

6 JOHN T. LARKINS, Executive Director

7  
8 ALSO PRESENT:

9 RALPH CARUSO

10 F. CHERRY

11 N. CHOKSHI

12 F. ELTAWILA

13 JOHN FLACH

14 WILLIAM JONES

15 MARK KIRK

16 RALPH LANDRY

17 SHAH MALIK

18 JOCELYN MITCHELL

19 GARETH PARY

20 NATHAN SIU

21 MOHAMMED SHUCIRI

22 ERIC THORNSBURY

23 EDWARD THRON

24 JARED WERMIEL

25 HUGH WOODS

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## A-G-E-N-D-A

1		
2	<u>AGENDA ITEM</u>	<u>PAGE</u>
3	Opening Remarks by Chairman Apostolakis . . . . .	4
4	NRC-RES Presentation: Status of PTS Rule . . . . .	8
5	Screening Criterion Re-Evaluation	
6	Siemens S-RELAP5 Appendix K Small . . . . .	91
7	Break LOCA Code	
8	Proposed ANS Standard on Internal Events PRA .	142
9	Reprioritization of Generic Safety	
10	Issue 152 . . . . .	222
11	Adjournment	
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

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

(8:30 a.m.)

CHAIRMAN APOSTOLAKIS: The meeting will now come to order. This is the first day of the 479th meeting of the Advisory Committee on Reactor Safeguards. At today's meeting the committee will consider the following.

Treatment of uncertainties in the elements of the PTS technical basis reevaluation project; Siemens S-RELAP5, Appendix K Small Break LOCA code; proposed ANS standard on external events PRA; reprioritization, proposed resolution of genetic safety issue 152; design basis for valves that might be subjected to significant blowdown loads; and proposed ACRS reports.

The portion of the session associated with the Siemens code may be closed to discuss Siemens' Power Corporation's proprietary information. This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act.

Dr. John P. Larkins is the designated Federal Official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements from members

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1 of the public regarding today's sessions. A  
2 transcript of portions of the meeting is being kept,  
3 and it is requested that the speakers use one of the  
4 microphones, identify themselves, and speak with  
5 sufficient clarity and volume so that it can be  
6 readily heard.

7 While this is my first day as the  
8 Committee's Chairman, and I think the first thing we  
9 should do is thank Dr. Powers, who is just joining  
10 us --

11 (Laughter.)

12 CHAIRMAN APOSTOLAKIS: -- for the superb  
13 job that he did the last two years leading this  
14 committee. Thank you very much, Dana.

15 (Applause.)

16 CHAIRMAN APOSTOLAKIS: I would also like  
17 to thank my colleagues for electing me chairman of  
18 this committee. I have been a member for about 5-1/2  
19 years now, and I have served under three chairmen --  
20 Professor Searle, Dr. Kress, and Dr. Powers.

21 And although their managerial styles were  
22 somewhat different, they all had one common objective,  
23 namely to make sure that this committee provided sound  
24 technical advice to the commission in a timely manner,  
25 and I can only promise to try to do the same.

1           Sadly, today, and this week, happens to be  
2           the last meeting of Professor Searle. He is  
3           completing his second term on the committee. Bob, I'm  
4           sure I am speaking on behalf of all of the members for  
5           the committee when I say that we will really miss you  
6           and your wise advice.

7           And finally also during the 5-1/2 years  
8           that I have been a member, I must say that I have been  
9           very impressed by the professionalism of the ACRS  
10          staff under the able leadership of Dr. Larkins. I  
11          believe it should be on the record that this committee  
12          could not function without the support that we are  
13          getting from the ACRS staff.

14          DR. SEARLE: I may have some remarks to  
15          make, but I imagine that there will be a more  
16          appropriate time a little later to do that.

17          CHAIRMAN APOSTOLAKIS: Whenever you want,  
18          Bob. Are there any comments or statements that other  
19          members would like to make?

20          DR. SEARLE: I would like to make a brief  
21          statement. For the benefit of the members of the  
22          commission staff that are so intimately involved with  
23          the ACRS, but whom we have interacted with from time  
24          to time, I would like to express my own personal  
25          appreciation and admiration for the way in which

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1 pretty much across the board they have conducted  
2 themselves and interacted with the committee.

3 I have always received the utmost  
4 cooperation when I was in a position where I had to  
5 work with them, and I guess the thing is that I  
6 believe we have a climate of mutual respect, and so  
7 that does the process well.

8 We talk about issues and we don't talk  
9 about personalities, and I am so very pleased to have  
10 had the opportunity to work with all of them. And  
11 since some of them are here, in here anyway right now,  
12 I just would like to say thank you very much.

13 CHAIRMAN APOSTOLAKIS: Very good. Thank  
14 you, Bob.

15 DR. KRESS: I think it is a shame that Bob  
16 is leaving, just when I am hearing how to speak Texan.

17 (Laughter.)

18 DR. POWERS: And need to learn how to  
19 speak Texas.

20 (Laughter.)

21 DR. SEARLE: Well, I am still working on  
22 Tennessee.

23 (Laughter.)

24 CHAIRMAN APOSTOLAKIS: Our first topic  
25 today is treatment of uncertainties in the elements of

1 the PTS technical basis reevaluation project. Dr.  
2 Shack, I believe you will lead us through this.

3 DR. SHACK: Okay. We had a subcommittee  
4 meeting on January 18th, where we had a fairly  
5 detailed discussion of the treatment of uncertainties  
6 in the PTS project, and as Tom Kress has pointed out  
7 before, not only is PTS important in its own right,  
8 but this we think is sort of a prototype example of  
9 the kind of detailed treatment of uncertainties one  
10 may need in other situations.

11 What is unique about this is the attempt  
12 to integrate the treatment of uncertainties in all  
13 aspects of the problem in the framework that  
14 uncertainties have been treated typically in PRAs.  
15 And I think we saw substantial progress at the  
16 subcommittee meeting in the treatment of how they were  
17 handling the aleatory and epistemic uncertainties in  
18 the fracture toughness.

19 We saw some work towards the treatment of  
20 uncertainties in the thermal hydraulics, and I  
21 believe we are going to get an overview of the  
22 approach to the treatment of uncertainties from  
23 pressurized thermal shock in the presentation before  
24 the full committee today.

25 But again this is a work in progress. We

1 are not really expecting to write a letter at the  
2 moment. This is a chance to sort of see how they are  
3 working their way through it, because they are  
4 breaking new ground here and it is not a conventional  
5 treatment of uncertainties that we are looking at.  
6 With that, I will turn it over to Mike Mayfield, I  
7 guess, to start, and Nathan Siu.

8 MR. MAYFIELD: Good morning. We  
9 appreciate the opportunity to come to the main  
10 committee again, or the full committee, and talk about  
11 the progress that we are making on this project.

12 As Dr. Shack pointed out, this is -- we  
13 are starting to move back some of the frontiers, at  
14 least in our traditional treatment of probablistic  
15 fracture mechanics as it relates to the structural  
16 integrity of major components.

17 I just wanted to set the stage a little  
18 bit, and then turn it over to Nathan Siu to work  
19 through the rest of the presentation. We just wanted  
20 to remind you first of all that the objective of the  
21 program is to develop a technical basis for the  
22 potential revision to the PTS rule.

23 We are not telling you or the public that  
24 we necessarily will revise the PTS rule. Our activity  
25 at this point is to look at the technical basis to see

1 if there is a justification for revising the rule, and  
2 what that might look like, and then to make  
3 recommendations to the Office of Nuclear Reactor  
4 Regulation, since the rule making function is their  
5 responsibility.

6 DR. POWERS: Could you remind me what  
7 prompted you to undertake this daunting task?

8 DR. SHACK: Sure. We have seen some  
9 improvements -- well, the PTS rule itself is based on  
10 technologies from the late '70s and early '80s. We  
11 have made some major improvements in a number of  
12 areas.

13 For instance, in my business in  
14 particularly, the probabilistic fracture mechanics  
15 area, our understanding of embrittlement and fracture  
16 toughness, and the flaw distributions that were a  
17 major source, and in fact the major source of  
18 uncertainty in the original analyses.

19 So we felt like based on some very limited  
20 scoping analyses, we felt like there was a strong  
21 basis to undertake a more rigorous treatment or  
22 reevaluation of PTS.

23 The notion at that point was that -- and  
24 I think going back to the Yankee Row evaluation, that  
25 there was significant conservatism embedded in the PTS

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1 rule, and the analyses that are in Reg Guide 1.154.

2 So we thought that the technology had  
3 improved to the point or matured to the point that we  
4 should take that up and revisit those technical  
5 underpinnings.

6 This is the first major application of  
7 risk informed methodology to what has been  
8 characterized as an adequate protection rule, and  
9 while I don't want to get into a debate on what we  
10 mean by adequate protection, the rule has been  
11 characterized as such, and it has to do with  
12 backfitting -- the regulatory piece of it has to do  
13 with backfitting requirements.

14 It was originally promulgated as an  
15 adequate protection rule when we revised it in the  
16 mid-1980s and early '90s, and it was again treated as  
17 an adequate protection rule.

18 But the fact that we are now taking a look  
19 at it in a risk informed approach is causing us to  
20 examine what we really mean and how we go about  
21 dealing with that.

22 So that will create for us some additional  
23 dialogue with the committee, I expect, as we go along.  
24 We are evaluating four plants in an effort to develop  
25 a generic approach that will cover the fleet of PWRs.

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1           We recognize going in that evaluating only  
2           four plants and trying to use that as a surrogate for  
3           some 80ish PWRs brings with it certain stretches of  
4           faith, and that is something that we are taking on as  
5           a specific activity somewhat later in the program.

6           But it is an uncertainty in what we are  
7           doing. The four plants we are looking at are Oconee,  
8           which is a BMW design, Calvert Cliffs, and Palisades  
9           are CE designs, and Beaver Valley, Unit 1, is a  
10          Westinghouse design.

11          We do not intend to do plant specific  
12          evaluations for the entire PWR fleet. That is well  
13          beyond our resource capability, and it is not  
14          something that is credible for us to undertake.

15          We do feel that by looking at this small  
16          sample that we can at least improve on the basis for  
17          the rule that is out there today, which is based  
18          totally on stylized transients, and no plant specific  
19          features.

20          We are looking to use the best available  
21          tools for the analysis, the tools that exist today.  
22          We are making some advances in some of the tools, but  
23          we are not looking to make major improvements in some  
24          of the underlying technologies.

25          And that we felt like the improvements

1 that have been made since the time the PTS rule was  
2 originally promulgated that improvements in the  
3 technologies up to this point provide a sufficient  
4 justification, and it is not a practical thing for us  
5 to undertake major revisions to thermal hydraulics  
6 neutron transport calculations, and that sort of  
7 thing.

8 So we are using the state of the  
9 technology by and large as it exists today. As Dr.  
10 Shack pointed out, this is one of the continuing  
11 series of briefings that we feel have been very useful  
12 in bringing the committee and keeping the committee up  
13 to date on what we are doing.

14 And we are soliciting your feedback as we  
15 go along. We didn't want to get into this project,  
16 which is a major resource investment for us, and spend  
17 a couple of years working on it, and get to the end  
18 only to have the committee say, well, you have missed  
19 these key issues.

20 So we wanted to try and solicit your input  
21 along the way, not so much in an effort to get your  
22 preendorsement of the program, but to help solicit  
23 your input, and if you identify something that we are  
24 missing, then we can get that fixed as we go along, so  
25 that at the end of the day we have a complete package

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1 that the committee can review.

2 DR. SHACK: Just to come back to Dana's  
3 question a little bit. If you were convinced that the  
4 analysis was conservative, what would be the impetus  
5 for revising the rule? Only Palisades is going to hit  
6 the screen criteria, at least under current  
7 projections, right, for 40 years?

8 MR. MAYFIELD: Well, that's true. For  
9 Palisades, it was a bit over 40, and there are a small  
10 number of plants that would be approaching the  
11 screening criterion out to 60. There is, however, a  
12 fair bit of uncertainty within the licensees, or at  
13 least it has been expressed to us, about what else  
14 would the staff do with new embrittlement  
15 correlations.

16 As the committee probably knows, very  
17 small changes in chemical composition for the wells,  
18 and our understanding of the chemical composition for  
19 the wells can make very large changes in the estimates  
20 of embrittlement of the vessel.

21 So that is something that the -- I think  
22 the licensees would like to see a little more  
23 stability in what we are doing, and to remove the  
24 unnecessary conservatism.

25 So we originally took this on with the

1       notion that there was a fair bit of unnecessary  
2       conservatism embedded in the rule, and to try and  
3       bring it back, and base it on credible technology, as  
4       opposed to conservative estimates made out of  
5       ignorance. So that was motivating it initially, okay?

6               DR. SHACK: Okay.

7               DR. SEARLE: Mike, you made the comment  
8       earlier that this is based on existing technology.

9               MR. MAYFIELD: Yes.

10              DR. SEARLE: At the same time, I think it  
11       is worthwhile to recall that there were places where  
12       specifically focused activities took place and  
13       addressed what were at the time to be considered to be  
14       concerns. Namely, as I understand it, the ENDF(b)(6).

15              MR. MAYFIELD: Yes, sir.

16              DR. SEARLE: And the cross-section  
17       rendering grew out of a concern for the way in which  
18       iron was -- and some other things in that  
19       neighborhood, were being treated in the attenuation  
20       calculation.

21              MR. MAYFIELD: That's correct.

22              DR. SEARLE: So there have been some  
23       rather focused efforts in various areas to address and  
24       identify issues of that sort?

25              MR. MAYFIELD: That's exactly right. The

1 cross-section libraries was one effort. We have  
2 published -- and in fact the committee reviewed in  
3 December a regulatory guide on neutron transport  
4 calculations and improvements in the way that we go at  
5 that, and the way that uncertainties are handled in  
6 those calculations.

7 We have made improvements in the way we do  
8 the fracture mechanics analyses, and some of the  
9 underlying models there. We have got a much better  
10 handle on embrittlement trends today, and the flaw  
11 distribution work.

12 So there have been over the last 10 years  
13 a number of major undertakings to improvement the  
14 state of the technology.

15 DR. SEARLE: If there are -- I have become  
16 aware of a problem. Some people who are involved with  
17 the ASTM code group, apparently had questions  
18 concerning the attenuation calculation and submitted  
19 a large number of questions, which were apparently not  
20 addressed, at least not to their satisfaction, in the  
21 draft or in what is -- well, 1065, or whatever that  
22 number is.

23 Anyway, the Red Guide that was published  
24 just recently, and I believe that George received a  
25 communication on this concern, and I thought it had

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1       been passed along to other people in the commission.

2               MR. MAYFIELD:   I'm sorry, but you are  
3       catching me cold today here.

4               CHAIRMAN APOSTOLAKIS:   I'm not sure I  
5       follow.

6               DR. SEARLE:   The thing that we talked  
7       about here last week.   I'm sorry, but --

8               MR. MAYFIELD:   Historically, there has  
9       been some disagreement over how attenuation is  
10      handled, and it is an issue that we agree that the  
11      technical basis needs to be revisited.

12              I think it would be fair to say that the  
13      basis for arguing for a change is not a lot stronger  
14      than the basis arguing against the change.

15              DR. SEARLE:   I'm sorry for blindsiding  
16      you.

17              MR. MAYFIELD:   Well, I will be happy to  
18      talk to you about it, and see where we can go.   The  
19      key issue that we are here to talk about today, and  
20      that we met with the subcommittee on a couple of weeks  
21      ago, is the treatment of uncertainties and treatment  
22      of uncertainties in the major areas of the analysis.

23              We are also going to, in addition to  
24      giving you an overview, we are going to try and deal  
25      with some of the questions and comments that were

1 raised during the January 18th meeting.

2 And with that, Mr. Chairman, I would like  
3 to turn it over to Nathan Siu to do the bulk of the  
4 briefing.

5 MR. SIU: Good morning. I will first give  
6 you an outline of what I am going to talk about. You  
7 have quite a few slides in your packet, and a number  
8 of those are backup slides. So don't worry about the  
9 length of it. We can obviously tailor the  
10 presentation to the time that we have got.

11 But what I would like to talk about first  
12 of all are the objectives and the conceptual approach  
13 regarding the treatment of uncertainties. Sometimes  
14 we are going to get a little -- well, not muddled, but  
15 we can't avoid the general issue of how is the  
16 integrated analysis proceeding, because the  
17 uncertainty analysis is an integral part of the  
18 overall analysis.

19 And there will be times when we are  
20 talking about in general how is the overall  
21 computation and how we will proceed. But I would  
22 really like to emphasize the treatment of uncertainty  
23 is within that computational flow.

24 I will give you an overview of how we are  
25 proceeding with the analysis, and we will try and

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1 provide some of the details that were or the  
2 information that was perhaps lacking in the  
3 subcommittee presentation, where we provided a high  
4 level framework, and then some of the bits and pieces,  
5 and didn't talk too well to how those two link  
6 together.

7 We will talk about the status of the major  
8 discipline activities in PRA from a hydraulics and  
9 probabilistic fashion mechanics, and time permitting,  
10 we will get into each of these areas in a little bit  
11 more detail.

12 And in particular we have developed some  
13 draft results from the Oconee study. We have talked  
14 these results with Duke Energy a week or so ago and  
15 received comments on that.

16 These are highly draft results, but we  
17 wanted to give you a sense of how things are  
18 proceeding. In the case of the TH analysis, again,  
19 obviously we have TH results. Runs have been  
20 performed, and we have time temperature traces,  
21 pressure time traces.

22 The approach refers again to the treatment  
23 of uncertainties, and how we are going to deal with  
24 uncertainties in those computations, and similarly we  
25 are going to talk about the approach we are using for

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1 fracture mechanics.

2 And some of these things we are getting  
3 draft results, but that we are not ready to present at  
4 this point in time. At the end, I will then have a  
5 discussion of key issues and summarize where I think  
6 we are.

7 Okay. Again, this part of the analysis,  
8 we are assessing uncertainties in the estimates of PTS  
9 risks. That means that we are going to quantify the  
10 uncertainties, and also of course try to identify the  
11 driving sources of those uncertainties.

12 And the reason that we are doing this is  
13 to support the technical basis for a potential rule  
14 change. So, for example, we would be looking at  
15 potentially new screening criteria, and potentially  
16 new guidance for how you do a plant specific analysis  
17 if the screen criteria are not met.

18 This just illustrates a conceptual diagram  
19 of how the screen criterium might be developed, and  
20 shows the roles of uncertainties here, where this is  
21 the RT-PTS, and the RT and DT of the license, and this  
22 is the through wall crack frequency.

23 You might have estimates of the through  
24 wall crack frequency for a given plant, and the  
25 uncertainty bins about that estimate, and somehow we

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1 need to develop a line that relates the two, and  
2 develop a screening value for RT-PTS based on some  
3 notion of what is an acceptable through wall crack  
4 frequency.

5 That is conceptually how we might approach  
6 it. Again, please don't read too much into that  
7 diagram, because we have not put a lot of work into  
8 figuring out we are really going to proceed. But this  
9 shows how the uncertainties will play into that kind  
10 of process.

11 DR. POWERS: Could you explain to me  
12 better what the significance of the lines on either  
13 side of the square are?

14 MR. SIU: The dashed lines?

15 DR. POWERS: No, the --

16 MR. SIU: Oh, this would be the through  
17 wall crack frequency, or let's say the mean estimate,  
18 and then maybe you would have a 95th percentile, and  
19 a 5th percentile. So it indicates the range.

20 DR. POWERS: How do you decide to use 95  
21 rather than 99, or 80, or 2, or --

22 MR. SIU: Well, that's part of my problem.  
23 We have not really gone through the work of figuring  
24 out exactly how we are going to use these estimates.

25 DR. POWERS: How do people in other

1 contexts decide what to use?

2 MR. SIU: In other contexts?

3 DR. POWERS: Yes. I mean, you haven't  
4 done it here, but do we know -- I mean, some people  
5 put like standard errors are the length of those bars,  
6 and they calculate a variance, and they put the square  
7 root of the variance on either side for a bunch of  
8 measurements.

9 It escapes me exactly what the probability  
10 is on that, but maybe it is like 82 percent or  
11 something like that, and other people would use 95.  
12 I mean, how do you decide? Is that a subjective  
13 decision entirely, or --

14 MR. SIU: I imagine that it would be  
15 because one of the things that we will get to is that  
16 these error bars are going to include the computed  
17 uncertainty.

18 There will be uncertainties that we don't  
19 think that we can calculate very well given the  
20 current state of technology, and in particular model  
21 uncertainties associated with some of the codes that  
22 we are using.

23 So I think what you are going to get  
24 realistically is an estimate of the computed  
25 uncertainty, plus a description of uncertainties

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1 associated with other issues -- maybe sensitivity  
2 calculations, but some indication of what the full  
3 range of uncertainty might be.

4 So to -- I don't see necessarily -- and  
5 again we have not worked this out, but I don't see  
6 just coming up with a simple rule that says pick a 99  
7 and you are done.

8 DR. POWERS: But I think you have really  
9 answered my question.

10 CHAIRMAN APOSTOLAKIS: Have we used  
11 percentiles in any other situation? My impression is  
12 that we are using mean wise -- is that true -- when we  
13 allocate or when we decide that the contribution from  
14 this particular accident is such and such, why --

15 MR. SIU: Excuse me, George, but this is  
16 a screening criterion. This is the first step.

17 CHAIRMAN APOSTOLAKIS: So it is as  
18 screening guide then?

19 MR. SIU: Yes. They are trying to just  
20 say that if you meet a certain embrittlement level --  
21 and that is the current rule right now, but if you  
22 meet a certain level, and if you don't come up to that  
23 level of embrittlement, you don't have to do anything  
24 more.

25 CHAIRMAN APOSTOLAKIS: I see. Okay.

1 MR. LEITCH: The three data points there  
2 represent three different vessels, or is that at a  
3 different time and --

4 MR. SIU: Yes, as the embrittlement  
5 increases, RT-PTS would increase. Again, how we are  
6 going to match up with the four plants, which can have  
7 very different results, and how we are going to  
8 generalize to the larger population, these are big  
9 questions.

10 The analysis -- to do the uncertainty  
11 analysis now, we have to categorize the sources of  
12 uncertainty, because that is built into notions of  
13 which kind of matrix we will be using.

14 We have to construct an aleatory model,  
15 and I believe we briefed the committee about the basic  
16 notion of aleatory and epistemic uncertainties in the  
17 PTS analysis.

18 And we then have to propagate epistemic  
19 uncertainties through the aleatory model, and I will  
20 try to walk you through that in a fairly high level  
21 manner.

22 Conceptually, how we might approach this  
23 is that we would develop event sequences, using a PRA  
24 event sequence model to identify what are the  
25 potential challenges to the vessel, or scenarios that

1 could challenge the vessel.

2 And measure certain frequency, and let's  
3 call that lambda, and there is uncertainty about that  
4 frequency. That is the epistemic uncertainty about  
5 the perimeter lambda, and lambda is the measure of the  
6 aleatory uncertainty.

7 That result -- and again this is  
8 conceptually. We get fed into a thermal hydraulics  
9 analysis, where for each PRA scenario we identify a  
10 number of thermal hydraulic subscenarios, a different  
11 variance on that PRA scenario; and perhaps differences  
12 in timing of actions.

13 We would have to develop distributions for  
14 the probabilities of each of these variance, as well  
15 as distributions about the thermal hydraulic  
16 characteristic variances that we care about. For  
17 example, the pressure and temperature over time, the  
18 temperature in the down comer.

19 Using that information, we would feed into  
20 a stress strength analysis, where you look at the  
21 stress on the vessel, which is a function of these  
22 perimeters, the temperature and the pressure.  
23 Therefore, that of course would be uncertain as well.

24 And you compare that against the strength,  
25 which has its own uncertainties, and develop a

1 distribution for the conditional probability of vessel  
2 failure given this scenario, and subscenario, and  
3 integrate the results together, and get a through wall  
4 crack frequency with probability distribution.

5 And without getting into the details too  
6 much, there is something obvious here. This could be  
7 a common for an explosion here as you develop more  
8 thermal hydraulic subscenarios to append on to the PR  
9 scenarios.

10 And that would require a lot of thermal  
11 hydraulic analyses, and then you would have to feed  
12 those into the stress strength analysis, which also  
13 has its own variance.

14 We are not doing it that way for obvious  
15 reasons. It's just that we can't do the computations  
16 to this level. So let me talk a bit about some of the  
17 simplifications we are employing.

18 CHAIRMAN APOSTOLAKIS: How much of this  
19 was done in the original analysis?

20 MR. SIU: Not formally. My understanding  
21 is that there were sensitivity analyses, but there  
22 were no -- for example, even PRA uncertainties in the  
23 event sequence frequencies were not computed. This  
24 was back in the early '80s.

25 MR. MAYFIELD: The original rule had none

1 of the things that Nathan just talked about. They  
2 took some stylized transients and did what amounted to  
3 deterministic calculations.

4 Then there were some on the side  
5 probablistic fracture mechanics calculations done,  
6 where they tried to include some of the Monte Carlo  
7 scheme, including variations or distributions on  
8 flaws, on chemical compositions, some of the more  
9 obvious variables to include.

10 But it was nothing as elegant as what is  
11 being talked about here. There were subsequent  
12 analyses, called the integrated pressurized thermal  
13 shock analyses that Oak Ridge performed, and looked at  
14 three plants.

15 And those analyses looked more like what  
16 we are doing today. But the treatment of  
17 uncertainties was not as rigorous as what we are  
18 trying to do today.

19 MR. SIU: And that is an important point.  
20 Again, just because there were resource constraints,  
21 the time that it actually takes to run a thermal  
22 hydraulic calculation, maybe on the scale of hours,  
23 but also the pre-and-post processing requirements --  
24 you get a result and you have to look at it and make  
25 sure it makes sense before you go forward with it.

1 DR. POWERS: Why is RELAP5 and not the  
2 consolidated NRC, the hydraulic code, being used for  
3 these analyses?

4 MR. ELTAWILA: This is Farouk Eltawila  
5 from research. We actually are doing the analysis  
6 using both codes, but we have not finished the  
7 consolidation completely right now.

8 So once we complete the consolidation --  
9 so we are doing it, but we are relying on the lab  
10 because it has gone through a lot of assessments, and  
11 the consolidated code has not gone through this  
12 rigorous assessment at this time.

13 So eventually once we finish all the  
14 calculations, we are going to run with the final  
15 version of the consolidated codes.

16 DR. POWERS: So at some point in time, we  
17 will get a comparison between the two?

18 MR. ELTAWILA: Absolutely.

19 DR. POWERS: It may not be part of the GS  
20 effort, but at some time we will get to see how well  
21 the --

22 MR. ELTAWILA: Well, actually the analysis  
23 is done also at this time with the consolidated code,  
24 but we are focusing for the purpose of the rule making  
25 change, we are going to rely on the RELAP5 calculations.

1 DR. POWERS: I mean, that's fine, but we  
2 will get to see it sometime?

3 MR. ELTAWILA: Yes.

4 DR. POWERS: That's good. That's good.

5 MR. SIU: Correct me if I am wrong,  
6 Farouk, but even with the consolidated code, I imagine  
7 I can get significant resource requirements for a  
8 particular run?

9 MR. ELTAWILA: There is no doubt about it.

10 MR. SIU: So for that reason, we need to  
11 obviously use the standard strategy of being similar  
12 sequences to represent the results of the PRA analysis  
13 with a very limited set, a relatively limited set of  
14 thermal hydraulic times.

15 DR. POWERS: Can you tell me how you  
16 decide a sequence is similar?

17 MR. SIU: We have rules for doing that.  
18 I wasn't prepared to get into the details of the  
19 rules, and we can chat about that as we -- a little  
20 bit later perhaps, or if I haven't answered that by  
21 the end of the presentation, I will make sure that we  
22 come back to it.

23 We did present that at the subcommittee,  
24 and we had provided samples of the rules that we were  
25 using. Another issue with how we are approaching

1 this, in terms of that conceptual model -- remember I  
2 showed you bins for the uncertainties about  
3 temperature and pressure over time.

4 Part of the uncertainties in those bins of  
5 course comes from model uncertainties in principle.  
6 We don't yet have well established techniques for  
7 dealing model uncertainties. There are a number of  
8 proposed approaches.

9 We have done some initial work in that  
10 area, and so I think at this point it is fair to say  
11 that the formal methods are under development, and we  
12 can chat about that a lot.

13 But again for the purpose of what we are  
14 trying to do -- and that gets back to Mike's point  
15 about using available technology. This is one case  
16 where we are not trying to push the envelope very  
17 hard. We are trying to use what we have got.

18 One of the reasons, of course, is that we  
19 have limited data now to really apply the methods that  
20 we have got if you want to use, for example, a basing  
21 approach to estimate the -- to quantify the model  
22 uncertainties, we would like to have some data to use  
23 as part of that quantification process. And the  
24 amount of data relevant for these sequences is highly  
25 limited.

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1 CHAIRMAN APOSTOLAKIS: So you will come  
2 back to this?

3 MR. SIU: I wasn't planning to, but we can  
4 talk about it now if you would like. This is just a  
5 limitation, and so because of this limitation, this is  
6 how we are approaching the problem.

7 We are certainly going to quantify  
8 perimeter uncertainties. We are dealing with boundary  
9 conditions. Again, things like -- you can call them  
10 perimeters and a time when at which an action occurs,  
11 and variations in that.

12 Submodels to some extent -- for example,  
13 if you are talking about flow through an opening, we  
14 can deal with that. But talking about -- let's say  
15 RELAP5 is an assemblage of submodels and of course  
16 uncertainty is associated with that assemblage.

17 There is uncertainties with the nodding,  
18 and uncertainties with the application. These ere  
19 things that we are not addressing in the quantitative  
20 analysis at this point.

21 We are not planning to, and we are of  
22 course going to supplement whatever information we  
23 have with the results of experiments to address issues  
24 that were raised in the subcommittee, for example,  
25 about the possibility of a thermal plume.

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1                   And we are also going to perform selective  
2 sensitivity studies. So we are not going to just  
3 accept things directly as is, and in fact a comparison  
4 with the consolidated code probably would be another  
5 case of providing some benchmarking.

6                   But again I think this is where we are  
7 going to have the qualitative discussion of  
8 uncertainties, as well as the quantitative discussion.

9                   CHAIRMAN APOSTOLAKIS: But when you say  
10 submodel, I remember in one of the earlier  
11 presentations there was a diagram that said here we  
12 are using the correlation and we are not so sure. You  
13 are going to have an uncertainty about the correlation  
14 itself?

15                  MR. SIU: Yes, at that level, because we  
16 can translate that relatively simply into a boundary  
17 condition kind of representation, and I think that  
18 there is enough information on that particular  
19 submodel that this issue is perhaps of less interest,  
20 the issue of limited data.

21                  CHAIRMAN APOSTOLAKIS: But we have never  
22 really heard how you are going to do that, right? I  
23 mean, you never presented that, right?

24                  MR. SIU: This is still frankly under  
25 discussion.

1 CHAIRMAN APOSTOLAKIS: Okay.

2 MR. SIU: Given those simplifications,  
3 this is a variance on a diagram that can be seen  
4 before. I have tried to put -- there is a lot of  
5 information here that we don't have to get into at  
6 this point, but again it shows the PRA event sequence  
7 analysis, the thermal hydraulic analysis, and the  
8 probablistic fracture mechanics analysis.

9 The key point here is just simply the  
10 banding idea, that we are taking sequences, and we are  
11 banding them into a small number of thermal hydraulic  
12 bins, and then possibly reexpanding those bins to  
13 account for a variance in the -- let's say the  
14 boundary conditions just as a simple example.

15 There are uncertainties in all of the  
16 perimeters and that's why I have the little pi there  
17 to represent the epistemic uncertainties. These are  
18 being propagated through the analysis, and that gets  
19 fed into a stress strength analysis, where the stress  
20 now is a function of the deterministic temperature and  
21 pressure traces here.

22 CHAIRMAN APOSTOLAKIS: And this is a  
23 generic pi, right?

24 MR. SIU: This is a generic pi, yes. It  
25 is not the same pi.

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1 CHAIRMAN APOSTOLAKIS: It is not the same  
2 pi? Okay.

3 MR. SIU: But again the point is that for  
4 each of these thermal hydraulic subscenarios, we have  
5 a defined trace here. We don't have the bands  
6 anymore, and we try to accommodate the bands through  
7 the definition of these subscenarios, but this is a  
8 limitation in the approach that we are taken.

9 CHAIRMAN APOSTOLAKIS: I'm sorry, but I  
10 didn't follow that. What is it --

11 MR. SIU: In the conceptual model, we have  
12 the uncertainty bands, and let's say about  
13 temperature.

14 CHAIRMAN APOSTOLAKIS: Right.

15 MR. SIU: What you have here instead is a  
16 single trace that is dependent on your definition of  
17 the scenario. Let's say that instead of 10 minutes  
18 for the operator to throttle HPI, it is 9 minutes. It  
19 won't be to that fine level of detail, but that is the  
20 kind of idea.

21 Conceptually, you could have, of course,  
22 different bands, and we are trying to accommodate  
23 those variance through a discreet number of  
24 subscenarios. And a consequence of that is that we  
25 get basically a stress calculation for the

1 deterministic pressure, temperature, and of course the  
2 heat transfer coefficient, and --

3 CHAIRMAN APOSTOLAKIS: And so for the same  
4 thing --

5 MR. SIU: Let's say P-1.

6 CHAIRMAN APOSTOLAKIS: -- where you take  
7 scenarios 1 and 3, and that's one bin?

8 MR. SIU: This is one bin, that's right.

9 CHAIRMAN APOSTOLAKIS: According to the  
10 previous conceptual model, you would run the thermal  
11 hydraulic analysis, right?

12 MR. SIU: In the conceptual model --

13 CHAIRMAN APOSTOLAKIS: And you would have  
14 an uncertainty around P and D. Now, instead of doing  
15 that, you are running three cases, right; is that what  
16 this means?

17 MR. SIU: Yes. Don't take the three  
18 literally, but it is a small number.

19 CHAIRMAN APOSTOLAKIS: And what is  
20 different from the first to the second?

21 MR. SIU: Well, the first one just simply  
22 said in general I could run separate -- I could do  
23 this expansion if you will for one, two, three, four,  
24 however many. So we have to bin down, and the binning  
25 is a major modeling step.

1 CHAIRMAN APOSTOLAKIS: Right. But in the  
2 thermal hydraulic analysis, how do you decide to have  
3 a number of -- what is different between these three  
4 runs in the same bin?

5 MR. SIU: Consider perhaps that this was  
6 the action at 8 minutes, and this is 10 minutes, and  
7 this is 12 minutes. It could be.

8 CHAIRMAN APOSTOLAKIS: Okay.

9 MR. SIU: Now, we have a method for  
10 identifying what are the important variables to look  
11 at, and we are trying out methods to identify the  
12 subscenario.

13 CHAIRMAN APOSTOLAKIS: So what you said  
14 earlier was that, yes, this uncertainty and the  
15 boundary conditions would be handled, but the  
16 uncertainty in the T/H analysis itself, at this point  
17 at least you are not handling it?

18 MR. SIU: That's right.

19 CHAIRMAN APOSTOLAKIS: Okay.

20 DR. POWERS: So in other words, if I'm  
21 agitated over the quality of some heat transfer  
22 correlation, that it is embedded in RELAP?

23 CHAIRMAN APOSTOLAKIS: You will remain  
24 agitated.

25 DR. POWERS: Does that mean that that will

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1 affect the security of the free world, the security of  
2 the free world remains in threat?

3 MR. SIU: We are, of course, not doing  
4 this entirely arbitrarily. We have reasons, and that  
5 is explained in a fairly lengthy report why we are  
6 concentrating on certain issues and not on others.

7 And in the case of the PTS analysis, part  
8 of the point is that the time constance associated  
9 with the reactor pressure vessel, the wall, the  
10 thermal response to a transient, is relatively long.

11 And that means that some of the details  
12 that you might worry about for other situations may or  
13 may not have a great effect on the through wall crack  
14 frequency.

15 CHAIRMAN APOSTOLAKIS: And I don't think  
16 it is part of your charge to protect the free world is  
17 it?

18 MR. SIU: That wasn't my stated objective.

19 DR. POWERS: I guess maybe you need to  
20 point to me the heart in this lengthy document where  
21 that is stated, because it seems to me that taking a  
22 thermal response time of the wall to decide whether  
23 I work with heat transfer correlations or not is  
24 precisely the wrong thing to do.

25 MR. SIU: Okay.

1 DR. KRESS: If you are concluding that  
2 this heat transfer coefficient that Dana might be  
3 agitated about was very important to your final  
4 answer, you would include it in these variations, in  
5 that middle box, perhaps? That might be the thing  
6 that you are changing?

7 MR. SIU: You certainly could. You could.  
8 You know, at this point, I guess we -- and this is  
9 part of where we are getting feedback from the  
10 committee, of course.

11 We have identified certain things that we  
12 think are important and that we do need to address,  
13 and if the committee gives us a feedback that we have  
14 not considered some important things, that would be  
15 important for us to know.

16 CHAIRMAN APOSTOLAKIS: Yes, because a  
17 number of calculations will multiply tremendously if  
18 you are not careful here. So instead of the three  
19 subscenarios, you compare an extra 10 to describe  
20 these uncertainties.

21 DR. POWERS: George, let me ask you this  
22 question. If I set out and do some sort of a Monte  
23 Carlo approach on this thing, which -- and in which  
24 some respects they may be doing here, how many samples  
25 do I have to take in order to get an understanding of

1 what the uncertainty is?

2 CHAIRMAN APOSTOLAKIS: If you do a  
3 traditional -- you know, a straight sampling, I think  
4 it would be into the thousands. But they would  
5 probably do some latin hypercube sampling to determine  
6 the number of runs.

7 DR. POWERS: Well, even if I go to such a  
8 stretch of the imagination as using limited latin  
9 hypercube sampling --

10 CHAIRMAN APOSTOLAKIS: I think in the  
11 waste business where they have monster codes, the  
12 number of runs as I recall is not very high, maybe 70  
13 or 80.

14 DR. KRESS: Yes, that is what I recall.

15 CHAIRMAN APOSTOLAKIS: Which is not really  
16 too large when considering the goals that you are  
17 using.

18 DR. KRESS: I think you can get by with  
19 that few. I think Dana's point is going to be how can  
20 we trust this particular uncertainty, which looks like  
21 maybe 5 or 6 cases, when you really need about 70 to  
22 do it right.

23 MR. SIU: Well, actually, again, we were  
24 expanding on one particular thermal hydraulic bin.  
25 There are many thermal hydraulic bins. And the

1 actual number of runs -- take a wild guess -- in the  
2 end they might be on the order of a hundred.

3 DR. KRESS: So you may be covering enough  
4 there to --

5 DR. POWERS: Excuse me, but if I just drew  
6 a circle around this and said that everything that  
7 goes in here is basically a Monte Carlo analysis --  
8 and it's not, but let's say that it is. And I say I  
9 would like to know this uncertainty.

10 I would like to know that I sampled 95  
11 percent of the possible range of outcomes with a 95  
12 percent confidence. That is not an unpalatable kind  
13 of expectation, and I think you are up around 90  
14 calculations.

15 And the fact is that I could do that  
16 calculation. Can I come back after you are all over  
17 and answer that question? Let's see. At what  
18 confidence level did you sample what fraction of the  
19 possible response base here.

20 MR. SIU: I guess we haven't been thinking  
21 along those lines, partly because we weren't sure how  
22 to deal with again this issue of the integrated model  
23 uncertainty.

24 And to work the -- to overwork perhaps,  
25 and maybe that is an unfair term, but to work the

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1 perimeters side too hard given that you have got this  
2 other part that you haven't quantified -- I guess we  
3 just simply weren't thinking in those terms.

4 DR. POWERS: Well, I think that is a  
5 question that I would expect this committee to come  
6 back and ask you, is okay, you have a response base so  
7 big.

8 How much of it did you sample, and at what  
9 confidence level? Tom will ask you about the  
10 confidence level, and Bill will ask you about the  
11 fraction of the space issues.

12 MR. MAYFIELD: If I could, because we have  
13 had -- as we were first getting into this project,  
14 actually several years ago, some discussions about  
15 what is the level of rigor, and is it practical to put  
16 RELAP, or the consolidated code into a Monte Carlo  
17 scheme.

18 What level of resource are we going to  
19 invest in it. That question started being outweighed  
20 by plant to plant variability. We are doing four. So  
21 I think the qualitative opinion of those others that  
22 we are talking about is at some point -- that at some  
23 point the level of rigor in any individual transient  
24 analysis, or any individual plant analysis, is going  
25 to be swamped, or that the level of uncertainty in

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1 those analyses is going to be swamped by the plant-to-  
2 plant variability.

3 And we were starting to struggle with  
4 counting angels on heads of pins for one plant, and  
5 then losing that sense --

6 DR. POWERS: You came to that conclusion  
7 for some reason, and I guess it really surprised me,  
8 because it is not the intuition that I would come to.  
9 Can you explain?

10 Maybe not here, but at some point can you  
11 explain why you would think that the plant-to-plant  
12 variability would be so large compared to the  
13 phenomenological uncertainties?

14 MR. MAYFIELD: We can, and today is  
15 probably not the best time, but in general, if you  
16 just look back at the old IPTS studies, Oconee is  
17 probably not a good example, because that is the first  
18 one that they did, and there were a lot of assumptions  
19 made.

20 But if you just look at the difference in  
21 the calculated probability of failure between Robinson  
22 and Calvert, and that's a CE versus a Westinghouse  
23 design. They are about two orders of magnitude apart  
24 if I remember my numbers correctly, and yet for  
25 similar levels of embrittlement.

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1                   So we were struggling with why, what is  
2                   the big deal between them, and it got down to specific  
3                   sequences and what drives it. In the BMW plants, you  
4                   find that steam generator tube failures is the  
5                   dominating sequence, or I'm sorry, the main steam line  
6                   breaks the dominating sequence.

7                   Westinghouse tends to be small break LOCA.  
8                   I think that is the dominating sequence for CE also.  
9                   So it is that kind of stuff we felt like was going to  
10                  swamp uncertainties in the specific calculations. But  
11                  this was a judgment, as opposed to based on hard  
12                  calculation.

13                  CHAIRMAN APOSTOLAKIS: But I am not sure  
14                  that you should be trying to develop a methodology for  
15                  plant-to-plant uncertainty. I mean, you are  
16                  developing it for a particular type.

17                  MR. SIU: That's correct.

18                  CHAIRMAN APOSTOLAKIS: And then if you do  
19                  it for several plants. So the uncertainty from plant-  
20                  to-plant really shouldn't play much of a role here.

21                  MR. MAYFIELD: Well, until we go back to  
22                  Nathan's first chart, where we were trying to  
23                  establish --

24                  CHAIRMAN APOSTOLAKIS: Yes, for the  
25                  criteria, but not here.

1 MR. MAYFIELD: So the notion was -- yes,  
2 not here. The notion was what is the level of cut-off  
3 in rigor for a specific plant analysis.

4 CHAIRMAN APOSTOLAKIS: That's correct. I  
5 understand that.

6 MR. MAYFIELD: And so it was a judgment  
7 call as to what level we had to go to.

8 CHAIRMAN APOSTOLAKIS: But what I am  
9 getting out of all of this discussion -- and I realize  
10 that this is still a work in progress, but eventually  
11 it would be useful to try to see whether you can use  
12 a limited latin hypercube sampling scheme to  
13 demonstrate that you have picked the whole range of  
14 values.

15 That's essentially what it does. And also  
16 it limits significantly the number of runs that you  
17 have to make.

18 DR. POWERS: I will argue that the way  
19 that George did this -- the number of runs with a  
20 straightforward Monte Carlo is not larger.

21 CHAIRMAN APOSTOLAKIS: Well, all of the  
22 studies have seem to show that there is in orders of  
23 magnitude --

24 DR. POWERS: Well, having lived right down  
25 the hall from them, from them who developed the

1 limited latin hypercube sampling for a lot of the  
2 reactor accident codes, I am fairly confident in my  
3 position.

4 MR. MAYFIELD: I think Ali Mosleh might  
5 have a few comments.

6 MR. MOSLEH: We started with that as an  
7 approach to take, where it would remove some of the  
8 uncertainties that would inevitably be encountered in  
9 the process of reduction, and in the process that  
10 Nathan showed earlier, we have to go through binning,  
11 districtizing the continuous universe, and that  
12 introduces uncertainty.

13 We looked at as a potential problem with  
14 reducing the problem into smaller pieces, but at the  
15 same time the complexity of running a full Monte  
16 Carlo, even with latin hypercube, in a fully  
17 integrated model, going from the PRA oriented model  
18 and all the way to the PFM, was just in terms of size  
19 and resources, and capabilities, was just too much to  
20 handle in the scope of the analysis that we were  
21 doing.

22 CHAIRMAN APOSTOLAKIS: Well, I would bring  
23 again the work that has been done in the performance  
24 assessment of high level waste depositories, which  
25 cannot be simpler than what you guys are doing now.

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1 It is really huge.

2 So maybe what you can do is pick up some  
3 of their reports and see how they handle that, because  
4 they certainly have had the same problem.

5 MR. SIU: We will take a look at that, I  
6 think.

7 CHAIRMAN APOSTOLAKIS: That's all.

8 MR. SIU: What I am showing here on this  
9 diagram, just drilling down one lower level of detail  
10 than that three box diagram that you had on the  
11 previous figure, just to show you again the different  
12 analysis tracks; basically the PRA analysis track, and  
13 the thermal hydraulics analysis track, and  
14 probabilistic fracture mechanics analysis track.

15 Part of the point of this diagram is to  
16 point out that as the way the project is really being  
17 done, as opposed to how you might conceptualize it,  
18 these are indeed being done in parallel.

19 Some of the thermal hydraulics analysis  
20 is done before we really had significant interactions  
21 with the event sequence analysis. So there are some  
22 runs, for example, that we are using in our analysis,  
23 and some others are just indications of what might be  
24 interesting, but aren't really folded into the final  
25 analysis.

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1 And similarly there are currently in the  
2 results that you are going to be seeing, there isn't  
3 full feedback yet from thermal hydraulics into, for  
4 example, the PRA success criteria that we have used.

5 We have made some assumptions based on our  
6 understanding of the progression of the accident, and  
7 that understanding will be improved after we explore  
8 the detailed results of the thermal hydraulic  
9 calculations.

10 So there is a lot of interactions here  
11 that are taking place. Of course, the results of the  
12 PRA analysis will be eventually the frequencies of the  
13 various bins identified, and that gets fed into the  
14 probabilistic fracture mechanics analysis when we  
15 quantify through wall crack frequency.

16 Similar to thermal hydraulics analysis,  
17 it develops the subscenario histories that get fed  
18 into the wall crack frequency. One of the other  
19 things that I wanted to point out, some of the  
20 discussion that we had at the subcommittee meeting was  
21 really on this issue here, what are the potentially  
22 uncertainty important scenarios.

23 How do we justify narrowing down the  
24 problem to a limited set of issues, and so that was  
25 the point of that discussion. Okay. Where are we

1 now.

2 DR. SHACK: And just coming back to that,  
3 I mean, that is where you sort of addressed Dana's  
4 question of how important for example a heat transfer  
5 coefficient might be.

6 MR. SIU: We really did look at that  
7 particular one. Now, that was the specific issue of  
8 the heat transfer coefficient in the downcomer, and  
9 explored if you will through a sensitivity fashion, t  
10 he variance and the results is not very great compared  
11 to the variance that you would get from other sorts of  
12 issues.

13 Now, whether there are other concerns that  
14 were not addressed, we obviously did not do an  
15 exhaustive list, and it was based on the high level  
16 model of what is important and what isn't important,  
17 and again we would welcome feedback on that.

18 Where are we now. We have developed an  
19 aleatory model and that's what you saw. That is the  
20 event sequence model, the T/H subscenarios for  
21 different bins; and then there is a aleatory treatment  
22 of the K1C term in this probablistic fracture  
23 mechanics analysis for fracture toughness.

24 So at least conceptually we have the  
25 pieces, and we know how they are going to fit

1 together. We have categorized the different model  
2 perimeters both in the white paper that the committee  
3 saw several months ago, we categorized -- at least in  
4 the preliminary fashion -- the probabilistic fracture  
5 mechanics analysis perimeters.

6 And that has been revised a little bit,  
7 and Mark Kirk talked about that at the subcommittee,  
8 but we have also categorized the thermal hydraulic  
9 perimeters, and as was pointed out at the subcommittee  
10 meeting, the PRA analysis is conventional.

11 We are treating the uncertainties in the  
12 perimeters as being epistemic, and that is no big  
13 surprise.

14 In the PRA event sequence analysis, we do  
15 have draft distributions for Oconee. Again, we have  
16 received a lot of comments on them. We have our own  
17 comments as we reviewed the results in detail, but we  
18 will -- and we expect to revise those distributions as  
19 part of the iteration process.

20 Nevertheless, we thought it would be  
21 useful to bring it in front of the committee to give  
22 you an indication of what are the things that seemed  
23 to be important, and what sorts of uncertainties do we  
24 have in the results of the calculations to date.

25 We have in the thermal hydraulic

1 analysis, as I indicated in a previous slide, we have  
2 identified classes of scenarios where the boundary  
3 condition uncertainties appear to dominate the model  
4 structure.

5 And I am talking about the model as an  
6 assemblage, rather than individual submodels, because  
7 the submodels, where they affect the boundary  
8 conditions, we are treating through the boundary  
9 conditions.

10 CHAIRMAN APOSTOLAKIS: A boundary  
11 condition means at the time of operator action?

12 MR. SIU: For example, the size of a hole,  
13 discharged through the hole, and that sort of thing.  
14 Things are basically --

15 CHAIRMAN APOSTOLAKIS: And these would be  
16 handled as epistemic variances?

17 MR. SIU: Actually, these are aleatory.  
18 Again, you think of the variation in the operator  
19 actions. This is a level below which we are modeling.  
20 So you are saying that -- you see, the PRA defines  
21 success and failure in very global terms.

22 Let's say that success is throttling  
23 before 10 minutes. Well, there are variance on  
24 success, but there are also variance on failure. If  
25 I don't throttle in 10 minutes, or if I throttle in 15

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1 minutes, what is the difference.

2 CHAIRMAN APOSTOLAKIS: And how about the  
3 size of the hole?

4 MR. SIU: The size of the hole also is --  
5 I mean, we have got a big category that is called  
6 small LOCA , and that accommodate a wide variety of  
7 break sizes and locations. So again there is a  
8 variation there that is all lumped into that category.

9 CHAIRMAN APOSTOLAKIS: So you think that  
10 is an aleatory issue?

11 MR. SIU: That is an aleatory issue. It  
12 is different than saying if I have a particular sized  
13 hole, would I know about it. Then we have identified  
14 the potentially important perimeters, and that was a  
15 table which we will clean up, and which the  
16 subcommittee has seen in the report.

17 And we need to clarify a few things there,  
18 but again we feel comfortable, and at least as a first  
19 shot, we know which perimeters we need to focus on,  
20 and we are developing a process for quantifying those  
21 subscenario probabilities.

22 And that question came up in the  
23 subcommittee as well. Clearly, we are not taking 5th  
24 percentiles of variables and combining them and saying  
25 that is a 5th percentile of the outcome.

1                   So basically we are looking at a DPD or  
2                   dispute probability distribution kind of approach to  
3                   identifying subscenarios.       So it would be a  
4                   discretized approach.

5                   CHAIRMAN APOSTOLAKIS:   And that is what  
6                   those guys did on the performance assessment and it  
7                   may be useful to you.

8                   MR. SIU:   Yes.

9                   CHAIRMAN APOSTOLAKIS:   And to see what  
10                  they did.

11                  MR. SIU:   Okay.

12                  DR. KRESS:   The important perimeters  
13                  identification, was that a PIRT process?

14                  MR. SIU:   Marilyn, who did the work,  
15                  started with PIRT, and looked at the approach, but  
16                  basically had to extend it. And frankly through the  
17                  use of modeling arguments, physical modeling  
18                  arguments, concluded that a very limited set of issues  
19                  was important.

20                  Again, a review of the committee would be  
21                  helpful to say whether those arguments are convincing.  
22                  We will demonstrate this process as part of the Ocone  
23                  analysis, and obviously we intend to use this for the  
24                  other plants as well.

25                  The probabilistic fracture mechanics. We

1 do have distributions for most of the model  
2 perimeters. For example, we have distributions for  
3 the flaw characteristics, and I think the committee  
4 was presented with that material, or was it the  
5 subcommittee. I don't remember.

6 We have distributions for fluence, for  
7 chemistry, the copper content and nickel content, and  
8 phosphorous. The current work is focusing on treating  
9 uncertainties and fracture toughness, and that is the  
10 K1C, and then the RT/NDT, or actually the radiation --

11 DR. POWERS: I have examined a document  
12 that I cannot recall exactly, discussing the need for  
13 continued research in the embrittlement of reactor  
14 vessels that has the phrase in it that the  
15 correlations that have been developed are only -- I  
16 say I believe, but it goes something like this.

17 Semi-empirical in nature and only include  
18 the effects of copper, nickel, product form, and  
19 fluence. It does not go on and tell me what else  
20 ought to be in there. But it looks like a lot to me.

21 I mean, nickel, copper, product form, and  
22 fluence, and it was a little hard for me to come up  
23 with what else there ought to be. But I am not an  
24 expert in that fashion.

25 My point is that that seemed to suggest

1 that this was an inadequate understanding here, that  
2 there was something missing, something better ought to  
3 be available.

4 Does that mean that we have something here  
5 through the implausible unknown that just bars  
6 progress here or something?

7 MR. MAYFIELD: The model that is going to  
8 be used in these calculations is the latest thing that  
9 we have put together, and that I think we have briefed  
10 the committee on, but I am not sure.

11 It is based on a statistical analysis of  
12 the existing embrittlement data, and coupled with a  
13 fair bit of work from Professor Odette, and some of  
14 the other radiation damage mechanists that have been  
15 looking at this.

16 The work does go beyond just sort of the  
17 traditional product form, copper, nickel, composition.  
18 It has looked at factors that pop up, such as long  
19 term thermal embrittlement. So there is a time at  
20 temperature factor that gets rolled in.

21 We have been looking at what factors show  
22 up in the statistical analysis, and do they have a  
23 physical basis. Conversely, is there something from  
24 the physical metallurgy that should be in the data,  
25 and we have gone looking for that.

1                   And in some cases there has been some  
2                   extensive dialogue between the mechanists and the  
3                   statisticians. We think that the model that we have  
4                   today embraces the physical understanding of  
5                   embrittlement, down at a fairly basic level.

6                   And it embraces that, as well as  
7                   statistical trends in the data, and so that's as good  
8                   as I get, I guess is the point.

9                   DR. POWERS: As good as you can get now,  
10                  or as good as can ever be gotten?

11                  MR. MAYFIELD: Well, that's why we  
12                  continue to work on this. We are not convinced that  
13                  we have the answer. However, today, and at the level  
14                  of fluence that the vessels are expected to see  
15                  through 60 years, we think we have a model that  
16                  captures those trends.

17                  DR. POWERS: The phrase that I am  
18                  imperfectly reproducing here has this only term in  
19                  there, as though there was some heat factor, a very  
20                  important factor, missing. It didn't say what it was  
21                  unfortunately. It just said we only have this stuff.

22                  Now, you have suggested as one the time  
23                  and temperature factor there, but is there some great  
24                  imponderable that just constitutes a barrier that we  
25                  have to put in some fudge factor here to say, well, it

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1 can be no bigger effect than this?

2 MR. MAYFIELD: I don't think so, but Mark  
3 Kirk has come up and perhaps he has --

4 MR. KIRK: I think, of course, that future  
5 knowledge is never perfect, but I think the answer is  
6 that we have beaten that one pretty well. We have  
7 looked at a lot of model -- at radiation experiments  
8 on model materials that are designed to bring out  
9 certain forms of radiation damage.

10 And those data have been considered in the  
11 development of the model, and I think that helps to  
12 screen out some of the imponderables that one might  
13 otherwise be worried about.

14 But as Mike said, the form of the  
15 correlation that we are now using, much of it has a  
16 very firm physical basis, and we feel that it is  
17 important to combine both the physical and the  
18 statistical understandings.

19 And not so much for fitting the data,  
20 because of course you can do that without any physical  
21 understanding whatsoever, but to provide -- and I  
22 don't think this is a word in Websters. Well, I won't  
23 use it then. But the ability to extrapolate, which is  
24 of course what we are always doing here.

25 But we could certainly go into this in

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1 more detail like Mike said. I think or I know that we  
2 have briefed at least the materials subcommittee on  
3 the embrittlement correlation.

4 That is something that we could do in the  
5 future. Certainly this is an area, along with what  
6 was brought up earlier about through all attenuation,  
7 in which there has been a lot of interest, both within  
8 the NRC, and the industry, and the international  
9 nuclear community, and continues to be -- and in fact  
10 at the ASTM E-1002 meeting last week on radiation  
11 damage mechanisms, there was discussion of this issue  
12 yet again.

13 And I spoke earlier this week with Stan  
14 Rosinski, who is a program manager at EPRI, and he  
15 indicated that he was going to initiate a small  
16 project under their materials reliability project,  
17 using funding from their materials reliability project  
18 to do in the short term a review of what technical  
19 basis there exists through all attenuation functions  
20 to provide the NRC some assistance in that regard.

21 So that information will be coming in, and  
22 if it comes in during an appropriate time frame, and  
23 I think it will, it would be considered. And just to  
24 also mention so that there is not the perception that  
25 the NRC is working in a vacuum on this.

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1                   We are currently in the process of  
2                   developing a technical basis document for the  
3                   embrittlement correlation. We have got a deadline on  
4                   that later this year to have a draft new reg.

5                   Equally again, EPRI is also working on a  
6                   tech basis document concerning embrittlement  
7                   correlations, and that is due out in February, and  
8                   EPRI has agreed to provide that to the NRC so we can  
9                   have the value of that information as well.

10                  DR. POWERS: So I get the impression that  
11                  what you are telling me is that I should not worry  
12                  about this only. That you have put in here enough  
13                  description of this embrittlement process for the  
14                  regulatory decisions that you are looking to make  
15                  here?

16                  MR. MAYFIELD: I believe that is a true  
17                  statement.

18                  MR. SIU: And from the standpoint of the  
19                  uncertainty analysis again, those things that are not  
20                  specifically in the models are treated as contributing  
21                  towards aleatory uncertainties. This was basically  
22                  the reason why we decided that the K1C term needed to  
23                  be treated as an aleatory issue.

24                  DR. SEARLE: Don't worry any more. Just  
25                  get nervous.

1 DR. POWERS: Well, I will quit the  
2 subterfuge here. It shows me that for both research  
3 programs on vessel embrittlement are no longer needed  
4 for making regulatory decisions.

5 MR. SIU: I will show you -- these are  
6 pretty hot off the press -- draft PRA results overview  
7 for Oconee-1, and what is new about this is not only  
8 the scenario frequencies, which se came up with a few  
9 weeks ago, and again had some review with Duke Energy  
10 to talk about specifics relative to how we  
11 characterize the plant and operations.

12 But also the characterization of  
13 importance with respect to probablistic fracture  
14 mechanics. We have been conducting a scoping study  
15 for Oconee just to get an idea of where the numbers  
16 are coming out.

17 So we have a current version of the FAVOR  
18 code that is being used to propagate the thermal  
19 hydraulics traces, the PRAs events frequencies,  
20 through to the end to develop some notion of small  
21 crack frequency.

22 We are not confident yet enough about the  
23 probablistic fracture mechanics material to give you  
24 a conditional probability of through wall crack given  
25 a scenario, because again this is really new stuff.

1 But at least I think we can indicate that  
2 these were the kinds of scenarios that were turning  
3 out to contribute to the results, and I am going to  
4 give you a caveat about these descriptions here in a  
5 second.

6 So, please, again don't take down  
7 literally as they are described. But we have  
8 basically -- if you focus in on these numbers here,  
9 these refer to specific thermal hydraulic runs, and  
10 certain assumptions are made, and the analysis is  
11 done.

12 Frequencies are assigned to these runs,  
13 and they are run through the probabilistic fracture  
14 mechanics. These are the kinds of scenarios that  
15 turned out to be relatively important, and the one  
16 that I put in gray right now appears to be the most  
17 important one.

18 Again, all of these things are subject to  
19 change as we dig into these results and identify what  
20 is really driving them, and whether we have got it  
21 right or not.

22 CHAIRMAN APOSTOLAKIS: If you go to the  
23 conceptual model, can you tell us at which point these  
24 frequencies are calculated?

25 MR. SIU: Sure. This is the output of the

1 event tree analysis basically. I'm sorry. Let me go  
2 to the framework, as I think that would be better.

3 CHAIRMAN APOSTOLAKIS: Yes, whichever.

4 MR. SIU: What you are seeing is that we  
5 have binned the scenarios into about 40 thermal  
6 hydraulic runs. We didn't use all 40 as it turned  
7 out, but that was the universe which we were  
8 considering.

9 CHAIRMAN APOSTOLAKIS: For one scenario?

10 MR. SIU: No, no. All the possible PTS  
11 thermal hydraulic scenarios. We ran 40 cases of  
12 RELAP, and we are binning the thousands of sequences  
13 that we got into one of those 40 cases.

14 CHAIRMAN APOSTOLAKIS: Okay.

15 MR. SIU: So when you see a specific  
16 number, like Run Number 3, that is a specific one run  
17 out of the set of, let's say, 40 roughly. And we have  
18 got the probability distributions about those  
19 frequencies.

20 We have not done this part here. The  
21 fractionation into subscenarios, which we talked  
22 about, we haven't approached, but we have not applied  
23 it yet to Ocone.

24 So we are taking a particular if you will,  
25 and all of these are collapsed into one. There is

1       only one trace associated with that bin, and that  
2       trace gets fed into the fracture mechanics analysis  
3       with this distribution, obviously the convolution of  
4       the --

5                   CHAIRMAN APOSTOLAKIS: So the frequencies  
6       on slide 11 are between the first two boxes?

7                   MR. SIU: That's correct. After you have  
8       been --

9                   CHAIRMAN APOSTOLAKIS: Over there?

10                  MR. SIU: That's right.

11                  CHAIRMAN APOSTOLAKIS: But what you show  
12       as description is one of the scenarios that goes into  
13       that.

14                  MR. SIU: That is the scenario that  
15       characterized that particular bin.

16                  CHAIRMAN APOSTOLAKIS: But that bin may  
17       include other scenarios as well.

18                  MR. SIU: Exactly.

19                  CHAIRMAN APOSTOLAKIS: And the one you  
20       showed here is what, is a representative, or just one  
21       of them?

22                  MR. SIU: The one I showed on this chart  
23       here?

24                  CHAIRMAN APOSTOLAKIS: On 11.

25                  MR. SIU: Okay. Let me get back to Slide

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1 11, because this is worth talking about.

2 CHAIRMAN APOSTOLAKIS: So when you say the  
3 one that you have shaded there, the large MSLB is  
4 medium?

5 MR. SIU: Yes, lots and lots of scenarios  
6 feed into this bin. The total number of sequences was  
7 around 14,500 I believe.

8 CHAIRMAN APOSTOLAKIS: So lots of them are  
9 going into 25?

10 MR. SIU: That's correct.

11 CHAIRMAN APOSTOLAKIS: And why are you  
12 showing the large main stream line break?

13 MR. SIU: This is the description of this  
14 particular run. So this is the -- to run RELAP, of  
15 course, you have to provide the initial conditions,  
16 the boundary conditions, and certain things that occur  
17 over time.

18 This is a description in very loose terms  
19 of what that run did, the T/H run.

20 CHAIRMAN APOSTOLAKIS: But there are other  
21 scenarios that lead into --

22 MR. SIU: That's right. We have been many  
23 scenarios into this, which some of them may not follow  
24 this description very closely.

25 CHAIRMAN APOSTOLAKIS: Okay. So the

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1 reason why you have not is because it is kind of  
2 representative of that?

3 MR. SIU: In a sense. I mean, if I gave  
4 you a number, it wouldn't mean anything either. So I  
5 have to give some idea of what kind of scenario this  
6 run represents.

7 But, yes, there are lots and lots of  
8 scenarios feeding into these, and we are examining --  
9 now that we have got some sense of priorities here, to  
10 see if this is really right.

11 Are we feeding the right stuff into this  
12 bin, and do we need actually another run because the  
13 contributions from this are so large, but they are not  
14 really well represented by that run. That is the  
15 question that we have to raise after we get a chance  
16 to get some results.

17 CHAIRMAN APOSTOLAKIS: So this includes  
18 now aleatory stuff and everything?

19 MR. SIU: Again, we do not have the  
20 subscenario fractionation.

21 CHAIRMAN APOSTOLAKIS: We don't have it?

22 MR. SIU: We do not. This is simply the  
23 PRA results.

24 CHAIRMAN APOSTOLAKIS: So does the  
25 operator intervene here anywhere?

1 MR. SIU: Well, he fails to. For example,  
2 he fails to throttle the HPI.

3 CHAIRMAN APOSTOLAKIS: So you are just  
4 using a representative time for that?

5 MR. SIU: That's right.

6 CHAIRMAN APOSTOLAKIS: Which later on  
7 would be refined.

8 MR. SIU: Which has to be refined based on  
9 now a more careful look at that particular scenario.

10 CHAIRMAN APOSTOLAKIS: So up until this  
11 point, you really don't have any model uncertainty do  
12 you?

13 MR. SIU: That's correct.

14 CHAIRMAN APOSTOLAKIS: So this is a  
15 traditional PRA.

16 MR. SIU: That's right.

17 CHAIRMAN APOSTOLAKIS: But the new thing  
18 is that you have these bins that you are showing?

19 MR. SIU: Yes.

20 CHAIRMAN APOSTOLAKIS: Okay. Fine.

21 MR. SIU: And now to say what is new or  
22 not, but simply this is how we are progressing through  
23 the analysis.

24 CHAIRMAN APOSTOLAKIS: So this will go  
25 into 25, but 25 has not been run yet?

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1 MR. SIU: No, 25 has been run. That's why  
2 -- look, 25 -- I can show you. In your viewgraph, on  
3 the back of the viewgraphs, this is Run 25, the  
4 thermal hydraulic trace. This -- and I don't know if  
5 it is smoothed out or not, but it gets fed into FAVOR,  
6 with a frequency and uncertainty about that frequency.

7 And based on the combined results of all  
8 of those things, including the PRA frequencies, we  
9 have some sense of priority, and this is what you are  
10 seeing.

11 DR. POWERS: Now, when you formulate the  
12 RELAP model for this number 25 calculation, which of  
13 the myriad of conditions do you tell it about? Do you  
14 tell it about the mean condition or the 95th  
15 percentile condition, or the 5th percentile condition?

16 MR. SIU: I will give you a high level  
17 description, but I think Dave -- well, Dave is here.  
18 Can you answer to that?

19 MR. BASSETTE: Let me see if I caught the  
20 question correctly. This is David Basette. Of  
21 course, RELAP gives you a median or a nominal best  
22 estimate calculation for a given, or however you fix  
23 the initial boundary conditions, it gives you a best  
24 estimate calculation.

25 DR. POWERS: He has described this grade

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1 line as main steam line break, with full high pressure  
2 injection. He has told us, however, that there are  
3 scenarios within that bin that can deviate to some  
4 amount.

5 He has provided a synoptic description of  
6 a distribution for that bin that includes a mean, a  
7 95th, and a 5th percentile. Now, you have to  
8 formulate a run with RELAP.

9 You cannot put those distributions in.  
10 You have to say it is this plant, and at this time  
11 this operator does this successfully or  
12 unsuccessfully. Which one of those did you tell RELAP  
13 about?

14 MR. SIU: Let me respond to that, as I  
15 think I can take that. This is a somewhat more  
16 careful description of that particular scenario. So,  
17 for example, you see high pressure injection 21  
18 seconds into the transient based on the control logic  
19 for HPI.

20 Now, there are variance on this. You  
21 could say the operator doesn't throttle in 5 minutes.  
22 The operator doesn't throttle in 10 minutes. The  
23 operator doesn't throttle in 15 minutes. That's not  
24 here.

25 This is literally what they have. So the

1 PRA at this point was not telling the thermal  
2 hydraulics this is the variant that you need to look  
3 at.

4 When we talk about subscenarios, which  
5 again we have not applied the Oconee yet. We have to  
6 start investigating those variance, and say what are  
7 the possible variance that we want to model, and then  
8 identify are there RELAP runs that will represent  
9 those variance reasonably well, or do we need new  
10 runs. We have not done that yet.

11 DR. POWERS: For this particular case, is  
12 the scenario you told about RELAP indicative of a  
13 frequency equal to mean, the 95th, the 5th, or some  
14 other one? Yes is not a suitable answer.

15 MR. SIU: No, there is no frequency  
16 associated.

17 DR. POWERS: There is a frequency  
18 associated with whatever calculation you told RELAP  
19 about.

20 MR. SIU: We have not -- let me give you  
21 an example. Let's talk main steam line break. This  
22 is a large break, and we have defined large to be  
23 greater than 8 inches here, because the size, I  
24 believe, of the TBBs.

25 We have not said that we have a frequency

1 for breaks in the range of 8 to 9 inches, from 9 to 10  
2 inches, 10 to 11. Yeah, you could -- we would have to  
3 give you -- and I don't know this off the top of my  
4 head -- what was the size of the particular hole, and  
5 what was the shape of the hole, and what discharge  
6 coefficients are associated with that.

7 So I don't have that information there.  
8 You could come up with, if you will, density functions  
9 for these characteristics like the break size. We  
10 haven't done that.

11 So I guess you could say, well, what is  
12 the frequency that you have of a break between or  
13 larger than 8 inches. Yes, we do have that. That is  
14 the PRA frequency that we have used, and that is the  
15 .0 -- well, I shouldn't give you a number off the top  
16 of my head.

17 We do have that based on an empirical  
18 dataset. I mean, we had one failure in 600 odd  
19 reactor years.

20 MR. MAYFIELD: I think the answer is that  
21 it doesn't necessary represent any of the frequencies  
22 here. It is a descriptor of a class of transients  
23 that fits in the bin, and at this stage, I don't think  
24 we can tell you that they have gone back to the PRA,  
25 and we have taken up a bunch of things through some

1 rules that have been developed, and have taken a bunch  
2 of transients that fit that set of rules, and put them  
3 in this bin.

4 And he is telling you about the  
5 distribution of frequency on those transients, and I  
6 don't think we can tell you today that the particular  
7 RELAP run that was made, called Number 25, where that  
8 fits in this frequency, and it is my guess that it is  
9 probably closer to the mean than any. But I don't  
10 think we can pin that down.

11 DR. POWERS: I think that would be an  
12 inadequate answer for me, to say, well, it is roughly  
13 the mean, or maybe the appropriate answer is it is  
14 none of these particular ones, but its going to be  
15 kind of representative in a sense that it will be  
16 carefully explained.

17 MR. SIU: Yes. I think as we define  
18 really what those subscenarios are -- I mean, right  
19 now you have a cartoon. It says we will develop  
20 subscenarios, but you have to develop those  
21 subscenarios based on the underlying principles.

22 And the principles would be, for example,  
23 what are the key variables, and what variations are  
24 you going to consider, and what probability are you  
25 going to assign to each of these variations.

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1                   And then I think at that point, I think we  
2                   can give you a more meaningful answer, because now by  
3                   definition when you have these discreet scenarios, you  
4                   have binned things. It is either in this bin, that  
5                   bin, or that bin. We haven't done that yet.

6                   MR. MAYFIELD: Does that answer your  
7                   question?

8                   DR. POWERS: Well, the underlying question  
9                   is we are going to have a bunch of thermal  
10                  hydraulics, and they believe they have got these huge  
11                  uncertainties in their codes that need to be resolved.

12                  And they are going to come in and say, oh,  
13                  this is giving me an unfair answer, and that the  
14                  thermal hydraulics don't make any difference, because  
15                  had you done this thing out here at either 95th or 5th  
16                  percentile, and I am not sure which one.

17                  You would have seen it, and it would have  
18                  made all the difference in the world, this strange  
19                  coefficient in an equally strange empirical  
20                  correlation that does not include anything in it,  
21                  except maybe copper, nickel, or fluence.

22                  And that is what I have to listen to on  
23                  why this is an unfair characterization of the  
24                  uncertainly of the thermal hydraulics.

25                  MR. ELTAWILA: I have tried to resist

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1 getting into this, but when it comes to thermal  
2 hydraulic uncertainly, I think you raised that issue  
3 several times. When we are dealing with single faced  
4 flow, which is the case for this particular  
5 application, the uncertainty in the heat transfer  
6 coefficient -- and we are going to give you a paper.

7 We have done specific studies which shows  
8 that is not important. The main important perimeter  
9 would be the pressure and the temperature, and have  
10 confidence that the code can calculate these very  
11 accurately or reasonably accurately.

12 I think your question has the right issue,  
13 that the particular thermal hydraulic calculation that  
14 we presented, it is a representative of one particular  
15 scenario, which will give you a mean answer for that  
16 particular scenario.

17 We have not gone back now to look at all  
18 the other scenarios and redefining process. Is there  
19 much variation if I change the break size, or I change  
20 operator action. What will be the effect on the  
21 pressure and the temperature, and that's when we will  
22 be able to at that point to give you the 95 percent  
23 and 5 percent uncertainty.

24 But the model uncertainty itself is not  
25 going to be the driver in this case. In this case, it

1 is going to be the boundary condition as everybody  
2 said here.

3 DR. SEARLE: I must express some curiosity  
4 about the difference between runs 3 and 4 on page 11.  
5 There is a factor of 2 in the flow area, and a factor  
6 of two orders of magnitude in the mean probability.

7 MR. SIU: I was afraid that you were going  
8 to ask that.

9 DR. SEARLE: Clearly, there has got to be  
10 a snake in the grass somewhere.

11 MR. SIU: There is a reason for that, and  
12 now it actually gets back to George's question, and  
13 that's why I wanted to characterize these as not  
14 literally what the PRA sequences are, but what the  
15 thermal hydraulic run is.

16 Again, there was a binning choice to say  
17 out of the myriad of sequences that we have, we have  
18 some of them going to this one, and some of them going  
19 to this one, and so on and so forth.

20 What you are seeing here in the PRA space,  
21 we don't have a fine distinction between 2 inch LOCAs  
22 and 2.8 inch LOCAs, and 1.4 inch LOCAs. We have  
23 LOCAs, small LOCAs with a certain frequency.

24 What you are seeing here in this  
25 particular scenario, and what this particular scenario

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1 is really representing LOCAs where, even though the  
2 HPI is on, the pressurization is sufficient that you  
3 are going down to a lower pressure.

4 So again I don't want to take these labels  
5 literally. This is the RELAP run that was done, and  
6 we binned a bunch of stuff into that. Again, we are  
7 going to reexamine that as we go further.

8 DR. SEARLE: My only comment is that the  
9 way in which you differentiate between the runs is  
10 probably woefully inadequate at this point if you are  
11 going to really examine the differences in the  
12 probabilities.

13 MR. SIU: We know, of course, exactly what  
14 the input decks are, and we know what scenarios feed  
15 into those. That's correct.

16 CHAIRMAN APOSTOLAKIS: So you said earlier  
17 that the size of the break within the class of small  
18 breaks is aleatory.

19 MR. SIU: That's right.

20 CHAIRMAN APOSTOLAKIS: So can you  
21 elaborate a little bit on that? I mean, what kind of  
22 distribution did you assume here, and so what fraction  
23 of --

24 MR. SIU: Again, this is part of the  
25 problem with flashing results at a summary level. The

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1 scenarios that got fed into this particular bin are  
2 LOCAs, with either the HPI throttled or the break was  
3 large enough that the system depressurized quickly.  
4 Most of the contributing ones I think were just small  
5 break LOCAs, where HPI was throttled.

6 That doesn't match exactly the description  
7 you have here. In the physical world, when you have  
8 a break that is large enough, you do depressurize the  
9 system.

10 CHAIRMAN APOSTOLAKIS: But then it is not  
11 a small break anymore is it?

12 MR. SIU: Well, remember now that the  
13 small break refers to the diameter for which we have  
14 event statistics.

15 CHAIRMAN APOSTOLAKIS: Right.

16 MR. SIU: And small, actually believe  
17 extends beyond 2.8.

18 CHAIRMAN APOSTOLAKIS: Well, how do you  
19 decide? I mean, what is the aleatory probability that  
20 I would have a 2 inch small break, or a 2.8?

21 MR. SIU: That has not been addressed.  
22 This is the PRA sequences within which, and we still  
23 have to fractionate, and when we fractionate, we will  
24 actually find that maybe there is some bifurcation at  
25 some critical value, and we can argue if we know that

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1 critical value very well.

2 But the pressure is going to go along one  
3 path, and the other one is going to drop rapidly.

4 CHAIRMAN APOSTOLAKIS: I don't understand  
5 that. I mean, the frequencies you show there on the  
6 table include the frequency of the initiating event.

7 MR. SIU: That's correct.

8 CHAIRMAN APOSTOLAKIS: So the initiating  
9 event in one case is a 2 inch break, and --

10 MR. SIU: No.

11 CHAIRMAN APOSTOLAKIS: It's not?

12 MR. SIU: No. The initiating event is a  
13 small break LOCA, which includes a whole range of  
14 sizes. So that's why this is so anonymous. You say,  
15 oh, my goodness. How do I know really that a 2.8 inch  
16 break is two orders of magnitude less likely than the  
17 2 inch break, because everything else looks the same.

18 It is the binning that we assign the  
19 sequences to this particular thermal hydrologic  
20 scenario.

21 CHAIRMAN APOSTOLAKIS: So for this  
22 calculation, the frequency of the 2 inch and the 2.8  
23 inch break is the same?

24 MR. SIU: Exactly. It is a small LOCA.

25 CHAIRMAN APOSTOLAKIS: It's a small LOCA.

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1 MR. SIU: And this one we don't throttle,  
2 and this one we do.

3 DR. SHACK: So what we are looking at is  
4 the difference between pressurized and depressurized?

5 MR. SIU: That's right.

6 CHAIRMAN APOSTOLAKIS: But later on you  
7 will have some fraction?

8 MR. SIU: Oh, yes. Again, that is one of  
9 the important perimeters obviously as you go through  
10 this, because you have qualitatively different  
11 behaviors.

12 CHAIRMAN APOSTOLAKIS: And that's why it  
13 is --

14 MR. SIU: That's right. We have 15  
15 minutes?

16 CHAIRMAN APOSTOLAKIS: We have 15 minutes,  
17 yes. Now, at some point, at some subcommittee meeting  
18 -- and I don't know if you did it last night, but I  
19 really would like to follow one sequence from  
20 beginning to end.

21 CHAIRMAN APOSTOLAKIS: Right. With all  
22 the uncertainties, have you discretized how you did  
23 it? Did it happen with some epistemic uncertainty  
24 with you, Mike?

25 MR. MAYFIELD: Well, it is our intent --

1 and we were talking about it before the session  
2 started, that probably in the May-June time frame, we  
3 will be far enough along with our calculations that we  
4 can come to -- I don't like coming in -- we felt like  
5 we needed to do something.

6 CHAIRMAN APOSTOLAKIS: No, I am not  
7 complaining.

8 MR. MAYFIELD: What we would like to do is  
9 have gotten far enough through this so that we are not  
10 giving you real time results; that we have had a  
11 chance to look at it and make sure that it is holding  
12 together. So it is probably in the May-June time  
13 frame.

14 CHAIRMAN APOSTOLAKIS: But we will take  
15 one sequence and beat it to death all the way?

16 MR. MAYFIELD: We will take one sequence  
17 and walk you right through it. That's the intent.

18 MR. SIU: That's right.

19 CHAIRMAN APOSTOLAKIS: One question I had,  
20 since I am beginning to understand this, but as you go  
21 to your Slide Number 12, before you do that, could you  
22 put up your --

23 MR. SIU: This is the backup slide --

24 CHAIRMAN APOSTOLAKIS: Which is the same  
25 as this?

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1 MR. SIU: That's correct.

2 CHAIRMAN APOSTOLAKIS: So that is the  
3 scenario that you are calling Number 25?

4 MR. SIU: That's correct.

5 CHAIRMAN APOSTOLAKIS: And the Number 27  
6 would be the one where you succeed --

7 MR. SIU: Well, whatever scenario. There  
8 is a mapping of it.

9 CHAIRMAN APOSTOLAKIS: But you are listing  
10 those two, 25 and 27, and runs as you call them.

11 MR. SIU: That's correct.

12 CHAIRMAN APOSTOLAKIS: And those two are  
13 the ones in red, and the one --

14 MR. SIU: This would feed into 27,  
15 correct.

16 CHAIRMAN APOSTOLAKIS: What happens with  
17 all the other scenarios now? You are throwing them  
18 out into different bins?

19 MR. SIU: We are throwing them in  
20 different bins.

21 CHAIRMAN APOSTOLAKIS: And some of them  
22 may not be steam line break bin?

23 MR. SIU: That's correct.

24 CHAIRMAN APOSTOLAKIS: Okay.

25 MR. SIU: And some that feed into the

1 steam line break bin may not be steam line breaks.

2 VICE CHAIRMAN BONACA: So you are looking  
3 at the pressure temperature behavior, and the fluid  
4 behavior, and --

5 MR. SIU: That's right. That's the  
6 binning and the mapping between scenarios, and that's  
7 where we discussed with the subcommittee some of the  
8 subjective judgment is right now in going from all  
9 these sequences to a somewhat more detailed  
10 description, which we feel pretty comfortable with.

11 But then jumping from that to the limited  
12 set of thermal hydraulic bins that we do have.

13 MR. MAYFIELD: And part of the work, yes,  
14 is subjective, but to try and bring in a rule based  
15 scheme, where it is not just tossing coins, but there  
16 is actually some technical basis for the judgment.

17 VICE CHAIRMAN BONACA: So it is very plan  
18 dependent?

19 MR. SIU: Yes.

20 VICE CHAIRMAN BONACA: And so I understand  
21 much more than I did before.

22 CHAIRMAN APOSTOLAKIS: Okay. So what else  
23 would you like to tell us?

24 MR. SIU: Okay. Let me just talk in  
25 summary about the draft PRA results. We do obviously

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1 have issues and we have talked about these. The  
2 binning of the sequences, and the time frame for the  
3 operator actions, which we now have the thermal  
4 hydraulic runs to get a better sense of that.

5 And dependencies. This particular  
6 scenario involves three operator actions or failures.  
7 Failure to isolate the break, and failure to isolate  
8 the flow, and failure to throttle HPI flow.

9 We need to make sure that we are handling  
10 the dependencies not only for the dominant scenarios,  
11 but obviously the scenarios that might have dropped  
12 off the map because we didn't address those in detail.

13 CHAIRMAN APOSTOLAKIS: Where do the  
14 operator --

15 MR. SIU: This is the Atheana Team. This  
16 is a subjective assessment process based on a  
17 description of context. At the Duke Energy meeting,  
18 we actually got very positive responses on our  
19 descriptions of the context, and actually there was  
20 some discussion about the numbers that were assigned.

21 But we didn't seem to be way off is my  
22 notion of that. Again, these are things that we will  
23 continue to refine. We had put intentionally  
24 conservative numbers in many places just to make sure  
25 that we didn't lose anything as part of this process,

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1 and now we are reexamining what we have got.

2 Thermal hydraulics analysis. I think we  
3 have talked about this already. This just illustrates  
4 more of a process rather than results, because we  
5 don't have results at this point on the uncertainty  
6 part of the analysis.

7 We have identified the key sources of  
8 uncertainty, and we talked about boundary conditions  
9 on models, and of classified scenarios regarding in a  
10 simplistic fashion whether they involve single-faced  
11 flow, or two-faced flow.

12 And for single-faced flows, we are going  
13 to follow the approach that we have basically  
14 described already. We are going to look at  
15 representative boundary condition variations to define  
16 subscenarios, and we are going to develop  
17 distributions for the subscenario probabilities.

18 And then either identify an existing T/H  
19 run to map to, or perform an additional run, and  
20 that's just the approach that we envision at this  
21 point.

22 CHAIRMAN APOSTOLAKIS: Are you going to  
23 identify -- and not necessarily only here in the  
24 thermal hydraulic analysis, but the overall analysis,  
25 the important perimeters or models that seem to drive

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1 the risk?

2 MR. SIU: That's right. That's part of  
3 the assessment process. It's not only what is the  
4 number, but what is driving that number.

5 CHAIRMAN APOSTOLAKIS: And how are you  
6 going to do that? I mean, you have perimeters all  
7 over the place.

8 MR. SIU: Yes. I imagine that there will  
9 be some sense of decomposing the results, because of  
10 course one of the results of a risk assessment is that  
11 the dominant scenarios also typically dominate the  
12 uncertainties.

13 That's just the way that the math works  
14 out. You can have a very unlikely scenario that is  
15 very uncertain, but it doesn't really contribute then  
16 to the final result. So I think we will be able to  
17 concentrate on a few scenarios, and that's the hope.

18 CHAIRMAN APOSTOLAKIS: But then you are  
19 going to the P/H analysis and FAVOR, and --

20 MR. SIU: But again the point of what  
21 Professor Almenas showed was that there is a rationale  
22 for identifying what are the important perimeters, and  
23 so that would at least be our starting point for  
24 talking about what seems to be driving this.

25 CHAIRMAN APOSTOLAKIS: My understanding is

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1 that in the waste area that they have been struggling  
2 with this issue now for 2 or 3 years, and I have seen  
3 a paper or two where they have proposed something to  
4 Hizenberg, who used to be a member of the staff.

5 I am not saying that is the way to do it,  
6 but since those guys have attempted, it would be  
7 worthwhile looking.

8 MR. SIU: Thank you, yes.

9 CHAIRMAN APOSTOLAKIS: Actually, your  
10 problem has a lot of similarities with that problem,  
11 because it involves complex computer programs and  
12 uncertainty propagation, and so on, and so you can  
13 benefit a lot from what those guys have done.

14 MR. SIU: Yes.

15 CHAIRMAN APOSTOLAKIS: Of course, they  
16 cannot use the traditional importance measures that we  
17 use in level one and PRAs.

18 MR. SIU: Right.

19 CHAIRMAN APOSTOLAKIS: Because you have  
20 computer programs with physical phenomena. That's why  
21 it may be worthwhile to look at what they have.

22 MR. SIU: This is a Mark Kirk slide  
23 obviously. It is 21st Century stuff. I am way  
24 behind. But this is just an indication of --

25 MR. KIRK: What is wrong with this?

1 MR. SIU: Nothing is wrong. This is  
2 great. Let's walk through it.

3 DR. POWERS: The thing that jumps out  
4 immediately is that the embrittlement model only has  
5 fluence, copper, nickel, and product form on it. All  
6 this other stuff that you told me that yo were going  
7 to put into it apparently doesn't make this viewgraph  
8 here.

9 MR. SIU: Well, my understanding of what  
10 are the important perimeters, yes, are here. And the  
11 point is to show that these are the major uncertain  
12 elements feeding into the shift model, which I  
13 understand work is still ongoing as to the shift model  
14 itself.

15 It has a blue band around it, and I don't  
16 know if that is an indicator, but this is one place  
17 where work is going on, and that's one of the issues  
18 that I indicate, and where we are still doing things.

19 But the point is to show that there are  
20 perimeters feeding in, and there are epistemic  
21 uncertainties associated with these perimeters, and  
22 they get fed into the process, to the resistance side  
23 if you will of the stress strength equation.

24 And on this side, on the driving force,  
25 you have uncertainties in the flaw density and flaw

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1 size. Again, we have characterized these  
2 distributions already.

3 Of course, you have the thermal hydraulic  
4 input, pressure and temperature, and you have the  
5 vessel dimensions that get fed into the stress  
6 intensity factor calculation, and determine if the  
7 applied stress is greater than the strength.

8 And this box here shows again the  
9 recognition that because of the things that are not in  
10 this model explicitly, you have chosen a model at a  
11 certain level, and the strength is an aleatory issue,  
12 and that gets fed into eventually an aleatory  
13 description of the vessel response to the thermal  
14 hydraulic scenario, which is the applied stress.

15 In the interest of time, I think I will  
16 move on. There is a similar diagram for arrest  
17 toughness. Okay. Only two slides to go. Key issues.  
18 These issues again become apparent as we dig into the  
19 results. We finally have a prioritization of results  
20 that tells us which things to focus on.

21 The success criteria, and how much time is  
22 available for the operators to perform their actions  
23 is something that we need to look at very carefully.  
24 And more generally how do we quantify the human error  
25 probabilities, which is -- obviously a consideration

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1 of uncertainties is an important part of that  
2 quantification process.

3 And in the thermal hydraulics analysis,  
4 there is the question of how we are going to deal with  
5 model uncertainties, especially for the two-phase  
6 scenarios, and we still have to develop just as a  
7 mechanical matter the perimeter of distributions, and  
8 what are the uncertainties for the boundary  
9 conditions.

10 Probabilistic fracture mechanics analysis.  
11 We have uncertainties in the fracture toughness and  
12 the radiation shift. Again, that is that  
13 embrittlement model that I talked about, and there are  
14 significant uncertainties in crack arrest and how you  
15 model that, that still need to be addressed.

16 I separated the integrated analysis out  
17 from these three because in some fashion we have been  
18 focusing so much on the three boxes, and we have not  
19 talked enough about the integration of those boxes,  
20 and I am talking about our project, as well as this  
21 presentation.

22 And this binning is obviously really,  
23 really important. It drives a lot of the results. We  
24 have to look at that very carefully. This is one  
25 where again I suspect we wouldn't be quantifying the

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1       uncertainties in our binning process, but we would  
2       have to recognize it is a source of uncertainty.

3               We believe that we are consistently  
4       treating uncertainties across the different  
5       disciplines, and we are trying very hard to be  
6       consistent.

7               We think we are quantifying most of the  
8       potentially important source of uncertainties, and  
9       again we have a rationale for saying that. So the  
10      model perimeters, boundary conditions, and submodels.  
11      We are addressing those explicitly.

12              Model structure uncertainties associated  
13      with the system codes, for example. And as was  
14      pointed out, maybe these are not important for many of  
15      the scenarios that we care about, but they are likely  
16      to be important for some of the scenarios.

17              And I believe at this point that we can  
18      only treat them qualitatively, but we will see. We  
19      recognize that we may need to refine our models,  
20      depending on the results of experiment sensitivity  
21      and perhaps the integrated code word.

22              We will document the approach and we will  
23      update to the white paper the committee saw earlier.  
24      And this was mentioned already, but work is in  
25      progress, and we are iterating on the initial results.

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1           So later when spring comes by, hopefully  
2 we will have something. But we indeed can walk  
3 through a scenario, and what we tried to do today, of  
4 course, was give you some sense of at least the  
5 beginning parts of that scenario.

6           We think that the approach for treating  
7 uncertainties may be useful, and another risk informed  
8 applications, and certainly it is a model that we are  
9 going to try out as we start approaching other issues.  
10 And with that --

11           MR. LEITCH: Might this work lead to  
12 relaxation of some conservatism that is in the  
13 pressure temperature curves that are in the tech specs  
14 now?

15           MR. MAYFIELD: That's another possible  
16 application of this. We have backed off quite a ways  
17 there, but that is another possible application of  
18 this, as well as using this kind of scheme to look at  
19 relief for the boilers.

20           As the embrittlement trends tend to go up,  
21 the boilers are being pinched more and more on their  
22 hydro test temperatures, and the time that it takes  
23 them to get to those temperatures. So we think this  
24 structure may be a good way to look at the  
25 underpinnings for those pressure temperature and hydro

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1 test temperature requirements.

2 MR. LEITCH: I think that some licensees  
3 have already applied for some relaxation in those  
4 curves to give them greater operating flexibility. Is  
5 the basis for that some of this work?

6 MR. MAYFIELD: No, it is simply a change  
7 in the fracture toughness curve.

8 MR. LEITCH: Okay.

9 MR. MAYFIELD: We went way from the very  
10 conservative reference fracture toughness curve, and  
11 are permitting them to use the initiation fracture  
12 toughness curve, and that's the big change that was  
13 made in the ASME code.

14 MR. LEITCH: Okay. Thank you.

15 MR. MAYFIELD: Mr. Chairman, there are two  
16 points that I would like to make as we close. We have  
17 named four plants here, and I would like to emphasize  
18 with the committee and on the record that we are using  
19 them because they have kindly volunteered to support  
20 this effort, and not because we are concerned about  
21 their integrity from a pressurized thermal shock  
22 standpoint.

23 So they have stepped forward and  
24 volunteered to help us in this activity. And finally  
25 I would note that we welcome the opportunity to come

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1 before the committee and discuss the pressure vessel  
2 embrittlement research, and the need for it, and to  
3 explain to you why Dr. Powers is so completely wrong  
4 in his assessment.

5 (Laughter.)

6 MR. MAYFIELD: And unless there are any  
7 other questions, we thank you.

8 DR. POWERS: I would hope that Dr. Powers  
9 would get a chance to rebut.

10 CHAIRMAN APOSTOLAKIS: Dr. Shack, are we  
11 done with this?

12 DR. SHACK: We are done with this.

13 CHAIRMAN APOSTOLAKIS: Well, we finished  
14 a minute-and-a-half early, which pleases me to no end.  
15 Thank you very much, Nathan and Mike. We will recess  
16 until 10:35.

17 (Whereupon, a recess was taken at 10:14  
18 a.m., and the Committee meeting was resumed at 10:34  
19 a.m.)

20 CHAIRMAN APOSTOLAKIS: We are back in  
21 session. The next topic is the Siemens S-RELAP5  
22 Appendix Case, Small Break LOCA Code. Dr. Wallace as  
23 I understand it could not get here on time, but Dr.  
24 Kress has kindly agreed to lead us through this. Dr.  
25 Kress.

1 DR. KRESS: Thank you. Dr. Wallace is  
2 having airplane delay problems, and that's why he is  
3 not here. I am sure that he would have wanted to be  
4 here.

5 The purpose of this meeting today is for  
6 the full committee to review the NRC staff safety  
7 evaluation report on the Siemens Power Corporation S-  
8 RELAP5, which is a thermal hydraulic code.

9 The application for its use is for  
10 Appendix K Small Break LOCA analysis only. You want  
11 to keep that in mind, because our review should focus  
12 on the Appendix K requirements, and not best estimate,  
13 or those things.

14 We will get a chance later when we come  
15 back to us for application to have this code be used  
16 for best estimate for large break LOCA, but that's not  
17 part of today's meeting.

18 We did have a couple of subcommittee  
19 meetings, one back in August, and the latest one on  
20 January 16th and 17th. We had a real turnout of  
21 committee members to that. I think the people there  
22 were me and Graham Wallis.

23 So what you hear today is -- and we did  
24 have our consultants there, too, our usual suspects.  
25 But what you will hear today is a very abbreviated

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1 summary of what went on in the subcommittee meeting.

2 So with that -- and we are expected to  
3 have a letter on this.

4 CHAIRMAN APOSTOLAKIS: In fact, we have a  
5 draft.

6 DR. KRESS: I think there is a draft.

7 CHAIRMAN APOSTOLAKIS: There is a draft in  
8 there.

9 DR. KRESS: So with that, I will turn the  
10 floor over to Ralph Landry.

11 MR. LANDRY: Thank you, Dr. Kress. As Dr.  
12 Kress said, my name is Ralph Landry. I was the lead  
13 on the review of the Siemens S-RELAP5 code, and what  
14 we would like to do today is present to you the  
15 results of our review of S-RELAP5.

16 And as Dr. Kress said, S-RELAP5 has been  
17 submitted by Siemens Power Corporation for application  
18 to small break LOCA in PWRs, specifically Westinghouse  
19 and Combustion Engineering Design PWRs, under the  
20 guidelines of 10 CFR, Part 50, Appendix K.

21 So that a lot of what we did in the review  
22 is supposed to be along the guidelines of Appendix K  
23 and the requirements that came out post-TMI-2  
24 accident. But we looked at a lot of depth in this  
25 code,, a lot more depth than has typically been done

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1 in small break LOCA analyses code reviews, because we  
2 knew that the code was coming in again for a large  
3 break LOCA for a best estimate application.

4 So while we were looking at the code, we  
5 looked at a lot of depth in it to make sure that we  
6 understand this thoroughly before we even start the  
7 next phase of the review.

8 What I would like to do today is cover  
9 some of the milestones in the application which we  
10 received and talk about very briefly some of the code  
11 modifications that have been made.

12 This code is a combination of a group of  
13 codes that have been approved individually, some  
14 additional modifications. This combines the A&F RELAP  
15 code, which was submitted and approved for small break  
16 LOCA under Appendix K, which combines that with the  
17 TOODEE2 HROD model code; the RODEX2 fuel model code,  
18 and the ICECON containment model code.

19 So that the code that is now running under  
20 the name of S-RELAP5 is a combination of the codes to  
21 run as an integrated unit, rather than individual  
22 codes from which data must be taken and put into the  
23 next code, that code run, and you can iterate back and  
24 forth.

25 But now the codes can talk to each other

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1 and transfer information at specific time intervals  
2 without having to manually take data from one code to  
3 another.

4 I would also like to spend a little time  
5 talking about the assessment which is done for this  
6 code. The assessment has been done more extensively  
7 than is required under the guidelines of Appendix K  
8 and the requirements of NUREG 0737.

9 We would like to talk about some of the  
10 regulatory requirements and how the regulatory  
11 requirements for a small break LOCA have been  
12 satisfied in the code, and the conclusions of the  
13 staff.

14 We received the code just a little over a  
15 year ago. Now, when the application came in, Siemens  
16 understood that the manner in which we conduct code  
17 reviews today is that we have to have not only the  
18 documentation for the application, documentation for  
19 the code, but the code itself.

20 The applicant submitted to us the code in  
21 a source code form and in a bindery form so that we  
22 could install both on the computer. We could build  
23 the code ourselves and make sure that the code builds  
24 the same as the code that is being used by the  
25 applicant.

1           We have test cases that we can run on the  
2 code, and we have of course all documentation for the  
3 code. We requested or sent out a request for  
4 additional information in December, and we have now  
5 received the formal response to those requests for  
6 additional information.

7           That sounds like there is not much time in  
8 which to review the REIs. In reality, the way we have  
9 been conducting code reviews has been to communicate  
10 to the applicant as we perform the review the concerns  
11 and issues that we have in our examination of the  
12 code.

13           So that we have communicated our REIs to  
14 the applicant throughout the past year. Then when we  
15 had all the REIs together, we then sent the REIs  
16 through the normal signature process, and formally  
17 asked them in December.

18           We have received draft copies of their  
19 responses along the way from the applicant, and now  
20 the applicant has formalized and gone through their QA  
21 procedure, and is sending their formal response to the  
22 REIs.

23           So it sounds like there is a big time lag  
24 before the REIs, and then suddenly everything comes at  
25 the end. In reality, it is not a big time lag,

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1 because we ask the questions and get answers as we go  
2 through the review.

3 And we have found in conducting these  
4 reviews that this is a very efficient way for us to  
5 conduct a review. We have prepared a draft safety  
6 evaluation report that was submitted to the Thermal  
7 Hydraulic Subcommittee for their review.

8 We have discussed that with the Thermal  
9 Hydraulic Subcommittee as Dr. Kress pointed out. We  
10 have had meetings with the subcommittee, and we talked  
11 very briefly with them back in March in the context of  
12 other code reviews.

13 That, yes, we had received the code, and  
14 yes, we were accepting it for review. There seemed to  
15 be sufficient material to allow us to do a formal  
16 review.

17 We met with them in August to go through  
18 the review plans, and to talk in detail about the  
19 contents of the code, and then we met with the  
20 subcommittee again in January, at which point we  
21 reviewed with them the safety evaluation report, which  
22 the staff had prepared.

23 And we are meeting today with the full  
24 committee, and we plan on finalizing the SER after  
25 this meeting.

1           We will go through and make sure that we  
2           have covered every concern that we have raised, and  
3           that we have covered every concern that the  
4           subcommittee has raised, and the concerns that you may  
5           raise today. So that when we issue a final SER, we  
6           can have all the issues properly closed.

7           Very briefly, some of the modifications  
8           that have been made to the code. The code started at  
9           A&F RELAP, which is a version of RELAP5 MOD2. You are  
10          probably all aware that the version that research has  
11          is RELAP5 MOD3.

12          Siemens started with a MOD2 code, and made  
13          some changes, such as making the code  
14          multidimensional, TOODEE2 capable, in the hydraulic  
15          components.

16          This is used primarily in the areas such  
17          as the downcomer, where we have been seeing that 1D  
18          modeling does not seem to be the best way. That there  
19          are TOODEE hydraulic effects, and so the applicant has  
20          modified the code to make it 2D hydraulic capable,  
21          especially in those areas where 2D effects become  
22          important.

23          There have been changes made in the  
24          energy equations. They have been reformulated to get  
25          rid of some of the problems that we have seen with

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1 RELAP5 in the past.

2 One of the problems that we had several  
3 years ago was a misapplication of the code for  
4 containment analysis, and that came back to us, and we  
5 looked at what was being done.

6 And we said, wait a minute, you can't do  
7 this with RELAP5 because if you go from a very high  
8 pressure node to a very low pressure node, with a very  
9 large change in area and volume, the code doesn't  
10 conserve energy properly, and this is not the intent  
11 of the code.

12 Well, changes have been made in the way  
13 the energy equation is formulated in the code so that  
14 some of those problems are alleviated in this version  
15 of S-RELAP5.

16 We looked a lot at the numerical solution  
17 scheme that has been installed in the code. The  
18 numerical solution has been changed, and the approach  
19 to the S-RELAP5 code over the other RELAP5 codes to  
20 correct some of the numerical problems that create  
21 numerical instabilities, numerical diffusion, and  
22 other problems.

23 Those have long been a problem with the  
24 code. Sometimes they are created because the code  
25 developer's intent is to make the code fast running.

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1 Well, they make it fast running, but they make the use  
2 of the code a real art form because if you don't use  
3 the code exactly right, you can create numerical  
4 instabilities.

5 Some of that has been taken out to make  
6 the code more robust, and with the recognition that  
7 you can still have a fast running code today without  
8 having to use the numerical schemes that make it  
9 unstable.

10 DR. POWERS: Instability tends to be a  
11 self-revealing thing.

12 MR. LANDRY: Right.

13 DR. POWERS: I mean, you get a bunch of  
14 spikes with RELAP.

15 MR. LANDRY: Right.

16 DR. POWERS: The other issue of numerical  
17 diffusion is a little more subtle isn't it?

18 MR. LANDRY: Yes.

19 DR. POWERS: Is it possible to tell just  
20 by routine examination of the results if you are  
21 getting a numerical diffusion?

22 MR. LANDRY: A knowledgeable user can.

23 DR. POWERS: All right.

24 MR. LANDRY: What Siemens has done is  
25 improved the numerics and the solution techniques, so

1 that it reduces the amount of numerical diffusion, and  
2 it makes it less of an art so that the user, while  
3 they still are using knowledgeable users, it becomes  
4 less of an art, and less sensitive to the user.

5 They have improved the aspect of numerical  
6 diffusion.

7 DR. POWERS: What I am struggling with is  
8 when people talk about uncertainty analysis -- and I  
9 am dealing with an issue somewhat tangential to this  
10 particular SER -- they sometimes raise the issue of  
11 the numerical solution itself being a source of  
12 uncertainty.

13 And I am wondering is that a major  
14 uncertainty here?

15 MR. LANDRY: We don't think it is. So we  
16 are going to get into that more when we look at the  
17 code for the large break application, because that is  
18 based on an uncertainty analysis.

19 But in the discussions which we have had  
20 with Siemens' personnel at this stage, it appears to  
21 us that they have done a lot to take that numerical  
22 uncertainty out of, or reduce it, in the code.

23 DR. POWERS: Now, are there things that  
24 one should worry about other than the numerical  
25 diffusion and instabilities in these codes as far as

1 the solution algorithm itself goes?

2 MR. LANDRY: There could be if the code is  
3 used by an unknowledgeable user, because you have to  
4 make sure that you are not making all the standard  
5 mistakes that a user would make, violating courant  
6 limits, and things of that nature.

7 DR. POWERS: This code lets you know about  
8 violating courant limits?

9 MR. LANDRY: Well, codes don't always come  
10 right out and tell you that. You have to be  
11 knowledgeable enough to recognize what the code is  
12 doing.

13 DR. SEARLE: That is where some of the  
14 instabilities come in.

15 MR. LANDRY: That is where some of the  
16 instabilities come in, but a lot of this is in the  
17 hands of the user also to recognize when the code is  
18 not behaving --

19 DR. POWERS: Noding schemes area also a  
20 problem.

21 MR. LANDRY: -- numerically correct, and  
22 when the result that the code is giving is wrong for  
23 numerical reasons, and not because of a  
24 phenomenological reasons.

25 Let's see. One of the points that we

1 looked at was with the heat transfer model. While the  
2 vast majority of the correlations that are used in the  
3 code are directly out of the RELAP5 set of codes, a  
4 change has been made to incorporate, instead of  
5 Dittus-Boeter for field boiling and for gas heat  
6 transfer, another correlation, the Shiralkar-Rouse  
7 correlation, which has a better representation of  
8 data.

9 It is a newer correlation, and represents  
10 data that has been checked against  
11 FLECHT SEASET data, and appears to be a better  
12 correlation to use. A very close correlation to  
13 Dittus-Boeter, but the uncertainty in the data seems  
14 to be much better.

15 So we feel like that is the kind of  
16 attitude that we want to see in an applicant that they  
17 will not just use a correlation because it has been  
18 used for 35 years, but look at it and say there is a  
19 better correlation today.

20 And let's try it out, and if it works  
21 right, and it gives very good answers, and it is  
22 stable, and it represents data better, let's go to a  
23 better correlation.

24 DR. SHACK: Just for my information, where  
25 does the virtual mass term arise from in here? Why do

1 I get a virtual mass term in the momentum equation?

2 MR. LANDRY: Gee, I wish Graham Wallace  
3 was here so he could go into that one. Let me ask Joe  
4 Kelly from Siemens if he could respond to that.

5 MR. KELLY: Joe Kelly from Siemens Power.  
6 It comes out in the toofuwood (phonetic) model, and so  
7 if you have an equation for the relative velocity, it  
8 comes in the time rate of change and in the relative  
9 velocity in the phases.

10 So it is the idea of like if you have a  
11 ball of liquid, or excuse me, a bubble trying to be  
12 accelerated in a liquid, it has to also accelerate  
13 some of the liquid around it.

14 MR. LANDRY: Thanks, Joe. Joe has been  
15 dealing a great deal in this discussion with the  
16 concerns that Dr. Wallace has raised on momentum, and  
17 so I appreciate his response.

18 Some of the models that have been changed  
19 to be consistent with the requirements of Appendix K  
20 include adding the Moody choke flow model. Power  
21 current flow limit has been upgraded.

22 DR. KRESS: We had some discussion about  
23 that in the subcommittee. Why do you have a code that  
24 is configured in such a way that it is basically  
25 incompatible with something like a Moody model, in the

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1 sense that the code itself calculates the things that  
2 create the critical flow as things progress down the  
3 pipe to the hole?

4 But the Moody model takes boundary  
5 conditions and calculates the same thing in a  
6 different way. Do you recall how that discussion  
7 turned out?

8 MR. LANDRY: That discussion came out that  
9 if all of the conditions were being calculated and fed  
10 directly into the Moody model, there could be a  
11 problem. But the code calculates fluid conditions,  
12 which then become the boundary conditions for a hard  
13 line Moody model.

14 And once those conditions are input into  
15 the Moody model, the Moody model will calculate  
16 correctly as it is supposed to calculate.

17 DR. KRESS: So you just calculate the  
18 boundary conditions?

19 MR. LANDRY: Right.

20 DR. KRESS: And where do you stop the  
21 calculation to decide where the boundary is?

22 MR. LANDRY: That is in the nodalizing of  
23 the pipe or --

24 DR. KRESS: It is the hole in it, the  
25 nodes of the pipe with the hole in it, you stop there?

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1 MR. LANDRY: Yes, but that has to be in  
2 the user guideline specifications; that part of the  
3 sensitivity studies are where to come with the final  
4 mode before you nodalize for the break itself to see  
5 that you are getting the right conditions into the  
6 node for the break.

7 Okay. They have added to the code EPRA  
8 pump data. They have added, as I said earlier, the  
9 ICECON code, RODEX2, TOODEE2, and they have changed  
10 the code architecture, so that even though it is based  
11 on the RELAP5 MOD2 code, the architecture now matches  
12 the RELAP5 MOD3 series of codes, the more modern  
13 architecture, and it is based on FORTRAN 77.  
14 So they are upgrading into a more modern structure.

15 DR. SEARLE: I have a couple of questions.  
16 Well, one basically. Is there somewhere in all of  
17 this that tells us what the limits are on the  
18 application of this code?

19 MR. LANDRY: In the submittal, yes. This  
20 application is for a small break LOCA.

21 DR. SEARLE: No, no, I am talking about in  
22 terms of the models that are being used to define  
23 specific physical phenomena, are there any cautions  
24 about trying to apply this code in cases where clearly  
25 you don't have that situation?

1 DR. KRESS: Are you thinking maybe about  
2 upgrades? Is there something --

3 DR. SEARLE: Well, for example, we know  
4 that there are a bunch of people running now talking  
5 about increasing the burn up on fuels. I think there  
6 are probably problems with Baker-Just when you go  
7 above 40K maybe.

8 DR. KRESS: Yes, I think you're right.

9 DR. SEARLE: And is there anything that  
10 cautions you that you may be walking the plank if you  
11 try to use this in the wrong region?

12 MR. LANDRY: Well, the documentation  
13 provides the perimeter range over which the different  
14 models are reviewed, assessed, and acceptable. We  
15 have to rely on user guidelines that they will not use  
16 the code outside those ranges.

17 And then we do have the option or we have  
18 the requirement when a calculation comes in to review  
19 the application of the code to see that it was applied  
20 and used within the proper range of perimeters for  
21 each model.

22 DR. SEARLE: You mentioned user  
23 guidelines.

24 MR. LANDRY: Yes.

25 DR. SEARLE: Have you looked at the user

1 guidelines to convince yourself that a reasonably  
2 sensitized user would be able to pick up on any  
3 problems by looking at those guidelines and thinking  
4 about what it is that he is trying to apply to them?

5 MR. LANDRY: Well, the manuals that we  
6 have seen, we would in our judgment say, yes, the  
7 reasonable user would understand where the code is to  
8 be used and where it's not.

9 This code -- I think what you may be  
10 referring to is other codes which are given out, or  
11 sold, or distributed throughout the world, and  
12 throughout the industry, and you don't have the  
13 control over the user.

14 This code is used solely within the  
15 corporate structure of Siemens Power. So that they do  
16 have through their quality assurance program have the  
17 control to ensure that the code is used properly, and  
18 it is not used outside acceptable ranges or applicable  
19 areas for even things like Baker-Just equation.

20 DR. KRESS: And we had a concern in the  
21 subcommittee about default values built in, and they  
22 might not properly be used. But Ralph's answer was  
23 what set our mind to ease on that, that it is within  
24 the corporation, and when they get specific  
25 applications, that is one of the things that they look

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1 at.

2 MR. LANDRY: Right. It is not a pure  
3 black box where the code is used, and just an answer  
4 is given to us. We have the responsibility to review  
5 the way it has been applied also.

6 MR. LEITCH: I seem to recall some earlier  
7 versions of RELAP5, when you put in various sizes of  
8 small break LOCAs, a prediction of peak fuel  
9 temperatures had some fairly significant  
10 discontinuities in it, and gave rise to questions  
11 about the validity of the code. Does this have that  
12 same problem?

13 MR. LANDRY: This I don't believe does,  
14 because the RODEX2 model has been incorporated in the  
15 code.

16 MR. LEITCH: Say again? RODEX2?

17 MR. LANDRY: Which is the fuel model. The  
18 fuel model, which Siemens is using in this code, is a  
19 fuel model which we have reviewed and approved for use  
20 in the Siemens fuel design work. We have reviewed  
21 that pretty heavily, and that is not using the RELAP5  
22 fuel model now.

23 MR. LEITCH: Okay.

24 MR. LANDRY: In talking briefly about the  
25 code assessment that has been done, the small break

1 LOCA assessment cases are pretty well defined for  
2 applications. Post-TMI, the requirement came out in  
3 NUREG 0737, Section II.K.3.30, of what was required  
4 for assessment of a small break LOCA code.

5 And there the position of the staff is  
6 very short, and says that appropriate LOFT and semi-  
7 scale tests are to be used for assessment of small  
8 break LOCA.

9 If you go down in the text, it then  
10 suggests two specific tests; a specific LOFT test, and  
11 a specific semi-scale test, should be used for the  
12 assessment purposes.

13 DR. KRESS: That was a subject discussed  
14 also at the subcommittee.

15 MR. LANDRY: Right.

16 DR. KRESS: And I remember the flavor of  
17 the discussion was why is it that we believe that just  
18 two tests provide sufficient validation for a code for  
19 Appendix K purposes. And I don't recall what the  
20 answer to that was.

21 MR. LANDRY: Well, those two tests looked  
22 at two specific problems that came out from the  
23 calculations that were done for the TMI-2 accident.

24 DR. KRESS: As I remember, one of them, I  
25 believe, was the LOFT test. Basically you could match

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1 it with just some energy balance, which almost any  
2 company could do.

3 MR. LANDRY: Right. But in assessing the  
4 S-RELAP5 code, Siemens has gone beyond those two  
5 tests that were required. In fact, they looked at all  
6 the test data that were available and said these two  
7 tests are superseded by other tests at a later time.

8 DR. KRESS: That was the answer. I  
9 remember it now.

10 MR. LANDRY: And would be better tests,  
11 and tests that would give a more thorough examination  
12 of the capability of the code. In fact, the  
13 assessment was done against a different semi-scale  
14 test, and a different LOFT test, against the --

15 DR. KRESS: And that leads me to another  
16 question. Do we have a bad rule when we specify just  
17 those two tests are sufficient to validate a code?

18 You know, it has nothing to do with this  
19 Siemens application. But is this a bad rule that we  
20 have?

21 MR. LANDRY: Well, I would rather say that  
22 at the time, and with the data that were available, we  
23 felt that this was --

24 DR. KRESS: Well, at the time, that may be  
25 just about all it was.

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1 MR. LANDRY: -- the best information we  
2 had for assessing the phenomena that we saw occurring  
3 in CMI, and that the codes had to predict in  
4 particular -- well, there are other tests or other  
5 assessments that have to be done.

6 DR. KRESS: Does the rule read -- well, it  
7 may not be in the rules. It is in the NUREG.

8 MR. LANDRY: The NUREG says --

9 DR. KRESS: Does it suggest at least these  
10 tests?

11 MR. LANDRY: Well, I quoted the position  
12 of the staff in the SER verbatim, and the position  
13 simply says or concludes with that they have to assess  
14 against appropriate LOFT and semi-scale tests.

15 In the descriptive material that follows  
16 that position, it suggests that these two tests are  
17 the tests that must be used, L3-1, and S-07-10B.

18 DR. KRESS: So Siemens could have stopped  
19 with just those two?

20 MR. LANDRY: According to those  
21 requirements, they could have, but they didn't.

22 MR. BOEHUERT: But it's really up to you  
23 guys though, isn't it, Ralph?

24 MR. LANDRY: Yeah. But they didn't stop  
25 there. They went into two different LOFT and semi-

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1 scale tests, plus 2D flow tests, and UPTF tests, and  
2 a very recent BETHSY test.

3 But then in looking at the assessment that  
4 was done, Siemens put together what they called an  
5 informal PIRT, because Appendix K doesn't require a  
6 PIRT.

7 But they put together an informal PIRT  
8 that looked at different locations in the reactor  
9 cooling system, and different phenomena that would  
10 occur, and how they rank those phenomena, and then  
11 what test data, what test facilities, what test data  
12 would best represent the phenomena that they are  
13 trying to examine.

14 That was then used and the total  
15 assessment was based on that informal PERT. So the  
16 assessment that was performed was not just based on  
17 the one semi-scale and LOFT test, but it was based on  
18 these tests, plus all the tests that were done in  
19 response to their informal PERT.

20 So our conclusion was that they examined  
21 significant perimeters throughout the range that could  
22 occur in different components of the system, and  
23 throughout the different aspects of the small break  
24 LOCA.

25 They have substituted newer tests, which

1 are supposedly and should have better data, better  
2 qualified data, for the older tests. So they have  
3 used good tests, better qualified data, and a more  
4 expanded assessment that is required.

5 DR. POWERS: A NUREG is not a rule. It is  
6 a recommendation.

7 MR. LANDRY: That is correct. The only  
8 caveat that we make is that following the issuance of  
9 the NUREG and the bulletins and orders, some plants  
10 may have had put into their licensing basis the  
11 requirement that they have to analyze these two tests.

12 So that when we get the applications and  
13 using this code that we would have to make sure that  
14 if it is in the licensing basis of a particular plant  
15 that they use S-07-10B and L3-1.

16 That those cases would be analyzed or  
17 there would be a change made to their licensing basis  
18 to use these assessment cases instead.

19 DR. POWERS: An interesting point.

20 MR. LANDRY: Now, we have already touched  
21 on some of the regulatory requirements in a previous  
22 discussion. In looking at the application which we  
23 have received, the modeling requirements of 10 CFR,  
24 Part 50, Appendix K, which such is Moody critical  
25 flow, have been incorporated in the code.

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1           We believe that the assessment not only  
2           meets the intent of II.K.3.30, but goes beyond the  
3           requirements of II.K.3.30. A full assessment has  
4           been done, a very good assessment.

5           Instead of calling it an informal PERT,  
6           this is a step beyond the requirements of Appendix K.

7           Many sensitivity studies have been put  
8           into the application, and these are required of all  
9           licensing basis LOCA codes. They have looked at a  
10          range of break size once they determine the worst  
11          break.

12          Then they vary the effect of time step,  
13          loop seal model, and pump model, radial flow foreign  
14          coefficient, nodalization, and what they found in all  
15          of these sensitivity studies after they determined the  
16          worst break size is that each of these effects is less  
17          than five degrees on peak clad temperature.

18          So that then comes to the conclusion that,  
19          yes, they have a converged solution, and the code is  
20          functioning properly.

21                 DR. KRESS: It also says that peak clad  
22                 temperature is not very sensitive to those things.

23                 DR. POWERS: Why does it show that they  
24                 have got a converged solution?

25                 MR. LANDRY: I'm sorry?

1 DR. POWERS: Why does it show that they  
2 have got a converged solution?

3 MR. LANDRY: Well, in addition to looking  
4 at the numeric response, it shows that there isn't a  
5 big variation for any of these perimeters.  
6 Altogether, it is not just those perimeter variations.

7 DR. POWERS: You can't tell from the fact  
8 that it is only 5 degrees. You can only tell how the  
9 iteration approaches that 5 degrees.

10 MR. LANDRY: Correct. Correct. It's not  
11 just that. It is everything combined that indicates  
12 that they are converging.

13 DR. POWERS: All right.

14 MR. LANDRY: Conclusions that the staff  
15 has arrived at is that the ANF RELAP code which was  
16 approved, the RODEX2, TOODEE2, ICECON codes, all of  
17 which were approved individually by the staff, have  
18 been combined into an integrated code, an integrated  
19 package that can perform the entire calculation  
20 without transferring data manually from code to code.

21 We believe that the code documentation  
22 supports the modifications made to the ANF RELAP code.  
23 We accept the modifications.

24 DR. KRESS: Let me ask you a question  
25 about that. I think in our subcommittee meeting, we

1 put it this way. We expressed some disappointment in  
2 the status of documentation, in the sense that the  
3 equations and models that we were presented were  
4 different than the ones that are in the documentation  
5 we had.

6 And that some errors in the previous  
7 equations were still in the documentation. Is that  
8 going to be fixed over some time period, or is the  
9 situation going to be different when they submit for  
10 the best estimate application, or maybe I should be  
11 asking this to the Siemens people. I don't know.

12 MR. LANDRY: Well, I think Jerry Holm from  
13 Siemens will address -- would you rather address that  
14 now or later, Jerry?

15 MR. HOLM: I can address it right now.  
16 There were a number of what were characterized in the  
17 subcommittee meetings as typos identified in two of  
18 the documents that we submitted, the models and  
19 correlations document in the programmer's manual.

20 And in conjunction with supplying the  
21 response to the request for additional information, we  
22 went through and tried to identify all the typos in  
23 those two documents, and we have provided revised  
24 documents, along with the RAI responses.

25 DR. KRESS: And those will be the

1 documents, plus any MODs that you make, and that you  
2 will submit for the best estimate analysis?

3 MR. HOLM: They will be the starting point  
4 for the best estimate. There have been some small  
5 number of additional model changes made for the best  
6 estimate program, and we will describe those and  
7 modify those documents.

8 DR. KRESS: You will get rid of the Moody  
9 model, for example?

10 MR. HOLM: It won't be used for the large  
11 break LOCA, but it will still be in there, because we  
12 have to use it for small breaks.

13 DR. KRESS: So it would be an option, I  
14 guess?

15 MR. HOLM: Yes.

16 MR. LANDRY: Okay. As was just discussed,  
17 we point out errors in the course of the review and in  
18 documentation. One thing that we would like to  
19 emphasize is that this has been a very fast review.

20 If you look at the history of reviewing  
21 computer codes, one year is a fairly quick turnaround  
22 on a review, and we feel that is primarily because  
23 Siemens Power Corporation has been very responsive and  
24 very cooperative during the conduct of this review.

25 When we asked questions, they were very

1 quick to work together with us to arrive at an  
2 acceptable answer. We feel that their cooperation and  
3 their willingness to work through any problems that we  
4 discovered in this review was instrumental in being  
5 able to conduct a review in such a relatively short  
6 period of time.

7 DR. KRESS: I would like to second that  
8 comment, Ralph. We found in the subcommittee meeting  
9 that their ability to answer our questions, and their  
10 candidness with their responses was actually  
11 refreshing. So I agree with you.

12 DR. SEARLE: Are we going to see some  
13 actual run results later?

14 DR. KRESS: Probably not. Did you plan on  
15 presenting some results still?

16 MR. LANDRY: Yes. In my presentation I  
17 will show one data --

18 DR. SEARLE: Very good. Thank you.

19 MR. LANDRY: So the conclusion of the  
20 staff's review is that we find the S-RELAP5 code  
21 acceptable for use in satisfying the requirements for  
22 analysis of the small break LOCA under the  
23 requirements of 10 CFR, Part 50, Appendix K.

24 DR. KRESS: That is the major finding  
25 right there.

1 MR. LANDRY: That is the import that you  
2 have to get to.

3 DR. KRESS: You have to get there,  
4 otherwise --

5 MR. LANDRY: Otherwise, we go back and  
6 start over.

7 DR. KRESS: -- you go back and start over,  
8 yes. Okay. I guess now we turn the thing over to  
9 Jerry Holm, of Siemens.

10 DR. SEARLE: Jerry, I've got to say this  
11 logo you have on here with a PWR bird cage, and a BWR  
12 box, gives me the cold shivers.

13 MR. HOLM: The topic today will be the  
14 Siemens PWR Appendix K small break LOCA analysis, and  
15 this is going to be based on the code S-RELAP5, and my  
16 name is Jerry Holm, and I am the manager of product  
17 licensing for Siemens.

18 And I will give a short introduction, and  
19 then Joe Kelly will give some more detailed  
20 information about the code and the methodology. But  
21 of course we have to keep it to something of an  
22 overview since we have only got about 45 minutes or  
23 less.

24 Again, I am just going to give about three  
25 slides for an introduction, and then Joe Kelly will

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1 talk about the S-RELAP5 code, and the first thing he  
2 will show is the relationship to the RELAP5 family of  
3 codes, since RELAP5 itself is extensively used in the  
4 industry.

5 We will give a summary of Siemens'  
6 enhancements, and only a selected few of those that  
7 Ralph Landry talked about, the ones that we thought  
8 were most important. We will give a summary of the  
9 methodology for the Appendix K LOCA, analysis, and  
10 then a summary of validation.

11 And we have chosen one of the benchmark  
12 cases to show some plots from so you can see the  
13 technical comparisons. Then I will get up at the end  
14 and just make a quick conclusion.

15 Okay. Ralph Landry alluded to the fact  
16 that we are going to be presenting or submitting to  
17 the staff a large break LOCA methodology, and what we  
18 call our realistic large break LOCA methodology using  
19 S-RELAP5, and that submittal will be later this year.

20 Right now what we have submitted to the  
21 NRC is the use of S-RELAP5 for small break LOCA, and  
22 we have also submitted it for non-LOCA methodology.  
23 Our future plans are to extend this code to BWR LOCA  
24 analysis, and long LOCA analysis.

25 And in fact the R&D program for the

1 conversion to a BWR LOCA will start later this year  
2 after we submit the realistic LOCA methodology and  
3 the development staff free up to do that work.

4 Our motivation for this is primarily that  
5 the cost of benchmarking and doing maintenance on  
6 codes is increasing, and our desire is to choose one  
7 code to try to maximize the results of our  
8 benchmarking work, and also to maximize the expertise  
9 of our staff.

10 It is a lot cheaper for us to do work and  
11 become experts in one code, rather than six, and that  
12 is the main purpose. We have been working on S-RELAP5  
13 for realistic LOCA methodology for close to 15 years  
14 now, and it is that extensive effort that led us to  
15 choose this as the base code.

16 We provided, we think, an extensive amount  
17 of information to support the staff's review, and we  
18 have a topical report which describes the methodology  
19 in the benchmarking.

20 And then in addition to that, we provided  
21 a significant amount of supporting documentation; our  
22 models and correlation manual, a programmers guide, an  
23 input requirements manual. We provided on a CD-ROM  
24 the code source and an executable version, and sample  
25 cases so that the staff could actually run the code.

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1 And we have made a presentation to the  
2 NRC in March of last year, and two presentations to  
3 the ACRS Thermal-Hydraulic Subcommittee. And then we  
4 provided a formal response to the RAIs which we sent  
5 last Friday.

6 And the main point is that we have tried  
7 to provide sufficient information to support the use  
8 of the code for small break LOCA. With that, I will  
9 turn it over to Joe Kelly.

10 MR. KELLY: Okay. This is the same  
11 outline slide that you saw just a minute ago with  
12 Jerry, and I am going to give a very brief overview of  
13 the history of S-RELAP5 thermal hydraulics code, and  
14 then talk about the Appendix K methodology for small  
15 break LOCA.

16 And show one example of the validation,  
17 and that is the BETHSY test, and it is the  
18 International Standard Problem Number 27. Actually,  
19 Ralph Landry covered this, but I had it in pictorial  
20 form, and it is the relationship of the S-RELAP5 code  
21 to the other flavors of RELAP, and also the other  
22 codes that we have incorporated in it.

23 We started with MOD-2 of the RELAP5 code  
24 which was developed at the IENL, and we made changes  
25 to it to perform non-LOCA transients, main stream line

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1 break, and small break LOCA Appendix K analysis.

2 And this resulted in the ANF-RELAP code  
3 which had been submitted and approved in several  
4 different topical reports between the years of 1983 and '89.  
5 And so this is the code that we have been currently  
6 been using in our licensing applications.

7 Since that time, RELAP5 Mod 3 was  
8 developed, and from that we have primarily taken  
9 upgrades to the code architecture to make it more  
10 portable. Again, as Ralph said.

11 Also, there are three stand alone codes;  
12 RODEX2, which is fuel rod performance, TOODEE2, which  
13 is a hot rod model accounting for diversion flow due  
14 to flow blockage; and ICECON, which is a containment  
15 analysis code.

16 Again, these are stand alone, and they had  
17 all been submitted and approved individually, and they  
18 were used in concert with ANF RELAP, and that required  
19 manual transfer of data from one code to the other.

20 You know, the output of one is input to  
21 the other, and sometimes it would require an iterative  
22 process in those two. So what we have done now is  
23 build these three codes into what is now history lot  
24 5, and so the data transfers happen automatically so  
25 you don't have a staff intervention there.

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1 And also so that if it is something like  
2 the effect of containment pressure on a large break  
3 LOCA, that is an integral part of the analysis, and  
4 not something that has to be done off-line, iterating  
5 between the results of two codes.

6 DR. KRESS: This may be a little off the  
7 subject, but how do you validate a hot rod model like  
8 TOODEE2? Don't you have to have a full bundle test,  
9 with an actual and a radial power distribution? How  
10 is something like that actually validated?

11 MR. KELLY: Well, unfortunately, you have  
12 the wrong person up here to answer that, because my  
13 experience is more in realistic, and this is more  
14 Appendix K, and from what little I know of it, what it  
15 does is that it implements NUREG 0630, and the  
16 regulations to do with that.

17 DR. KRESS: Okay. I understand that.  
18 Okay. But you may need something more when you get to  
19 the realistic.

20 MR. KELLY: If on realistic we were going  
21 to try and take credit for the enhancement in heat  
22 transfer that you see when you have blockages is a  
23 drop with shattering, et cetera.

24 And that would be a much longer assessment  
25 program to validate that, using something like the

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1 FLECHT-SEASET 163 rod test, but we are not planning to  
2 try and take credit for that.

3 And then finally there are a number of  
4 enhancements that Siemens developed, which I will  
5 briefly show in the next slide. There are a number of  
6 enhancements, but they mainly fall into four different  
7 areas.

8 They are mass conservation, energy  
9 conservation, momentum conservation, and the  
10 constitutive models.

11 In mass conservation, the numerics have  
12 been improved to minimize mass error during long term  
13 transients, and I will show something on that in the  
14 next slide.

15 Energy conservation, again, Ralph  
16 mentioned this. We reformulated the energy equation  
17 to eliminate the problem that would occur when you  
18 have a flow going across a large pressure drop.

19 It is not important for small break, but  
20 it is important for large break, having to do with  
21 energy deposition into the containment.

22 For momentum conservation, traditional  
23 RELAP5 uses cross-flow junctions, and in a way to try  
24 to emulate multi-dimensional, or multi-regional flows  
25 might be a better way of saying it.

1           What we did instead was implement a 2-D  
2 component, and is primarily used in either the core or  
3 the downcomer. And what had been seen in the past  
4 with cross-flow junctions was anomalous flow  
5 recirculations. The 2-D component eliminates those.

6           Of course, there are hundreds of  
7 constitutive models in the codes, and a number of  
8 those have been upgraded, primarily to increase  
9 accuracy in the large break LOCA application.

10           But there are also modifications to what  
11 is called a vertical stratification model, which helps  
12 improve the loop seal clearing prediction.

13           And in talking about long term mass  
14 conservation, when system thermal hydraulic codes,  
15 such as TRAC and RELAP5 were first applied to small  
16 break LOCA back shortly after the TMI, one of the  
17 primary challenges was long term mass conservation.

18           When you start running these transients  
19 out to a million time steps, what would happen is that  
20 the errors in solving the mass equation would  
21 accumulate over time, such that in effect the code  
22 would be either creating or destroying mass.

23           And if that fraction became appreciable  
24 relative to the inventory in the vessel, then there is  
25 no validity in the calculation whatsoever. So this is

1 an area that Siemens paid some attention to.

2 And so what I am going to show is from  
3 results from integral assessments and the small break  
4 LOCA sample problem, which were part of the submittal  
5 in the topical report.

6 So the three integral tests and the PWR  
7 sample problem, the transient time for each of the  
8 tests, the number of time steps, and the mass error,  
9 and again, this is the error in conserving mass for  
10 the entire system, normalized with the initial mass  
11 and expressed in percent.

12 So, for example, if you go to the BETHSY  
13 test, there were over a million time steps, and the  
14 cumulative mass error is less than 2/1000ths of 1  
15 percent. So that is very good. So we do not have a  
16 problem anymore with long term mass conservation.

17 And that is all that I am going to say  
18 about the code, unless I get questions, and we are  
19 going to switch to an overview of the methodology.

20 And the first thing to realize is that we  
21 define a methodology as basically two things. It is  
22 the codes that we use, but it is also how we use those  
23 codes.

24 And once a topical report has been  
25 approved that methodology is then encapsulated into an

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1 analysis guideline. And then that analysis guideline,  
2 together with the quality assurance procedure --  
3 because as Ralph said, all our users are in-house, and  
4 they are subject to the analysis guideline and a QA  
5 procedure.

6 So consequently you have the plant model  
7 nodelization specified, and you ensure that the  
8 Appendix K conservatisms are correctly applied. Also,  
9 there are sometimes additional conservatisms that  
10 Siemens prescribes.

11 For example, the way that we do loop seal  
12 modeling for the small break LOCA; and also things  
13 like the delays in diesel start times. And these are  
14 all specified as exactly what you are going to do in  
15 the analysis guideline.

16 And then because of the QA procedure, the  
17 analysts are constrained to adhere to those  
18 guidelines. So that gets rid of things like the user  
19 effects that you hear about a lot these days.

20 When you looking at performing small break  
21 LOCA analysis, you can do a PERT and come up with  
22 many, many phenomena that appear to be important. But  
23 there are really four major factors.

24 The first is, if you will, the transient  
25 that you are running, for determining the limiting

1 single failure; and for most of our plants, this is  
2 usually a loss of one diesel generator set.

3 So consequently we are going under the  
4 assumption of only one high head safety injection  
5 system being available. That's what makes the small  
6 break LOCA something interesting.

7 The next is where you are in the fuel  
8 cycle, and the limiting condition is normally the end  
9 of cycle, and the reason for that is that gives you a  
10 top-skew power profile, so that your high power part  
11 of the core is in the part of the core that will  
12 become uncovered.

13 The next is break size, and so we perform  
14 a break spectrum to determine the limiting condition,  
15 and that is really looking for a window. And what the  
16 window is bounded by are very small breaks, where the  
17 break flow would be smaller than the capability of the  
18 safety injection system to make it up. So those  
19 cases don't even uncover.

20 It is bounded on the other side by breaks  
21 that start getting large enough so that you get a  
22 fairly rapid depressurization to the accumulator set  
23 point, which then recovers the core.

24 So what you need is a break that is small  
25 enough that the flow is -- excuse me, large enough so

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1 that the flow is greater than the safety injection  
2 makeup, but small enough that you get a gradual  
3 depressurization rate so that you have a prolonged  
4 transient with significant core uncover.

5 And then finally there is how you treat  
6 loop seal clearing. The peak clad temperature is  
7 affected by both which loop is clear and the number of  
8 loops.

9 So we have come up with a proposal and a  
10 methodology for this in order to remove the  
11 variability that you see between calculations. I did  
12 bring backup slides on both the break spectrum and the  
13 loop seal clearing. So if there are questions about  
14 that, I can provide more details.

15 Now, looking at the validation matrix.  
16 Actually, there is four of them. The first is called  
17 the general matrix, and it is a set of separate  
18 effects and integral effects tests, and those are  
19 performed and documented for every code version.

20 Then there is the small break LOCA matrix,  
21 and again it is both integral and separate effects  
22 tests, which is what Ralph showed. And that was part  
23 of the small break LOCA submittal.

24 Similarly, there is a non-LOCA assessment  
25 matrix, and those are a set of integral tests which

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1 were part of the non-LOCA submittal, and for the  
2 realistic large break LOCA, there is a PIRT based  
3 matrix that is much more extensive. You know, in the  
4 order of more than a hundred tests.

5 And so when we come in with the realistic,  
6 you will be seeing that, and what that does is that it  
7 shows not only code applicability of the transient,  
8 but also how we determine the uncertainties in the  
9 models so that it can then get propagated through the  
10 uncertainty analysis.

11 And the small break validation matrix you  
12 have already seen. It is one BETHSY test,  
13 International Standard Problem 27, two-inch LOCA  
14 break, and this one goes through pretty much all of  
15 the expected phenomena that you want to see.

16 You know, the natural circulation phrase,  
17 loop seal clearing, core boil-off, and also recovery.

18 Semi-scale S-UT-8 has core uncover before  
19 loop seal clearing. So it is a different kind of  
20 test. LOFT LP-SB-03 is basically a core boil-off and  
21 uncover.

22 UPTF loop seal clearing, this is a  
23 proprietary test that was run at KWU, and so it is a  
24 full-scale model of the loop seal. And so there is a  
25 separate effects test to examine the clearing process.

1                   And then 2-D flow test, and the purpose of  
2 those was to provide some assessment for our 2-D  
3 component.

4                   I am going to show the results of one, and  
5 this is the BETHSY ISP-27, and it is probably being  
6 shown for two reasons. One of those is that it is the  
7 most comprehensive test, in the sense of going through  
8 all of the phenomena. The other one is that it is  
9 also the best data comparison.

10                  BETHSY is a full-height, 1/100 square  
11 model of a 3-loop RWR. So as test facilities go, it  
12 is pretty big. For example, it is 17 times larger  
13 than semi-scale.

14                  Test 9.1b is a 2 inch break with no high  
15 head safety injection. It results in deep core  
16 uncover and rod heat-up.

17                  In the S-RELAP5 assessment, the input  
18 model follows our small break LOCA modeling  
19 guidelines, with a few small changes. Obviously if  
20 you are doing an experiment and you want a realistic  
21 prediction, you don't use ANS, plus 20 percent, for  
22 the power.

23                  You use the actual power that was used in  
24 the test. Also, we note from the test results that  
25 one of the intact loops, and so loop number 2 clears.

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1           And so what we have done is apply our loop  
2       seal modeling methodology, where we bias the broken  
3       loop and one intact loop to plug. So then in our  
4       calculation, we clear loop number 2 just as it was  
5       done in the test.

6           And that loop seal clearing is something  
7       that we can talk more about if you would like. It is  
8       something that in reality is more statistical, and you  
9       can't really do it deterministically.

10          And so what we have done is put in a  
11       biasing methodology to limit the variability and  
12       ensure a conservative result. Also, for the critical  
13       flow model, getting the break flow correctly in a  
14       small break test, if you want to do a prediction of  
15       the test, it is very important.

16          And so you can't use Moody here. So we  
17       use the more realistic critical flaw model in the  
18       code. Similarly, even though I said BETHSY is pretty  
19       large, it is only about 420 rods, and so it is just  
20       slightly larger than one 17-by-17 assembly.

21          So using a 2-D component for the core  
22       didn't make a lot of sense, and we used a 1-D core  
23       model. And as I said, we get an excellent comparison  
24       of both the core collapsed liquid level, and the  
25       maximum rod temperature. And that's what I am going

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1 to show.

2 So this is the core collapsed liquid level  
3 comparison. The black line is the data, and the red  
4 line is the S-RELAP5 prediction. It says core  
5 collapsed level in meters. It is actually core, plus  
6 a good chunk of the lower plenum, okay?

7 And it's versus time, and the data is done  
8 by delta-P cell, and so what you are really seeing is  
9 a delta-P measurement. And that is what we have  
10 plotted also for S-RELAP5.

11 This is not a sum of wood fractions, but  
12 rather it is a pressure difference between replacing  
13 the lower plenum and the top of the core. So what you  
14 are seeing here in the initial part is the front  
15 coast down, and that is the frictional pressure drop  
16 having to do with the flow coasting down.

17 Once you get to this point, the two-phase  
18 mixture level is in the upper plenum, and the core,  
19 although two-phase, is completely covered. That's why  
20 the collapsed liquid level just sits here constant for  
21 a while.

22 The little blips in both the data and the  
23 calculation is the depression and recovery of the core  
24 level did a loop seal clearing. Immediately after  
25 that, the liquid level in the upper plenum has receded

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1 into the core, and you begin the boil off part of the  
2 transient.

3 It is at this point that you have reached  
4 a pressure, such that the accumulators begin to  
5 inject. You recover the core inventory, and the PCT  
6 location would occur about this point in time.

7 And for the maximum clad temperature, it  
8 is temperature versus time, and again the black curve  
9 is the data, and the red curve is S-RELAP5, and as you  
10 can see, there is a very good prediction of the dryout  
11 time, and also the peak temperature and the recovery.

12 And there is about a 20 to 25 degree K  
13 overprediction in the S-RELAP5 calculation, but this  
14 is considered to be an excellent comparison.

15 DR. KRESS: Could I see your previous  
16 curve a minute? Although it doesn't matter to the  
17 temperature, what causes the bouncing around to 4,000  
18 seconds?

19 MR. HOLM: Well, that is a good question.  
20 At this point, the core is two-phase. It is a liquid  
21 solid at about this point. So you have a two-phase  
22 level in the core, and remember I said that there are  
23 delta-P measurements, and not just measurements, but  
24 it is the delta-P in the core.

25 So you are not seeing void fraction

1 changes, because this looks like a two meter change in  
2 level, which would be catastrophic. But actually it  
3 is an instantaneous delta-P difference between two  
4 computational volumes.

5 And what you are seeing is a liquid level  
6 crossing a cell boundary, and the thing that we  
7 discussed in the subcommittee about having to  
8 accelerate the liquid, and it gives you a little bump  
9 in the momentum equation.

10 And so there is an instantaneous pressure  
11 spike associated with the level crossing. So what you  
12 are probably seeing, because you see so many of them,  
13 is the level doing this, going back and forth across  
14 the cell boundary.

15 But the indication of the collapsed level  
16 is artificial, in the sense that we are not taking two  
17 meters of water in and out. So, in summary, the  
18 proposed Siemens SBLOCA methodology replaces the  
19 combination of ANF-RELAP and the TOODEE2 code with S-  
20 RELAP5, thereby streamlining the analysis.

21 And that is good for us from the  
22 standpoint of being able to concentrate more  
23 effectively, but it also makes the reviews easier.  
24 And also we have done some work to improve the loop  
25 seal clearing behavior, and that is the biasing

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1 methodology.

2 And now I did not show this, but Ralph  
3 alluded to it as well, and it is in the topical  
4 report, but the results from the PWR sample problem  
5 and the sensitivity calculations show that this  
6 methodology is both convergent and robust.

7 The assessment shows that S-RELAP5 is  
8 capable of capturing the important phenomena for  
9 SDLOCA, specifically loop seal clearing, core boil-  
10 off, and recovery, with an acceptable level of  
11 accuracy.

12 And therefore the proposed methodology, or  
13 the proposed use of S-RELAP5 for an Appendix K SDLOCA  
14 is suitable for licensing. And then I will give the  
15 floor back to Jerry Holm.

16 MR. HOLM: Since I only have one slide, I  
17 will use this mike if that is okay. The bottom line  
18 from our perspective is that the SER provides Siemens  
19 with the ability to reference the topical report in  
20 future licensing submittals without further NRC  
21 review, and that's why we submit topical reports.

22 And the draft SER to be seen has no  
23 additional conditions or restrictions over and above  
24 what we have put on the methodology ourselves inside  
25 the topical report. So we consider that a very

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1 successful review from our perspective.

2 Our goal in this meeting is to hopefully  
3 come out of here with concurrence from the committee  
4 that the NRC can issue this SER by the end of  
5 February, and that is our presentation, unless you  
6 have questions.

7 DR. KRESS: Do the members have any  
8 burning questions that they want to ask? I remind the  
9 committee that there is under Tab 3 that there is a  
10 report on the subcommittee meeting, and provided by  
11 the cognizant engineer.

12 And we also have one of our consultant's  
13 reports under PINK3, and then we have a draft letter  
14 that we can look at.

15 DR. SEARLE: Is the consolidation of these  
16 cases the aspirations of doing BWR with the same codes  
17 as you do PWRs with? Does this suggest that these  
18 predictions are going to become once again the realm  
19 of the physics, rather than the realm of the  
20 programmer?

21 DR. KRESS: I am not sure I know what you  
22 mean.

23 DR. SEARLE: I am being facetious. I am  
24 very happy to see that it does appear that physics is  
25 being to reemerge in the storm tossed waters of this

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1 whole process.

2 CHAIRMAN APOSTOLAKIS: Are we done?

3 DR. KRESS: Yes, I can refer it back to  
4 you.

5 CHAIRMAN APOSTOLAKIS: Well, it seems that  
6 we are doing great today, right? We are 20 minutes  
7 ahead of time.

8 DR. KRESS: We have a skillful chairman.

9 CHAIRMAN APOSTOLAKIS: Wow, I'm impressed.  
10 Yes, sir?

11 DR. POWERS: Let me point out that I had  
12 passed out to members a section of the research report  
13 which involves a pretty categorical disagreement  
14 between two members in assessing three research  
15 programs.

16 And one of those members is being  
17 vigorously and heavily lobbied, but has not wavered  
18 one iota in his position. We will need to have an  
19 ACRS position.

20 We need to look at that and be prepared at  
21 least to interrogate the two people on their  
22 positions, or to establish a run.

23 CHAIRMAN APOSTOLAKIS: Okay. By the way,  
24 are we going to receive the full research report?

25 DR. POWERS: Undoubtedly at some time.

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1 Like since I don't have at least three of the inputs,  
2 and I am struggling with at least three others.

3 CHAIRMAN APOSTOLAKIS: But sometime during  
4 this meeting you mean?

5 DR. POWERS: I didn't say that.

6 CHAIRMAN APOSTOLAKIS: That's why I asked  
7 you. If you had said it, I would not have asked.

8 CHAIRMAN APOSTOLAKIS: Okay. So we will  
9 recess and reconvene at one o'clock.

10 (Whereupon, the committee recessed at  
11 11:40 a.m.)  
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A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

(1:01 p.m.)

CHAIRMAN APOSTOLAKIS: Okay. This afternoon the first subject is the proposed American Nuclear Society Standard on Eternal Events PRA, and we have three members of the group that developed the standard here, Bob Budnitz, Ravi Ravindra, and Niles Chokshi, right?

Ravi Ravindra is with EQE, and Dr. Budnitz is with Dr. Budnitz. We all have the draft, and I understand that it is not out for public comment yet is it?

And there will be no transparencies, but we will have a short introduction by Dr. Budnitz, and then perhaps we can discuss the standard. So, Bob.

MR. BUDNITZ: I am going to spend what I think is less than 10 minutes with an introduction, and what I am going to do, because I think it is the right thing to do, is to outline for you a half-a-dozen technical issues that we face, and some only a minute or so about them, so that you will know what we think are the important issues that confronted us.

And there was some stuff that we did that wasn't or we don't think was controversial, although you might, and that's fine. But we are going to at

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1 least outline to you what we think is the central  
2 technical challenge that we faced going in and how we  
3 resolved it.

4 And then you can ask questions, and we  
5 will be happy to discuss with you whatever. And just  
6 to be sure that you understand, there was a five  
7 member writing group, and the others were Tori Ye from  
8 Southern California Edison, and Bill Henries from M-  
9 Yankee.

10 But in fact the writers are in front of  
11 you. The three of us wrote everything that you see.  
12 Those others didn't write anything, although they were  
13 very important in review. Nilesch had principal  
14 responsibility for the seismic hazard part, and Ravi  
15 Ravindra wrote the seismic peculiars part, the part on  
16 seismic margins, the part on wind.

17 I wrote all the rest -- the flooding.  
18 Ravi and I together wrote the part on how you screen  
19 other events, and Nilesch was in there working on all  
20 that stuff, too. So it was a three-person effort.

21 CHAIRMAN APOSTOLAKIS: Does ANS have a  
22 procedure in which --

23 MR. BUDNITZ: Yes, I am going to say that  
24 next. The procedure is as follows. The American  
25 Nuclear Society has a committee, a risk committee, a

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1 Risk Informs Standards Consensus Committee, and Paul  
2 Miko chairs it.

3 It has 24 members on it, and it has been  
4 in existence a couple of years, and that committee in  
5 the ANS is the balloting committee. That committee  
6 appointed us, and we report to them.

7 The ANS committee recently balloted to  
8 release this standard for public comment. There is  
9 two ballots. There is a ballot to release public  
10 comment, and then a few months from now, or a few  
11 centuries from now, depending on how it goes, they  
12 will ballot to accept the standard, and then it goes  
13 out.

14 So it was released for public comment on  
15 January 26th, which was just the other day, 60 days,  
16 and anybody can get it. We sent it to you in advance.  
17 It was publicly available about the first of the year,  
18 and we sent it out to a lot of people in the first  
19 year, but the comment period started on the 26th.

20 And that process will run its course as we  
21 get public comments and we respond to them. We  
22 started this process in the summer of '99. It was  
23 about a year-and-a-half, but all of the serious  
24 writing was done between about the 1st of January a  
25 year ago and August.

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1           We pretty much had this thing wrapped up  
2           in that 7 or 8 month period, and from August until we  
3           released it, we held it up for 4 or 5 months because  
4           we were waiting to watch what happened to the ASME  
5           standard which were coordinated, and I will say  
6           something about that next.

7           As I hope you know, the ASME, American  
8           Society of Mechanical Engineers, outfit has a  
9           committee on which I serve, which I spent three years  
10          trying to put together a standard for PRA methodology  
11          for internal events, accidents that initiate from  
12          transients and LOCAs, and that's what we mean by  
13          internal events.

14          And that process after 3 years isn't quite  
15          done, although it is converging very rapidly now. I  
16          am on that committee, and we hope that in another  
17          couple of months we will have that done, because we  
18          are now responding to public comments from the draft  
19          that was issued for public comment in August.

20          We think in another couple of months that  
21          will be done, and we were waiting to release this for  
22          that period because the ASME standard had not settled  
23          down.

24          There were some very important questions  
25          that were being discussed, which we will come to in a

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1 minute, which we were hostage to, in the sense that we  
2 rely on, and we waited.

3 It turned out that that came out in a way  
4 that didn't effect very much of anything that we had  
5 written, and so then we released it for public  
6 comment.

7 So I am just going to make it real quick  
8 and short so that we have time for discussion. I am  
9 going to talk about the scope. The scope of our thing  
10 is earthquakes, wind, flooding.

11 And then a section that I am going to call  
12 other external events. They are external to the plan.  
13 Fires is not part of this, unless it is a forest fire.  
14 But aircraft crash, industrial facilities, and so on.

15 Earthquakes have a separate chapter, and  
16 winds, and flooding, they have separate chapters. And  
17 we have another one on other. Now, the other has two  
18 sections. One is screening, so you can screen  
19 something like hail storms if you are in Arizona.

20 But if you can't screen it, there is also  
21 a section on how you analyze it if you can't screen  
22 it. And then we also have a separate chapter on  
23 seismic margins, separate from seismic PRA, and I will  
24 describe that in a minute. So that is the scope.

25 Now, a crucial piece of this is that the

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1 scope also includes important sections that are this  
2 long, just a few lines, because we referenced the ASME  
3 standard by reference. We say do ASME, and I will  
4 just describe what they are.

5 For example, the whole system's analysis  
6 part of PRA, we reference ASME directly. I mean, we  
7 weren't going to rewrite how you do a Bayesian update  
8 of generic data. ASME does that. Although we have  
9 some places where we supplement ASME because we need  
10 to.

11 Like, for example, in HRA, human  
12 reliability analysis, if you have to do something a  
13 little different for seismic, we tell them that, but  
14 the rest of it we reference directly.

15 We reference directly the peer review  
16 requirements of the ASME, and how you put together a  
17 peer review team, but we have supplementary guidance  
18 in there, some requirements about peer review. For  
19 example, emphasizing lockdowns, because that is  
20 something important for us that was not quite so  
21 emphasized in ASME.

22 We reference the documentation section in  
23 ASME directly, but we have supplemental requirements  
24 and documentation, and how you document seismic  
25 margins, or when, or whatever.

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1                   And we also reference the application  
2 section, the crucial section on applications in ASME  
3 which tells you how you go about doing application  
4 once you have got a PRA.

5                   We also in order to make it seamless with  
6 ASME, we use the same format. The ASME has high level  
7 requirements in a broad area, and then what we call  
8 sporting requirements, which are the ones that you  
9 have really got to meet, that are below that and we  
10 did the same thing.

11                  The idea was so that a person who is using  
12 it together would see the same sort of thing. But  
13 crucially we don't have three columns of capability,  
14 and I will come to that in a minute.

15                  We don't have that. We have one, which  
16 was intended to be what ASME's column 2 was in the  
17 first round before they got to three, which is what we  
18 will call a good quality, state-of-the-art PRA today,  
19 and that's what we have. I will talk about that in a  
20 minute.

21                  And also crucially, for almost every  
22 requirement, you will see that we wrote a commentary.  
23 Sometimes short, and sometimes long. Sometimes longer  
24 than the requirement. ASME doesn't have any of that.  
25 We think that is a valuable addition, and you can quiz

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1 us about that if you want.

2 I mentioned already peer review, and I  
3 will come back to the three columns in a minute. We  
4 wrote a special set of requirements on peer review,  
5 and Ravi actually wrote them, emphasizing the need for  
6 walk-downs to make sure that for external events that  
7 you captured the plant, because plant specificity is  
8 crucial for these events which damage things in the  
9 plant.

10 PSHA. As you have observed, I'm sure, we  
11 exclusively endorse the Livermore and EPRI hazard  
12 studies of the late '80s by saying that if you did one  
13 of those, you met the standard for probabilistic  
14 seismic hazard analysis.

15 But what we mean by she made the standard  
16 for 1988, you still have to do an update to make sure  
17 that no earthquake information has come along since  
18 then that would invalidate what they did.

19 But we explicitly endorse that, but we  
20 also have a whole lot of requirements, which if you  
21 are doing it over, or if you didn't do that or  
22 whatever, that you have to meet.

23 And those requirements are pretty much  
24 tailored to the well-known -- and I will say this  
25 because I was an author, as was our chairman, George

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1       Apostolakis, of the well-known SSHAC process, the  
2       senior seismic hazard analysis committee that I served  
3       on and George did. I chaired it a few years ago.

4               And which has a process for seismic hazard  
5       analysis, and we explicitly have based our thing on  
6       that. If you are doing it over, or if you hadn't done  
7       it in IPEEE. I am just going on with issues, and then  
8       you can talk later.

9               Fragilities. Ravi wrote this piece. The  
10       seismic fragilities for PRA are the well-known  
11       standard methods that have been used for some years  
12       with the fragility curves.

13               But for seismic margins, we explicitly  
14       reference -- and if you do it, your okay, the CDFM,  
15       and if it was used in seismic margins, and if you do  
16       that, that's the acceptable method.

17               Uncertainties. This is a crucial point.  
18       We explicitly incorporate treatment of uncertainties  
19       in the standard, in the requirements, in the things  
20       that you have to do. You can't meet this standard if  
21       you have not considered uncertainties.

22               The reason that I am saying that is  
23       because if you don't know, I will tell you, but the  
24       word uncertainty appears almost nowhere in the ASME  
25       standard for internal events.

1 I am on that committee, and have been for  
2 3 years, and I am unhappy with that, but that's the  
3 way it is. I am a minority there. We have done that.  
4 We don't see how you can do an external events PRA  
5 without that.

6 One last topic, and then I will turn it  
7 over to you, and you can ask questions, or if my  
8 colleagues want to add something that I went by in  
9 this introduction, they will tell me.

10 Seismic margins. As you know, more or  
11 less half of the nuclear plants in the United States  
12 did a seismic margin review than a seismic PRA when  
13 they were satisfying the IPEEE around 6 or 8, or 10  
14 years ago.

15 And if they did a seismic margin review  
16 well, they ought to be able to meet the standard that  
17 we wrote for seismic margin. And the reason that we  
18 did that is because if you have done that rather than  
19 the other, and you meet it, we want to give them the  
20 benefit of that.

21 Because there are some applications for  
22 which seismic margin is very well tuned, and they  
23 ought to be able to say we met it and we can do those  
24 applications.

25 By the way, there are many applications

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1 where seismic margins is not well tuned, and I can  
2 mention those if you want, or I can them here, or you  
3 can ask me, and for those, those limitations you can't  
4 do it.

5 But at least if you did that, then you  
6 ought to get the benefit of that. So we have written  
7 a whole separate section of the standard outlining the  
8 method of seismic margins, and these are IPEEE  
9 margins.

10 And it is well know that those that did  
11 it, mostly we think did quite well there, and they  
12 ought to be able to meet the standard, and then there  
13 are some applications that they can do. The crucial  
14 limitations of seismic margins are as follows.

15 Well, I will just say what it is good for,  
16 for sure. If I have got some SSC that is very, very  
17 stout against earthquakes, and the seismic margin  
18 review has revealed that through the analysis, why  
19 that information is just as valid as if you did a  
20 seismic review.

21 And it turns out that there are a lot of  
22 applications like that, and that is very valuable, and  
23 they can do that. On the other hand, if in your  
24 application you have got some accident sequence in  
25 which a seismic failure combines with a human error,

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1 or with some non-seismic unavailability or something,  
2 seismic margins doesn't do that very well at all.

3 It doesn't capture it well, and the  
4 analysis isn't structured to do that, and it wasn't  
5 intended to. And certainly seismic margins can't  
6 produce for you a core damage frequency, at least not  
7 as structured.

8 So those sorts of applications are  
9 unavailable to some plant that has only a seismic  
10 margin review. However, it is our opinion, and when  
11 we issued this now just for comment, it is our opinion  
12 that nevertheless those that have a good one that can  
13 meet it ought to be able to get the benefits of what  
14 they can do, and that is our motivation.

15 I just have one other thing to say about  
16 that, and then I am done. For at least a decade, the  
17 community of people that play around in this sandbox,  
18 of which the three of us are among them, have  
19 struggled with what we could do to provide additional  
20 guidance, so that if someone with a seismic margin  
21 review could get more out of it.

22 And the proposal has been around for a  
23 long time, including a very thoughtful proposal that  
24 Ravindra came up with with Bob Murray about 10 years  
25 ago.

1           Your own staffer, Rich Cherry, ACRS staff,  
2           five years ago wrote a very useful paper about that.  
3           A couple of years ago, Bob Kennedy wrote another one,  
4           and we finally decided that it was time to do  
5           something to explore how to do better.

6           And this is relevant to this directly, but  
7           about a year ago Ravi and I went to the NRC and ANS --  
8           and Nilesh has got a conflict with this hat on, but  
9           NRC gave a grant to ANS to fund Ravi and me to do that  
10          study.

11          And Ravi and I have just within the last  
12          few weeks completed a study and published it, and I  
13          have it in front of me -- but you don't have it yet,  
14          although I will send it to you -- whose scope is the  
15          following.

16          We have explored how you could take a good  
17          quality seismic margin review, and extract more from  
18          it than you would think. For example, more risk type  
19          information, or more CDF type information, by doing in  
20          some cases directly, or by doing some additional work.

21          And we have written a paper that explores  
22          the things that you can do with it, and what the  
23          limitations are. And that has been published, and  
24          although it was reviewed by a few people, we are going  
25          to send it around the community of people, people like

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1 you, but also the seismic margin side of the community  
2 and get some feedback from them.

3 Because if what we propose makes sense to  
4 them, then sometime in the next 6, 8, or 12 months, we  
5 are going to propose an amendment to this standard, a  
6 supplement, and in which requirements for that will be  
7 in there.

8 So that if you can do that, then you can  
9 use the seismic margin review that you have to get  
10 more out of it than you now can. And in order to push  
11 that along, our final report, which I have in front of  
12 me, actually has in it proposed draft standard  
13 language, just like in the requirements that you see.

14 And it is Ravi's and my cut as to what the  
15 requirements would be, and that if you did them, then  
16 you could get more out of it, but there are some  
17 limitations.

18 And I will just end with that, and ask my  
19 colleagues, Chokshi and Ravindra, whether they want to  
20 add something that perhaps I went over too quickly,  
21 and then you get to ask us. Anything that I didn't  
22 cover?

23 Oh, wait, I have left something out. Very  
24 important. When we had what we thought was a  
25 satisfactory draft, about six months ago, we sent it

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1 around to 6 or 8 of our peers; peers meaning they  
2 could have been people like us and been on the  
3 committee, but the committee was just small.

4 And we got review comments back from most  
5 of them, which were very helpful for us, in terms that  
6 we made some changes. But this was an informal  
7 review.

8 And because mostly what we got back was,  
9 yeah, you are on the right track, we have a lot of  
10 confidence that what we are doing here is congruent  
11 with the larger community.

12 Crucially, we got comments back from Bob  
13 Kenney, from Leon Reiter, from Alan Cornell, from Bob  
14 Murray. EPRI actually funded Greg Hardy to do some  
15 work, and Bob Kassawara participated in that.

16 So we have before the final, we have those  
17 comments and feelings, and so we have a feeling like  
18 I said that that's okay, and then also crucially, John  
19 Stevenson, another important member of this community,  
20 was originally going to be a member of the writing  
21 team.

22 And then just as we were starting, he  
23 dropped off, but has remained sort of an associate  
24 member right along. We have sent him everything, and  
25 he has made comments. His stuff is here, too. Okay.

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1 I just wanted to be sure that I put that in.

2 And then finally, this work was partially  
3 supported by the Nuclear Regulatory Commission, who,  
4 besides that special project that Ravi and I did, the  
5 NRC gave a grant to ANS to support this, and the  
6 support by the way paid for staff and so on.

7 But it also paid for things like our  
8 travel and some administrative expenses. So I want to  
9 recognize that Nuclear Regulatory Commission support  
10 for this effort.

11 CHAIRMAN APOSTOLAKIS: Thank you, Bob.

12 MR. LEITCH: My first question I think  
13 relates to exactly the issue that you were talking  
14 about, and perhaps it is my lack of understanding  
15 concerning exactly what a seismic margin assessment  
16 is.

17 I am referring to page 5, the third  
18 paragraph. I guess these are all paginated the same  
19 way.

20 MR. BUDNITZ: I hope so.

21 CHAIRMAN APOSTOLAKIS: Maybe you can use  
22 the page numbers at the top.

23 MR. LEITCH: Yes, that is page 5.

24 MR. BUDNITZ: By the way, if you could  
25 also point to the section, like 1.3.2, it will help

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1 us.

2 CHAIRMAN APOSTOLAKIS: Page 5.

3 MR. LEITCH: It is the paragraph that  
4 immediately precedes 1.3.3, and it says throughout the  
5 standard the phrase, PRA, is used in a generic sense.

6 And then the intent is to include SMA  
7 methods, as well as PRA methods within the scope of  
8 the phrase, PRA. So when we see PRA in this document  
9 then, as I understand it, it may mean either what we  
10 normally understand by PRA, or it may mean SMA.

11 And I'm just not sure that I understand  
12 the distinction between those two. Could you held me  
13 with that a little?

14 MR. BUDNITZ: Sure. Well, what I meant by  
15 that paragraph, which I wrote or I suppose I'll say  
16 we, is that, for example, it says 1.4 to 1.10, and  
17 when you are talking about peer review or that sort of  
18 stuff, and we just didn't say PRA or SMA everywhere.

19 But the sections that are explicitly SMA,  
20 differ. You pretty much have to sort it out. Are you  
21 unclear about what an SMA is and what it does?

22 MR. LEITCH: Yes.

23 MR. BUDNITZ: There was an expert panel  
24 that I chaired in 1984, '85, and '86, although these  
25 fellows were involved, which invented that method.

1 The purpose of a seismic margin review is to evaluate  
2 the plant, and ascertain its seismic capacity, defined  
3 in terms of the way we define fragilities; the  
4 fragility curve or fragilities.

5 But if you have, say, four components,  
6 then you have to combine them in the right way, for  
7 example, and they might even have various other  
8 things.

9 So the purpose of a seismic margin review  
10 is that you go to your plant and you evaluate its  
11 capacity. You don't pay any attention to the hazard.  
12 Now, the way it was structured was a little different  
13 than that.

14 You pick what we call a review level  
15 earthquake. In the east, we suggested it, and almost  
16 everybody picked .3G. The idea was that it has to be  
17 higher by a factor than your design basis, which is  
18 3.1 or .15.

19 But by the way, if you are in Arizona, in  
20 Palo Verde, with a .25G design, you pick .5 as your  
21 review in other words. And you review the plant to  
22 the review level earthquake, and it has guidance in  
23 there that tells you how you can screen out using the  
24 guidance a whole lot of SSCs that clearly are stronger  
25 than that, and then you have to evaluate the ones that

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1 aren't.

2 So, for example, you might end up in  
3 typical power station with only 2 or 3 dozen  
4 components, SSCs, for which you have to actually do an  
5 evaluation.

6 And for those, it goes further. You don't  
7 work out in the seismic margin method that everybody  
8 uses. You don't work out the full seismic fragility  
9 curve. You develop what we invented and called the  
10 HCLPFC capacity, the high confidence low property  
11 failure capacity, which is the capacity which  
12 literally on a full fragility curve is the capacity in  
13 which there is a 95 percent confidence that you have  
14 less than a 5 percent probable of failure.

15 But really it was intended to be the  
16 capacity at which -- we have a very high confidence  
17 that this thing wouldn't fail, because you don't  
18 really believe the tales of these log normals all that  
19 well.

20 And the notion was -- and there is a  
21 method called the CDFM method, the conservative  
22 deterministic failure margin method, or else you can  
23 get it from your fragility curves, for working out the  
24 HCLPFC capacity of a pump, or a valve, or a wall, or  
25 a large tank.

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1           And what the seismic review margin was or  
2 did was that it worked out the HCLPFC capacities of  
3 every one of those SSCs that wasn't screened out, and  
4 then it combined them to work out the HCLPFC capacity  
5 of the station by choosing two success paths -- they  
6 are supposed to be different if they can be -- that  
7 the operators would use.

8           Say you need this component, and you need  
9 this component, and you need this component, and you  
10 need that system, and you need this thing.

11          And then we will imagine that they are called success  
12 paths A and B.

13          And you would work out the HCLPFC capacity  
14 of the success path A, and the HCLPFC capacity of  
15 success path B. And then the stronger of those was  
16 the HCLPFC capacity of the plant, because if you used  
17 that success path, you had high confidence that with  
18 that HCLPFC capacity that you could shut down, and  
19 that's how it is done.

20          That is a real tour. There is a little  
21 more to it, but that's a quick tour.

22          DR. KRESS: Somehow on page 18, your  
23 discussion on the definition of seismic margin doesn't  
24 reflect very much of what you just said, but still it  
25 is not a very satisfactory definition.

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1 MR. BUDNITZ: That's fair.

2 DR. SHACK: There is nothing about margin  
3 in it.

4 MR. BUDNITZ: Probably what we should have  
5 done was just said go to the SMA literature.

6 DR. KRESS: Or something maybe.

7 MR. RAVINDRA: Initially, we were thinking  
8 of writing an appendix, like what we have for the  
9 seismic PRA, and we were thinking of writing an  
10 appendix that describes the salient features of the  
11 SMA method.

12 And we were kind of debating whether such  
13 an appendix would help the user or not.

14 DR. KRESS: Well, would that show up in  
15 your proposed addendum to the thing?

16 MR. BUDNITZ: No, but we could do that.  
17 There is a lot out there that we could probably pull  
18 together. We ended up not doing it. There are 5 or  
19 6 reports, which taken together, tell you everything  
20 you want to know about it.

21 CHAIRMAN APOSTOLAKIS: There is a danger  
22 here of jumping back and forth. Why don't we start  
23 with questions on Chapter 1, called the introduction.  
24 Do the members have any questions, which is the first  
25 10 pages. Which numbering scheme are we following?

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1 Let's go with the printed numbers at the--  
2 MR. BUDNITZ: Well, we can do it by  
3 section. If you go to Section 1.9 --

4 CHAIRMAN APOSTOLAKIS: Well, let's do it  
5 by chapter, the first 10 pages. Any questions? Well,  
6 I have some. On page 5 and 6, Section 1.3.3, there is  
7 a very interesting discussion of LRF, and maybe it is  
8 just an opportunity to comment on it.

9 You state that some accident sequences  
10 that are externally seismic initiated, which do not  
11 contribute to LRF in the internal event analysis, in  
12 fact now contribute to LRF because you assume there is  
13 no evacuation, right?

14 MR. BUDNITZ: Yes.

15 CHAIRMAN APOSTOLAKIS: And the evacuation  
16 was the criterion for whether something is early or  
17 not.

18 MR. BUDNITZ: Or it is impaired or  
19 something.

20 CHAIRMAN APOSTOLAKIS: And you assume  
21 there is no evacuation at all?

22 MR. BUDNITZ: No, we told the analyst to  
23 figure out what they assume.

24 CHAIRMAN APOSTOLAKIS: To do what?

25 MR. BUDNITZ: To work it out. If

1 evacuation is impaired, then you do count for that.  
2 We don't say assume no evacuation.

3 CHAIRMAN APOSTOLAKIS: But that is a  
4 judgment call isn't it?

5 MR. BUDNITZ: Absolutely, but that is the  
6 analyst's job.

7 CHAIRMAN APOSTOLAKIS: They are not going  
8 to do any analysis for that and see what buildings  
9 collapse, and bridges fall down. They will just make  
10 a judgment, that the evacuation is really not  
11 effective against LRF, right?

12 DR. POWERS: George, I think you could  
13 -- you know, your consequence code, typically you  
14 could have quite a range of inputs to the code.

15 CHAIRMAN APOSTOLAKIS: But they don't do  
16 that though I don't think. It is just a judgment on  
17 the part of the analyst. You don't run any codes to  
18 see the impact of evacuation, right? It is just a  
19 judgment on your part.

20 MR. BUDNITZ: Well, just to describe what  
21 we said. If this isn't clear, we have to clarify it.

22 CHAIRMAN APOSTOLAKIS: No, it is clear.  
23 I just wanted to --

24 MR. BUDNITZ: To meet the standard, the  
25 analyst is not to take the LRF from the internal

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1 events and swallow it whole. He may observe that in  
2 fact protective actions are impeded, and perhaps not  
3 as effective, or whatever, for a big tornado, let's  
4 say.

5 And the analyst is explicitly told that  
6 the analyst shall account for that before he  
7 categorizes alert sequence for LRF or not, depending  
8 on the event. Nothing more, but nothing less.

9 CHAIRMAN APOSTOLAKIS: Very good.

10 MR. RAVINDRA: I think that after the core  
11 damage, if the containment systems don't function,  
12 then you have a question of release; am I right?

13 MR. BUDNITZ: Sometimes.

14 MR. RAVINDRA: So because of that, in the  
15 seismic event, the containment systems are not any  
16 stronger than the actual core itself. Therefore, the  
17 assumption that the containment systems would remain  
18 after the core damage has occurred may be not really  
19 true for seismic events.

20 MR. BUDNITZ: So that is the reason that  
21 you have to look at that.

22 MR. RAVINDRA: Yes, that you have to look  
23 at that.

24 MR. BUDNITZ: Sure.

25 DR. KRESS: That is accounted for in the

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1 PRA.

2 VICE CHAIRMAN BONACA: Yes, the PRA  
3 accounts for that.

4 CHAIRMAN APOSTOLAKIS: That is just a  
5 definition of LRF. Look, there was no question. It's  
6 just that I like it.

7 DR. KRESS: We are glad that you pointed  
8 that out actually.

9 CHAIRMAN APOSTOLAKIS: On page 7, you  
10 state what you also told us, that this category was  
11 consistent during the spirit of category 2 of ASME  
12 standard. And I am wondering why the forces that  
13 forced ASME to have a category one did not apply to  
14 you?

15 MR. RAVINDRA: Currently, they are at  
16 work.

17 CHAIRMAN APOSTOLAKIS: They are at work  
18 now?

19 MR. BUDNITZ: Yes.

20 DR. KRESS: They are working on it.

21 CHAIRMAN APOSTOLAKIS: Are they doing any  
22 work?

23 DR. SHACK: You have a seismic margins  
24 analysis, which to a certain extent is a category one.

25 MR. BUDNITZ: There is actually a

1 technical thing here. We don't believe, the three of  
2 us, that we know how to write a capability category  
3 three just to start for seismic, or for tornados, or  
4 for the external hazards.

5 And the reason is because there are  
6 certain technical things that you have to do that we  
7 don't do, and we don't know how to do. A category  
8 three --

9 CHAIRMAN APOSTOLAKIS: One is the  
10 question, not three.

11 MR. BUDNITZ: How about three? So we  
12 don't know how to write three, okay? We don't know,  
13 for example, how to capture in a way that you would  
14 actually like to capture the correlations. We don't  
15 know how to do HRA well for post-seismic or post-  
16 tornado human actions.

17 Those are major things that are pointed  
18 out there. There are a whole lot of things. We don't  
19 know how to do three. If somebody came in and said  
20 they put down a category and claimed it was a category  
21 three, I would have real trouble trying to agree with  
22 that unless we had done something that no one has ever  
23 done.

24 And by the way the notion of category  
25 three in ASME was somebody at least had to have done

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1 it sometime so we would have an example. It can't be  
2 something that is a dream.

3 Now, category one is different, capability  
4 category one. The idea of capability category one is  
5 that you have compromised your peer rate compared to  
6 the middle column, which is the -- by one of several  
7 things.

8 For example, you might use generic rather  
9 than plant specific things. You might be conservative  
10 rather than realistic. I don't mean conservative for  
11 screening, but actually conservative in your analysis.  
12 Or you might not have much level of detail.

13 VICE CHAIRMAN BONACA: But you are  
14 allowing this in the standard, too.

15 MR. BUDNITZ: Right. So we could have  
16 candidly written another category for that, but  
17 instead we have allowed it here. If you do less, why  
18 is there some stuff that you can't do. But we didn't  
19 write a whole column for it. We could have, but we  
20 didn't.

21 VICE CHAIRMAN BONACA: I would just like  
22 to express a personal opinion. I was very impressed  
23 by this standard, for the simple reason that it looked  
24 like a standard, and the ASME standard, I don't feel  
25 like it looks like one.

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1           And yet you are allowing the kind of  
2 latitude in the approach in the context of the  
3 standard, which should be there. But I felt that it  
4 was well developed, and by the way, the commentary  
5 that you have is a key issue, because it allows you to  
6 pull out all the discussion that I saw in the ASME  
7 rev. 10, which I think was the one impeding somewhat  
8 the document.

9           And here it is separated that way, but I  
10 think that one of the great strengths of this thing is  
11 that you don't have category one, two, or three.

12           DR. KRESS: With respect to your one  
13 category, in your Chapter 6, you strictly endorse the  
14 ASME, which is Chapter 3 in the ASME.

15           MR. BUDNITZ: We don't endorse it. We  
16 incorporate it by reference.

17           DR. KRESS: Incorporate it by reference.  
18 I'm sorry.

19           MR. BUDNITZ: But that is an important way  
20 to say it.

21           DR. KRESS: That is. But my question is  
22 that chapter in the ASME document is cast in terms of  
23 the three categories. Is there any conflict between  
24 yours and that, or can one just assume that you are  
25 looking at the category two parts?

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1 MR. BUDNITZ: I'm glad you asked that.

2 DR. KRESS: Okay.

3 MR. BUDNITZ: I am sure that after the  
4 ASME process has run its course, but before we  
5 finalize this finally, because that is probably a few  
6 months away, we are going to have to rewrite some of  
7 this to clarify that.

8 But the problem is that the ASME process -  
9 - I'm part of it and I'm on the committee -- is still  
10 in the works, and so we are trying to get this thing  
11 out and gone, and go through the process and get the  
12 technical stuff right.

13 And later on we are going to have to  
14 clarify exactly what by reference means, because the  
15 thing that we referred to when we wrote this -- that  
16 Chapter 3 is different. It changed last week, and we  
17 have another meeting in two weeks and it is going to  
18 change again. And sometimes the change is  
19 significant.

20 DR. KRESS: I had that problem trying to  
21 relate the two, because I don't have the latest one  
22 either.

23 MR. BUDNITZ: If you think about the  
24 middle category as a good quality pairing, that's --

25 CHAIRMAN APOSTOLAKIS: But maybe what Dr.

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1       Shack said is really the reason why you don't have  
2       pressure. You have a screening, you have the SMA,  
3       which the main idea behind category one was to use a  
4       quick calculation to rank systems, structures, and  
5       components, and to do certain things very quickly for  
6       which those people felt that you didn't need a  
7       detailed uncertainty analysis.

8               MR. BUDNITZ: Actually, I don't agree with  
9       you. That is only one of the motivations behind the  
10      capability of one in ASME. Unfortunately -- and I say  
11      this now as a member of that team -- some people think  
12      they can do more with it than that, and that is  
13      partially true.

14             But I don't think there is an awful lot  
15      more -- some people think there is a lot more that  
16      they can do than I can think of.

17             CHAIRMAN APOSTOLAKIS: Well, that is the  
18      essence of it. The idea was to be able to screen  
19      quickly and identify contributors --

20             MR. BUDNITZ: Well, some people think the  
21      idea of it was more than that. Some people think that  
22      you can do everything you can do in PRA with that  
23      thing.

24             CHAIRMAN APOSTOLAKIS: No, no, no. That's  
25      not reality.

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1 MR. BUDNITZ: I am just exaggerating.  
2 Nobody really thinks that.

3 CHAIRMAN APOSTOLAKIS: Ravi.

4 MR. RAVINDRA: Now, the chapter on the  
5 external event screening, if the analyst wants to use  
6 it, he can treat that as any other external event, and  
7 decide based on the frequency of the break itself, he  
8 can screen it out, and based on some bounding  
9 calculations, he can screen it out.

10 Or he can use the seismic margin approach  
11 to go a little further to screen out initial  
12 components and systems. So this is a continuous  
13 screening process. So the method is already there.  
14 Now just to reformat it into category one or category  
15 two.

16 We were also waiting for the ASME to  
17 complete his work, and for the dust to settle down,  
18 and only then can we do it.

19 CHAIRMAN APOSTOLAKIS: Okay. On page 7,  
20 you say that the ASME, the bottom paragraph -- well,  
21 first of all, you say that a well executed SMA  
22 represents a good fit to many of the applications  
23 contemplated for ASME category one.

24 MR. BUDNITZ: Yes.

25 CHAIRMAN APOSTOLAKIS: And then you go on

1 and say especially insofar as an SMA generally is well  
2 suited to the categorization of SSCs according to  
3 their size and capacity, and to the screening of SSCs  
4 according to their safety significance.

5 This refers to what you said earlier, Bob,  
6 with the two parts and so on?

7 MR. BUDNITZ: Yes.

8 CHAIRMAN APOSTOLAKIS: Okay.

9 MR. BUDNITZ: But there are limitations.

10 CHAIRMAN APOSTOLAKIS: But the  
11 categorization, you see, that word means something  
12 about internal event PRA. You don't mean  
13 categorization according to some importance measure  
14 and so on do you?

15 MR. BUDNITZ: I think it says  
16 categorization of SSCs according to their capacity.

17 CHAIRMAN APOSTOLAKIS: And what does that  
18 mean?

19 MR. BUDNITZ: HCLPF above .3G.

20 CHAIRMAN APOSTOLAKIS: Okay. That kind of  
21 thing.

22 MR. BUDNITZ: The sort of things that SMA  
23 does for you.

24 DR. SHACK: Just coming back in my  
25 absolutely simple-minded view of these things, as I

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1 don't know anything about it, it seemed to me that in  
2 a seismic margin analysis, you have a simple amount of  
3 -- I mean, you have identified two of the ways that  
4 you can succeed. So you have sort of set a bound on  
5 things.

6 MR. BUDNITZ: Correct.

7 DR. SHACK: And so to that extent, you  
8 actually have some PRA like information, but what you  
9 don't have is a complete set of event trees. But you  
10 have picked your two success paths, and so to that  
11 extent you do have some bounding information.

12 MR. BUDNITZ: Correct.

13 DR. SHACK: For example, suppose you  
14 stupidly forgot about the strongest success path,  
15 where you had a whole bunch of SSCs that were  
16 extremely stout earthquakes, but had no human  
17 intervention, and it was all automatic, and you knew  
18 it and so on.

19 You might completely misunderstand your  
20 seismic capacity. You might think it is smaller, when  
21 it is really very strong.

22 MR. BUDNITZ: Correct.

23 CHAIRMAN APOSTOLAKIS: Anything else on  
24 chapter one?

25 (No audible response.)

1 CHAIRMAN APOSTOLAKIS: Okay. Chapter 2 is  
2 definitions. Any comments?

3 MR. WALLIS: Well, the seismic margin one  
4 didn't help me, and then when I looked at Chapter 3.5,  
5 you launch into methodology without saying what it is  
6 that you are doing.

7 In seismic fragility, there is a very nice  
8 definition of Seismic fragility.

9 MR. BUDNITZ: Point taken.

10 MR. WALLIS: It is not there for seismic  
11 margin.

12 MR. BUDNITZ: Perhaps Ravi and Nilesch, we  
13 have to go back and rewrite that appendix on seismic  
14 margin that we wrote for --

15 VICE CHAIRMAN BONACA: On the positive  
16 side, I didn't see any glaring error or mistake.

17 CHAIRMAN APOSTOLAKIS: Oh, you mean on  
18 chapter two?

19 VICE CHAIRMAN BONACA: Yes.

20 CHAIRMAN APOSTOLAKIS: I have a couple of  
21 comments on chapter two. Anybody else wants to go  
22 ahead of me? The definitions?

23 DR. KRESS: The definition of core damage.

24 MR. BUDNITZ: Oh, wait. We took that  
25 straight from ASME. All the systems stuff, and just

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1 so you understand, but we were constrained and so we  
2 decided to make it seamless with the ASME standard  
3 that we are going to use, and if their definition is  
4 changing, and it has changed a little bit, we are  
5 going to incorporate it.

6 Perhaps I need to say that up front. The  
7 idea was --

8 DR. KRESS: That might be helpful.

9 MR. BUDNITZ: We are doing a low power  
10 shutdown standard by the way, too. If all the  
11 definitions aren't the same, you sure won't be able to  
12 use them together for applications. Let me make a  
13 point to be sure to say that.

14 CHAIRMAN APOSTOLAKIS: On the same page,  
15 page 13, the discussion of epistemic uncertainty  
16 focuses on model uncertainty, but part of epistemic is  
17 perimeter uncertainty as well.

18 And maybe if you can make that a little  
19 bit clearer, because the definition seems to focus  
20 almost exclusively on the modeling assumptions.

21 MR. BUDNITZ: I don't see that.

22 CHAIRMAN APOSTOLAKIS: I see it.

23 MR. BUDNITZ: Okay. Thank you.

24 CHAIRMAN APOSTOLAKIS: Anything from the  
25 members on definitions? That's it. Now, Chapter 3 is

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1 very big. So maybe we can break it up. Maybe go and  
2 include 3.1 and 3.2, and 3.3, first; is that  
3 reasonable? Technical requirements, general. Now,  
4 which pages are these?

5 It starts from page 20. Does anybody have  
6 any comments on that?

7 (No audible response.)

8 CHAIRMAN APOSTOLAKIS: No? Okay. 3.4,  
9 technical requirements. Yes, let's do the whole 3.4.

10 MR. BUDNITZ: Oh, by the way, I want to  
11 make a comment about context here that I think will  
12 help you. Having just spent 3 years with the ASME  
13 team, one of the complexities that the ASME team faced  
14 and faces in writing its standard is that there are a  
15 hundred plants out there that have had a PRA, and  
16 because of twins, there are 60 or 70 PRAs.

17 For many of the sections of internal PSHA,  
18 the plants use different methods, very different HRA  
19 methods, very different methods for success criteria,  
20 and very different methods for this and that.

21 And to try and write a standard that  
22 captures and enables those with good quality to still  
23 meet it turned out to be a difficult trick. And it  
24 was a big struggle.

25 It is important for you to understand that

1 it is our opinion here as writers of this that there  
2 is far less variability in the way the size of PRAs  
3 that were done were done and were accomplished.

4 They are mostly similar; the fragilities  
5 part, the hazard part. So it was simpler for us. We  
6 didn't have to struggle in very many places. We are  
7 trying to write a requirement and that we know someone  
8 had done quality work different ways. That was good  
9 luck for us.

10 CHAIRMAN APOSTOLAKIS: Let's go to page  
11 24. I mean, it may be an unfair question, but I think  
12 we have to see if we can resolve it. The seismic  
13 hazard analysis high level requirement, (a), says that  
14 the frequency of earthquakes shall be based on a site  
15 specific PSHA that reflects the composite distribution  
16 of the informed technical community.

17 Now I know where that comes from, but  
18 somebody who takes this and is innocent in the ways of  
19 life, how does he make sure that this is a composite  
20 distribution of the informed technical community? I  
21 mean, are you imposing an impossible requirement?

22 MR. CHOKSHI: I think if you go, in terms  
23 of how you meet the requirement, it basically says the  
24 SSHAC approach is one --

25 CHAIRMAN APOSTOLAKIS: But the whole thing

1 rests on experts you choose, right?

2 MR. CHOKSHI: Yes.

3 CHAIRMAN APOSTOLAKIS: And how you define  
4 the community.

5 MR. CHOKSHI: Yes, but the chart lays out  
6 the selection of experts, and the process of how you  
7 go about doing that.

8 CHAIRMAN APOSTOLAKIS: So that is really  
9 the intent?

10 MR. CHOKSHI: Yes.

11 MR. BUDNITZ: And in fact if you turn to  
12 the detail a few pages later, it goes to that  
13 directly.

14 CHAIRMAN APOSTOLAKIS: And the same thing  
15 on the same page, page 24, there are words like  
16 credible and I wonder. I mean, that becomes clearer -  
17 -

18 DR. SHACK: The big difference here is  
19 their commentary gets a lot of that in, and the high  
20 level requirements become very concrete --

21 CHAIRMAN APOSTOLAKIS: When you go to  
22 their comments.

23 DR. SHACK: Yes, and their commentary is  
24 a very strong suggestion, like do it.

25 MR. CHOKSHI: We were struggling how to

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1 get some of these ideas across and the commentary was  
2 a good vehicle to do it.

3 VICE CHAIRMAN BONACA: It is a good  
4 commentary, and I agree, but it gives you the written  
5 path, which is the standard way to do it.

6 DR. SHACK: It gave you guidance.

7 VICE CHAIRMAN BONACA: It doesn't say you  
8 can't do it otherwise.

9 CHAIRMAN APOSTOLAKIS: I am a little  
10 confused though. If you go to page 26, where the  
11 commentary says existing LNEL and EPRI hazard studies  
12 and many hazard studies conducted for plant PSHAs also  
13 meet this overall requirement.

14 Now, are these two studies, studies that  
15 differ by a factor of 10?

16 MR. BUDNITZ: It is Livermore '93.

17 CHAIRMAN APOSTOLAKIS: So it is the  
18 updated Livermore?

19 MR. BUDNITZ: Yes.

20 CHAIRMAN APOSTOLAKIS: So they don't  
21 differ that much anymore.

22 MR. BUDNITZ: Except for details.

23 CHAIRMAN APOSTOLAKIS: All right. On page  
24 31, the last note at the bottom of the page, HA-D3,  
25 somewhere in the middle it says that the

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1 characterization of ground motion includes an  
2 epistemic uncertainty in the ground motion model.

3 Have people done that? Have people  
4 developed an epistemic uncertainty in the ground  
5 motion model?

6 MR. RAVINDRA: For each ground motion --  
7 well, there are many ground motion models, and so the  
8 collection of that represents the distribution.

9 CHAIRMAN APOSTOLAKIS: But who developed  
10 the distribution? I mean, I can have five models with  
11 uncertainties, and as you know, people have been  
12 arguing about a particular model from Southern  
13 California and so on.

14 But if I pick one, how do I develop the  
15 epistemic uncertainty in the model itself given that  
16 I have the other six models floating around? Is there  
17 a methodology that tells me how to do that, or do I  
18 have to --

19 MR. BUDNITZ: I understand your point,  
20 George. Suppose the word said, "an epistemic  
21 uncertainty amongst the several ground motion models."  
22 Suppose it said that.

23 CHAIRMAN APOSTOLAKIS: Yes, we need a  
24 better word. I am not sure that is the best, because  
25 that is related to another question that I have

1 regarding sensitivity studies.

2 MR. BUDNITZ: But that is not a small  
3 point. In fact --

4 CHAIRMAN APOSTOLAKIS: It is not a small  
5 point, no.

6 MR. BUDNITZ: In fact, if you go with --  
7 let's say you go with Dave Boore's model.

8 CHAIRMAN APOSTOLAKIS: Yes, good fellow.

9 MR. BUDNITZ: Then if you are ignorant  
10 that Abramson has done a different model, then you may  
11 not capture this model epistemic uncertainty.

12 CHAIRMAN APOSTOLAKIS: Exactly. But if I  
13 am aware though that Abramson has another model, I  
14 still don't know how to meet the standard. You know,  
15 how do I develop my epistemic uncertainty now, and I  
16 think that is something that needs elaboration,  
17 because I don't think we should ask the user of the  
18 standard to do research.

19 By the way, I am focusing on things that  
20 I thought required discussion. I think this is a very  
21 good standard.

22 MR. BUDNITZ: Well, George, let's go on  
23 then. Just keeping reading, because --

24 MR. RAVINDRA: In terms of the person  
25 writing the commentary, I think the civil engineering

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1 professionals are the first one that came up with that  
2 concept. Most of the civil engineering standards and  
3 building codes come with commentary so that the user  
4 knows the basis, and not just the requirements.

5 CHAIRMAN APOSTOLAKIS: Wonderful. It is  
6 about time we learned something from you guys.

7 MR. BUDNITZ: George, let's keep going.  
8 The next sentence --

9 CHAIRMAN APOSTOLAKIS: I read the next  
10 sentence.

11 MR. BUDNITZ: But it says that SSHAC gives  
12 guidance on an acceptable process to be used for  
13 determination of -- and in fact you and I were  
14 authors, and that guidance isn't really enough.

15 CHAIRMAN APOSTOLAKIS: It is not. I think  
16 you need to soften a little bit what you are saying  
17 here, and find a way around it.

18 Now, on page 33 -- and this is something  
19 that is not unique to the standard, but something that  
20 bothers me in general, but look at the requirement HA-  
21 F2, which I think is a reasonable thing to say, but I  
22 will voice my concern.

23 The PSHA shall include the appropriate  
24 sensitivity studies, and then you have a commentary,  
25 which is fine. It says examples of useful sensitivity

1 studies include an evaluation of alternate schemes  
2 used to assign weights to experts, and so on, and so  
3 on.

4 My problem with sensitivity studies is  
5 that I don't know what to do with them. What if some  
6 combination of these things shows a core damage  
7 frequency that is way out of this world, or it is  
8 above the goal? Now what do I do?

9 I did the sensitivity study, and I am  
10 above the goal, and everything else that I have done  
11 shows that I am below the goal. What good is it? I  
12 mean, shouldn't we be through Bayesians assign  
13 probabilities to all of these things, and include  
14 them? I mean, Bob, I don't know what to do with that.

15 MR. BUDNITZ: Read the sentence.

16 CHAIRMAN APOSTOLAKIS: I read the  
17 sentence.

18 MR. BUDNITZ: It tells you why. The PSHA  
19 shall include appropriate sensitivity studies and  
20 intermediate results. Why? To identify factors that  
21 are important to the site hazard, and that make the  
22 analysis traceable and reviewable.

23 Now, here is the point. If you do a  
24 sensitivity study and find out that Factor 44 is not  
25 important, then you have learned something. If you do

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1 a sensitivity study and find out that Factor 44 is  
2 important and you didn't include it, you have actually  
3 erred. So that is how it is used.

4 CHAIRMAN APOSTOLAKIS: No, that is not the  
5 way that I read it. If I assign different weights to  
6 individual expert models, or an evaluation of the way  
7 different experts make different assignments, and I  
8 find a result that is an order of magnitude greater  
9 than what I believe is a realistic estimate, I don't  
10 know what to do with it.

11 What do I do? Do I report it to the  
12 regulator, for example? And what is the regulator  
13 going to do? Because you give a realistic  
14 distribution and they say, well, if I do this gain  
15 here, I am a factor of 10 higher.

16 MR. CHOKSHI: I think within the  
17 sensitivity studies you still have to be realistic.  
18 You still have to use realistic assumptions and  
19 values.

20 CHAIRMAN APOSTOLAKIS: I think this is a  
21 relic of traditional engineering, where they were not  
22 doing uncertainly analysis, and let's play with the  
23 variables a little bit to see what happens.

24 When you do a rigorous uncertainty  
25 analysis the way you guys demand it, I think you have

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1 to be very careful with what kinds of sensitivity  
2 studies you are asking.

3 I mean, I can see saying, you know, maybe  
4 the distribution has a higher this or that, but it has  
5 to be constrained. Otherwise, I can see it getting  
6 out of hand, and that is not the intent for sure.

7 MR. BUDNITZ: Look at the note.  
8 Sensitivity studies in the intermediate results  
9 provide important information to reviewers. And by  
10 the way, you might also say the analysts, of course.

11 CHAIRMAN APOSTOLAKIS: Yes.

12 MR. BUDNITZ: About how some of the key  
13 assumptions affect the final results of this complex  
14 process.

15 CHAIRMAN APOSTOLAKIS: Right.

16 MR. BUDNITZ: It is no more, but it is no  
17 less.

18 CHAIRMAN APOSTOLAKIS: Bob, let's say I do  
19 find that I have two key assumptions, and then I  
20 change things. I assume something else and the thing  
21 jumps up. Am I under a requirement here that says,  
22 no, you are not going to play that game.

23 If you want this factor to become six, you  
24 also have to tell me what is the probability that it  
25 will be come six. That's where I am going. Otherwise,

1 I don't know what to do with it.

2 MR. BUDNITZ: George, this is a deep  
3 intellectual challenge. Let me give you an example,  
4 all right?

5 CHAIRMAN APOSTOLAKIS: All you have to do  
6 is say do I look --

7 MR. BUDNITZ: No, let me just give you an  
8 example straight from seismic hazard. Suppose there  
9 were five of us at the table, and --

10 CHAIRMAN APOSTOLAKIS: When in fact you  
11 are only three. But go ahead.

12 MR. BUDNITZ: But suppose there were five  
13 of us at the table who were ground motion experts, and  
14 who had different ground motion models, and even  
15 though they are all different, A, B, C, and D, whether  
16 you used A, B, C, or D models didn't make much  
17 difference to the results.

18 But you went to E, and you used hers, or  
19 his -- it doesn't make a difference -- and it made a  
20 big difference. Now you know something. What you  
21 know is -- first of all, you know what I just said,  
22 but you also know that there is the possibility that  
23 the other four might be wrong, and so then you have  
24 got to go and inquire.

25 So what you do with it depends on what you

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1 learn, but we don't tell you to incorporate it in the  
2 analysis. It is nothing more than important  
3 information about how some of the assumptions effect  
4 the result.

5 CHAIRMAN APOSTOLAKIS: But you know that  
6 the paralysis that this --

7 MR. BUDNITZ: Are you suggesting that we  
8 should not have done that? Are you suggesting not to  
9 do sensitivity analysis? Are you suggesting not to  
10 publish intermediate results?

11 CHAIRMAN APOSTOLAKIS: No, I want you to  
12 define them better, and tell me what to do if I find  
13 a situation like that.

14 MR. BUDNITZ: I can't tell you what a  
15 decision maker would do.

16 DR. KRESS: If you are requiring a good  
17 vigorous uncertainty analysis, what do you need with  
18 a sensitivity analysis?

19 CHAIRMAN APOSTOLAKIS: Exactly.

20 DR. KRESS: I think that is the point.

21 CHAIRMAN APOSTOLAKIS: And you guys do  
22 require a vigorous uncertainly analysis.

23 MR. CHOKSHI: Even if you do a vigorous  
24 uncertainty analysis in something like hazard, you  
25 will be making some --

1 CHAIRMAN APOSTOLAKIS: You can say  
2 identify what is important.

3 MR. CHOKSHI: Exactly.

4 CHAIRMAN APOSTOLAKIS: I think it is time  
5 that we abandon this.

6 MR. BUDNITZ: George, you and I both  
7 understand how difficult it is to deal with the inside  
8 that you got from this assumption that you made that  
9 you know is wrong. I mean, sometimes you can assume  
10 something that is physically incorrect, and couldn't  
11 happen.

12 You say, gee, let's suppose the water has  
13 density, too, or something.

14 CHAIRMAN APOSTOLAKIS: It's not always  
15 easy.

16 MR. BUDNITZ: And it is not going to make  
17 any difference, and if it doesn't make any difference,  
18 it doesn't.

19 CHAIRMAN APOSTOLAKIS: But this is  
20 related, Bob, to the issue of assigning equal weights  
21 to the experts, I think. All of these things go  
22 together.

23 MR. BUDNITZ: It is all related.

24 CHAIRMAN APOSTOLAKIS: We have to finally  
25 say, look, this is the probability that I am assigning

1 to this, okay? Whatever that is. You don't disagree  
2 with that do you?

3 MR. BUDNITZ: I am not going to argue  
4 that. Let me describe. In the end, George, there is  
5 an analyst, a person, or perhaps it is a team.

6 CHAIRMAN APOSTOLAKIS: Yes.

7 MR. BUDNITZ: And if they sign the thing  
8 and say I, we, take professional responsibility for  
9 what we did, and the sensitivity study showed  
10 something cockeyed, and we don't believe it.

11 CHAIRMAN APOSTOLAKIS: Oh, they say we  
12 don't believe it.

13 MR. BUDNITZ: No, they might say. Let's  
14 assume that, or else they might say, gee, maybe we  
15 should believe it. In other words, it comes down to  
16 professional responsibility doesn't it?

17 CHAIRMAN APOSTOLAKIS: And eventually  
18 maybe --

19 MR. BUDNITZ: Well, he assigns the  
20 probabilities after it. If he finds out that it  
21 doesn't make any difference, then he is not going to  
22 worry a priori about assigning probabilities to these  
23 things. I mean, I look at it as a way of narrowing  
24 down --

25 DR. KRESS: You can't really do that

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1 because in order to do a sensitivity analysis, you  
2 have to put ranges on these things. And you are not  
3 going to just arbitrarily choose those. You are going  
4 to choose something that is within the range of  
5 probability.

6 CHAIRMAN APOSTOLAKIS: Exactly.

7 DR. KRESS: So you do assign some sort of  
8 probability to it.

9 MR. BUDNITZ: There is assigned  
10 probabilities, and there is assigned probabilities.

11 CHAIRMAN APOSTOLAKIS: I would like to see  
12 a discussion or part of the commentary here that  
13 reflects what we just said.

14 MR. BUDNITZ: That is very helpful.

15 CHAIRMAN APOSTOLAKIS: That's all I am  
16 saying.

17 MR. BUDNITZ: That is very helpful.

18 CHAIRMAN APOSTOLAKIS: Page 43. You  
19 already talked about it, the HRA thing, and you  
20 recognize that this aspect can represent an important  
21 source of uncertainty in the numerical results.

22 You are silent regarding references here,  
23 where I see in other places that you are more than  
24 willing to provide references.

25 DR. KRESS: Does George have a lot of

1 references on this?

2 CHAIRMAN APOSTOLAKIS: No, but for  
3 example, if --

4 MR. BUDNITZ: Are you looking at SAB2?

5 CHAIRMAN APOSTOLAKIS: I am looking at  
6 SAB2, yes, the very last sentence.

7 MR. BUDNITZ: The point is well taken. It  
8 seems to me that we could and should provide some  
9 citations.

10 CHAIRMAN APOSTOLAKIS: Especially if there  
11 some studies that are particularly related.

12 MR. BUDNITZ: Absolutely. It is an  
13 omission.

14 CHAIRMAN APOSTOLAKIS: Any other comments  
15 on 3.1, .2, .3, from my colleagues?

16 MR. LEITCH: I have a question about 37.

17 CHAIRMAN APOSTOLAKIS: Page 37?

18 MR. LEITCH: Page 37, yes.

19 MR. BUDNITZ: Can you cite the  
20 requirement, like SM-A1 or something?

21 CHAIRMAN APOSTOLAKIS: Yes, we can do  
22 that.

23 MR. BUDNITZ: It is somehow different from  
24 yours because of the printer.

25 MR. LEITCH: This is 3.4.2.1,

1 Introduction.

2 CHAIRMAN APOSTOLAKIS: Introduction to the  
3 seismic PRA technical requirements.

4 MR. LEITCH: And it speaks about the  
5 trimming of certain events and the adding of certain  
6 events. And it gives some examples of trimming.  
7 Could you help me with an example of adding?

8 MR. BUDNITZ: Of course, and perhaps we  
9 can add that. The internal events PRA model basically  
10 has in their basic events no structures. Walls don't  
11 fail. But there can be a basic event of wall fails,  
12 and then of course harm is pump, or piping, for  
13 example.

14 That is an example of where one must  
15 expand the horizon of the SSCs concerned. There are  
16 others, but that's an obvious one.

17 MR. LEITCH: That helps my understanding  
18 of it. Thank you.

19 CHAIRMAN APOSTOLAKIS: Any other comments  
20 on technical requirements for systems analysis,  
21 seismic fragility analysis? I don't have any, except  
22 that it seems to me that it would require a specialist  
23 to do this analysis. It is not like the internal  
24 events.

25 MR. BUDNITZ: I would argue that you

1 require a specialist to do internal events, too.

2 DR. KRESS: I was kind of shocked to hear  
3 that.

4 CHAIRMAN APOSTOLAKIS: Well, what I mean  
5 is that you can have a systems engineer spending some  
6 time learning what the fault trees and the event tree,  
7 and he can develop those and do a decent job.

8 I don't think you can take a systems  
9 engineer, train them a little bit, and have him do  
10 this. This is really a specialist's job. That is  
11 what I mean.

12 VICE CHAIRMAN BONACA: The hazard analysis  
13 has to be done by specialists.

14 CHAIRMAN APOSTOLAKIS: Yes, because there  
15 are so many disciplines that have to come today. Bob,  
16 you have been with it for too long, and you think it  
17 is trivial.

18 MR. BUDNITZ: Obviously, unless you know  
19 how buildings respond to ground motion, you can't do  
20 the response analysis. That's a specialty.

21 CHAIRMAN APOSTOLAKIS: Well, even  
22 understanding the fragility curve. So, shall we move  
23 on? I don't see -- well, Jack?

24 MR. SIEBER: I think that one of the  
25 problems here is that because a lot of confluence have

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1 fragility associated with them that the event trees  
2 change. You end up blocking off success paths as you  
3 go through. That has to be by a person more  
4 knowledgeable than system engineers that I know.

5 MR. BUDNITZ: The appendix on seismatary  
6 explicitly tells you that this must be done by a team  
7 of systems fragilities and so on people interacting,  
8 and short of that, it won't be successful, and it  
9 tells you that in plain English.

10 CHAIRMAN APOSTOLAKIS: Okay. So we will  
11 move on to -- I'm sorry.

12 MR. LEITCH: page 45, and it is  
13 requirement SAE8. There is a sentence there that  
14 puzzles me a little bit. It says that while this  
15 standard does not require the analyst to assume an  
16 unrecoverable loss of off-site power after a large A  
17 earthquake, the general practice in seismic PRAs has  
18 been to make such an assumption.

19 That seems a little confusing to me. Why  
20 doesn't this standard require that?

21 MR. BUDNITZ: We permit the analyst to  
22 argue if a basis can be established for the recovery  
23 of off-site power after the earthquake. They have to  
24 have basis. So I would just say that it does not  
25 require the analyst to assume that loss of off-site

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1 power is unrecoverable.

2 MR. WALLIS: Isn't this where you need one  
3 of your little notes that peer review will look over  
4 this assumption real closely?

5 MR. BUDNITZ: Well, just to give an  
6 example, there are some exit sequences that run up to  
7 120 hours and one might successfully argue that at my  
8 plant I will recover one of those through some --  
9 well, we just -- we didn't want to require that  
10 conservatism if there was a basis, and so we  
11 explicitly permitted it.

12 MR. LEITCH: Okay. I understand.

13 MR. BUDNITZ: And I am quite sure that is  
14 the right thing. You don't want to require something  
15 that they could argue for.

16 MR. RAVINDRA: Also, it is a function of  
17 the size of the earthquake. If it is a small  
18 earthquake, you make be able to quickly record some  
19 off-site power.

20 MR. LEITCH: This specifically says a  
21 large earthquake. But I understand.

22 CHAIRMAN APOSTOLAKIS: All right. 3.5,  
23 seismic margining assessment. We already have a  
24 comment from Dr. Wallis that he hasn't seen a  
25 beautiful description of what it is. Can you guys

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1 provide a beautiful description of what it is?

2 MR. BUDNITZ: We said we were going to  
3 write that appendix that we sort of didn't do yet.

4 CHAIRMAN APOSTOLAKIS: All right.

5 MR. UHRIG: I am a little bit confused  
6 here. 3.5.1 has the feed high level requirements. If  
7 you go to the definition of success paths, it talks  
8 about bringing the plant to a stable hot or cold  
9 shutdown condition, and maintain it in this condition  
10 for 72 hours.

11 And then seismic requirement B here is the  
12 minimum of two diverse success paths, and so two of  
13 those methods, shall be developed consistent with  
14 structures and equipment that can be used to bring the  
15 plant to a safe stable shutdown, and maintain this  
16 condition for a period of 72 hours following an  
17 earthquake larger than the RLE, which is the review  
18 level earthquake.

19 Whereas, it doesn't talk about the review  
20 level earthquake in the definition of the success  
21 paths.

22 MR. BUDNITZ: Correct. The success path -  
23 - you are looking at the definition section, back in  
24 the definition section?

25 MR. UHRIG: Yes.

1 DR. POWERS: Page 65.

2 MR. UHRIG: Well, that's where the  
3 requirements are. The definitions are back about 10  
4 pages.

5 MR. BUDNITZ: No, page 18 says a success  
6 path is a set of components that can be used to bring  
7 the path to a stable condition in 72 conditions.

8 DR. POWERS: Right.

9 MR. BUDNITZ: Now, this says -- oh, you  
10 are talking about the hot or cold? Maybe we need to  
11 add that.

12 MR. UHRIG: No, no.

13 MR. BUDNITZ: This says --

14 MR. UHRIG: You want two sets of  
15 components.

16 MR. BUDNITZ: -- this requires. So that  
17 defines or requires that you shall develop two of them  
18 that can do it after an earthquake larger than the  
19 RLE. So that is more restrictive, except for the --

20 MR. UHRIG: It really doesn't define the  
21 level of earthquake.

22 MR. BUDNITZ: Correct. It just tells what  
23 the path is.

24 MR. WALLIS: And what is this review level  
25 earthquake? It seems to have a pretty wishy-washy --

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1 MR. UHRIG: Well, it is about a factor of  
2 two greater than your safe shutdown isn't it?

3 CHAIRMAN APOSTOLAKIS: Let's answer this  
4 question.

5 MR. BUDNITZ: Nilesh, do you want to  
6 answer that?

7 CHAIRMAN APOSTOLAKIS: Let's finish this  
8 question first

9 MR. UHRIG: No, I think it is pertinent  
10 here, but the way I interpret this is that roughly a  
11 factor of two greater than these safe shutdown  
12 earthquake is what you are defining as the review  
13 level earthquake.

14 Certainly at least 50 percent greater; .3  
15 versus .5, and you have a .5 for the review level, and  
16 the .3 is your SSE. Or if you have a .5 as a safe  
17 shutdown, then what would you say, a .8?

18 MR. BUDNITZ: Well, of course, we don't  
19 use it up there, but that's right. It is specifically  
20 instructed that the margin method doesn't apply for  
21 places where the design basis of this earthquake would  
22 be way above high-G. It just doesn't. Go ahead. You  
23 are looking at requirement SM-A1 is where it tells you  
24 about that.

25 CHAIRMAN APOSTOLAKIS: Page what?

1 MR. BUDNITZ: SM-A1. It is sort of page  
2 66 in my version. The requirement is that it just has  
3 to be larger, and then the guidance says more.

4 MR. WALLIS: But how much larger? Larger  
5 by a fraction, or by a factor of two?

6 CHAIRMAN APOSTOLAKIS: The note tells you  
7 more.

8 MR. CHOKSHI: I think the background of  
9 the matter, and based on similar experiences used in  
10 nuclear power plants, there has been two level  
11 earthquakes that have been established, 0.3G, and  
12 0.5G, and basically they look at those two, because  
13 that provides a very good level for screening.

14 You can screen a number of margins at  
15 0.3G, and you can screen fewer at .5G. So primarily  
16 in the margin matter it is 0.3G or 0.5G are used if  
17 anyone wants to know what your design basis was.

18 So if you are at 0.2G, you can still use  
19 0.3G, but if your design basis was much greater than  
20 0.3G, most likely you will have to use 0.5G. So the  
21 practical is 0.3G and 0.5G dealing with earthquakes.

22 MR. WALLIS: Is your standard saying that  
23 you shall use 0.3G and 0.5G?

24 CHAIRMAN APOSTOLAKIS: No.

25 MR. CHOKSHI: Well, by reference,

1       referencing the matters. You know, if you go to the  
2       definition, and if you look at page 17, and in the  
3       note it refers to that point; that the majority of  
4       plans in the eastern and midwestern United States held  
5       reviews of 0.3G, because their design basis is  
6       generally lower than 0.3G.

7               And then if you go to the seismic margin  
8       methods, which are referenced here in the EPRI  
9       reports, they explicitly talk about 0.3G and 0.5G.

10              MR. BUDNITZ: But the requirement is only  
11       that the hourly shall be selected greater than the  
12       SSE. That is the only thing that is required.

13              Now, if you select a review level  
14       earthquake that is 20 percent above your SSE, you  
15       don't get as much information.

16              MR. WALLIS: So don't you need more  
17       guidance about how to select?

18              CHAIRMAN APOSTOLAKIS: There is a whole  
19       NUREG.

20              MR. WALLIS: So there is a whole NUREG,  
21       which I don't have the benefit of.

22              CHAIRMAN APOSTOLAKIS: There is a whole  
23       NUREG.

24              MR. UHRIG: The other issue that was  
25       confusing me here on page 66, and this issue is that

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1 you have a high level requirement E, which says the  
2 seismic margin calculations shall be performed for  
3 critical failure modes in structures, systems, and  
4 components, such as structure failure modes, et  
5 cetera, and failure modes again.

6 And then down to requirement G, the  
7 seismic margin shall be reported based on margins  
8 calculated for the success paths. And I am confused  
9 by the shift in emphasis here.

10 MR. BUDNITZ: Oh, let me -- let's go to  
11 that.

12 MR. UHRIG: Require E versus Require G.

13 MR. RAVINDRA: Do you want me to answer  
14 that?

15 MR. BUDNITZ: Go ahead.

16 MR. RAVINDRA: For every component that is  
17 on the success path, we either screen the component  
18 out because it has a high capacity, or we make a  
19 calculation as to the seismic capacity of the  
20 component.

21 Now, the success path is a chain of a  
22 series of components, and so when you calculate the  
23 success path capacity, generally you take the lowest  
24 of the capacities of the components that appear on the  
25 success path.

1 MR. BUDNITZ: The weakest of them.

2 MR. RAVINDRA: The weakest.

3 DR. SHACK: The ones looking at a  
4 component margin is looking at the plant seismic  
5 margin.

6 MR. BUDNITZ: So, you see, G says the  
7 plant seismic margin shall be reported based on the  
8 margins calculated for the success paths. I mean, if  
9 it is four components -- A, B, C, and D -- and let's  
10 say that three of them have a HCLPF capacity of 0.1G,  
11 and one of them has a HCLPF capacity of 0.2G, then  
12 0.2G is the capacity of the success path because that  
13 is the weakest link.

14 MR. UHRIG: Yes.

15 MR. BUDNITZ: I mean, it is a little more  
16 complicated than that. If you do and's and or's, you  
17 have to take the strongest of the or's, and the  
18 weakest of the and's. Maybe I said that backwards.

19 MR. UHRIG: Is there anything magic about  
20 72 hours? Is that when all the after shocks have  
21 gone?

22 MR. BUDNITZ: No.

23 MR. UHRIG: So is that just an arbitrary  
24 number?

25 MR. BUDNITZ: No. It is what the systems

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1 people have always used. Nothing more than that. It  
2 comes straight from the systems, and not from the  
3 after shocks.

4 MR. SIEBER: That's right.

5 CHAIRMAN APOSTOLAKIS: Anything else?

6 (No audible response.)

7 CHAIRMAN APOSTOLAKIS: Where are we now?  
8 Oh, 3.6 and 3.7., other external events. Comments on  
9 this?

10 (No audible response.)

11 CHAIRMAN APOSTOLAKIS: And 3.8, high  
12 winds.

13 VICE CHAIRMAN BONACA: I thought those  
14 were very good sections.

15 CHAIRMAN APOSTOLAKIS: I thought so, too.

16 VICE CHAIRMAN BONACA: And particularly  
17 the commentary. It is so helpful because it gives you  
18 a lot of reference. It is almost like hands-on, and  
19 it is succinct enough. The other thing is that it  
20 provides a clear understanding of how you are looking  
21 missiles and how you are looking for targets. So it  
22 is well done.

23 CHAIRMAN APOSTOLAKIS: Have there been any  
24 PRAs with high winds?

25 MR. RAVINDRA: The example is Indian

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1 Point.

2 CHAIRMAN APOSTOLAKIS: High winds?

3 MR. RAVINDRA: For high winds, yes,  
4 because there were some structures that were not  
5 designed for the missile and for the loading, and they  
6 had the potential to fade and collapse on other  
7 structures.

8 And so the high wind was considered as an  
9 important external event for Indian Point. There was  
10 a partial look into some systems that are affected by  
11 the high winds.

12 But the experience is somewhat limited  
13 compared to the seismic. And when it comes to the  
14 external flooding, the experience is much more  
15 limited.

16 MR. BUDNITZ: There are 3 or 4 external  
17 flooding PRAs that I happen to know about.

18 CHAIRMAN APOSTOLAKIS: That dominate?

19 MR. BUDNITZ: That are important enough  
20 that they actually carried it through.

21 MR. UHRIG: Quad Cities?

22 CHAIRMAN APOSTOLAKIS: No, that was  
23 internal.

24 MR. BUDNITZ: The one I know is the  
25 Westinghouse plant in Kishko, in Slovenia. But by the

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1 way, it is a perfectly good Westinghouse plant. It  
2 just happens to be on a river that floods every  
3 hundred years.

4 And although the dike is big enough, they  
5 had to do the whole analysis because it wasn't all  
6 that big.

7 VICE CHAIRMAN BONACA: And winds with the  
8 early plants, they really had no screening, and so  
9 they were very vulnerable. Adam Neck was a perfect  
10 example. It had plenty of missiles and plenty of  
11 targets. So it was really a dominant contributor.

12 MR. BUDNITZ: And ANO did a complete  
13 flooding analysis right down to the end, and then  
14 found that it wasn't important, and so it didn't  
15 matter much. But they actually did this some years  
16 ago.

17 MR. UHRIG: George, can I go back to one  
18 quick question here. In 3.5, you talk about generic  
19 data. What is the source of this generic data? Page  
20 66. It says that it must be justified if you use it.

21 There is two or three places in here where  
22 it refers to generic data, and I just wondered.

23 MR. RAVINDRA: Over the years, there has  
24 been a collection of data from sources, either the  
25 qualification test data, which has gone beyond the

1 qualification level for components, and --

2 MR. UHRIG: Is this coming out of the reg  
3 guides?

4 MR. RAVINDRA: No, this is the sanction  
5 qualification data. The industry has collected data  
6 on the seismic qualification of different kinds of  
7 components, and that part of the database.

8 Then we have also collected the data on  
9 the earthquake experience, looking at how the nuclear  
10 plant type equipment were found in the large real  
11 earthquakes.

12 And then there have also been some tests  
13 conducted by Lawrence Livermore Lab and Sandia, and  
14 Brookhaven, sponsored by NRC, to do the fragility  
15 testing. All that information forms a database that  
16 is generic, and not specific to any particular  
17 component in the plant.

18 So if someone wants to use generic data,  
19 he has to certify that it is really applicable to the  
20 particular component.

21 MR. UHRIG: So he has to show that the  
22 numerical values in his plant are comparable to those  
23 that are being used there?

24 MR. RAVINDRA: Yes.

25 MR. BUDNITZ: Which comes around to saying

1 that my compact valve is similar enough to those that  
2 were tested or observed.

3 CHAIRMAN APOSTOLAKIS: All right.

4 MR. UHRIG: Thank you.

5 MR. BUDNITZ: I mean, that's what it comes  
6 down to in terms of the engineering.

7 CHAIRMAN APOSTOLAKIS: All right. 3.9,  
8 external flooding.

9 DR. KRESS: Just a general question, and  
10 not on 3.9, but when you incorporate references to  
11 acceptable methodologies -- for example, in the high  
12 winds, you have three or four.

13 Now, the NRC, I don't know how they will  
14 use this standard, but if they say we want you to use  
15 this standard for the quality of your PRA, are they  
16 going to have to go in and study all these references,  
17 and decide whether or not they really think they are  
18 acceptable?

19 What was the criteria for deciding that  
20 they were acceptable methodologies? Was it just the  
21 expert judgment of you three, which I figure it was.  
22 That's probably good enough for me, but I don't know  
23 if it is good enough for NRC or not.

24 MR. BUDNITZ: We decided that a particular  
25 methodology or in some cases an application, go there

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1 and see what they did, would be acceptable. And what  
2 we are seeking is a review of our peer community to  
3 make sure that they also agree.

4 CHAIRMAN APOSTOLAKIS: But eventually the  
5 staff will have to decide whether to adopt this,  
6 right?

7 MR. BUDNITZ: Whether they also agree.

8 CHAIRMAN APOSTOLAKIS: And that's when  
9 this question will come up.

10 DR. KRESS: I would hate to have to go to  
11 every one of these and review every method on them.

12 CHAIRMAN APOSTOLAKIS: They have already  
13 members who know that. There is some knowledge within  
14 the staff. PRA configuration control. Fine?

15 DR. SEARLE: Yes.

16 CHAIRMAN APOSTOLAKIS: Risk assessment  
17 application process.

18 DR. KRESS: That's fine. They didn't  
19 reference. They incorporated by reference the --

20 MR. BUDNITZ: You skipped right over peer  
21 review.

22 CHAIRMAN APOSTOLAKIS: I skipped what?

23 MR. BUDNITZ: The peer review.

24 CHAIRMAN APOSTOLAKIS: Because it is  
25 unimportant. Peer review.

1 VICE CHAIRMAN BONACA: Here I think you  
2 are making a reference to the ASME description of  
3 that, and that is somewhat of a contested issue here.

4 You know, what do you mean by -- I mean,  
5 you seem to impose additional requirements here just  
6 because I expect the expertise that you need in  
7 seismicity, and special exception events is somewhat  
8 different than the one that you use for the level one.

9 MR. BUDNITZ: Right, but --

10 VICE CHAIRMAN BONACA: And so maybe that  
11 is a moot issue here.

12 MR. BUDNITZ: But the general requirements  
13 are taken from ASME by reference. For example, ASME  
14 has a section that describes how you pick two of your  
15 that don't have a conflict of interest, or that type  
16 of requirement. That requirement, we just are not  
17 going to do it over.

18 CHAIRMAN APOSTOLAKIS: So, application  
19 process and documentation. I don't know --

20 DR. KRESS: You skipped over my section  
21 again.

22 CHAIRMAN APOSTOLAKIS: No, risk assessment  
23 and application process?

24 DR. KRESS: I wanted him to reiterate this  
25 is incorporated by reference to Chapter 3 of the ASME,

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1 and go back to it to see if there was any  
2 incapacibilities or any inconsistencies. I don't know  
3 what Chapter 3 now looks like in the ASME.

4 And the version that I had, there did seem  
5 to be some inconsistencies, and so I don't know if  
6 they will stay or not.

7 MR. BUDNITZ: The only person around this  
8 table that knows is I, because I am on the team.

9 DR. KRESS: Yes.

10 MR. BUDNITZ: But it is not a secret, and  
11 I can tell you. It is very important that you should  
12 understand that there has been a change in the words,  
13 which may or may not represent a change in the  
14 philosophy, but let me describe.

15 When the three columns first came out a  
16 year-and-a-half ago, they were described as  
17 application categories.

18 DR. KRESS: Right.

19 MR. BUDNITZ: Like somebody thought that  
20 ISI would be in category one, and core damage  
21 frequency application is in category two. Over the  
22 last 18 months, it has become transparent that that is  
23 not the right way to think about it, and those three  
24 columns are now capability categories for the PRA, or  
25 for elements of the PRA.

1           Now, what that means is that you grade  
2 your PRA once, just once. You go find out your  
3 capability one for this, or capability two for that.  
4 Or by the way, in our case, you either meet it or you  
5 don't.

6           If you don't meet a piece of this, you can  
7 still the thing if that piece you don't meet doesn't  
8 matter.

9           Now, what Section 3 in ASME does is it  
10 says, okay, you have an application. You go to the  
11 application and you decide which pieces of the PRA you  
12 need for that application.

13           For example, you may not need the HRA  
14 piece, or maybe it is at the center of your  
15 application. So you decide which piece, and then you  
16 decide whether or not for your application that you  
17 need capability two or capability one, or capability  
18 three, although I kind of think it will always be two,  
19 but let's not argue, except for screening.

20           And then you go to the PRA, and see what  
21 you have got. If you need capability two for the  
22 application that you have got, and everything that  
23 needs it is two, then you are home.

24           If you need capability two, HRA, and you  
25 have a capability one, then you can't do it. You have

1 to either upgrade it or do something else. So that's  
2 exactly what it is, and this is just the same.

3 DR. KRESS: Okay. It sounds like they are  
4 consistent now.

5 MR. BUDNITZ: Now, here, what you do is  
6 that since we don't have three categories, you are  
7 going to decide whether you need -- for example,  
8 suppose in the application you don't need the hazard,  
9 because the only thing you are worrying about is the  
10 capacity of a large pump.

11 Then if you meet the standard for the  
12 fragility's part, then you can use it, even if you  
13 don't meet the standard for the hazard part. It is  
14 just as simple as that, and I think it is pretty  
15 straightforward.

16 CHAIRMAN APOSTOLAKIS: Does the industry  
17 certification process include external events?

18 MR. BUDNITZ: No.

19 CHAIRMAN APOSTOLAKIS: And do they plan to  
20 use this?

21 MR. BUDNITZ: No, they have made an  
22 informal commitment, and it is not in writing, but  
23 they have said the words; that they will add to the  
24 certification process review requirements that cover  
25 this topic, and also low power shutdown when it comes

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1 along, and also fire when it comes along, so that they  
2 would have the same scope in the end.

3 CHAIRMAN APOSTOLAKIS: Okay.

4 MR. WALLIS: And what about the Section 7  
5 documentation? I found the small print part, the  
6 note, useful, and it deserves bigger print. And we  
7 might even borrow some of your remarks, speaking about  
8 documentation for other purposes, such as thermal  
9 hydraulics.

10 CHAIRMAN APOSTOLAKIS: Are you allowing us  
11 to do this?

12 MR. BUDNITZ: I don't run anything, but it  
13 is my view that if you cite any American National  
14 Standard, as is in anything else, you can do anything  
15 that you want with it. It is a public document, and  
16 you just have to reference where it came from.

17 MR. WALLIS: We have a bit of a struggle  
18 with documentation requirements in other fields, and  
19 not just in this one, and we find that a surprising  
20 reluctance on the part of the originators of documents  
21 to make sure that they are right, and it is  
22 surprising.

23 DR. SEARLE: One is moved to wonder  
24 whether or not the clientele that will use this  
25 standard is any more competent in reading these words

1 than these other people have been decoding similar  
2 remarks.

3 DR. KRESS: I don't think this needs much  
4 decoding. It is pretty clear.

5 CHAIRMAN APOSTOLAKIS: Okay. We have two  
6 minutes. Does anyone have a comment that is of great  
7 significance?

8 DR. KRESS: I think they did a good job.

9 MR. WALLIS: They did a good job.

10 CHAIRMAN APOSTOLAKIS: It is a good job,  
11 but that is not of great significance.

12 (Laughter.)

13 DR. KRESS: For this committee, that is.

14 DR. SEARLE: It is, and actually, George,  
15 I was surprised.

16 CHAIRMAN APOSTOLAKIS: Okay. We don't  
17 even have two minutes because NEI wants to say a few  
18 words. Bob, real quick.

19 MR. BUDNITZ: I need 10 seconds. I just  
20 turned to page 109 as I was turning through.

21 CHAIRMAN APOSTOLAKIS: And you have a  
22 question.

23 MR. BUDNITZ: And in the middle of the  
24 page is two references to Bernard, et al.

25 CHAIRMAN APOSTOLAKIS: Two references to

1 what?

2 MR. BUDNITZ: Bernard, et al, and I want  
3 to tell you that Don Bernard died a month ago, and I  
4 miss him, and I just want to say that I miss him. He  
5 was a terrific guy, and this field we are in is richer  
6 for his work, and I just wanted to say that for 10  
7 seconds, okay?

8 CHAIRMAN APOSTOLAKIS: Thank you. Okay.  
9 Mr. Heymer. Do you want to come sit up front, or --

10 MR. HEYMER: I will just make comments  
11 here, George, and it will be very quick. My name is  
12 Adrian Heymer, and I am project manager at NEI with  
13 the Reg Reform Group.

14 The reason why I am here and some of the  
15 other people aren't is because they are out of town.  
16 The standard has only been out for a couple of days,  
17 and we have got some preliminary feedback. We did  
18 call some people when it came out.

19 We have had some feedback from EPRI,  
20 preliminary feedback, and preliminary feedback from a  
21 couple of the other groups.

22 And that feedback which came in this  
23 morning by a telephone call -- and as I sat here  
24 listening to the presentation, I just wondered if we  
25 were looking at the same documents.

1                   And it may be because when you do a quick  
2 read, you read from the dark side and think the worst,  
3 and have not had time to digest it. But the gut feel,  
4 or at least the initial feel from the industry that  
5 have looked at it is that for reasons best known to  
6 themselves, I guess, judging by the discussions that  
7 have gone on, they feel they are precluded from using  
8 seismic margins approach.

9                   DR. SEARLE: By this?

10                  MR. HEYMER: Yes.

11                  CHAIRMAN APOSTOLAKIS: Why?

12                  MR. HEYMER: They just -- the comment I  
13 got back is that we have invested a lot of time and  
14 effort in seismic margins, and we failed to use this  
15 in a risk informed approach, and we would have to go  
16 to a seismic PRA.

17                  So that is -- and I think that may be a  
18 process of the way that they have read it, and how  
19 they think they might have to apply it. But I think  
20 that might need some interaction, and we will provide  
21 you some comments on that as we will, and there will  
22 be some interaction on that as we go.

23                  CHAIRMAN APOSTOLAKIS: Thank you.

24                  MR. BUDNITZ: Just to say, about 50 plants  
25 did a seismic margin review using the EPRI method. We

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1 wrote these requirements to track the EPRI method. It  
2 is our judgment without knowing in detail that most of  
3 the plants that use the EPRI method will be able to  
4 show that they meet the standard.

5 Now, you don't go any further than that.  
6 If they have a competent margin review, it is our  
7 opinion that we have written the standards so that  
8 they will meet it.

9 Now, once they have met the standard, if  
10 they can't use it, that's not a fault of our having  
11 written the standard to tell them what they did, and  
12 to check it right, I think. In other words, I don't  
13 quite understand the match here.

14 MR. HEYMER: Well, you will have to take  
15 the comment in the sense of people are reading it for  
16 a couple of days, and they need to think about it, and  
17 sit down, and produce some comments, and there is  
18 going to be some industry iteration.

19 Because it was also interesting to note  
20 that the same people that made that comment said now  
21 what would really be good in this standard is if we  
22 had some additional guidance to take the seismic  
23 margins approach further.

24 And that's what I heard you were going to  
25 do anyway. So I encourage you to work on that and

1 incorporate in the standard if you can.

2 MR. RAVINDRA: Can I add one thing to  
3 that?

4 MR. HEYMER: Yes.

5 MR. RAVINDRA: This committee has a  
6 subcommittee that endorsed our earlier draft of the  
7 standard.

8 CHAIRMAN APOSTOLAKIS: I think Adrian made  
9 the point. Thank you.

10 MR. HEYMER: There was a comment on the  
11 uniform hazards spectra, and there was a feeling that  
12 you are asking us to reevaluate that, and verify it,  
13 and there was significant effort and resources  
14 expended in doing that some time ago.

15 And it wasn't clear to the people who were  
16 reading it why we have to go back and reassess that.

17 MR. CHOKSHI: I also got an informal  
18 feedback on that point, and all it needs is a little  
19 bit more guidance and explanation.

20 MR. HEYMER: I think some of the other  
21 points that have been mentioned here have been good.  
22 I think on the plus side, I think the commentary  
23 section, I think if you expand on that, a lot of  
24 people found that very useful and a very good  
25 addition.

1           And there was a lot of positive comment in  
2           that regard. And I guess if we are saying that we are  
3           going to allow seismic margins, or at least not to  
4           cover seismic margins in the standard. And there is  
5           also going to be a section in there on the seismic  
6           PRA.

7           Perhaps we need some insights or some  
8           screening criteria of when one would be appropriate,  
9           and when you should move to a seismic PRA. And that's  
10          about it with regards to the extent of the comments.

11          CHAIRMAN APOSTOLAKIS: Thank you, Adrian.

12          MR. BUDNITZ: Thank you.

13          CHAIRMAN APOSTOLAKIS: Thank you,  
14          gentlemen, very much. This has been very enlightening  
15          and useful, and very friendly. You did a great job.

16          MR. BUDNITZ: Can I ask one further  
17          question?

18          CHAIRMAN APOSTOLAKIS: Yes.

19          MR. BUDNITZ: I have no idea what to  
20          expect. Are you going to consider writing a letter?

21          CHAIRMAN APOSTOLAKIS: Yes, we will  
22          consider writing a letter.

23          MR. BUDNITZ: Thank you. I just didn't  
24          know.

25          CHAIRMAN APOSTOLAKIS: We will recess

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1 until 2:50.

2 (Whereupon, the committee hearing  
3 recessed at 2:33 p.m., and was resumed at 2:50 p.m.)

4 CHAIRMAN APOSTOLAKIS: Okay. The next  
5 issue is Reprioritization of Generic Safety Issue 152,  
6 Design Basis for Valves that Might be Subjected to  
7 Significant Blowdown Loads. Mr. Leitch is our leader  
8 on this. Graham.

9 MR. LEITCH: Dr. Apostolakis, the purpose  
10 of this session is to hear a presentation from the NRC  
11 staff regarding the proposed resolution of generic  
12 safety issue 152.

13 And that issue is the design basis for  
14 valves that might be subjected to significant blowdown  
15 loads. It is of particular interest for HPCI and  
16 RCIC, and reactor water cleanout valves on boiling  
17 water reactors.

18 And the concern was that while the valves  
19 might meet the NRC approved design basis, the design  
20 basis might not address the need for the valves to  
21 close against the differential pressure resulting from  
22 a large sized high energy pipe break.

23 So with those words of introduction, I  
24 will turn it over to Mr. Michael Mayfield, who will  
25 introduce the staff's presentation on this topic.

1 MR. MAYFIELD: Thank you. I am here this  
2 afternoon, and Ken Karwoski, who has recently joined  
3 my division, is going to make the presentation.

4 He is supported this afternoon by Sher  
5 Bhatar, the Chief of the Engineering Research  
6 Applications Branch, and Tom Scarborough from NRR.

7 So we are here to talk about the closeout,  
8 and not just reprioritization of this generic safety  
9 issue. So with that, Ken, why don't you go ahead.

10 MR. KARWOSKI: Good afternoon. My name is  
11 Ken Karwoski, and I will be discussing the staff's  
12 basis for proposing the closeout of generic safety  
13 issue 152 and seek ACRS endorsement on this proposal.

14 Generic safety issue 152 was raised by the  
15 ACRS back in the 1989 time frame, and as a result of  
16 its review of the staff activities related to generic  
17 safety issue 87, which had to do with the failure of  
18 the high pressure coolant injection isolation valves  
19 to close following a postulated pipe break.

20 GSI-87 is closed and it was closed in-part  
21 as a result of industry activities in response to  
22 Generic Letter 89-10 and its supplements, and in  
23 particular Supplement 3 to Generic Letter 89-10.

24 Generic Letter 89-10 focused on the  
25 ability of valves to function as designed. What the

1 ACRS was concerned about though was the adequacy of  
2 that design, were those valves capable of closing  
3 following a postulated high energy line break.

4 In order to understand the staff's basis  
5 for closing out generic safety issue 152, I would like  
6 to spend a few minutes on Generic Letter 89-10. In  
7 the mid-to-late '80s, the Office of Research did some  
8 testing on motor operated valves and identified a  
9 number of valve performance weaknesses.

10 As a result of that, they issued Generic  
11 Letter 89-10, and once again focusing on the ability  
12 of the valves to function as designed.

13 However, as part of that, licensees had to  
14 resurrect what the design basis for these valves were,  
15 and how to dig out the information to say what are  
16 these valves, or how are these valves supposed to  
17 operate, and under what conditions.

18 After the research testing results became  
19 available, the industry also did some additional  
20 testings on motor operated valves. They confirmed a  
21 lot of the problems that were identified in the  
22 research sponsored tests, and as a result of that,  
23 they started to develop working groups and users  
24 groups.

25 And there currently is still a joint

1 owners group addressing valve issues, not only motor  
2 operated valves, but air operated valves. Generic  
3 Letter 89-10 had seven supplements, and those  
4 supplements were -- the first one was issued in '89,  
5 and the last one in 1996.

6 Although Generic Letter 89-10 focused on  
7 the ability of the valves to operate as designed, the  
8 capabilities of the valves, that is, the actual design  
9 basis of the valves, was captured as a result of  
10 industry activities.

11 And the adequacy of the design was  
12 confirmed in part based on NRC inspections performed  
13 in response to 89-10, and confirmed through review  
14 of various documents, including the inspection  
15 reports, FSARs, and other licensee and NRC documents.

16 The NRC inspections did evaluate the  
17 reasonableness of the design pressures. If there  
18 looked like there was an indication where the valves  
19 were not designed to a full differential pressure,  
20 some of those issues were flagged to ONRR.

21 One of the examples that we provided in  
22 our write-up was Big Rock Point, where the valves were  
23 not designed for a full differential pressure, and  
24 ONRR subsequently evaluated those exceptions on a  
25 case-by-case basis and determined that in the case of

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1 Big Rock Point that even though the valves were not  
2 designed for that condition, it was acceptable from a  
3 safety standpoint.

4 Priority focus of many of the early  
5 inspections in response to Generic Letter 89-10 were  
6 the more risk significant valves of HPCI, RCIC and  
7 reactive water cleanup.

8 Although the inspections focused on those,  
9 the lessons learned from the inspections applied to  
10 all motor operated valves, and in some cases applied  
11 to other valve types.

12 The staff briefed the ARCS numerous times  
13 in the 1990s regarding motor operated valves. In  
14 particular, in October of '93, the staff briefed the  
15 ARCS subcommittee on mechanical components, and at  
16 that time the chairman of the subcommittee, who  
17 happened to be the individual that raised the concern,  
18 indicated that he believed that the issue had been  
19 addressed and would recommend closure to that.

20 Subsequent to that, research confirmed  
21 many of the results and analysis presented to the ACRS  
22 at that time, and we confirmed basically that the  
23 actions taken by the licensees and by the industry in  
24 general, that we believed that there was sufficient  
25 evidence to close Generic Safety Issue 152.

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1                   And that concludes my presentation.    If  
2                   there are any questions, I will be glad to try to  
3                   address them.

4                   MR. LEITCH:     So the reason for our  
5                   confidence then is that Supplement 3 to Generic Letter  
6                   89-10 basically focused the industry's attention in  
7                   this area.    The industry did get the message, and  
8                   investigated these valves and corrected them, if  
9                   necessary.

10                  And that was all backed up by NRC  
11                  inspection activities?

12                  MR. KARWOSKI:   Yes.   Basically, although  
13                  89-10 focused on the adequacy or the capability of the  
14                  valves to function as designed, the industry took the  
15                  initiative on their own, and in some cases upgraded  
16                  the design of some of these valves.

17                  So we are confident that those valves are  
18                  capable of operating under a postulated pipe break  
19                  event.   And the industry has and continues to take an  
20                  initiative in MOVs.

21                  There is a periodic valve verification  
22                  program currently underway.   So they have taken those  
23                  lessons, and they continue to apply them, and as they  
24                  identify weaknesses, they improve their programs.

25                  MR. WALLIS:     Can I ask you about the

1 distinction between design and performance? I mean,  
2 you have used the word design a lot. And they may  
3 well be designed to do something. Do they actually do  
4 it?

5 I mean, if they were tested against the  
6 full differential pressure several times, did they  
7 still work?

8 MR. KARWOSKI: In the early days, I think  
9 the early testing indicated that, no, they wouldn't  
10 work under those conditions. As a result of 89-10 and  
11 the work done in response to that, that is where the  
12 licensee said, okay, here is the pressure that I need  
13 to operate against. Do they operate.

14 And that's where -- and so that is the  
15 performance aspect, and that is what the whole purpose  
16 of the 89-10 program was; is do they function as they  
17 were designed.

18 MR. SIEBER: Yeah, but they were relied on  
19 testable prototypes, as opposed to valves in a plant,  
20 in order to establish the relationship between design  
21 and actual performance; is that not correct?

22 For example, there was an industry  
23 program, and they did it in some steam plant  
24 someplace, a coal plant, where they tested prototype  
25 valves of various types in order to see whether the

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1 valve would lock up under these high DPs and high  
2 flows, or how much force it took in order to move the  
3 stem.

4 And a lot of utilities found that the  
5 motors were too small, or the gear trains were wrong.  
6 And then when they changed the gear train, it was too  
7 slow to perform the isolation in the time frame called  
8 for by the safety analysis.

9 Or if they changed the motor and didn't  
10 change the valve, the motor was so strong that it  
11 would drive the valve disk through the bottom of the  
12 valve.

13 Or you would overheat the wiring to it,  
14 and so this was not without a lot of problems. I  
15 presume that in the inspection process that every BWR  
16 was evaluated as to whether they did in fact determine  
17 what the design conditions were, and did it have an  
18 appropriate prototype test to say that their valve was  
19 good or not good.

20 And did either leave things as is, or  
21 change gear trains, motor operators, or the valves  
22 themselves. But that's what I gathered from the  
23 inspection material that I reviewed. Is that correct?

24 MR. KARWOSKI: Tom Scarborough may be able  
25 to add more, but the inspection did look at the

1       reasonableness of the design and focused on valve  
2       factors and whether or not the licensees were  
3       implementing the latest lessons learned.

4               With respect to the actual testing of the  
5       valves, I know that there were some concerns expressed  
6       by licensees regarding the reasonableness to test all  
7       the motor operated valves under postulated pipe break  
8       events.

9               And so in some cases there may be  
10      groupings of valves, where they tried to group valves  
11      in order to limit the amount of testing based on the  
12      limitations in the plant. But Tom may be able to add  
13      more.

14              MR. SCARBOROUGH: Yes. This is Tom  
15      Scarborough. One of the things that you mentioned,  
16      that earlier program on the prototypes. Once they got  
17      89-10, they realized that they needed a better way of  
18      learning more about blowdown flow conditions.

19              And the Electric Power Research Institute  
20      established that multi-million dollar program to do a  
21      number of blowdown tests and develop a first  
22      principle's model to look for blowdown performance.

23              And they found that there were critical  
24      perimeters of the sharpness of the edges, internal  
25      edges, and the clearances, in part in running the

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1 models.

2 And so what happened, especially for the  
3 HPCI, RCIC, a lot of licensees ended up running the  
4 EPRI model, and determining if they had any concerns  
5 regarding performance under blowdown conditions.

6 And then if they did, they would go in and  
7 adjust the internal clearances, or round off the  
8 internal edges to the valve. So that is how they were  
9 able to address performance, because of the definite  
10 concerns of trying to run a test on those type valves.

11 And during the inspections which I  
12 participated in, a large number of them, we did look  
13 at the difference of pressures that they were  
14 assuming, and how they came up with the thrust  
15 requirements for the used valve factors in the EPRI  
16 model, and then what actions did they take to address  
17 those. So those are the types of things that we  
18 looked at.

19 MR. WALLIS: So the assurance that they  
20 will work is based on the fact that they conform with  
21 an EPRI model?

22 MR. SCARBOROUGH: That's part of the  
23 basis. They would run the model, and we would prepare  
24 a safety evaluation on the model, and we evaluated it,  
25 and the licensees would use that as part of their

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1 determination.

2 Some licensees --Comanche Peak, for  
3 example -- actually did run some blowdown tests on  
4 their unit two when they were starting up to get  
5 direct information that they could apply to unit one.

6 So there was some actual test data that  
7 people had, but in a large number of cases it was  
8 using the EPRI model for the blowdown conditions.

9 MR. SIEBER: I guess in an operating plant  
10 you just can't create the conditions necessary to test  
11 the valves without taking a saw and sawing them off.

12 MR. SCARBOROUGH: Right.

13 MR. WALLIS: It is a basic problem, but it  
14 is very difficult to be sure a valve will work without  
15 testing. I mean, you can't just compute, and you're  
16 not always sure it will always do exactly what you  
17 thought it would do.

18 MR. SIEBER: Well, the EPRI models is an  
19 empirical model, and it is based on tests of prototype  
20 valves under a variety of conditions. So it is  
21 probably the best thing that you can do.

22 DR. POWERS: If I recall the SDR on that  
23 model properly, and I may not, my recollection is that  
24 there were questions about the length of upstream and  
25 downstream piping around the valve. Did those get

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1 resolved?

2 MR. SCARBOROUGH: Yes. As part of the  
3 evaluation of the model itself, and adjustments to the  
4 model, this was like a 2 or 3 year process when we  
5 reviewed it, and we were able to resolve those.

6 There were some changes to the model  
7 that were made, and the model, as it turned out, seems  
8 to be reasonable, and it seems to be tracking pretty  
9 well.

10 DR. POWERS: And I further recall that  
11 there were questions about whether the valves being  
12 tested had experienced the kind of aging and  
13 degradation that valves in the plants would have  
14 experienced. Did that issue get resolved?

15 MR. SCARBOROUGH: Right. And in the case  
16 of the Board Warner valves, we were concerned that  
17 there wasn't enough, and so EPRI did add an additional  
18 5 percent margin any time that you are using a Board  
19 Warner valve with the EPRI model.

20 But we did evaluate and thought there was  
21 enough preconditioning of those valves as part of  
22 that, and that was part of our evaluation of what the  
23 model was predicting, and what the actual thrust  
24 requirements were.

25 So we went back and looked at all of

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1 those, and in the final analysis, whether or not we  
2 accepted the model was based on having enough margin  
3 to account for any preconditioning that the valves had  
4 not achieved as part of the test process.

5 DR. POWERS: I guess the question always  
6 arises on how you decide how much margin to ascribe  
7 the phenomena that are of aging and degradation kind  
8 of nature.

9 MR. SCARBOROUGH: And that is part of what  
10 the joint owners group program that Ken mentioned are  
11 doing. Right now they are doing testing of valves in  
12 the plants under flow conditions -- not blowdown, but  
13 flow conditions -- and looking for changes in the  
14 thrust requirements.

15 And at the end of October of 2002, their  
16 five year testing program will be complete, and they  
17 will be preparing an updated report to establish a  
18 long term periodic verification program, with some  
19 potential need for testing either static or dynamic,  
20 but with diagnostics to evaluate that.

21 And one of the things that they are  
22 finding so far is if you open the valve up and do any  
23 maintenance, internal maintenance on the valve, the  
24 thrust requirements drop dramatically immediately.

25 But then they rise back up, and so that is

1 something that had been found during the EPRI testing,  
2 and they are confirming it through the JOG program,  
3 and that will probably be part of their long term  
4 program when they come in in 2002.

5 DR. KRESS: Since the subject of your  
6 report is adequacy of the design basis, I guess your  
7 basic conclusion is that the design basis was  
8 inadequate?

9 MR. KARWOSKI: No, the conclusion is that  
10 the licensees, as a result of 89-10, and the emphasis  
11 on MOVs during the 1990s, that we confirmed that  
12 licensees did design the valves, or the valves are  
13 capable of operating under blowdown conditions.

14 DR. KRESS: With the improvements?

15 MR. KARWOSKI: With the improvements.

16 DR. KRESS: But those improvements didn't  
17 come about because of the design basis?

18 MR. KARWOSKI: Well, you see, that is  
19 where the concern has broken up into two phases; the  
20 adequacy of the design, which is GSI-152, and then the  
21 capability of the valves to function as designed,  
22 which was the focus of 89-10. It is hard to separate  
23 the two, but that's the distinction between the two  
24 points.

25 DR. KRESS: But my conclusion would have

1       been that the design basis was inadequate.

2               MR. SIEBER: In some plants.

3               MR. MAYFIELD: This is Mike Mayfield.  
4       That was the question that was put on the table, and  
5       as I understand from looking and reading that I have  
6       done, and in the briefings that I have had, what the  
7       89-10 determined was that in general things were okay.  
8       And where there were some difficulties, the licensees  
9       had taken action to correct those.

10              DR. KRESS: But they weren't required to?

11              MR. MAYFIELD: They weren't required to.  
12       And as it turns out, the resolution to this generic  
13       safety issue doesn't require any subsequent action on  
14       the part of the staff because the licensees had  
15       already taken that action.

16              DR. KRESS: That is what I was going to  
17       get to; do we need to change the design basis.

18              MR. MAYFIELD: And I think the answer to  
19       that is that when you say design basis, as I  
20       understand it, these were -- did they correctly  
21       estimate how big the opening would be, and had they  
22       fully expected the full break, the full opening break,  
23       downstream in the valve.

24              And in some cases -- and I understand that  
25       the answer to that was no, and they have gone back and

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1 fixed that.

2 MR. KARWOSKI: Or like I mentioned at Big  
3 Rock Point, where they analyzed and determined that  
4 even though they weren't designed for that, that it  
5 was not a safety factor.

6 DR. KRESS: I guess in another world,  
7 where we might be getting new reactors every 3 or 4  
8 months, or something, you would be constrained to go  
9 back and change the rule, or change the design basis.  
10 And under the situation now, you don't have that.

11 MR. MAYFIELD: I don't think it is so much  
12 that they -- I don't know that there is anything that  
13 we would go change other than we would look a lot  
14 harder perhaps at specifics that were included in the  
15 design.

16 MR. KARWOSKI: And I think the concern,  
17 the original concern was for older plants rather than  
18 the newer, because in the newer plants, they are  
19 frequently analyzed for pipe breaks.

20 MR. SIEBER: And the actual requirement  
21 comes from the ASME code does it not, and which says  
22 that under certain conditions you classify this as a  
23 high energy line, and if you need to be able to  
24 isolate it, as opposed to someplace in a rule or a reg  
25 guide saying that.

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1                   So if you endorse the code, and you have  
2                   a code book plant, the requirement is embedded in your  
3                   license, in your FSAR.

4                   MR. KARWOSKI: But also from a practical  
5                   standpoint, if a licensee says they are going to  
6                   operate this system in this fashion, and it calls for  
7                   the valve to close -- and this was part of the 89-10  
8                   review --

9                   MR. SIEBER: Right.

10                  MR. KARWOSKI: -- they have to show that  
11                  the valve is in fact capable of doing that.

12                  MR. SIEBER: Of closing.

13                  MR. KARWOSKI: Because they were supposed  
14                  to review the procedures and determine under what  
15                  conditions the valves were expected to operate.

16                  MR. WALLIS: It is a little tricky,  
17                  because your are asked to demonstrate that a valve  
18                  will do something which it never does, and so you  
19                  never have a realistic test really in the plant.

20                  So it must be rather difficult to give  
21                  such conclusive proof when this thing has been sitting  
22                  there all this time, and it is always going to work  
23                  when it is called upon to work when it never does it  
24                  routinely.

25                  MR. KARWOSKI: That's correct, but that's

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1 the purpose for the testing and the monitoring, to  
2 provide you added assurance. And there is in most  
3 cases redundancy.

4 MR. WALLIS: But then you don't test  
5 something that has been sitting in the plant for 10  
6 years.

7 MR. SIEBER: I think that 89-10 requires  
8 licensees to commit to periodic testing.

9 MR. WALLIS: At full pressure.

10 MR. SIEBER: Well, to test the torque  
11 requirement and the stem factor, and so on, and that's  
12 what MOVATS and MOVs, and all those are required to  
13 do.

14 MR. SCARBOROUGH: The new Generic Letter  
15 96-05, which is sort of the follow-on of 89-10, is the  
16 periodic verification, and that is part of the joint  
17 owners group program; is that now that they have  
18 established the design basis capability for these  
19 valves, how do we monitor them and make sure that we  
20 don't have degradation.

21 And those programs have in place where  
22 they use diagnostic testing, and there is a dynamic  
23 diagnostic testing program going on to look for areas  
24 of degradation.

25 And then they are going to have an ongoing

1 static diagnostic, with possible some dynamic  
2 diagnostic testing in the future. So they have a  
3 program established to look for that type degradation.

4 MR. LEITCH: Any further questions?

5 MR. WALLIS: Why do valves stick?

6 MR. SIEBER: Packing glands dry out and  
7 operators pull up on the nuts. They rust.

8 MR. KARWOSKI: And pressure locking from  
9 a binding.

10 DR. KRESS: The perversity of nature.

11 MR. WALLIS: Maybe small leaks that build  
12 up oil or something?

13 MR. SIEBER: No, that's the BWR.

14 MR. WALLIS: So if you knew why they  
15 deteriorated, you could specifically look for those  
16 things?

17 MR. KARWOSKI: That is correct, whether it  
18 be the grease deteriorating or whatever, correct.

19 MR. UHRIG: Isn't most of that done with  
20 signature analysis in the testing?

21 MR. SCARBOROUGH: Yes. Now a lot of the  
22 plants use stem mounted string gages for a direct  
23 measure of the torque and thrust. But in the future,  
24 especially for the low risk valves, they are looking  
25 for a motor control center improvements in that area

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1 that have been made in the last 2 or 3 years, which  
2 are quite dramatic.

3 And which they can actually get a good  
4 impression of what the thrusts are that are coming out  
5 of the motor, and so there are a lot of improvements  
6 in that area that they are looking for as well.

7 MR. LEITCH: Okay. Any other comments or  
8 questions?

9 (No audible response.)

10 MR. LEITCH: Thank you.

11 MR. KARWOSKI: Thank you.

12 MR. LEITCH: Dr. Apostolakis is away from  
13 us for a few minutes. I think the next thing on the  
14 agenda is writing reports.

15 DR. POWERS: Fortunately, FACA prevents  
16 you from starting anything until it's time.

17 MR. LEITCH: So let's adjourn until four  
18 o'clock then.

19 (Whereupon, the meeting was concluded at  
20 3:15 p.m.)

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This is to certify that the attached proceedings  
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