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ORIGINAL

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Thermal-Hydraulic Phenomena and Reliability
and Probabilistic Risk Assessment
Subcommittees

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
JOINT MEETING OF THE
MATERIALS AND METALLURGY, THERMAL-HYDRAULIC
PHENOMENA AND RELIABILITY AND PROBABILISTIC
RISK ASSESSMENT SUBCOMMITTEES

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THURSDAY

NOVEMBER 15, 2001

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ROCKVILLE, MARYLAND

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The ACRS/ACNW Joint Subcommittee met at
Nuclear Regulatory Commission, Two White Flint North,
T2B3, 11545 Rockville Pike, at 8:30 a.m., William J.
Shack, presiding.

SUBCOMMITTEE MEMBERS:

WILLIAM J. SHACK	Chairman, ACRS
DR. THOMAS S. KRESS	Co-Chair, ACRS
DR. DANA POWERS	Member, ACRS
MR. MARIO V. BONACA	Member, ACRS

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1 ACRS STAFF PRESENT:

2 Mr. Michael T. Markley, ACRS

3

4 ALSO PRESENT:

5 Mr. Ralph Meyer

6 Mr. Steve Bajorek

7 Mr. Norm Lauben

8 Ms. Carolyn Fairbanks

9 Mr. Alan Kuritzky

10 Ms. Mary Drouin

11 Mr. Tom King

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

8:31 a.m.

CHAIRMAN SHACK: The meeting will now come to order, the Joint Meeting of the Subcommittees on Human Factors and Safety Research Program, previously scheduled for today, has been postponed. This is a joint meeting of the Advisory Committee on Reactor Safeguards, Subcommittees on Materials and Metallurgy, Thermal-Hydraulic Phenomena and Reliability and Probabilistic Risk Assessment.

I am William Shack, Chairman of the Subcommittee on Materials and Metallurgy. Graham Wallis, Chairman of the Subcommittee on Thermal-Hydraulic Phenomena and George Apostolakis, Chairman of the Subcommittee on Reliability and PRA were unable to attend this meeting, and we are proceeding with this meeting on their behalf.

The Subcommittee members in attendance are Mario Bonaca, Thomas Kress and Dana Powers. The purpose of this meeting is to discuss the status of NRC staff and industry initiatives to risk-inform the technical requirements of 10 CFR 50.46 for emergency core cooling systems for light water nuclear power reactors.

The subcommittees will gather information,

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1 analyze relevant issues and facts and formulate
2 proposed positions and actions as appropriate for
3 deliberation by the full Committee. Michael T.
4 Markley is the cognizant ACRS staff engineer for this
5 meeting.

6 The rules for participation in today's
7 meetings have been announced as part of the notice of
8 this meeting previously published in the Federal
9 Register on November 6th, 2001. A transcript of the
10 meeting is being kept and will be made available as
11 stated in the Federal Register Notice.

12 It is requested that speakers first
13 identify themselves and speak with sufficient clarity
14 and volume so that they can be readily heard. We have
15 received no written comments or requests for time to
16 make oral statements from members of the public
17 regarding today's meeting.

18 I guess we're going to hear an update from
19 the staff on some of the technical work they've been
20 doing to support the rulemaking for changes, and I see
21 Tom King is in attendance here, and I'd like to note
22 this is probably one of the last times we're going to
23 get to see Tom at a subcommittee meeting, since he's
24 going on to retirement.

25 We certainly enjoyed having you for many

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1 extended discussions.

2 MR. KING: Thank you, but you know, you
3 may see me again. So don't be too optimistic over
4 there.

5 DR. POWERS: Well, in light of his
6 advancing years, should we get him a bottle of Geritol
7 or something like that?

8 CHAIRMAN SHACK: Well, that's one of the
9 politer bottles that you buy.

10 MR. KING: I'll take a bottle. It doesn't
11 have to be Geritol, though.

12 (Laughter)

13 CHAIRMAN SHACK: Since I don't see Mark
14 Cunningham, we'll assume that Tom King is going to
15 speak to --

16 MR. KING: Yes. We were going to provide
17 the status report on where we stand at this point.
18 You know, the SECY paper was out. We've not received
19 an SRM yet from the Commission, but we're proceeding
20 as if we're going to go forward with the rulemaking,
21 that the Commission's going to approve proceeding.

22 We're doing the technical work to see what
23 would that rulemaking look like. Today's meeting is
24 to provide you a status report on the options and
25 issues that we're dealing with in doing that technical

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1 work and try and solicit some at least informal
2 feedback from the subcommittee on questions, views,
3 concerns you may have.

4 So with that, I'll turn it over to Mary
5 and the others who are going to give the presentation.

6 DR. POWERS: Tom, is there anything going
7 on that you might call Option 4, which would be the
8 complete reexamination of the regulations?

9 MR. KING: The short answer is, yes, there
10 is. There's a meeting this afternoon where NEI is
11 going to come in and give us their views on this clean
12 sheet of paper approach for -- particularly directed
13 toward future plants.

14 DR. POWERS: Yes.

15 MR. KING: We owe the Commission a paper
16 in June of '02 with our recommendations on whether or
17 not to proceed to do that, and if so, what are the
18 options. And if we can, what's our recommended option
19 for doing that.

20 So there is some work underway. This is
21 clearly as a policy question. The Commission's going
22 to have to make a decision and our target date is June
23 to get them something.

24 DR. POWERS: I think we might want to
25 alert the Planning and Procedures Committee that it

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1 sounds like in the April, May, June time frame that we
2 ought to try to help staff where we can on the
3 development of that paper.

4 MR. KING: Yes. I think I -- in fact, I
5 ran into Med in the elevator and I said we need to sit
6 down and schedule several meetings with subcommittees
7 and the full committee, PBMR, GTMHR.

8 DR. POWERS: Is it the type of thing, Tom,
9 where we ought to have sort of an ad hoc committee?
10 I mean, it doesn't really fit within any of the
11 existing subcommittee structures. What I'm fishing
12 around for is how to be most helpful to you and not a
13 pain in the neck on this, because this is not a lot of
14 time to prepare that paper.

15 MR. KING: Yes. The idea of the paper is
16 to look at the pros and cons, look at the options,
17 give the Commission a recommendation. But assuming
18 the recommendation is to go forward, we also want to
19 give them at least a conceptual idea of what this new
20 clean sheet of paper approach would look like, so at
21 least they know what they're being asked to approve.

22 DR. POWERS: Yes.

23 MR. KING: So there is some technical work
24 that goes along with this.

25 DR. POWERS: Sure; sure. And we may want

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1 to pursue that a little bit in December just to line
2 out schedules and things like that, from our own part.

3 MR. KING: Okay.

4 MS. DROUIN: We ready?

5 CHAIRMAN SHACK: Yes.

6 MS. DROUIN: My name's Mary Drouin, with
7 the Office of Research.

8 MR. KING: Who?

9 (Laughter)

10 MS. DROUIN: Cute, Tom.

11 DR. POWERS: Are you related to the
12 outstanding individual that produced the ITE Insights
13 Report that has had such a tremendous impact?

14 MS. DROUIN: Yes.

15 DR. POWERS: Okay.

16 MR. KURITZKY: We'd just like to get you
17 off to a good start.

18 (Laughter)

19 MS. DROUIN: And I greatly appreciate
20 that; really, I do. Before we get started we'll go
21 around and let everyone at the table introduce
22 themselves.

23 MR. MEYER: I'm Ralph Meyer, from
24 Research.

25 DR. POWERS: Are you new in this?

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1 MR. MEYER: What?

2 DR. POWERS: Are you new in this
3 organization?

4 MR. MEYER: Lots of jokes this morning.

5 MR. KURITZKY: I'm Al Kuritzky. Work with
6 Area Branch.

7 MR. BAJOREK: Steve Bajorek, Research.

8 MS. FAIRBANKS: Carolyn Fairbanks,
9 Research with the Materials Engineering Branch.

10 MR. LAUBEN: Norm Lauben. I'm very new,
11 about 30, 40 years.

12 CHAIRMAN SHACK: Yeah, I know; I know.

13 DR. POWERS: Well, you know, as a rookie
14 trainee, maybe you'll listen to these experienced
15 hands and, you know, get some insights here.

16 MS. DROUIN: Okay. I think the last time
17 that we were in front of the subcommittee on 50.46,
18 the Option 3 part, was back in the summer as we were
19 writing our SECY paper.

20 And at that time, you know, we made the
21 commitment to maintain contact throughout the program
22 and solicit input and feedback from the committee as
23 we move forward. There are a lot of issues associated
24 with risk-informing 50.46.

25 So we did want to come in at this point,

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1 since we have been proceeding with the technical work.
2 We had said in the SECY to the Commission that we
3 would not wait on the SRM to continue with the
4 technical work. We were going to move forward.

5 The rulemaking aspect, though, is
6 contingent upon when the SRM comes out. So we've had
7 about four months behind us in proceeding forward, and
8 we thought it was very timely at this point to give
9 you, you know, our status, what our -- kind of our
10 early thinkings are and issues we may have come
11 across.

12 So I'm not going to spend a lot of time
13 going through the background. We'll just quickly, you
14 know, refresh your memory of what our changes were,
15 what our recommended changes were to the Commission on
16 50.46.

17 We primarily are going to focus on the
18 technical work that we've been doing in support of the
19 recommended changes we made to the Commission and then
20 quickly go over what our schedule is at this point.

21 Again, primary purpose for being here is
22 to solicit feedback from the committee and comment,
23 one, on our overall approach because we're still --
24 have not quite solidified our approach. We are
25 converging on it and we thought, again, this would be

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1 a good time.

2 We are encountering some, you know,
3 technical and implementation issues that we wanted to
4 bring to your attention and still, on some of our
5 recommended changes, whether we still feel that
6 they're feasible or not.

7 At this point, of course, we're not
8 requesting any letter from the committee. On the
9 background, you know, starting way back with SECY-300,
10 which instigated the program, 264-R Plan, 86 and 198
11 were two different updates of the framework.

12 198 gave our recommendations for 50.44,
13 and then our most recent SECY 133, which provided our
14 recommendations for risk-informing 50.46. Now, I'll
15 personally use the term "50.46," and when I use it, I
16 use it loosely.

17 It encompasses Appendix K and also GDC 35.
18 This here shows in a figure, an overview of 50.46,
19 plus Appendix K and GDC 35. I think it's a good
20 breakdown of the regulation in terms of how the
21 different requirements are grouped.

22 When you come over from the right -- or
23 from the left to the right, sorry. I still haven't
24 learned my left from my right yet. And you look at
25 the requirements, they tend to be divided up into what

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1 we call these four functional groups.

2 The first one we're looking at the ECCS
3 reliability. Now, of course, when you look at the
4 50.46 and Appendix K, you're not going to see the word
5 "reliability" there, but for example, when you look at
6 GDC 35 and you look at the single failure criteria
7 requirement and the LOCA/LOOP, what that in essence
8 does in an indirect way of sitting with the
9 reliability of the ECCS as is.

10 So we have those requirements and this box
11 actually says what the technical requirements are.
12 The next LOOP tend to deal with the acceptance
13 criteria of the emergency core cooling system. The
14 next group is the evaluation model.

15 And finally, the last one is dealing with
16 the LOCA break size. And it's those different groups
17 that in 133 that we made recommendations to. Now,
18 when we go back to 133 we had two sets of
19 recommendations.

20 We had some that we called short-term
21 considerations and we had those that we considered
22 long-term. The short-term considerations dealt with
23 those first three boxes, looking at the ECCS
24 reliability, looking at the acceptance criteria and
25 the evaluation model.

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1 In terms of the acceptance criteria in the
2 evaluation model, those we were going in and making a
3 recommendation to put a permanent change right into
4 the rule. That change would, though, be voluntary.
5 So it would be entered in through like an "or" gate.

6 Then an alternative to that would be an
7 alternative on the reliability side, and that is
8 dealing with GDC 35. We thought we could do those in
9 the short-term, and the technical work that we had
10 proposed on the short-term would be finished in the
11 April and July time frame of 2002.

12 On the long-term considerations we felt
13 there was still a lot more work done even to determine
14 if the feasibility was doable. And so we were looking
15 at the outside, two to three years to just finish the
16 feasibility study.

17 And again, in doing anything that -- in
18 terms of looking at Option 3, part 50, we have our
19 framework document which sets the guidelines and rules
20 of how we make the decisions that we make.

21 So at this point we're going to get right
22 into the technical work we were at, and we're going to
23 start first with the acceptance criteria in the
24 evaluation model, and so I'm going to turn it over to
25 Steve Bajorek.

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1 MR. BAJOREK: Okay. Thank you, Mary.
2 Want to just slide over?

3 MS. DROUIN: Want us just to change it for
4 you?

5 MR. BAJOREK: Well, no. Let me --

6 MS. DROUIN: Okay.

7 MR. BAJOREK: -- let me just kind of
8 introduce what we're going to do next. The next
9 segment should be in a package that we just handed
10 out. We have three presentations in this. We're
11 going to start off with Norm Lauben.

12 He's going to talk about revisions to the
13 decay heat standard, how we deal with the
14 uncertainties. I'm going to talk about the use of the
15 evaluation models and the impact that may have on how
16 we do those analyses.

17 And Ralph Mayer is going to talk about the
18 50.46 performance-based criteria, and I think also
19 deal with a couple of cladding-type of issues that
20 have been brought up before. But Norm.

21 MR. LAUBEN: Yes. Let's see.

22 MR. BAJOREK: How's the --

23 MR. LAUBEN: I was happy to sit here, if
24 you want to change the slides for me.

25 MR. BAJOREK: Give me your --

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1 THE REPORTER: Mr. Lauben, can you use the
2 microphone there?

3 MR. LAUBEN: Yes. I'll tell you what.
4 Why don't you move over a chair. Then I can just use
5 this microphone. And as long as I don't hit anyone in
6 the eye, I can use my laser beam.

7 MS. DROUIN: High tech. You might set a
8 fire.

9 MR. LAUBEN: Yes, right.

10 Carolyn, you may want to get out of the
11 way.

12 (Laughter)

13 MR. LAUBEN: Okay. Let's see. Yes,
14 that's -- let's see. This is what we're talking
15 about. That's who you are and that's who I am. So we
16 can go to the next slide. The real context for this
17 is going to be in Steve's presentation.

18 So mostly what I'm going to talk about are
19 the decay heat standards and their uncertainties and
20 some of the issues that we have uncovered with respect
21 to them, and how that all fits. But the context in
22 terms of conservatism and so forth is really, really
23 in Steve's presentation.

24 But so the hard part is to come after my
25 presentation, I hope, unless you all have questions

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1 that I'm not expecting. Okay. This is just kind of
2 a review, first of all.

3 10 CFR 50.46 and Appendix K was
4 promulgated in '74, required the use as a draft, '71
5 ANS decay heat standard with a multiplier of 1.2 and
6 the assumption of infinite operating time for use in
7 ECCS evaluation models.

8 It's very simple. The '71 standard did
9 virtually have a curve with a table of uncertainties
10 that we chose 1.2 out of, and the assumption of -- you
11 could have finite operating time if you wanted to do
12 summation calculations, but we chose infinite
13 operation, which made the '71 standard very simple to
14 implement.

15 It was not -- there was no difficulty at
16 all in that. Anyway, number one, the research and
17 analysis since 1973 has shown that the most
18 significant conservatism in Appendix K is the decay
19 heat requirement.

20 The 1988 ECCS rule change allowed use of
21 a realistic evaluation model analysis option with an
22 uncertainty evaluation. In other words, instead of
23 using the conservative Appendix K, now you can use the
24 best estimate option.

25 So there's always two choices. One is the

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1 best estimate option that was allowed since 1988. The
2 other was the Appendix K conservative option which was
3 the only option from 1974 to '88. But then after '88
4 it was still grandfathered. So licensees still have
5 a choice today of whether they want to use the best
6 estimate option or the Appendix K option.

7 Regulatory Guide 1.157, which accompanied
8 the '88 rule change, declared the acceptability of
9 using the '79 ANS decay heat standard for a realistic
10 option.

11 It said there's a few more physical things
12 that you need to consider, such as neutron absorption
13 efficient products and things of that sort. So it
14 says it's now become a little bit more complicated.

15 The '79 option now has three isotopes --
16 fissionable isotopes that you have to worry about, not
17 just one. So it's now more complicated. It has three
18 different ways of applying the standard. You can use
19 summation calculations -- excuse me.

20 Yes. You can use a summation calculation
21 for groups of decay products and you can also use some
22 integrated values for post-fissions, or you can use
23 integrated values for infinite decay heat and a
24 summation methodology where you can change that
25 infinite irradiation into finite irradiation.

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1 So there's lots more choices that you have
2 to use when you start to use the '79 or then
3 eventually the '94 option. But okay. Regulatory
4 Guide 1.157 only applies to the best estimate option.

5 That Regulatory Guide does not apply to
6 Appendix K. Appendix K is self-standing. There's no
7 regulatory guides associated with it today or in the
8 past. It's just -- it's self-standing. You abide by
9 those rules and that's it. So 1.157 applies to the
10 best estimate option.

11 There's nothing to prevent a licensee or
12 an applicant from using all or part of an even newer
13 standard, the 1994 decay heat standard today, if you
14 want to, because there's no -- there are -- there's
15 really no requirements to -- as it says in the second
16 bullet.

17 The only technical requirement in the
18 realistic option has to do with the things that Mary
19 has addressed, i.e., the break spectrum in GDC 35.
20 Otherwise -- and those things apply to both the best
21 estimate and the realistic option. Okay. Back to --

22 CHAIRMAN SHACK: The current best estimate
23 models have been improved and they're really based on
24 the '74 guide or --

25 MR. LAUBEN: No. No. No. No. No. No.

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1 No. No. No. No. Oh, excuse me. No. No. No.
2 What I said was that Reg. Guide 1.157, that's the
3 guidance as to what's acceptable to the staff with
4 respect to the best estimate option.

5 The best estimate option in 50.46 doesn't
6 say very much. It says, do a best estimate with a
7 high degree of certainty that your peak clad
8 temperatures won't exceed the limit. That's really
9 what it says, or that the criteria won't be exceeded
10 with a high probability. That's really all it says.

11 DR. KRESS: Does it explicitly call out
12 95.95?

13 MR. LAUBEN: No, it does not. That's
14 called out -- the 95 percent probability is called out
15 in the Regulatory Guide.

16 DR. KRESS: Yes, okay.

17 MR. LAUBEN: Not in the rule. The rule
18 doesn't say anything about that. The rule just says,
19 high probability that the criteria won't be exceeded.
20 You have to go to the Reg. Guide before you first see
21 the words, "95 percent" used.

22 DR. KRESS: So if somebody wanted to, they
23 could come in with less confidence level if they could
24 justify it?

25 MR. LAUBEN: If they could justify it.

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1 DR. KRESS: Had a reason for it?

2 MR. LAUBEN: That's true of any regulatory
3 guide. You don't have to abide by a regulatory guide.
4 You can -- it's something that's acceptable to the
5 staff, but if you want to do something else, risk the
6 prolonged review that would be required for something
7 that's not in a regulatory guide, you can do it.
8 That's the rules.

9 DR. KRESS: Okay.

10 MR. LAUBEN: So at any rate, the
11 Regulatory Guide's been in place since '88 for best
12 estimate option. And it did say that the '79 standard
13 was acceptable. That's because the Regulatory Guide
14 came out in '88.

15 The '94 standard wasn't available at the
16 time, obviously. Okay. The last bullet. The '94
17 ANS-5 standard is potentially more accurate and less
18 conservative than the '71 draft standard, but requires
19 more choices to be specified by the user, as I
20 mentioned.

21 Instead of three fissionable isotopes, the
22 '94 standard has four fissionable isotopes. Still a
23 lot more than the one that was implied by the curve
24 that was in the '71 standard. So there's much more to
25 be -- choices that you have to make when you're using

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1 the more modern standards.

2 More choices in '94 than there was in '79,
3 and certainly, many, many more choices than you had to
4 make from '71 standard. In fact, the '71 standard had
5 so few choices that the options could be contained in
6 two or three sentences in Appendix K.

7 Okay. If NRC makes it -- okay. Here's
8 the problem. You have a lot of choices now that you
9 have to make with the '94 standard, if you want to use
10 that. So the question is, who's going to make the
11 choices?

12 If NRC makes the choices ahead of time,
13 that may make life easier, but it also means that we
14 would have to make choices that would conservatively
15 bound any number of things that you have to consider
16 when you're applying the decay heat standard.

17 So let's see. What is -- let's see. If
18 NRC makes a choice -- yes, right. Okay. Anyway, if
19 NRC makes the choices, however, it's likely to make
20 the process more predictable and stable.

21 That is, if the choices are made at a time
22 by the NRC, no one argues with them, then there's no
23 -- there's very little potential for review, now, when
24 somebody comes in and says, I'm applying the '94
25 standard and here are the things that I choose to

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1 implement out of that standard.

2 If each applicant or licensee selects the
3 options, then obviously, there's a lengthy review
4 process involved. Okay. Now, here are --

5 CHAIRMAN SHACK: Is there really a lengthy
6 review process? I mean, is it --

7 MR. LAUBEN: Yes, there could be. It
8 depends on -- it would depend on how the licensee or
9 applicant came in and decided to implement the
10 standard. He may be very -- he may want to get a lot
11 out of this, so he may be very tight in how he defines
12 his operating cycles, because that's one of the things
13 that you have to choose in here.

14 Or he may want to do a bounding histogram
15 that he could have, in which case it might not be. It
16 just depends on how much margin he's trying to shave
17 by using it, and that's the point of us making some of
18 these choices first.

19 And I can go through -- these are the six
20 that I identified as being the most important choices
21 that you have to make. Operating time. Well, in the
22 old standard infinite operating time is easy.

23 That's conservative. It's easy to use.
24 It actually reduces -- it reduces the complexity of
25 your uncertainty analysis. It makes life very easy

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1 and it's obviously a conservative assumption, too.
2 But like I say, if you wanted to use a bounding
3 histogram of operating cycles, you could do that.

4 But if it was tightly bound then you may
5 run the risk of it doesn't apply to the next cycle of
6 operation or something like that. And that's part of
7 the problem, how tightly do you want to do this?

8 You going to leave it up to the individual
9 licensees or are you going to leave it up to -- or
10 should the NRC decide ahead of time? Part of the
11 reason I'm bringing this up is that -- and we didn't
12 mention this, but there was a petition by NEI to use
13 the '94 standard, just use it.

14 Well, they didn't say how they would use
15 it. They just said use it. So that -- the
16 implication is not clear. Do you mean for the NRC to
17 make choices ahead of time, or do you choose to come
18 in and make your own choices?

19 And if you're going to make your own
20 choices and each licensee makes a different choice,
21 then it does increase the potential for review.

22 CHAIRMAN SHACK: Let me put the question
23 a different way. You know, suppose you're just using
24 this to determine that decay heat --

25 MR. LAUBEN: That's all --

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1 CHAIRMAN SHACK: -- that seems to me one
2 question. Well, is in fact -- I mean, do you feel
3 that your calculation of decay heat is now covering
4 some other non-conservatism somewhere else? I mean,
5 that would seem to me --

6 MR. LAUBEN: Yes.

7 CHAIRMAN SHACK: -- the difficult thing to
8 assess when you're trying --

9 MR. LAUBEN: Indeed

10 CHAIRMAN SHACK: -- to trade these off.

11 MR. LAUBEN: Indeed.

12 CHAIRMAN SHACK: Just looking at the decay
13 heat --

14 MR. LAUBEN: Yes.

15 CHAIRMAN SHACK: -- by itself I would
16 think --

17 MR. LAUBEN: Yes. Yes.

18 CHAIRMAN SHACK: -- looking at these would
19 be a relatively straightforward thing.

20 MR. LAUBEN: Relatively straightforward
21 thing. I agree. And Steve's going to address the
22 other part.

23 CHAIRMAN SHACK: Right. Okay.

24 MR. LAUBEN: I left the hard stuff for
25 him. But indeed, you're right. It should be

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1 relatively straightforward, but the point is, even --
2 there are still some issues that need to be addressed,
3 just to do the straightforward part.

4 And that's what I'm attempting to address
5 here, that in the petition there was no mention of how
6 you even deal with the straightforward part. So I
7 bring these issues up here. I've brought them up in
8 a couple public meetings in the past, but there didn't
9 seem to be as much interest then, however. Okay.

10 Okay. Second one, fission fractions per
11 isotope. Well, this requires some -- okay. Well,
12 like I said, the '71 standard assumed ^{235}U only. Three
13 additional isotopes in the '94 standard; fission
14 fractions vary with time and space.

15 You need a physics calculation to
16 determine what those fission fractions are for each
17 isotope. They vary with time. They vary with space.
18 They're burnup dependent and enrichment dependent.

19 So it's not -- you know -- it's not a
20 straightforward thing. You can make simple choices,
21 simple bonding choices like all ^{235}U . That's a simple
22 bonding choice. Okay.

23 Neutron capture. This effect was added in
24 '79 and '94. The effect is burnup dependent and adds
25 to the decay heat. There's also some uncertainty in

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1 it, although the amount is low until you get up to
2 beyond the times of interest that I think we're
3 interested in, like 10,000 seconds or so.

4 However, it's still something that needs
5 to be considered and addressed, and you can choose
6 times that are very high and then, you know, you're
7 conservative, because it's a T to the fourth effect in
8 the equation. It's there for neutron capture.

9 Okay. Fission energy. Each fissionable
10 isotope has different recoverable fission energies.
11 The standard in the past has always been to shoot 200
12 MEV per fission, because that's conservative. You can
13 actually reduce conservatism by using higher values
14 because that number appears in the denominator.

15 So you can, if you can justify it, choose
16 other numbers for other fissionable isotopes. So
17 that's another choice you have to make, or somebody
18 has to make, either the NRC ahead of time or the
19 licensees or whoever.

20 Okay. Actinide heavy element decay. The
21 same basic equations are in all three standards for
22 actinide decay. However, required ²³⁵U fission yield
23 is not specified and is burnup dependent. It was not
24 even specified in the '71 standard -- excuse me -- it
25 wasn't even specified there.

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1 It was assumed I think that the value was
2 .7, but I don't -- you can -- I can't find the
3 documentation of it anywhere. In the examples in the
4 '79 and '94 standard I think it was like .7. There
5 are codes that use a default value of one. But the
6 point is, it's another choice to be made.

7 Okay. Tabular data. As I think I
8 mentioned earlier, there are three tables now for each
9 fissionable isotope, four fissionable isotopes. That
10 means you have 12 tables. You have 12 tables you can
11 go to and that depends on your method that you choose
12 to evaluate the decay heat.

13 That's quite different than just one table
14 that you had in the previous '71 standard. Okay. So
15 those are the key choices you have to make. At least
16 -- like you say, they're not -- they don't have to be
17 that difficult.

18 They can be chosen in a bounding way, but
19 if you want to reduce your conservatism you may not
20 want to make them quite as bounding as somebody else
21 might want to make them. Okay. So that's it. I
22 guess we can go to the next slide, then.

23 Okay. The issue here is uncertainty and
24 conservatism. Well, as we all know, now that we have
25 a decay heat standard that has many more variables in

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1 it, your uncertainty analysis becomes a different
2 issue than it did before.

3 There are RMS equations or something like
4 that, that you have to go through and use to determine
5 your overall uncertainty in this. There are
6 uncertainties with two of the table types, the post-
7 fission type and the infinite irradiation tables, that
8 could be used.

9 They're different because they come out
10 with different values when you do this. But in
11 addition to the uncertainties in those tables for
12 those methods, you now have to look at other
13 uncertainties like uncertainties in power, or any of
14 the other variables that we're talking about,
15 uncertainties in fractions of fissionable isotopes.

16 So all these things now have
17 uncertainties, uncertainties in neutron absorption.
18 What if -- although the standard says, don't bother
19 doing that because we've picked conservative values
20 for you. So but the point is how to deal with
21 uncertainties now becomes an issue.

22 It wasn't an issue before, but how to
23 combine them and deal with them does become an issue.
24 There are equations in the standard, however. Let's
25 see. Let me see. I don't want to get ahead of myself

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1 here.

2 Okay. Oh, yes, okay. Let me not get
3 ahead of myself then. Okay. Bullet number 3 here.
4 Use of the '94 standard with nominal inputs and
5 uncertainties could result in a substantial reduction
6 of overall conservatism in the Appendix K analysis.

7 And number 4, thus the magnitude of one or
8 more non-conservatisms is too large. If it is, the
9 appropriate overall conservatism may be in jeopardy.
10 I think this is Steve's presentation. I'm jumping the
11 gun a little bit.

12 But the point is here, is that if you now
13 reserve the conservatism in your analysis you now have
14 to worry about those other things that create
15 uncertainties in your analysis that you didn't have to
16 worry about before, because you don't have a bounding,
17 conservative -- it may be in jeopardy.

18 Let me just say that. It may be in
19 jeopardy. Okay. The current version of Appendix K
20 makes no break size distinction concerning application
21 of the decay heat requirement. Longer transients,
22 such as small breaks, would derive substantially
23 larger benefit from a reduction in decay heat,
24 compared to faster large breaks.

25 Large breaks, some of them, depending on

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1 -- depending on a particular plant that you're looking
2 at, some large breaks can be over so quickly, peak
3 clad temperature can turn around so quickly, that it's
4 virtually a stored energy issue and not a decay heat
5 issue.

6 So large breaks that turn around quickly
7 are going to be -- are not going to be decay heat
8 dominated the way some small breaks that may be
9 uncovered, albeit later, for a longer period of time
10 become much more decay heat dominated.

11 Among the required features of Appendix K,
12 decay heat is the only one, except for the ones that
13 Mary talked about, i.e., the break size and the GDC 35
14 types of things. The only thing that really applies
15 to small breaks in Appendix K specifically is decay
16 heat.

17 Or let me put it this way, largely. There
18 are some other things that can influence it, too, but
19 I mean it's by and large virtually the entire
20 predominant feature of Appendix K, is decay heat for
21 small breaks.

22 Okay. RES is evaluating -- okay. Number
23 5 -- or 6. This may be somewhat new. We are
24 evaluating potential errors in the uncertainty methods
25 in the '79 ANS and '94 standards. Therefore, previous

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1 sensitivities may not be appropriate.

2 Some of our assessments before -- the
3 uncertainties -- in other words, some of the
4 equations, I don't want to say for certain that
5 they're wrong, but I've had a number of physicists and
6 statisticians tell me that they are.

7 But wrong may not be a good adjective. It
8 may be that they were -- that they used methods that
9 were designed to enhance the uncertainty, and that it
10 has to be looked at more carefully. I think in fact
11 we've talked with the ANS Standards Subcommittee on
12 this subject and they -- those members agree also.

13 They believe that this should be fixed.
14 So our choice is either to convene a group of experts
15 under ANS and work this through or make the exceptions
16 ourselves. I tend to -- would tend to prefer to work
17 this through the ANS committees.

18 I think that's a better way, get a new
19 standard out which everyone agrees on these
20 methodologies and so forth. So that's something, like
21 you say, not necessarily that difficult to do, but
22 still something that you sort of need to establish
23 your baseline by doing these straightforward things
24 first.

25 And I think that's what we -- so that's

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1 what we mean when we say, number 7, we're going to do
2 some additional work. We need to get some of these
3 things straightened out.

4 And now, as I said a couple times, number
5 8 there, the context of the decay heat work and the
6 -- is really the basic subject of Steve's
7 presentation. So I don't know if there are any other
8 questions or not. Okay. Thank you.

9 MR. BAJOREK: Those go back to Norm.
10 Thank you, Norm. Where I'm going to pick up now,
11 then, is if we start to change the decay heat model,
12 going from '71 or '79 to something that's technically
13 better, what are the consequences that we're going to
14 see in two different evaluation models that have been
15 presented to the staff, the classic Appendix K model
16 and how this might impact best estimate analyses, as
17 well.

18 Our directive to do this comes from the
19 SECY-01-133, and what I've summarized here in the
20 first three or four bullets are some of the items that
21 specifically discuss this.

22 What basically 01-133 asks us to do is to
23 take a look at Appendix K, identify those models which
24 are unnecessary conservatisms, come up with revisions
25 to them, but also keep in mind that Appendix K may not

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1 cover everything.

2 We do have new knowledge in front of us
3 and there may be issues related to Appendix K where
4 there may be non-conservatisms involved. So we've
5 been asked to look for the unnecessary conservatisms,
6 as well as look at features that may not be
7 appropriately counted for.

8 DR. KRESS: Is there such a thing as a
9 necessary conservatism?

10 MR. BAJOREK: I think there is, and I
11 think Norm hinted on it. We see that the '71 decay
12 heat model is very overly-conservative technically,
13 compared to what it should be to an accurate
14 correlation.

15 But that excess conservatism has been used
16 in evaluation models to account for other things. It
17 forgives a lot of sins, okay, uncertainties in other
18 models, processes where you may have questions, but
19 from a regulatory viewpoint you may feel comfortable
20 with because you know there's so much conservatism in
21 the Appendix K, as well as in things like the single
22 failure criteria.

23 I'm going to talk about a few things that
24 we would consider as non-conservatisms in a couple of
25 minutes here. Principally, the focus of the efforts

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1 in our branch have been by the norm to take a look at
2 the decay heat standard itself, what its
3 implementation should be, and then to look at options
4 to deal with incorporation of a revised decay heat
5 standard and how we should deal with some of these
6 things that we're terming as non-conservatism.

7 Well, I think the first question is, well,
8 what is this thing that you would refer to as a non-
9 conservatism? And I would say that there are three
10 potential sources. First, there may be models in
11 Appendix K that even though they're intended to be
12 conservative, later information has shown them not to
13 be.

14 Now, the only example that we're aware of
15 is in the case of the Dougal-Rohsenow Model for post-
16 critical heat flux heat transfer. Information that
17 was uncovered in the '70s and '80s showed that it was
18 non-conservative.

19 And in the '88 rule change there were
20 restrictions placed on the Dougal-Rohsenow Model. It
21 could only be grandfathered and if there was a change
22 to the analysis, you had to justify its conservatism.

23 And to my understanding, most evaluation
24 models have basically replaced that at this time. So
25 that's not really an issue anymore. However, Appendix

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1 K, while it gives prescriptions for several thermal-
2 hydraulic models, it doesn't account for everything.

3 And there has been the concern that these
4 models, which have not been specifically discussed by
5 Appendix K, may have a large uncertainty when they're
6 applied in an evaluation model. This was the focus of
7 another SECY paper, 86-318, that actually looked at an
8 issue very similar to what we're doing right now.

9 The premise for 86-318 was reduce the
10 decay heat by changing to an updated standard. I
11 think they were looking at the '79 standard at that
12 time. And the conclusion at that time was that, no,
13 that was not a good thing to do unless you accounted
14 for uncertainties in the other thermal hydraulic
15 models.

16 Now, it having been written in 1986, you
17 can see that this was basically a formulation for the
18 1988 rule change and the best estimate rule that
19 required people to actually address these
20 uncertainties.

21 But it still remains a concern that if we
22 start to do things with Appendix K, we still have to
23 do something to look at those uncertainties and assure
24 ourselves that there is some conservatism remaining in
25 that type of an evaluation model.

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1 The third source of potential non-
2 conservatism are things that have arisen out of
3 thermal hydraulic test programs that were conducted in
4 the late '80s and the early '90s. These are processes
5 -- we'll talk about those in the next overhead.

6 These are processes that were identified
7 in the test programs that Appendix K didn't know about
8 in 1971, and had basically fallen through the cracks.
9 SECY 133 is asking us to identify what some of these
10 processes are and make sure that they are at least
11 compensated for by any revision in the decay heat
12 standard, plus some adequate multiplier.

13 A couple of examples that are considered
14 non-conservatism, and these are large break models.
15 The first one to refer to is downcomer boiling, and
16 this is something that was seen in the 2D/3D Program,
17 CCTF, SSTF that were run in Japan and also UPTF that
18 was run in Germany in the last '80s, early '90s.

19 They noted that some of the heat transfer
20 that occurred in the core wasn't as good as they
21 anticipated it to be. They thought the reflood rate
22 was going to be a little bit higher. In looking at
23 some of that data, part of it was attributed to things
24 that had gone on in the downcomer.

25 Later in the transient the fluid begins to

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1 boil, takes awhile to get that energy out of the
2 walls. This voids part of the downcomer and two
3 things go on. One, you reduce your gravitational head
4 that drives fluid into the core.

5 And secondly, when that downcomer fluid
6 frosts up, part of it gets pushed back out the break.
7 So your result is a lower collapsed level in the
8 downcomer than you would have if you had made the
9 assumption it didn't boil and you were full up to the
10 cold leg.

11 Now, typically Appendix K evaluation
12 models don't really account for this. There are two
13 reasons. One, the models themselves are based on
14 equilibrium models that stem from work in the '60s and
15 early '70s.

16 They assumed that both the vapor and the
17 liquid were at the same temperature. Boiling does not
18 begin until you brought everything up to the
19 saturation temperature. Subcooled boiling, however,
20 is well-recognized to begin while you still have some
21 subcooling remaining in your bulk fluid.

22 So we know it will begin earlier. This is
23 also complicated by the simplified nodalization that's
24 used in many of these Appendix K evaluation models.
25 They lump everything in the downcomer together, as

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1 opposed to allowing a thermal stratification to occur,
2 which is put in most of the realistic codes like RELAP
3 or TRAC or COBRA.

4 Now, the most vulnerable plants are ones
5 that have relatively high power, low containment
6 pressure. The large break transient extends for a
7 fairly long period of time. So you're depending on
8 your downcomer driving head during -- after your
9 accumulator period, okay, when boiling may occur to
10 start to recover your core.

11 So the longer this transient proceeds, the
12 larger this defect is going to be. The other one --

13 CHAIRMAN SHACK: Would this be a problem
14 even with the current best estimate models? Would
15 they account for this?

16 MR. BAJOREK: They account for it. Most
17 of the realistic codes have what they will call
18 mechanistic models for subcooled boiling. And what
19 this allows you to do is to boil in the downcomer well
20 in advance of the time when everything is at
21 saturation.

22 In fact, this is how this issue started to
23 arise, because in the realistic calculations people
24 were noticing, hey, there's not as much margin here as
25 everyone had hoped, and in looking at those

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1 calculations the cause was this downcomer voiding that
2 was going on in the calculations.

3 Let me show you an example of what goes
4 on. This figure is from the calculation using
5 COBRA/TRAC for a combustion engineering system 80
6 plant. The plant in this case is at 3800 megawatts,
7 sort of a standard 3800 system 80 design.

8 What's shown in the figure is the upper
9 curve, the saturation temperature, and the lower,
10 which is the liquid temperature in the downcomer.
11 Now, early in time at 50 seconds or so, the
12 accumulators come on.

13 In this plant the accumulators are
14 enormous with respect to other types of designs. So
15 you get a very high amount of subcooling early in the
16 transient. Well, eventually enough heat comes out of
17 the vessel wall and core barrel, so at roughly 180,
18 about 180 seconds or so into the transient the
19 downcomer is effectively saturated.

20 This figure shows the collapsed level in
21 the downcomer. Now, early on at 50 seconds or so,
22 that's when the accumulators are active. They just
23 fill the downcomers all the way up to the spray
24 nozzles and up into the cold legs.

25 At by about 100 seconds, the level in that

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1 downcomer is about to the bottom of the cold light.
2 So they're effectively filled. Liquid is still
3 subcooled at that time. If you recall from the last
4 figure, saturation occurs at about 180 seconds.

5 And what you notice in the collapsed
6 liquid level is now a fairly significant decrease,
7 dropping from cold level to two or three meters lower
8 in this calculation. Eventually, your pressure
9 decreases, the pump's safety ejection comes on and you
10 recover your downcomer level and subsequently the
11 core.

12 Now, on the system 80 3800 megawatt plant,
13 which this calculation is for, there's not a real big
14 concern. This shows the peak cladding temperature in
15 the core. The reflood peak is reached shortly after
16 the accumulators inject.

17 Turned around, the core quenches by 140,
18 150 seconds. So with regards to downcomer boiling
19 it's basically no harm, no foul. Downcomer boiling
20 doesn't take place until after you've gotten the
21 energy out of the core, not much of a concern.

22 Well, now let's try to uprate the unit.
23 Now, to do this I took calculations that had been
24 performed for a system 80+, effectively the same
25 geometry. There is a difference in downcomer

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1 injection location, but if I compare the transients,
2 I basically see that same accumulator effect.

3 We fill the downcomer, okay, and the
4 downcomer again boils around, oh, around 150 seconds,
5 a little bit earlier, because now we're looking at a
6 plant 3800 to 3914 megawatt thermal. Now, the energy
7 has not been removed from the core by the time
8 downcomer boiling begins.

9 And you see that rather than the peak
10 cladding temperature decreasing, as it would have at
11 150, 160, it starts off and reaches a second peak, in
12 this case at about 400 seconds. Quench of the core
13 because of the reduced reflood rate does not occur out
14 until roughly 900 seconds or so.

15 The transient is significantly prolonged
16 because of the downcomer boiling process. We'll get
17 back to the net PCT effect in a second, but let me
18 mention the other non-conservatism that has been
19 talked about for several years, and this one's
20 referred to as fuel relocation.

21 During the transient the clad will swell
22 at several locations, usually just below your peak
23 temperature location. Experiments that have been run
24 in this country, in France, in Germany, have found
25 that upon ballooning, the pellet fragments above the

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1 ballooned location relocate and move into this balloon
2 zone.

3 Now, if you're doing a calculation and you
4 don't account for fuel relocation, you have a
5 situation where you have a stack of pellets with the
6 balloon clad. The clad effectively behaves like a
7 fin. Ballooning in some ways is good for the clad
8 because you remove it from the heat source, push it
9 off into the fluid where it gets effectively good
10 cooling.

11 That's why you really shouldn't see your
12 PCT location at the burst or the balloon location.
13 However, the concern from these experiments is that
14 upon ballooning you don't maintain a concentric stack
15 of pellets.

16 The pellets are fragmented due to prior
17 operation. They come down, increase the local power
18 and increase the pellet to clad gap conductance, which
19 would significantly increase your PCT. Now, one of
20 the things that we've been working on has been
21 attempting to get estimates of what does all this
22 mean.

23 If we change the decay heat from '71 to
24 '79 or '94, how does that impact the analysis and how
25 does these non-conservatisms stack up? Decay heat,

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1 we've gotten estimates from two different sources.
2 Westinghouse had a meeting with the staff about a year
3 ago and they were asked their estimate of what would
4 happen if they took their Appendix K model and reduced
5 the decay heat to the '79 standard.

6 Their estimates were 250 to 340 degrees,
7 and there had been some calculations done to
8 substantiate those numbers. We also had one of our
9 contractors modify a RELAP to do a similar
10 calculation. They looked at an older vintage
11 combustion engineering unit.

12 I think it was Millstone or Calvert
13 Cliffs.

14 MR. LAUBEN: Millstone.

15 MR. BAJOREK: And they estimated that it
16 was 372, so more or less consistent with the
17 Westinghouse estimate, 3- to 400 degrees due to the
18 decay heat relaxation. Both also estimated what would
19 be the benefit of going from Baker-Just to Cathcart-
20 Powell for the metal heat reaction.

21 Smaller in effect, less than 100 degrees,
22 and you can see the estimates of 50 and 75 degrees.
23 Now, for downcomer boiling and relocation we've gone
24 to information that the vendors have provided us,
25 information that has been obtained publicly.

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1 We have three estimates for the downcomer
2 boiling. Westinghouse took a look at their
3 calculations for a four-LOOP ice condenser unit and
4 they estimated that the penalty by accounting for
5 downcomer boiling in your calculation relative to
6 ignoring it was roughly 400 degrees.

7 ISL did some RELAP calculations for us,
8 again taking a look at a system 80+ unit. This is
9 similar to what I just showed you, but their interest
10 there is looking at the Korean next generation, which
11 is even at a higher power than the Palo Verde and the
12 powers that we're looking at for a system 80+ in this
13 country.

14 Now, their estimate was 700 degrees, or I
15 should say that's our estimate in taking a look at the
16 first reflood peak and the second reflood peak. What
17 I think you should gather from that is a few hundred
18 degrees.

19 I don't think it's 700 degrees. I think
20 that's a RELAP problem. The interfacial drag is too
21 high. We've seen that consistently in other RELAP
22 calculations. Once you get some bubbles it pushes up
23 far too much liquid into the downcomer.

24 Okay. So I think that number's too large.
25 The calculation that I showed you there in the last

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1 four figures, if I subtract away a power effect and
2 look at the difference in PCTS and attribute that to
3 the downcomer boiling, my estimate was slightly over
4 300 degrees on that one.

5 So for at least for the downcomer boiling
6 we're seeing three separate organizations using
7 different relisting codes, all basically agreeing that
8 downcomer, it's not a 10 or a 20-degree effect. It's
9 something larger.

10 And those values, three, four -- three or
11 400 degrees are basically on the same order of the
12 decay heat change that would be envisioned for
13 Appendix K models that do not account for this process
14 correctly.

15 Fuel relocation. A technical paper was
16 written by the French and they took a look at the
17 experiments. They estimated some filling fractions of
18 the balloon region, did some CATHARE, which is
19 considered a realistic code for relocation versus not
20 accounting for relocation.

21 Their estimate -- or I should say our
22 estimate comparing their numbers translates to 313
23 degrees by accounting for this fuel relocation. Those
24 are the two that we see public information, we've
25 heard talked about at technical meetings and the

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1 vendors have made us aware of.

2 They know that some of these are going on.
3 It's a question on how you should really deal with
4 those. We don't want to say that we're clairvoyant
5 and we know everything with respect to the non-
6 conservatisms.

7 So I made a couple of phone calls to a
8 couple of university professors; what would you
9 consider a non-conservatism. We got a few things.
10 Some fit into Appendix K. Some really don't. They're
11 more plant condition issues.

12 An example may be, do you account for
13 secondary to primary leakage during a LOCA. We know
14 that during steady-state operation there is a amount
15 of leakage allowed from the primary to the secondary
16 side.

17 Well, if you account for that during an
18 analysis you would be increasing the amount of steam
19 binding, okay, and potentially having a penalty. I
20 guess my point on the final one there is even though
21 we have a list of several things that we would account
22 for, we would consider non-conservatisms, we still
23 feel we want to do a little bit more work, not going
24 on a witch hunt, but trying to make sure that we are
25 at least informed on things that are recognized as

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1 these major non-conservatisms.

2 DR. POWERS: You have looked or reported
3 some examinations of a comparison between Cathcart-
4 Powel and Baker-Just for the parabolic reconstants.
5 Has anybody looked at what effect would happen if we
6 had deviations from parabolic?

7 MR. BAJOREK: I'm not aware of it, but
8 Ralph is best to answer that one.

9 MR. MEYER: No, I don't have that.

10 DR. POWERS: It has always struck me that
11 one of the best justifications for using Baker-Just in
12 the face of several examinations that took place later
13 that suggested it was quite conservative was the fact
14 -- a couple of things.

15 One, you really don't know the surface
16 area that you're oxidizing, and the second loophole is
17 that we usually calculate these things in a fairly
18 stylized fashion and don't calculate the epitaxial
19 stresses that arise in cylindrical coordinates that
20 might cause delamination of the oxide, locally if not
21 globally, especially around things which cause
22 deformations of the ballooned region around grid
23 spacers and the like that would cause a deviation from
24 strictly parabolic kinetics, and that because those
25 things were challenging to do you just used Baker-Just

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1 to cover your ignorance there.

2 But I don't know that anybody has ever
3 gone through and looked and said, how much ignorance
4 are we covering.

5 MR. BAJOREK: Right. Ralph.

6 MR. MEYER: Well, we are going to look at
7 that in the work that we're doing at Argonne right
8 now. I would say that based on the early results that
9 are now coming out of the program, I don't expect to
10 find much here because what we have found in the last
11 couple of months for the BWR high burnup rods that
12 have undergone oxidation kinetics measurements, the
13 oxide layer doesn't seem to have any protective effect
14 in altering the rate of oxidation.

15 And our results for the high burnup
16 cladding appear to be virtually identical to results
17 for fresh tubing. Now --

18 DR. POWERS: Well, I guess the question I
19 would ask is, have you ballooned that cladding around
20 a grid spacer and can you come to that conclusion?

21 MR. MEYER: Have we -- well, so far we
22 haven't made measurements with balloon cladding, but
23 we are going to make measurements with balloon
24 cladding. Now, you're asking about, is the location
25 of a balloon close to a grid spacer and I can't tell

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1 you the answer.

2 What I can tell you is that we are
3 discussing right now whether the upper fasting point
4 for the fuel rods should be shaped like a grid so that
5 we would get any grid effects on this.

6 But I think the best answer we can give,
7 and I think it's an adequate answer, is that we are in
8 the process of testing under conditions that are just
9 as prototypical as you can imagine, and we would be
10 able to detect any deviation in the oxidation kinetics
11 that results from the deformation and related
12 processes, like flaking off of the oxide, because we
13 will have at the outset very careful measurements of
14 oxidation kinetics on undeformed irradiated tubing in
15 order to compare with the more integral tests that
16 we're going to do.

17 DR. POWERS: Have you tried to determine
18 the conditions by say modeling or some sort that would
19 optimize the conditions for delamination of the oxide?
20 I know that the French have set up what looks to me to
21 be a relatively impressive model of those epitaxial
22 stresses.

23 I have never taken their model and tried
24 to say, okay, now, what kinds of things lead to high
25 strains and stresses at the interface that would cause

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1 delamination? But it looks like they have one that's
2 sophisticated enough so that you could do that sort of
3 thing.

4 MR. MEYER: Well, we don't have a model
5 with that level of sophistication, but I don't see why
6 you couldn't get that information more reliably from
7 a test rather than a model.

8 DR. POWERS: Well, I mean, the problem is
9 -- I mean, maybe you could if you're fairly
10 imaginative in the testing capabilities. It's just
11 that I worry that you can't test all -- I mean, I'm
12 just not smart enough to participate.

13 MR. MEYER: No, that's true, but the
14 indications right now are that the oxide isn't going
15 to affect the oxidation rate, that large amount of
16 oxide that has accumulated from corrosion and is
17 present at the time of this ballooning deformation.

18 Now, remember, the ballooning deformation
19 occurs at a relatively low temperature. So you
20 haven't gotten into the high temperature oxidation
21 region where you're going to build up 17 percent.

22 The ballooning deformation is over with
23 before you ever start accumulating the large amounts
24 during the high temperature portion of this transient.
25 So you're really only talking about the spallation of

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1 oxide that's on there from the corrosion process
2 during burnup operation.

3 In that part of it there's already a
4 preliminary indication it doesn't make any difference.

5 CHAIRMAN SHACK: Well, of course, that BWR
6 cladding has a relatively thin oxide --

7 MR. MEYER: It has a relatively small
8 amount of oxidation, that's absolutely true. It has
9 only seven to ten microns of oxide on it, and we have
10 PWR cladding that we're going to test soon that has
11 100 microns and even more than that in some locations.

12 So you know, I can't say that this is a
13 general observation, but there is an expectation that
14 even the heavier corrosion layer thicknesses, that
15 it's cracked and it's pervious. Is that the right
16 word? The opposite of impervious.

17 DR. POWERS: I mean, the challenge one
18 faces in this is that when we look at analog systems
19 with fluoride structure oxides on metal surfaces, the
20 analog systems that come immediately to mind are
21 things like cerium metal, uranium metal and plutonium
22 metal.

23 In every one of those cases they suffer
24 catastrophic delamination of the oxide at very thin
25 levels, and zirconium just doesn't do that.

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1 MR. MEYER: Yes.

2 DR. POWERS: And hafnium even more doesn't
3 do that. And you keep saying why, and what is it that
4 will cause delamination of this oxide? Is it so
5 extreme that it's outside the range of things that you
6 can have during a reactor upset condition?

7 And I don't know the answer to these
8 things but I keep struggling with it, because I can't
9 keep my oxides on plutonium, so why are you guys with
10 zirconium so successful at keeping your oxides intact?

11 MR. MEYER: Well, I haven't suggested that
12 it won't spall. What I have suggested, that it won't
13 make any difference if it does spall. And I think we
14 will be able to see both, whether it flakes off during
15 the deformation process and if it makes any
16 difference.

17 CHAIRMAN SHACK: Steve, just --

18 MR. BAJOREK: Sure.

19 CHAIRMAN SHACK: -- when I look at this
20 kind of one at a time thing it sort of suggests to me
21 that I'm not going to get anything from a best
22 estimate calculation, that everything's going to wash
23 out. That doesn't seem to jibe with experience.

24 MR. BAJOREK: The penalties that you see
25 for the realistic calculations are relative to what

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1 you would have gotten from that calculation without
2 conservatism boiling. For this one, the peak cladding
3 temperature was probably around 1900 degrees.

4 So there was a benefit in there. I mean,
5 it came due to relaxing the decay heat, okay, but if
6 you had ignored the boiling processes in the downcomer
7 you would have been dealing with a peak cladding
8 temperature 15 -- you know -- 1500 degrees or so.

9 So yes, there is a reduction, but the net
10 reduction isn't as large as what had been anticipated.
11 These numbers, by the way, are for large break. Now,
12 I've got some numbers, some estimates here for small
13 break, but the situation there is a lot more nebulous,
14 quite likely because most plants are large break
15 limited, or I should say, the vast majority are vast
16 break limited.

17 There hasn't been a tremendous amount of
18 work looking at the sensitivities with regards to
19 small break. Estimates that we have gotten from --
20 basically one of our contractors looked at the issue
21 and did some of their calculations, found some
22 information from Combustion Engineering and
23 Westinghouse that basically estimated close to 1,000
24 degrees, 800 to 1,000.

25 Their calculations, based on RELAP, were

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1 showing another range, five to 1,000 degrees by going
2 from '71 to the '79 standard. I don't have an
3 estimate for the metal water reaction.

4 If you were to do that separately, my
5 guess it would be larger than what you would see for
6 a large break, because it occurs over a much longer
7 period of time, but we're not aware of any unique
8 sensitivity studies at a high enough temperature
9 whether it would an effect.

10 MR. LAUBEN: It is about the same. I did
11 some with -- for the 2700 megawatt CE plant and it was
12 about the same.

13 MR. BAJOREK: Okay.

14 MR. LAUBEN: The same 50 to 75 degrees.

15 MR. BAJOREK: Okay.

16 MR. LAUBEN: Because intransient's usually
17 a little bit slower.

18 MR. BAJOREK: Well, you have lower decay
19 heat at the time.

20 MR. LAUBEN: Right.

21 MR. BAJOREK: So it's --

22 MR. LAUBEN: Right.

23 MR. BAJOREK: Okay. Let's go. Now, some
24 of the things that we might want to consider as non-
25 conservative issues, we've seen some cases with

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1 nodalization, where whether you uniquely look at
2 cross-flow into the hot assembly.

3 I think, Norm, you have these RELAP
4 calculations that show you get a 600-degree effect.
5 And this kind of goes back to the idea that these
6 codes were written '60s, '70s. You were -- had them
7 on CRAYS, 7600s, and you tended to want to simplify
8 your nodalization compared to what you could do so.

9 So by incorporating more complexity into
10 your model you start to see more variations, simply
11 because of the number of processes that lie cross-flow
12 that you would take into account.

13 Now, one that has been recognized in the
14 past has been the consequences of operator action
15 during a small break. Right now, you don't have to
16 worry about it as much in small break if you have the
17 loss of off-site power, the pumps trip on reactor
18 trip.

19 If you have off-site power available,
20 which is another one of the avenues that is being
21 pursued under risk-informed regulation, now you have
22 to depend on the operators to trip the pumps according
23 to their EOPs.

24 This usually calls for them to recognize
25 that the rods are on the bottom, you've got a safety

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1 injection pump and that you've lost, by looking at
2 your monitors, lost some cooling into your hot leg.
3 Once you recognize that the reactor pumps are tripped.

4 Now, this is going to depend on how
5 quickly they go through the EOPs, their recognition of
6 these various signals while there's a lot of confusion
7 going on. Calculations that had been performed in the
8 mid-80s looking at this, found that there were periods
9 of time where the operator could trip them while you
10 had a plant at an elevated pressure and lost
11 inventory.

12 Then if you tripped the pumps you
13 collapsed the froth over core -- over the core, you're
14 still at high pressure, meaning you weren't getting as
15 much safety injection into the system, and could get
16 a very high peak cladding temperature.

17 So it's one of the things that may need to
18 be considered. The other two have more to do with
19 model and correlation uncertainty. In taking a look
20 at the decay heat sensitivity, the contractor noted
21 that, hey, being off just a couple of inches in your
22 level swell, where your froth level is in the small
23 break, can result in several hundred degree increase
24 or decrease in what your peak cladding temperature is.

25 LOOP seal clearance refers to the effect

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1 out in a small break when steam starts to slip through
2 one or more of the LOOP seals of a plant. This
3 redistributes the fluid. Some goes out the break.

4 Some goes to the vessel; some stays in the
5 LOOP seal. And what happens then is you get a
6 different two-phase hydraulic loss through the LOOPS.
7 If that loss is high you tend to suppress the core
8 level much more than if you had a nice, clean blow in
9 that LOOP.

10 People who have tried to model this in
11 codes have had a fairly difficult time doing this. I
12 don't put a basis down on this because I'm talking a
13 little bit more from personal experience in developing
14 a small break evaluation model.

15 This was a very complex issue when we saw
16 hundreds of degrees of variation. We have also seen
17 some experimental tests that have raised it as a
18 concern, mainly due to LOOP seal replug. Some of the
19 ROSA tests said that you've got very good heat
20 transfer in your steam generator.

21 What that means is later in the transient
22 you can put enough condensate into the LOOP seal to
23 replug it, force it to blow again. So in terms of the
24 non-conservatism, it's something that we feel would at
25 least have to be looked at in terms of the consequence

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1 of reducing decay heat if we're going to be relaxing
2 the amount of conservatism that we see now.

3 The next thing that I want to move into
4 are options that we're currently looking at. And I
5 want to emphasize that we have not reached a staff
6 consensus on which option should be pursued.

7 MR. BONACA: I have a question on one of
8 the thoughts just --

9 MR. BAJOREK: Sure.

10 MR. BONACA: You just made a pretty strong
11 case for some of the conservatisms that you have in
12 Appendix K, I mean, in the tradeoffs. And in the best
13 estimate, when you do best estimate calculations, do
14 you have -- there is no modeling of downcomer boiling
15 in best estimate testing.

16 MR. BAJOREK: In best estimate you do.

17 MR. BONACA: You do?

18 MR. BAJOREK: Yes.

19 MR. BONACA: Okay. That's one of the --
20 what I --

21 MR. BAJOREK: The two fluid codes would
22 take a look at non-equilibrium.

23 MR. BONACA: Okay. So yes, all right.

24 MR. BAJOREK: Phases that allow voids to
25 develop. The RELAP, as we noted --

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1 MR. BONACA: Yes, that's right.

2 MR. BAJOREK: -- in the calculations we
3 think isn't doing it very well, but it's doing it very
4 conservatively, which gave that 700 number. We think
5 that the COBRA formation is maybe doing that in a more
6 kinder, gentler fashion, but it's still significant,
7 three to 400 degrees.

8 MR. BONACA: I guess the point I'm making,
9 it would be interesting to have a comparison of these
10 effects also for the best estimate so we could have an
11 understanding of what tradeoffs have already occurred.

12 And now in the best estimate modeling do
13 you still -- are most -- what's happening to the decay
14 heat curve? Which one is being used?

15 MR. BAJOREK: Usually, the '79.

16 MR. BONACA: Seventy-nine.

17 MR. BAJOREK: Yes.

18 MR. BONACA: Not '94 effect.

19 MR. BAJOREK: No. In fact, what I wanted
20 to point out with this overhead -- this is not in your
21 package -- but to point out the work that we need to
22 do in coming up with an option for Appendix K and a
23 revision to the decay heat, just to make sure that
24 that revision satisfies a new option for the Appendix
25 K, but also addresses some of the issues in a best

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1 estimate model.

2 And I think as you noted and as Norm
3 noted, for a best estimate evaluation model, Reg.
4 Guide 1.157 simply says for decay heat, calculate in
5 a best estimate manner. It considers by way of a
6 reference that the '79 decay heat is acceptable.

7 Now, you could take that Reg. Guide at
8 this time and use the '94, but it's certainly not
9 clear to anyone that goes through when we're
10 developing a model. Perhaps even a little bit more
11 cloudy is the metal water reaction.

12 Again, the Reg. Guide says to calculate it
13 in a best estimate manner and it cites Cathcart, et
14 al., Cathcart, Powel and who else may have been on
15 that, their data is acceptable and doesn't even cite
16 the correlation.

17 It just says "that data is acceptable,"
18 and leaves it go at that point for the licensee and
19 the review process to sort out what is truly a best
20 estimate model.

21 CHAIRMAN SHACK: What have people actually
22 done in the best estimate models today for the metal
23 water action? Do they use Cathcart-Powel?

24 MR. BAJOREK: Yes. Yes. They've been
25 using Cathcart-Powel. There is an uncertainty in the

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1 application that I'm aware of in how it's applied. So
2 they're -- Westinghouse is using Cathcart-Powel.
3 There is an uncertainty about that calculation.

4 CHAIRMAN SHACK: In my simple-minded view
5 of this thing, you know, the thing I'm normally
6 looking at when I have a conservative calculation, you
7 know, when I decide how conservative it is I go out
8 and I get a better calculation and I compare the two.

9 Well, you know, now I've got a better
10 calculation. It would seem to me that, you know, I
11 look at all my best estimate calculations and I go off
12 and I do my simple Appendix K calculation, it would
13 seem to be relatively straightforward to do.

14 You know, suppose I change my Appendix K
15 calculation with the decay heat and I look at my best
16 estimate calculations, you know, and --

17 MR. BAJOREK: We have that. That was
18 discussed in the meeting last year. There's a figure.
19 I'm not sure if it's proprietary or not. That's why
20 I didn't -- that's why I wanted to stay with stuff
21 that I knew was public.

22 Those calculations showed that the
23 Appendix K evaluation model, okay, with '71 decay
24 heat, gave a peak cladding temperature that was just
25 larger than best estimate plus uncertainties. Okay.

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1 When they reduced the decay heat, the
2 Appendix K calculation gave values that were closer to
3 the best estimate, but without the uncertainties.
4 It's somewhere in the middle. Now, you have to take
5 it a bit with a grain of salt, because I think the
6 plant types were slightly different and there were --
7 it was more of a apple versus a different type of
8 apple.

9 CHAIRMAN SHACK: Pear.

10 MR. BAJOREK: Yes. So it wasn't
11 straightforward, but the calculations suggested that
12 if you reduced the decay heat in that -- for that
13 plant in that Appendix K evaluation model, the PCT
14 would not -- would be more favorable than what you
15 would be getting out of a best estimate methodology.

16 And that raises some concerns going back
17 to the SECY paper 86-318, which says, hey, there are
18 models which can result in a fairly large uncertainty
19 and you should account for those in your overall peak
20 cladding temperature and your analysis methodology.

21 MR. LAUBEN: But you're right about -- as
22 long as you have the standard of a best estimate
23 calculation to compare with the Appendix K
24 calculation, you can do it. But if you don't have
25 that standard, what do you do?

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1 And for some plants, some vendors, some
2 plants, you have the standard with which you can
3 compare, and the calculation Steve has was actually
4 done by the same vendor, that he was able to compare
5 one to the other.

6 So that was an apple -- as close as you
7 can get to an apple and an apple. But it's not as
8 easy to do if you don't have a best estimate standard
9 by which you can compare to the existing Appendix K
10 calculation. That's --

11 CHAIRMAN SHACK: Well, I guess I just
12 don't have a feel whether we have enough best estimate
13 results --

14 MR. LAUBEN: Yes.

15 CHAIRMAN SHACK: -- available now to be
16 able --

17 MR. LAUBEN: Good.

18 CHAIRMAN SHACK: -- to make the benchmark.

19 MR. LAUBEN: Yes.

20 MR. BAJOREK: One of the problems that
21 occurs --

22 MR. LAUBEN: Good question.

23 MR. BAJOREK: -- is because they are
24 complex analyses to perform, you know you're getting
25 margin. So immediately what you want to do is to use

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1 that margin, okay, for an operating enhancing the core
2 peaking factors.

3 So if you do the work you don't want to do
4 it at the levels that you already have the Appendix K
5 calculation. And because of that you always wind up
6 in this apples versus oranges type of comparison.

7 Three options that we are looking at right
8 now, and as I mentioned in this previous figure, we
9 feel that in coming up with an alternative option to
10 Appendix K we have work that needs to be done.

11 We also need to do work on what I'll call
12 the realistic option, to clarify the use of the '94
13 standard for decay heat. How you would use Cathcart-
14 Powel, if that's to be recommended for metal water
15 reaction?

16 What is the difference and how should we
17 deal with uncertainties and conservatism in either of
18 these analyses? Option A, as I'll refer to it. In
19 the realistic option -- and this is going to be true
20 in the two or three options that we'll discuss -- we
21 would revise Reg. Guide 1.157, clarify that you can,
22 perhaps should use the '94 decay heat standard, take
23 the work that Norm is doing to recommend how it should
24 be implemented into those decay heat questions, which
25 we have work ongoing.

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1 Recommend a specific metal water reaction
2 that should be used, and clean up. Perhaps, the more
3 nebulous part of that Reg. Guide is how you deal with
4 these uncertainties. This is why you need to quantify
5 the accuracy.

6 You need to deal with the uncertainties,
7 and then you were sort of left to the winds on how to
8 do that. And part of the difficulty in the
9 application is coming up with an appropriate
10 statistical method to account for those uncertainties.

11 And it's been one of the things that has
12 driven up the difficulty in that analysis. Now, in
13 this particular option the Appendix K revision would
14 involve replacing the ANS '71 standard with '94, plus
15 some uncertainty, okay, that would account for the
16 experimental uncertainty in the decay heat.

17 Okay. One, two, three sigma, something
18 along those order. It would address solely the decay
19 heat model uncertainty. We would ask licensees to
20 take a list that we would propose and they could
21 augment to address recognized non-conservatisms,
22 things like the downcomer boiling, fuel relocation,
23 other things that we may identify.

24 We think that the approach is consistent
25 with what was requested in the 0-133. That relax

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1 where it is clearly non-conservatism -- overly
2 conservative decay heat would account for
3 conservatisms.

4 DR. KRESS: When you say "consider non-
5 conservatisms" what does that actually mean?

6 MR. BAJOREK: They would be required to
7 account for those in their Appendix K evaluation
8 model.

9 DR. KRESS: Okay.

10 MR. BAJOREK: Okay. We would envision
11 -- and this would depend on NRR, on how they wanted to
12 deal with this -- the licensee coming in with
13 basically an alternative approach to Appendix K, a new
14 evaluation model, which would have reduced decay heat,
15 but those Appendix K evaluation models would have to
16 have features to account for downcomer boiling, fuel
17 relocation and in the case of small break, the issues
18 that we would have to identify for that.

19 MR. BONACA: More and more that would look
20 like the best estimate.

21 MR. BAJOREK: Well, we're -- you're
22 jumping ahead just a little bit, but I want to let
23 -- what I want to say. I want to lay this out because
24 as a staff we have not reached a consensus on this.
25 I want to summarize what we're looking at and lay out

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1 the pros and cons of each one.

2 And you raise a good point and we're going
3 to point that out. Now, one of the obstacles we see,
4 that this approach would result in a new methodology
5 and we think that it would be very likely that it
6 would require a review.

7 NRR would have to expend resources for
8 vendors. The licensees would have to deal with these
9 issues. They aren't straightforward and simple to
10 deal with. They would have to come up with new models
11 for those.

12 In some cases, experimental information to
13 address those may not be entirely satisfactory right
14 now. There's some 2D/3D data, UPTF, CCTF, that points
15 out the effect. I think it's questionable right now
16 whether it has the right range of conditions by which
17 you might want to develop a new model for.

18 So I think there are some questions there
19 that need to be answered and we are going to take a
20 look at that. We have to come up with a list of all
21 recognized non-conservatisms. We have a few.

22 I guess our fear is once we get this list,
23 if something else crops up or is recognized, there's
24 a difficulty in getting it in, okay, without violating
25 some type of a back-fit rule that we might want to

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1 keep on ourself.

2 Because of the difficulty in coming up
3 with new models, licensing those and dealing with the
4 potential uncertainties in the remaining models, we
5 start to think that this may not be that attractive to
6 vendors and licensees.

7 Our fear is that when you start to look at
8 expenses to come up with this, make Appendix K look
9 more realistic, but still be conservative, deal with
10 modeling uncertainties, you start to tip the balance
11 close enough to best estimate, there may not be an
12 advantage to going this way right now.

13 On a philosophical point, one of the
14 stones that we would throw at this option is that this
15 would effectively delay the transition from codes that
16 were developed in the '60s and early '70s to more
17 modern thermal-hydraulics codes.

18 Okay. We would be instituting codes that
19 people have objected to because of their ad hoc models
20 and implications in the past. The second option is
21 one that has been suggested by NRR.

22 It retains many of the features of
23 Appendix K -- excuse me -- of Option A that we talked
24 about. We would still deal with Reg. Guide 1.157 as
25 we had in the previous overhead.

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1 The idea here is to replace Appendix K,
2 take out the '71 model, replace it with '94, and apply
3 a conservative multiplier, not one that just accounts
4 for uncertainties in decay heat, but now has
5 additional conservatism built in, but sufficient to
6 cover the uncertainties that are observed in the
7 realistic calculations.

8 DR. KRESS: That sounds just like the
9 current Appendix K, only with a little better
10 quantification.

11 MR. LAUBEN: Right.

12 MR. BAJOREK: That's pretty much it.

13 CHAIRMAN SHACK: Well, and to come up with
14 the right multiplier you still have --

15 DR. KRESS: Yes.

16 CHAIRMAN SHACK: -- to do everything they
17 do.

18 DR. KRESS: You really have to do the --

19 CHAIRMAN SHACK: I mean, it's magic when
20 you're done, but --

21 MR. BONACA: It's one added superficiality
22 --

23 (All talking at once)

24 MR. LAUBEN: A lot of print.

25 MR. BAJOREK: It's a tough row to hoe.

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1 CHAIRMAN SHACK: Yes.

2 MR. BAJOREK: Jump ahead on here. If we
3 were to do this, our estimate is that this would take
4 the staff something on the order of ten man years,
5 because we would need to, one, make sure that we get
6 realistic codes behaving the way we want to.

7 We're fairly close on that. We still have
8 work to do. But we need to satisfy ourselves that
9 they're handling fuel relocation, downcomer boiling
10 appropriately. Okay. That's an issue in itself.

11 In the past, we haven't developed
12 evaluation models here at the staff. So we would have
13 to take our realistic code, revise it, change the
14 decay heat, put Baker-Just back in, prevent rewet
15 during blowdown, change the steam cooling models,
16 change this and the other thing to make it mimic an
17 evaluation model.

18 DR. KRESS: Let me ask you another
19 question about that. If you did that, including the
20 uncertainties, and then you ended up with your answer
21 at the end, and you took the 95 percentile and used
22 that to get your multiplier on your decay heat curve,
23 how is that any different at all than just the best
24 estimate approach?

25 MR. BAJOREK: You would not know what the

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1 uncertainties are here. You would be basing your
2 conclusions based on another set of calculations and
3 hoping those are mimicked by the Appendix K evaluation
4 model. Where things --

5 DR. KRESS: But you would have to make
6 Appendix K conservatism enough to cover all plants is
7 what --

8 MR. BAJOREK: That's right.

9 DR. KRESS: -- I think you're saying.

10 MR. BAJOREK: We jumped ahead.

11 DR. KRESS: Yes.

12 MR. BAJOREK: Where we say it may not be
13 technically achievable is that if we do this strictly
14 as it was proposed, come up with a multiplier. Well,
15 we could look at the worst plant.

16 DR. KRESS: Yes.

17 MR. BAJOREK: Like that one I showed you
18 earlier that has a very long transient.

19 DR. KRESS: Yes.

20 MR. BAJOREK: Treat it as an evaluation
21 model, put a multiplier on it; look at some other
22 issues, things that we might want. Well, I don't
23 think it takes a big stretch of the imagination to see
24 that you can wind up with a multiplier based on that
25 plant that when you apply it to lower power units

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1 you're going to have something that's even more
2 restrictive than the Appendix K as it is today.

3 DR. KRESS: Yes. I am --

4 MR. BAJOREK: I'm aware of one attempt,
5 not in this country, to do something like that. Their
6 approach was to take a realistic code, say we want to
7 stay away from all this uncertainty calculation, but
8 let's make our heat transfer conservative.

9 Let's make our plant initially
10 conservative and do it for a range of plants. Well,
11 they went through the exercise and they eventually
12 went back to a realistic methodology, because the
13 answers they were getting when they applied them for
14 all of the units were now even worse than what they
15 had been getting in Appendix K.

16 That's where the work comes in, because to
17 make this any benefit, we think, to industry we would
18 have to break this down into a plant-specific type of
19 multiplier.

20 And when you start looking at the
21 different types of BWRs, PWRs, BNWs, CE units, large
22 break and small break, the magnitude of number of
23 calculations that you have to do and get right becomes
24 very large, and that's what propagates into this.

25 I estimated a ten-year effort. I've been

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1 told that I was too low. It's substantial. Go to the
2 last bullet. One of the reasons we've noticed
3 downcomer boiling as a potential issue has been due to
4 plants being uprated.

5 In that first figure I showed you, the no
6 harm, no foul, that was primarily due to the
7 relatively low power of that unit. It quenched before
8 the downcomer boiled. As we start to uprate the
9 units, the transient link must get larger because you
10 have more decay heat, okay, to remain.

11 So as we start to uprate units beyond what
12 they are now, the multiplier, even if it captured the
13 downcomer boiling in today's power levels, may not
14 necessarily capture that effect if that plant is
15 uprated by another five or ten percent.

16 The margin is not going to go unused. It
17 will likely be absorbed in another power uprating. So
18 our fear is that even if we came up with multipliers,
19 they would be invalidated once the plants start to
20 deviate from the present-day operation.

21 Also been notified by some of the staff at
22 NRR, they said, well, even if you come up with
23 multipliers using TRAC or RELAP in our versions of
24 evaluation models, we've recognized over the years
25 that the sensitivity of evaluation models that we see

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1 from Combustion, from Westinghouse, from GE and BNW
2 aren't necessarily the same from one to the other,
3 much less how the staff's models would behalf.

4 They approximate things, but the power
5 sensitivity could be different. Nodalization can have
6 effect, as well. So as a result they said, well, even
7 if you spend your ten staff years coming up with a set
8 of multipliers, we're still going to have to go back
9 to the vendors to either verify or come up with
10 equivalent multipliers for their codes, because they
11 may behave significantly different.

12 Okay. Third option, and this is one where
13 we see it as perhaps an opportunity to move ahead
14 technically. And we see this as an option that says,
15 rather than continue to sink more resources into
16 Appendix K, maybe this is a point to say, let's put
17 the best technology into the best estimate rule.

18 Let's put those resources into revising
19 1.157, clarify how we would use the decay heat; what's
20 an appropriate way to apply it; what's an appropriate
21 model for the metal water reaction?

22 Pursue the other 50.46 risk informed
23 criteria, because there's a tremendous amount of true
24 margin that can be gained by relaxing plant boundary
25 condition assumptions, break size, loss of off-site

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1 power.

2 But retain in the realistic option of a
3 way of analyzing it to at least a conservative fashion
4 or at least to a fashion by which we know what the
5 true margin is.

6 So in Option C, by focusing our attention
7 on the best estimate rule, making it easier to use,
8 easier to apply, we feel that we'll at least maintain
9 the present-day margin in Appendix K, okay, and if we
10 go to a realistic type of calculation we'll know what
11 that margin is.

12 I think it's been said in some of the ACRS
13 meetings that safety is better served by having to
14 quantify measure of the margin, rather than some
15 nebulous amount of conservatism that we don't know the
16 extent of.

17 We already have clear guidelines for the
18 review. We would have to clarify those further in the
19 Reg. Guide 1.157. NRR wouldn't be able to apply their
20 reviews as they currently perform those. In the long
21 run, we feel that this would encourage vendors to
22 continue to develop and use realistic models and more
23 advanced thermal-hydraulic tools.

24 Westinghouse currently has an approval for
25 best estimate. Siemens-Framatome has submitted one

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1 several weeks ago. NRR says that in about a year they
2 think they can get approval for that. We've been told
3 that General Electric would be coming in, in a
4 realistic local methodology early next year.

5 We're seeing most of the vendors already
6 going down this path.

7 MR. BONACA: They already had Safer-
8 Gester, right, so.

9 MR. BAJOREK: Safer-Gester, my
10 understanding is that it's more consistent with an
11 inter-methodology. There are some -- it's not a true
12 best estimate and now they're ready to go the rest of
13 the way.

14 MR. LAUBEN: It has a 600 degree penalty
15 associated with its use, too. So it's not truly best
16 estimate. So it's TRAC-G that they're coming in with
17 to get approval.

18 MR. BAJOREK: Now, the cons of doing this.
19 Reduction in regulatory burden is probably minimal.
20 There would be benefit in clarification of the best
21 estimate rule and how you do this, but it's not a
22 tremendous leap. There's still a lot of work involved
23 there.

24 The expectations of SECY-01-133 may not be
25 met in going this approach. I think you go through

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1 there, there was an expectation that we would make a
2 definite revision to the Appendix K. So that -- we
3 would need to make I think a very strong argument on
4 why we wouldn't think that the Appendix K revision is
5 necessarily the right way to go as part of supporting
6 this option.

7 Where we plan to go from here, we feel
8 that we need to get a -- agree on a list of non-
9 conservatisms, lay that out in a little bit better
10 fashion. We've talked about a few. Let's try to make
11 that list complete.

12 We want to go back and look at the
13 experimental data, because if we have to start asking
14 people to look at these non-conservatisms, we should
15 be well aware of whether the current database supports
16 development of those models.

17 The reason I suspected we may have a
18 problem in doing that, I did a kind of a quick scaling
19 evaluation CCF. In taking a look at a parameter that
20 relates the energy that would be available in the
21 downcomer and core barrel walls, versus the energy
22 that would be required to raise the entire downcomer
23 to saturation.

24 In kind of a very crude fashion, looking
25 at energy available versus energy that would be

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1 necessary. For the PWR, if you'll look at the energy
2 that's available in the core barrel in the vessel
3 wall, it's about seven and a half times the amount of
4 energy that would be required to raise this bulk of
5 fluid in the downcomer to saturation.

6 That's a lot of stored heat. CCTF where
7 we did see evidence of downcomer boiling -- you don't
8 have to get the whole thing up to saturation, just
9 part of it -- we're looking at something closer to
10 one.

11 So this is why I said, well, when we look
12 at the experimental data, we need to take a look at
13 the tests versus what we were expecting in the PWR,
14 because when we go down this path now of treating
15 these non-conservatisms for Options A or B, the folks
16 who want to go down that are going to have to
17 demonstrate that the experimental data is adequate to
18 come up with models for that. That may require them
19 to participate in new test programs.

20 Third, once we lay this out it's probably
21 advisable for us to hold a public meeting to discuss
22 what this alternative approach to Appendix K would
23 look like, and I think as someone pointed out, well,
24 are you getting so close to best estimate now that
25 you're going to throw a party and no one's going to

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1 show up.

2 And if we get that word from the vendor
3 then maybe what's recommended in 0133 should be
4 revised somewhat. That's all I have, but we're
5 interested in your comments.

6 MR. BONACA: You made a case again for the
7 fact that in Appendix K you have tradeoffs that you
8 car calling for.

9 MR. BAJOREK: I couldn't hear you. I'm
10 sorry.

11 MR. BONACA: Yes. I'm saying that you
12 made a case for the fact that there are tradeoffs in
13 Appendix K right now that are an impediment to simply
14 moving on to 1994 ANS standard.

15 MR. BAJOREK: Right.

16 MR. BONACA: But the industry has
17 requested it and the way it came out was almost as if
18 in fact those issues were not there. Is there
19 consensus on the part of the industry, the technical
20 community, regarding these tradeoffs, these issues?
21 Or do you have to go to this public meeting before
22 that will be surfacing?

23 MR. BAJOREK: I think we have to go to the
24 public meeting to really surface that.

25 Norm, it was the vendors that came to you

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1 last year and pointed some of this out.

2 MR. LAUBEN: Well, we have -- let's see.
3 We have the questions that we've -- you know -- they
4 came with the request for rulemaking. We have
5 proposed some questions to them about their proposal.

6 But as Steve said, it isn't clear what
7 venue it's -- addressing those questions would take.
8 Would it be a public meeting? Would it be publishing
9 the questions and then having them respond to it, or
10 what I think -- I think eventually it has to be some
11 kind of a public meeting so that all interested
12 parties get a chance to address their concerns about
13 this.

14 So I don't know. Last -- let's see. A
15 couple of years ago we did ask -- informally now.
16 This was not formally at all. At some public meetings
17 we asked questions about, you know, similar to the
18 ones that I had on decay heat.

19 How would you -- you know -- this is not
20 as simple as it was, but we -- at that time there was
21 no apparent interest in the decay heat change. And so
22 --

23 MR. KURITZKY: Yes. I think in all
24 fairness to the industry and that --

25 MR. LAUBEN: Yes.

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1 MR. KURITZKY: -- those public meetings
2 were focused on --

3 MR. LAUBEN: Right.

4 MR. KURITZKY: -- on all the different
5 options.

6 MR. LAUBEN: Yes, right. Right. Right.

7 MR. KURITZKY: And industry was really
8 interested in the larger picture, local redefinitions
9 --

10 MR. LAUBEN: Right.

11 MR. KURITZKY: So they really didn't want
12 to spend time looking at other types of changes. So.

13 MR. LAUBEN: Right. So they're interest
14 in decay heat is relatively -- is subsequent to those
15 meetings. And I think we have to somehow get, you
16 know, stakeholder involvement in this, right.

17 MR. BONACA: The other question I had was,
18 you made a statement that typically, best estimate
19 results plus uncertainty, comes quite close to the
20 Appendix K, and that's the experience I've had, too,
21 I mean, in looking at that.

22 And that's -- and of course, the point of
23 comparison you used was PCT, peak core temperature,
24 okay. I'm trying to understand if there are other
25 measures of merit that you're using in these

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1 comparisons to see what is appropriate to make
2 reductions in what is not.

3 Or rather than appropriately, what is
4 convenient or not convenient. Is PCT the only
5 criteria you use in there to compare the two
6 approaches and --

7 MR. BAJOREK: We should probably look at
8 clad reaction. I think in the shorter transients
9 usually that the equivalent clad reaction is not as
10 limiting as PCT. That may not be the case as we get
11 out to fairly long duration transients. It probably
12 should get looked at, because we haven't done that
13 yet.

14 MR. BONACA: And one last question I have
15 is, again, I mean, if I have the best estimate, which
16 typically, I mean, it has certainly conservatism built
17 in plus uncertainty, and I come up with the results
18 very close to the Appendix K and typically pretty
19 close to 2200 degrees fahrenheit, I mean, typically,
20 these plants don't have a lot of margin there, really,
21 what is the opportunity for margin reductions or for
22 reducing regulatory burden?

23 MR. BAJOREK: It would probably be in --
24 I think reduction in break size would certainly amount
25 to --

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1 MR. BONACA: Well, that -- yes, that was
2 something we didn't want to -- I mean, that's a
3 different issue, talking about purely that we walk
4 down this path with the belief that there were
5 opportunities purely in the artificiality of Appendix
6 K, but then, you know, this comparison you're
7 referring to, it's a solid one.

8 I mean, I've seen it many times for
9 different plants and it's there.

10 MR. BAJOREK: Well, I guess, you know,
11 some of that -- they wouldn't necessarily wind up in
12 the Reg. Guide -- well, they could wind up in the Reg.
13 Guide. And when we developed the best estimate for
14 Westinghouse, in a number of cases the range over
15 which you addressed the uncertainty bounded all of the
16 data.

17 Appendix K doesn't have to do that. You
18 just have to be conservative relative to the mean. So
19 what happens when you go to best estimate under that
20 type of a regulatory requirement, Appendix K really
21 gets an advantage.

22 If the Reg. Guide were revised relative to
23 treatment of the experimental data that you have to
24 bound 95 percent or within two sigma, and made your
25 uncertainties smaller, first, you would make it clear

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1 for people developing new pools what they had to come
2 up with.

3 And secondly, I think there would be a
4 fair amount of margin gained by, you know, getting
5 away from the wings of some of this experimental data.
6 I can think of several models where you would get a
7 lot of benefit in taking that approach, but that's
8 something that would have to come from probably a Reg.
9 Guide as opposed to a regulation.

10 That, again, goes back to -- as I
11 mentioned on that one slide, the problem with 157 is
12 the discussion and treatment of the uncertainties. It
13 kind of leaves it too wide open, and if that were
14 clarified there would probably be a fair amount of
15 benefit in that.

16 CHAIRMAN SHACK: I'm not sure I understand
17 that last argument. Are you just saying you just cut
18 the uncertainty analysis at the 95th percentile? That
19 would certainly help.

20 MR. BAJOREK: I don't have a pen.

21 MR. BONACA: What you seem to say, that
22 you have more opportunities in the best estimate than
23 you have in Appendix K, of course.

24 MR. LAUBEN: Here's one that works on
25 slides.

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1 DR. KRESS: Just do it on the screen.

2 (Laughter)

3 MR. BAJOREK: Are you telling me to?

4 DR. POWERS: He's hoping somebody else
5 will to --

6 DR. KRESS: Yes.

7 MR. BONACA: To be the second.

8 DR. KRESS: I hate to be the only idiot in
9 the crowd.

10 MR. BAJOREK: If we take a look at an
11 uncertainty distribution in some model, we may see
12 some bias away from perfection. We've got everything
13 on here. But we also see a scatter in how well you
14 get a prediction to the experimental measurement. It
15 may take some distribution.

16 Well, if you want to range the uncertainty
17 for that model, well, you have to make a decision, do
18 I range it over best to worst, or do I say, hey, I
19 don't necessarily have to address the wings out in
20 here.

21 Most specifically, can I get away from
22 some of these worst situations? And in the
23 calculations that I see, what drives your 95th
24 percentile PCT frequently comes from this part of the
25 distribution, then an experimentalist may say it's a

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1 bit of an outlier and isn't representative of the bulk
2 of the data.

3 But right now, the Reg. Guide is not very
4 clear on where you draw that limit.

5 DR. KRESS: Well, it looks to me like
6 there's not a very lot to be gained by changing the
7 Appendix K part of the rule. It looks like what we
8 didn't know before was that the non-conservatism were
9 pretty much balanced out by the conservatisms.

10 And you know, that's -- you maybe don't
11 have them all quantified exactly right, but it's a
12 good guess that it's getting close.

13 MR. BAJOREK: Whoever picked out the
14 1.2 --

15 DR. KRESS: Yes, did a pretty good job.

16 MR. BAJOREK: -- did a pretty good job.

17 DR. KRESS: Yes. So since it would be a
18 big deal to change it and you have to worry about
19 back-fits, I guess, because it could require some
20 plants to redo their analysis and do things over, my
21 leaning right now is for your Option C.

22 But I would encourage you to continue on
23 with this action plan, because it does two things for
24 you. One, it bolsters your case because it does give
25 you a better look at what these non-conservatism are

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1 compared to conservatism, and it gives you information
2 that could be very insightful when you go into
3 evaluating the best estimate models.

4 MR. BAJOREK: Right.

5 DR. KRESS: So that's kind of my
6 inclination right now. I don't know how these other
7 guys feel about it.

8 MR. BONACA: Absolutely. I totally agree
9 with that. It seems to me Option C is the one that
10 has some opportunities.

11 CHAIRMAN SHACK: Well, clearly, there's a
12 difference of opinion, because somebody submitted a
13 petition to change it. So --

14 MR. BAJOREK: Yes.

15 DR. KRESS: Yes, but weren't they mostly
16 interested in changing the large break LOCA definition
17 in that? Or did they want --

18 MR. LAUBEN: No. No. I mean, this
19 petition is strictly for the decay heat.

20 MR. BAJOREK: Strictly decay heat.

21 MR. BONACA: Well, that's why I asked the
22 question about the technical community, because I
23 mean, the case you made today would discourage a
24 change without your investigation of this -- and you
25 have data that says that in fact you have -- you may

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1 not be able to support the intention of that
2 multiplier literally.

3 DR. KRESS: And anyway, you have the best
4 estimate option which --

5 MR. LAUBEN: Right.

6 DR. KRESS: -- let's them do what --

7 MR. BAJOREK: It's there, now.

8 DR. KRESS: It's there now.

9 MR. BAJOREK: It's there now. It's not
10 clear and there are things that could be done to make
11 it perhaps less onerous.

12 DR. KRESS: Yes. You have -- yes. That
13 might be the place to focus your attention, I think.

14 MR. BONACA: I mean, any use of these
15 changes would require a new analysis, anyway.

16 MR. BAJOREK: Yes.

17 MR. BONACA: And you know, Appendix K may
18 be less expensive one. I don't know.

19 MR. BAJOREK: Generally, it is.

20 CHAIRMAN SHACK: Well, I guess just to
21 follow along here.

22 MR. BAJOREK: Okay.

23 CHAIRMAN SHACK: I guess it seems to me we
24 have realistic analyses, you know. People can make
25 comparisons, you know. Your case is reasonably

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1 convincing in terms of discussion, you know, but I
2 just have to see more of these comparisons.

3 Now, Mario says he's looked at them and,
4 you know, they're there, but it seems to me that
5 really is the thing. You have best estimate
6 estimates. You have other estimate you can really get
7 a much more concrete comparison of what the effect
8 would be.

9 MS. DROUIN: I was going to say, Steve
10 covered the evaluation model. We now have the
11 acceptance criteria. I did notice, though, that on
12 the agenda you had a break at this point, whether you
13 want us to go ahead and get into the acceptance
14 criteria, or do you want to take a break now?

15 CHAIRMAN SHACK: Ralph's discussion looks
16 reasonably short. I think I'd just as soon keep on
17 going and then take the break.

18 MR. MEYER: Looks short, but the
19 discussion may be -- looks short, but may be
20 deceptive. All of the discussion so far has been on
21 analytical methods for calculating the peak cladding
22 temperature which are laid out in Appendix K.

23 There are in fact five acceptance criteria
24 specified in 50.46, not just peak cladding
25 temperature. These are the speed limits, so to speak,

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1 and they are listed here on this slide.

2 The objective in examining the acceptance
3 criteria in 50.46 for possible modification is to see
4 if we can remove some or all of the prescriptive
5 nature of these criteria, which are related
6 specifically to zircaloy cladding and to ZIRLO, which
7 are written into the present rule, and take them out
8 so that the rule could apply generally to any
9 zirconium-based alloy that's used for fuel rod
10 cladding.

11 I think that this can be done simply by
12 removing number 2 on this list, the maximum cladding
13 oxidation, which is specified at 17 percent, and I
14 want to discuss that. So I have in fact just one
15 option here.

16 It's either do it or don't do it. You
17 could, I guess, make some variations on this, but this
18 seems like a logical approach, relatively simple in
19 procedure, that would solve the problem.

20 DR. KRESS: What does it change, Ralph?

21 MR. MEYER: What?

22 DR. KRESS: It just changes the -- it's a
23 perceptions change.

24 MR. MEYER: What you would do here is to
25 take the 17 percent equivalent cladding reactive limit

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1 out of 50.46 and replace it with a performance-based
2 requirement that says simply that you should retain
3 some post-quench ductility in the cladding.

4 DR. KRESS: Yes, but isn't the 17 percent
5 a surrogate for that?

6 MR. MEYER: That's -- well, 17 percent was
7 a measure of that for zircaloy.

8 DR. KRESS: I see. It may not be the same
9 surrogate for other things.

10 MR. MEYER: That's correct. It may not be
11 the same, for example, for M-5. Even ZIRLO wasn't
12 tested carefully against this limit, although the rule
13 was changed to include it.

14 DR. KRESS: And if you made the change,
15 the licensee would have to come in, if you had a
16 different clad, and show you the database.

17 MR. MEYER: That's correct; that's
18 correct.

19 DR. KRESS: I think that'd be a good
20 change. That would clarify a lot of things.

21 MR. MEYER: Yes. Most of this is on the
22 next slide, but before you move to the next slide,
23 let's --

24 DR. POWERS: Before we get too excited
25 about making this change.

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1 MR. MEYER: Yes.

2 DR. POWERS: What you want to do is to
3 preserve some ductility so that you can cool this core
4 and keep it cool and not have it fall apart on you.

5 MR. MEYER: Right.

6 DR. POWERS: We test for ductility in a
7 variety of fashions and we get different results when
8 we test in different ways.

9 MR. MEYER: Yes.

10 DR. POWERS: How do we know that the test
11 that we propose to use for ductility is the one that's
12 applicable for the core and the post-quench
13 environment?

14 MR. MEYER: Could you say a little more so
15 I understand what's in your mind a little better?

16 DR. POWERS: Okay. What I know is if you
17 test it one way it says there's lots of ductility.
18 Test it a different way there's not so much ductility,
19 okay. That's laboratory tests of remaining ductility.

20 Okay. Now, what we want to have is the
21 core not fall apart after we have gone through the ECS
22 injection or something like that and we've got
23 -- everything's cooled down, and it doesn't because
24 there's some ductility there.

25 How do we know that the ductility we

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1 derive from whatever test we endorse is ductility that
2 actually exists in the clad under the conditions of
3 the post-quench environment?

4 MR. MEYER: Well, the -- first of all, the
5 testing that was done back in the early '70s and late
6 '60s was in fact done under a post-quench environment.
7 That is, the cladding pieces were taken through a
8 high-temperature steam oxidation.

9 They were cooled down. They were quenched
10 and then they were tested at a relatively low
11 temperature. And there -- while it's true that you
12 could use other methods than the ring compression
13 method that was used back in the '70s, and there would
14 be some scatter in the result, from reviewing what had
15 been done earlier, it still appears to be a reasonable
16 approach.

17 And in fact, we are at the present time in
18 an ad hoc expert group that has participation from a
19 number of international groups. We are exploring
20 several different test methods for determining
21 ductility.

22 All you're trying to do here is to have a
23 screening test where you can differentiate between
24 fully brittle material and material that has some
25 residual ductility. From what I've seen so far, I

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1 think the ring compression test will continue to be a
2 good way of doing this.

3 You can do it with a hardness indentation.
4 You could do it with some sort of plastic extrusion
5 method of providing the loading on the rings. But
6 it's materials property, and basically, any way you
7 test it except for some variations introduced by the
8 testing method, you're going to get about the same
9 answer.

10 So I guess the answer to your question is,
11 we are aware of the concern about the appropriateness
12 of the test. We have an effort underway to see if
13 some other procedure would be better than the one that
14 was used in the early '70s.

15 At the present time the general
16 configuration of ring compression test still appears
17 to be a good approach, and the details of the test
18 method that would be used for this would be laid out
19 in a regulatory guide.

20 And I guess we can just -- you're jumping
21 to the bottom line here and going --

22 CHAIRMAN SHACK: Going at it a different
23 way because I think Dana's coming from -- there's two
24 problems here. One, given a given temperature strain
25 history I end up with a certain condition of cladding,

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1 and to determine the ductility --

2 MR. MEYER: Yes.

3 CHAIRMAN SHACK: -- then it really is an
4 experimental problem of what is the right test.

5 MR. MEYER: Right. Right.

6 CHAIRMAN SHACK: And that's one we can
7 address.

8 MR. MEYER: Yes.

9 CHAIRMAN SHACK: I think in a fairly
10 straightforward way. I think Dana's concern is with
11 temperature strain history you put the clad through --

12 MR. MEYER: Oh. Oh. Oh. Okay.

13 CHAIRMAN SHACK: -- before you get to the
14 test.

15 MR. MEYER: Okay. Okay. Well, we're also
16 poking into that and the way -- we haven't completed
17 this, and you'll see that the last column on this
18 second slide here is that we will not have done enough
19 work to actually put this thing through a -- its paces
20 for one or two more years because we haven't finished
21 the work yet.

22 But we know pretty much now how this would
23 play out. You would use a temperature -- you would
24 simulate the several of the high-temperature LOCA
25 transients. You would have a slow temperature rise up

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1 to some temperature at which you would soak it for a
2 period of time to accumulate the oxidation.

3 You would cool it at some steam cooling
4 rate. I forget the number, but I think it's on the
5 order of five or ten degrees a second, down to 800
6 degrees centigrade, at which point you would then
7 flood it and quench it.

8 And we are exploring the effect of
9 different heating and cooling rates and the effect of
10 different temperatures at which you hold the specimen.
11 And it's likely that one would want to prescribe tests
12 at a series of temperatures, not just at a single
13 temperature, up to and including the peak cladding
14 temperature of 2200 fahrenheit, which is 1200, 1204
15 degrees centigrade.

16 And so we are doing those kind of tests in
17 the near future on a high burnup cladding and the
18 archive under-radiated fresh material that corresponds
19 to that to try and map out what these effects are and
20 what would be the best rates and temperatures to
21 conduct this temperature history for the ductility
22 test.

23 So that would all be set out in the
24 Regulatory Guide. Now, in the relatively near term we
25 could set out in a draft guide the conditions that we

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1 in fact are planning to use in the laboratory.

2 But if you rush this through before we're
3 able to actually do those tests in the laboratory and
4 see if the result appears satisfactory, then you run
5 the risk that we might have to change something.

6 MR. MEYER: Now, there is -- may I move to
7 another point? There is one thing that I wanted to
8 emphasize here, and that is that the peak cladding
9 temperature of 2200 degrees and the cladding oxidation
10 limit of 17 percent really arose as a pair of numbers
11 originally, and these both came from these ductility
12 tests, the ring compression tests.

13 The 17 percent -- okay. So you have some
14 flexibility if you want to move away from these
15 precise numbers you could say, well, let's work with
16 2300 degrees fahrenheit and maybe we would get 15
17 percent for zircaloy.

18 So there would be some flexibility in
19 working with both of those numbers, but you'll notice
20 that I've suggested that we keep the 2200 degree
21 fahrenheit number, and I've suggested that for what I
22 think is a good reason.

23 And that is during the ECCS hearing this
24 was the most contentious part of the debate about the
25 acceptance criteria. And in fact, a second line of

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1 concern was raised about the peak cladding
2 temperature, and that had to do with rapid oxidation
3 at higher temperatures.

4 And so the Commission reached a decision
5 to limit the temperature a relatively low value so
6 that you didn't have the concern of rapid oxidation.
7 And at the same time it fit in with the -- with
8 Hobson's ring compression test data on the ductility.

9 And so I think that if you were to alter
10 that temperature that you would probably open this up
11 to a lot of contention. And I don't believe there's
12 a need to change that because we can work with that as
13 a fixed number, and then let the maximum cladding
14 oxidation figure vary in order to capture the effects
15 of both cladding alloy variations and burnup effects.

16 And so it might go up or it might go down.
17 And it might be different for high burnup, low burnup,
18 different cladding alloys. And so you pull that out.
19 You put it into a Regulatory Guide. Everything else
20 can stay fixed and then the -- in 50.46.

21 And the 50.46 would not be pegged to
22 zircaloy or ZIRLO and could be used for all zirconium
23 based alloys.

24 CHAIRMAN SHACK: Why not just pull them
25 out to the Reg. Guide?

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1 MR. MEYER: Well, you could --

2 CHAIRMAN SHACK: Use the coolable geometry
3 and the long-term cooling as the fundamental
4 requirements, which they really are.

5 MR. MEYER: Yes.

6 CHAIRMAN SHACK: And then how you assure
7 that, put that in the Reg. Guide because if you get
8 new data some day --

9 MR. MEYER: Well, you could do that. I
10 think that you would also need to address the question
11 of rapid oxidation at higher temperatures. And to me
12 this would open up the possibility of litigation
13 unnecessarily.

14 There's no reason that we couldn't work
15 with that 2200 figure on the embrittlement criteria.
16 Leave it fixed. It was, you know, a hard fought
17 number in the beginning and it does not cause, as far
18 as I can see, any problems with the technical adequacy
19 of an embrittlement criterion that you would derive
20 with that as a fixed number, because you've got two
21 parameters to work with. So we can do it all with the
22 other one.

23 CHAIRMAN SHACK: It's just that, you know,
24 you don't really have the database on M-5 or even
25 ZIRLO. I'm not sure that people were worried about it

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1 as much.

2 MR. MEYER: No. It hasn't been worried
3 about too much in the past, but we're worrying about
4 it now. And in fact, just for your interest, I could
5 say that we've made excellent progress in our
6 discussions with Framatome about an agreement to begin
7 testing their M-5 cladding.

8 And we're now down to the point of some
9 legal language in a memorandum of understanding with
10 all the basic issues having been agreed upon between
11 us and Framatome. So I think the time is coming soon
12 that we will begin to test, first, the Framatome M-5
13 cladding on irradiated material at first, and then
14 hopefully, Westinghouse, their low cladding, although
15 those negotiations are simply on hold waiting the
16 outcome of the negotiations with Framatome.

17 DR. KRESS: You're fairly confident,
18 though, that the 2200 will keep you below a runaway
19 oxidation.

20 MR. MEYER: Yes.

21 DR. KRESS: That's well enough below it
22 that it's safe.

23 MR. MEYER: Yes. I'm not aware of
24 anything that would be significantly altered by making
25 these small alloy changes. I mean, it's still based

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1 --

2 DR. KRESS: Just not enough that has
3 changed.

4 MR. MEYER: -- and zirconium and zirconium
5 oxide.

6 CHAIRMAN SHACK: I mean, 2200 is more than
7 runaway oxidation. It really is sort of oxygen pickup
8 that --

9 MR. MEYER: Sure. 2200 first of all is
10 part of the embrittlement criteria.

11 CHAIRMAN SHACK: Yes.

12 MR. MEYER: And how it came about -- put
13 my backup slide. I've got my backup slide to make me
14 look smart here. When you ran a piece of zircaloy
15 cladding through a high temperature transient and
16 brought it back down, if you -- you're looking at the
17 outer surface on the left and the inner surface on the
18 right, it went through a phase change.

19 It was hexagonal close-packed in its alpha
20 phase at normal temperatures. And some of it changed
21 to a body center cubic structure at high temperatures,
22 and then you quenched it and brought it back down.

23 And you could tell what had been body
24 center cubic and it turns out that the body center
25 cubic phase is the one that provides your strength and

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1 ductility. And so what you really are interested in
2 is maintaining a ductile prior beta region in the
3 cladding.

4 And the gross amount of oxidation
5 correlated pretty well with the thickness of a ductile
6 prior beta layer. Above 1200 degrees centigrade, 2200
7 degrees fahrenheit, you've got additional oxygen
8 diffusion into this prior beta region that pretty much
9 upset that handy little correlation.

10 And so that was the reason that you didn't
11 go above 1200 degrees centigrade, because your use of
12 gross oxidation as a surrogate for this one layer fell
13 apart. Now, you could deal with that by backing down
14 the total amount of oxidation in say 15 percent or 14
15 percent, and let the temperature go up.

16 But the Commission did not do that. They
17 stuck with that number and then they said, and by the
18 way, we don't want to make it any higher because there
19 is this consideration of rapid oxidation at higher
20 temperatures and we don't have much information on
21 that.

22 And it was a huge -- that was a huge part
23 of the hearing. It was a huge part of the Commission
24 opinion, and it seems like the sensible thing to do is
25 to leave it alone and to work with the oxidation

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1 thickness for the embrittlement criteria.

2 CHAIRMAN SHACK: Any additional questions
3 for Ralph? If there are none, this seems like a good
4 place for a break and I suggest we come back at 11:05.

5 (Whereupon, a recess was taken
6 at 10:48 a.m. until 11:09 a.m.)

7 CHAIRMAN SHACK: So in that quandary, we
8 can start again.

9 MS. DROUIN: Okay. He has it on. It's
10 not working.

11 CHAIRMAN SHACK: Time to change bulbs.

12 (Pause)

13 MS. DROUIN: Okay. We just have one slide
14 here to bring in the status of what's happening on the
15 rulemaking side with NRR. Unfortunately, Sam Lee
16 couldn't be here today. There was a petition that was
17 sent in, in September by NEI.

18 The primary purpose was, as we saw with
19 50.44, if there's a part that can be -- that appears
20 to be -- that can -- that appears -- man, I just can't
21 get these words out of my mouth -- that can be
22 separated out and move on a faster track, they like to
23 see that be done that way.

24 And so they have submitted a petition to
25 separate out the decay heat part and put that on a

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1 faster track and make a separate rulemaking activity
2 out of that. We had noted in our SECY that all of
3 these things could be one rulemaking or several
4 rulemakings, and that would be decided as we move
5 forward.

6 But in their particular petition, you
7 know, it would allow the licensees optional adoption
8 of the latest standard and allow adoption by the
9 licensees of any subsequent revisions to the standards
10 that are endorsed by the NRC as we go forward in time.

11 Right now, the staff is currently
12 evaluating the petition. It's in the normal process.
13 Okay. Now, today so far we have talked about the
14 status on the evaluation criteria and the evaluation
15 model.

16 Those were two very important parts
17 because we are right now deviating on the
18 recommendations that we had made on the evaluation
19 criteria and the evaluation model. We had made one
20 set of recommendations, and now, as we move forward in
21 the technical work we are now proposing somewhat
22 different things.

23 On the reliability part, we've still got
24 a lot more work to do here, and as we've seen in the
25 criteria in the evaluation, we're coming up against

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1 some technical issues that we had not anticipated. So
2 with that, I'll turn it over to Alan.

3 MR. KURITZKY: Okay. As Mary said, the
4 previous discussion dealt with the proposed changes in
5 SECY 133 dealing with the ECCS evaluation model and
6 the acceptance criteria.

7 We also proposed changes in the near-term
8 to the reliability requirements, particularly those
9 that are included in, you know, GDC 35, dealing with
10 the loss of off-site power requirement and also the
11 single failure criterion.

12 In the SECY what we recommended was a
13 risk-informed alternative to those ECCS reliability
14 requirements. The idea was that we would replace the
15 existing requirements of GDC 35 with requirements that
16 were more risk-informed and more realistic.

17 Particularly, we would be deleting the --
18 oh, we'll call it the requirements or the assumption
19 that you have a loss of off-site power when you have
20 a LOCA, and also the need to model the single worst
21 additional failure.

22 Instead, we would be offering two
23 performance-based options that would get at -- that
24 would help assure ECCS reliability. A first option
25 would be a generic -- would be something that was done

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1 in a generic fashion by plant type that the NRC staff
2 would do ahead of the game.

3 We would put together, we would define by
4 plant group or plant type what minimum ECCS equipment
5 would be required for that group or type, and we would
6 -- that would also include whether or not you need to
7 consider the loss of off-site power for -- to prevent
8 accidents.

9 And the equipment requirements themselves
10 would be tied to different groups of accidents. You
11 may have one set for large LOCA ones and for small
12 LOCA, et cetera. The idea under Option 1 is that's
13 something that the NRC staff would do ahead of time so
14 that if a licensee wanted to implement it they would
15 not have to do any technical analysis.

16 It would be pretty much cut and dried.
17 They can choose to go with it. They don't have to do
18 any analysis and nor does -- do any review, and it's
19 -- it'll go quickly.

20 However, if a licensee decides that they
21 feel they are not getting as much unnecessary burden
22 reduction as they feel they could get, you know, doing
23 a more detailed analysis, a more plant-specific
24 analysis, they don't like the group they're in, they
25 feel some bad actor was dragging their group down,

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1 they will have the option to go ahead and do a plant-
2 specific analysis and that will be based on guidance
3 that we would include in a Regulatory Guide.

4 We would give them an ECCS function
5 reliability threshold that would be derived from,
6 well, what we're envisioning is probably something
7 derived from the core damage frequency threshold
8 that's in our framework, our Option 3 framework, the
9 qualitative guidelines we have there.

10 And then the licensee would go through and
11 do analysis using their own data, you know, whatever
12 analysis they want to do analysis mix they want, their
13 own PRA, and try and justify some -- they would have
14 to meet some reliability threshold for the ECCS
15 function, and it could be with whatever equipment they
16 have at their plant, whatever set they feel is
17 necessary.

18 And again, that would also cover whether
19 or not they would need to consider the simultaneous
20 loss of off-site power assumption for different acts
21 and classes. To kind of explain that a little bit
22 better I have -- this just shows you the --

23 CHAIRMAN SHACK: Now, your own Reg. Guide
24 would also give them some way to calculate LOCA
25 frequencies, right?

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1 MR. KURITZKY: Well, what the Reg. Guide
2 wold do would give them guidance on LOCA frequencies,
3 exactly. That's going to be one of the main things.
4 You'll see as we get to the technical issues, that's
5 one of the main things we are still wrestling with.
6 But that's -- yes, you're right. It would give them
7 guidance or --

8 CHAIRMAN SHACK: Or a set of numbers or
9 something.

10 MR. KURITZKY: Yes. It could give them a
11 set of numbers or it could --

12 THE REPORTER: Excuse me. Would you pull
13 your microphone up.

14 MR. KURITZKY: It can give you -- it would
15 give you a set of numbers or it could tell you things
16 you have to consider when you want to calculate your
17 own numbers. They say that latter part about things
18 you have to consider, some of that stuff may have to,
19 you know, I don't know whether it's something we'll do
20 now in the short-term, whether it's something that
21 would have to wait till we get to the long-term thing
22 of looking at the spectrum of LOCAs.

23 Just to kind of clarify a little bit about
24 what we're looking at from coming from these two
25 options, for Option 1 we're envisioning that we would

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1 have matrices that we have produced, and the matrices
2 would have plan group or plan type along one side.

3 You know, it'd have different acts and
4 classes along the other side. And it would delineate
5 what minimum system requirements you would have or
6 equipment requirements you would have for the ECCS
7 function.

8 And these -- the purpose of specifying
9 that equipment is if a plant finds out that they have
10 more equipment than the minimum required, it would
11 give them fuel or additional justification for making
12 some kind of operational relaxation, whether it be in
13 technical specifications or whether or not it would
14 allow some kind of design change.

15 That would be up to us to decide, you
16 know, the NRR to decide in the implementation phase.
17 But in addition, there would be a second matrix that
18 would identify the actual sections that are used in
19 the ECCS thermal-hydraulic performance calculations.

20 And specifically, it's the GDC-35
21 requirements of the single additional -- single worst
22 additional failure, and considering both with or
23 without off-site power available.

24 This matrix would again be the same thing,
25 plant type and accident type on the other side, and it

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1 would specify whether or not you do need to consider
2 a loss of -- a conditional or a current loss of off-
3 site power with that particular accident class, and
4 also whether or not -- what failures you'd need to
5 consider.

6 It could be a single failure. It could be
7 multiple failures. It would also allow you to address
8 passive failures. It would give us the opportunity to
9 finally try and resolve the footnote that's been in
10 Appendix A to Part 50 for -- since I was a small boy,
11 because all that would fall into this reliability
12 threshold. And so --

13 DR. POWERS: It seems to me that the
14 assumption is the ECCS requirements right now were
15 installed in response to the possibility of some
16 stochastic event during normal operations, and you're
17 trying to address that. That doesn't seem to me,
18 then, to span the entire spectrum of reasons for
19 having an ECCS.

20 MR. KURITZKY: Well, as far as I
21 understand, the ECCS -- we're looking at all the
22 different types of acts and issues that you could have
23 at the plant.

24 DR. POWERS: No, you're not. You're not
25 looking at all of them. You're not looking at any

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1 kind of sabotage. You're not looking at any kind of
2 external threat whatsoever here.

3 MR. KURITZKY: External threat. You're
4 referring to a sabotage threat or external events like
5 seismic activity?

6 DR. POWERS: Clearly, I'm talking about
7 sabotage.

8 MR. KURITZKY: Sabotage, yes. Yes.
9 Sabotage isn't --

10 DR. POWERS: Well, doesn't that -- I mean,
11 doesn't that make you -- I mean, why can you exclude
12 that?

13 MR. KURITZKY: That's an interesting
14 question. I mean, as I understand it -- I'm not privy
15 to all that's going on in the Agency on that topic.
16 There's a lot of work going on there and that's going
17 to impact -- I assume that's going to impact a lot of
18 the work that the Agency does.

19 It can impact a lot of the regulations.
20 I don't know how that's all going to fall out. I
21 would say I wouldn't want to hold up everything else
22 waiting to see how that falls out. So what we're
23 going to do is based on current risk insights.

24 And unfortunately, as we all know, they do
25 include sabotage as an initiator. I mean, it does not

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1 include sabotage is -- that's my answer.

2 DR. POWERS: I mean, it seems to me that
3 until you can establish that the only reason we have
4 any CTS in each plant is for stochastic events that
5 are covered by the PRA kinds of analyses, you can't go
6 around doing this.

7 MR. KURITZKY: Well, I don't know. I
8 guess my opinion is that I don't necessarily agree
9 with that. I feel that we have enough knowledge that
10 we can propose some changes based on what we feel are
11 reasonable events.

12 I think you make a good point and that's
13 one thing that just has been kind of overlooked by
14 PRAs, and it's not a question of something that's
15 overlooked because of the frequency is so low, which
16 we can make some probabilistic argument why we don't
17 need to worry about it, but it's one that obviously we
18 can't make that argument about. I guess that may be,
19 you know, policy --

20 MS. DROUIN: I'm confused by your -- I
21 wasn't even sure what your question was in all of that
22 data. But what I'm more confused by is your concern
23 doesn't seem to be addressed by the current set of the
24 way the regulation is written right now anyway.

25 DR. POWERS: Why not?

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1 MS. FAIRBANKS: I guess if I can
2 interrupt, I was going to say that later when I had a
3 slide come up that we were going to be providing from
4 our branch some support to PRAB. And one of the
5 things that we were trying to look at, too, was some
6 of these indirect causes.

7 And we had actually considered potentially
8 sabotage or maybe that would be the subset of
9 something like an indirect crane hit to piping, which
10 could cause a large break LOCA. But to fully risk
11 inform --

12 DR. POWERS: Well, I think you -- I mean,
13 I don't think there's an analogy, a good analogy
14 there, because one of the reasons for saying -- you
15 got a large break LOCA and a simultaneous loss of
16 power, it is clearly a, gee, this is a deliberate
17 sabotage event and I want to be able to respond to
18 that with my system.

19 And I don't think you can do both of them
20 with a stochastic event. I mean, that's why he's
21 interested in dropping out the simultaneity, because
22 it's hard to come up with a finite, nonvanishing
23 probability, is to have both at the same time. But
24 you can when you come to sabotage.

25 MS. FAIRBANKS: Yes, you're right.

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1 MS. DROUIN: If you give the sabotage a
2 probability of 1.0 -- the frequency --

3 DR. POWERS: No, I don't think I have to
4 do that. I have to say that in any event even those
5 of a vanishingly small probability can in fact occur,
6 and if they do occur I want something to protect me.

7 MS. DROUIN: So regardless of how small
8 the occurrence is, I mean, to me that's not being
9 risk-informed, and that's where we are right now. We
10 have two events there that are extremely low
11 frequency.

12 MR. KURITZKY: And I think also in the
13 off-site thought, Mary's point is that -- or to
14 address more your question, Dr. Powers, is that the
15 -- if we do make some of these changes, it does not
16 mean that -- you mentioned you'd like to have
17 something to protect you in case that event does
18 occur.

19 And it's not that these changes that we're
20 going to make here are necessarily going to strip away
21 all that protection. Your reliability may be somewhat
22 reduced, but it doesn't strip that away.

23 So then it's the question of that
24 reliability times the probability or the frequency of
25 a sabotage event that results in the loss of off-site

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1 power and large break LOCA, plus your residual
2 mitigated capability, is that frequency -- previously
3 something that gives us heartburn in that -- without
4 a quantification of sabotage frequency, I can't say
5 one way or the other.

6 DR. POWERS: I guess I'm wondering if
7 suppose somebody even figured out how to calculate the
8 sabotage frequency, would I want to give up that
9 protection?

10 MR. KURITZKY: Well, what protection
11 specifically are you giving up?

12 DR. POWERS: Be able to cool the core.

13 MR. KURITZKY: Well, what I'm saying, I
14 don't envision that what we would be changing would
15 necessarily give up your ability to cool the core.

16 DR. POWERS: I am --

17 MR. KURITZKY: You still have low pressure
18 injection pumps that are most likely going to be on
19 the -- so it's not -- you know -- there is a
20 mitigative capability remaining in the plant.

21 MR. BONACA: I think this is somewhat of
22 a broader issue of how the -- you know -- the issue of
23 security has always been dealt with. I think that the
24 fact that there is a security has always been
25 eliminating consideration of sabotage as initiator for

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1 this.

2 I mean, it's an issue but it's broader
3 than this specific one, I think.

4 MR. MARKLEY: I think the point here that
5 you're driving toward is that it was built on internal
6 threats.

7 MR. BONACA: Right.

8 MR. MARKLEY: And not external threats.

9 MR. BONACA: Correct.

10 MR. KURITZKY: Okay. So as I was
11 mentioning, we have these two types of matrices that
12 would really -- that we're looking at, we're
13 envisioning would come from this: the one we
14 specified with the minimum equipment, ECCS equipment
15 that the plant -- or plant type or plant group would
16 have to have for each different type of accident
17 initiator category.

18 And the second matrix would specify the
19 assumptions, failure assumptions to be used in doing
20 the thermal-hydraulic calculations by the types of
21 failures we'd have to consider, and also what
22 equipment -- also whether or not you'd have loss of
23 off-site power or not.

24 For Option 2 we would be producing a
25 Regulatory Guide. I guess I should have used the

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1 words "contain the requirements," since there are
2 requirements, but I guess it would provide the
3 guidance to licensees for performing a plant's
4 specific analysis like I had discussed previously
5 where they would essentially be going through the same
6 things that we're going to be going through, trying to
7 come up with the option on matrices.

8 The same issue that we are going to
9 wrestle with we would have to lay out in that
10 Regulatory Guide, at least to get to know how -- at
11 least one way that we would approve them in doing the
12 analysis.

13 And that would allow them, like I said
14 before, to try and get additional margin or additional
15 unnecessary burden reduction if they feel that the
16 first option didn't give them -- or didn't get them
17 where they wanted to go.

18 CHAIRMAN SHACK: Now, what -- you know,
19 when we redo this, what changes do you see the
20 licensees actually making in response to this? Is it
21 tech spec requirements on the --

22 MR. KURITZKY: I think one thing is
23 probably tech spec requirements; allowed outage times,
24 maybe some relaxation of allowed outage times. I
25 think the LOCA/LOOP assumption may allow them to

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1 extend the -- or relax the diesel generator start time
2 that -- the tech spec requirements for the ten-second
3 diesel start time.

4 Those are the two main things that I can
5 envision, relaxation of tech specs which includes, of
6 course, the diesel start time. What's not clear is
7 that if they are -- if they can do the calculation to
8 show that they can extend the diesel start time,
9 whether they would in fact push for a change on that
10 start time or allow the diesels to start later, or
11 whether or not they would just keep that margin for
12 some other usage or find that margin for some other
13 usage.

14 But that would be up to the licensees to
15 decide. So we will just have to make sure that
16 whatever that chance could entail, we're happy with
17 that they would do with it.

18 MS. DROUIN: You go back to the issues and
19 when we come back if they want to hear about that.

20 (Pause)

21 MS. DROUIN: We were going to skip the
22 next slide in and get into -- because it just seems to
23 go more along better with the discussion -- the issues
24 that we're encountering.

25 MR. KURITZKY: It's off the slide 13.

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1 Okay. In doing the technical work and pursuing the
2 technical work since we submitted the paper, SECY 133,
3 we have encountered a number of issues that we have to
4 wrestle with, technical issues, implementation issues.

5 We're also looking out for policy issues.
6 Some of the issues may border or be on some fine line
7 between technical and policy. But right now we have
8 a quite a long list, maybe 20, 30 issues that we've
9 come up against.

10 Some of them were relatively easy to
11 resolve and we've already resolved them internally, or
12 have those resolutions to them internally. Others we
13 still are wrestling with. We'll require more broad-
14 based discussions and probably public stakeholder
15 input.

16 And certainly, we welcome and one of the
17 purposes of this meeting is to get ACRS input on some
18 of these issues. The three of them that I have listed
19 on this slide are three of the more important ones
20 that we're wrestling with.

21 The first one we all were just starting to
22 discuss a little while ago was the LOCA scope and
23 frequency. We are planning -- or at least at this
24 point the most up-to-date column, state of the art
25 LOCA frequency numbers are in NUREG CR 57.50, and

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1 that's our starting point for getting LOCA frequencies
2 for this effort.

3 However, the new NUREG CR 57.50 LOCA
4 frequencies are just for pipe break LOCAs. They don't
5 consider nonpipe break failure methods, such as steam
6 generator man-way, or heavy load drops.

7 So we have to determine some way to
8 include those other types of LOCA initiators or LOCA
9 causes into our calculations. In addition, we need to
10 address the methodology in NUREG CR 57.50. We need to
11 determine whether or not it adequately addresses aging
12 effects and other unknown -- mechanisms that may show
13 up sometime in the future that would serve to
14 undermine the service data that is the basis for the
15 NUREG 57.50 numbers.

16 We are planning to have meetings with
17 contractors from the engineering folks, the
18 probabilistic factual mechanics experts meeting with
19 people involved with NUREG 57.50 to try and internally
20 come up with something that may be acceptable to all
21 parties, at which point we also want to go out to the
22 public and get their input on how we're going to
23 address the LOCA frequencies.

24 And obviously, it's a big driver. It's
25 going to drive both pieces that I was talking about

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1 previously, the LOCA/LOOP and the reliability. Both
2 -- the LOCA frequency is a parameter in the equation
3 for both of them.

4 So it's obviously a very important issue
5 that we need to come to some resolution on. Another
6 issue that's very important that we need to resolve
7 deals with the conditional loss off-site power
8 probability given a LOCA, going to that LOCA/LOOP
9 assumption.

10 And unfortunately -- but fortunately,
11 there is no data on LOCA/LOOPS. We're happy about
12 that, but as analysts it makes it a little trickier.
13 We have, instead, had to use as surrogates for an
14 actual loss of off-site power conditional on LOCA,
15 we've had to use just regular reactor trip events, and
16 also, ECCS actuations.

17 Now, ECCS actuations more closely resemble
18 the conditions you would have, at least electrically,
19 electrical load-wise, from a LOCA. However, again,
20 there's very few ECCS actuation events.

21 There's more readily available data on
22 reactor trips. The problem we have with reactor trips
23 is that the electrical loading conditions aren't
24 nearly as severe or not as severe as you would have if
25 you had a LOCA, because you don't have the ECCS loads

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1 coming onto the safety buses.

2 And that concern is further exacerbated by
3 the fact that we have a situation now where there are
4 plants sometimes operating with a degraded grade of
5 voltage, and when that condition occurs, given that we
6 have the degraded voltage relays or trip relays on the
7 safety buses, you can run into a situation where just
8 an extra load from the ECCS pump starting could be
9 enough to trip those relays, and even though power may
10 still be available on the grid, for all practical
11 purposes the plant is experiencing a loss of off-site
12 power because it's going to separate from the grid and
13 have to run on the diesels.

14 So that again is one of the data
15 limitations we have right now that we're working with.
16 And the third issue that we have up here involves
17 giving credit for non-safety grade -- non-ECCS systems
18 in the calculation.

19 The reliability threshold that we're
20 basing this on is probably going to come from a CDF
21 threshold from the framework. The CDF threshold is
22 based on values from a PRA.

23 PRAs and doing the core damage frequency
24 calculations do credit non-ECCS equipment for serving
25 a function, or a RCIC pump or in a BWR you could have

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1 a service -- cross-tie, or you know, a fire, a fire
2 protection pump.

3 So what we have to determine is what
4 credit are we going to give for non-ECCS systems in
5 this -- in our calculations or in trying to come up
6 with these matrices?

7 We don't want to get up in a situation
8 where a licensee may try and meet the entire
9 reliability threshold with non-safety grade systems
10 and then say, okay, I can have a lot of relief on my
11 true ECCS systems because I have all this reliability
12 from my -- you know -- additionally, my other nine
13 ECCS systems.

14 So we may have to come up with a -- as we
15 mentioned -- a sub-threshold, which would at least
16 assure a minimum reliability of the pure safety-grade
17 ECCS systems. So that's just another one of the
18 issues that we're wrestling with.

19 MR. BONACA: This is mostly on BWRs,
20 right?

21 MR. KURITZKY: Exactly.

22 MR. BONACA: And those which rely heavily
23 on the procedures that you have in place on how
24 integrated those systems are in the procedures?

25 MR. KURITZKY: Yes, that's the thing.

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1 Certain systems -- like I think, I don't know, maybe
2 the RCIC system, my understanding, may have a little
3 better pedigree than some of the other systems. But
4 again --

5 MR. BONACA: You know, if they're trained
6 and they're used that way and there is a real hardened
7 use for that, I think is different than purely if you
8 have some hypothetical, you know, ideas that was
9 implemented in the PRA but is not supported by
10 procedures.

11 MS. DROUIN: Yes, I mean, because the --
12 a lot of these it's not hypothetical, but particularly
13 when you look at boilers, they give a lot of credit to
14 systems whose primary function, you know, is not --

15 MR. BONACA: Not ECCS.

16 MS. DROUIN: -- is not the core coolant.

17 MR. BONACA: Oh.

18 MS. DROUIN: You know, the service for the
19 cross-tie, the fire water system, enhanced CRD. And
20 they do have procedures in place at the plants for
21 using these systems in those, you know, extreme cases.

22 But they aren't there for ECCS -- they are
23 not ECCS systems. And with boilers in particular,
24 they would have a very difficult time if we did give
25 them credit for meeting any kind of CDF threshold

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1 value.

2 But as Alan said, on the other hand, you
3 don't want them to come in and have so much credit
4 that we'd back off on the ECCS.

5 MR. BONACA: Right.

6 MS. DROUIN: And have a reliability of --
7 that's unacceptable to us.

8 MR. KURITZKY: And I guess one of the
9 other things that will come up when we -- or that we
10 have to consider when we look at the non-ECCS systems
11 is that right now the ECCS performance calculation is
12 just to look at the safety where you need the actual
13 ECCS systems.

14 And so when you make sure you meet your
15 20-200 DUEF (phonetic) threshold you have, relying on
16 just those ECCS systems. If we're going to credit
17 RCIC or service or cross-tie or something like that,
18 you know, there are at present no calculations
19 demonstrating that they can meet 20-200.

20 MR. BONACA: Right.

21 MR. KURITZKY: So we wouldn't want to have
22 the calculations need to be run. So we would want to
23 credit systems where it would be fairly obvious that
24 the function could be accomplished. So that's
25 -- those are three of the biggest issues that we're

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1 facing.

2 MR. BONACA: And I guess the same would be
3 under the fit for PWRs.

4 MS. DROUIN: Yes. Yes.

5 MR. BONACA: How credible is it that you
6 complete the fit, first of all, for the given plant
7 and then what credit do you give the function so that
8 you don't degrade the reliability of the ECCS?

9 MR. KURITZKY: Okay. So

10 CHAIRMAN SHACK: How would you -- or how
11 do you propose to address the LOCA frequency for the
12 non-pipe break LOCAs? Is this a database thing again,
13 you would look at experience and try to do estimates
14 on that?

15 MR. KURITZKY: That's kind of up in the
16 air right now. As I mentioned, we're going to try and
17 get some meetings together with some of our -- the
18 engineering folks and the PRA folks to kind of has
19 some of this out.

20 It may not -- you know -- it may be some
21 kind of bounding. We may put some kind of bound on
22 the numbers from 57.50 to try to account for some of
23 these other mechanisms. Some of them specifically may
24 have some data on them.

25 For instance, seismic LOCAs, you know,

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1 seismically induced pipe breaks, okay, or at least not
2 data, but the analyses show that they're very low
3 contributors. On the other hand, seismically indirect
4 -- you know -- seismic indirect LOCAs where you've
5 failed the supports on something and that falls and
6 breaks a pipe, well, the models show that to be on the
7 order of what you're getting from just the pipe break
8 LOCAs.

9 So in some of them we have some kind of
10 -- you know -- we don't call it data, but we have some
11 kind of models that give us some feel for what kind of
12 contribution they're going to make. Other ones are
13 really kind of floundering right now.

14 The shut-down conditions, drain-down
15 events, we really don't have very good weight of data
16 for that. There's not very many studies that are out
17 there, at least not -- and not in this country
18 particularly.

19 So it's -- right now we don't know exactly
20 how we're going to address that. That's why that
21 issue is out, you know, we're taking input from
22 anybody who wants to give us input on issues like
23 that. I don't have a proposal right now. Okay.
24 Well, let me just --

25 MS. DROUIN: No, let's keep going, time-

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1 wise.

2 (Pause)

3 MR. KURITZKY: Okay. So let me just move
4 on to the other piece that we had in SECY 133 was the
5 long-term piece looking at the possibility of
6 redefining large-break LOCA or the spectrum of breaks
7 that would be considered in the 50.46 analyses, and
8 Carolyn Fairbanks.

9 MS. FAIRBANKS: Yes. We've just really
10 initiated the work on this long-term objective out of
11 risk-informing 50.46. The objective here, which would
12 be at a time line of about the end of three years
13 would be to have a tech basis developed for redefining
14 the large-break LOCA.

15 We've developed a program approach here.
16 The approach that we were taking was really trying to
17 parallel the work that's being done to revise the PTS
18 rule, pressurized thermal shock rule. We wanted to do
19 this and we've had a meeting with industry a couple
20 months ago to relay that and to say that this is our
21 objective in following this example, to have a level
22 of rigor in our approach that's equivalent to that
23 that's being pursued with PTS.

24 So far we are doing some work on tasks one
25 and tasks three. There are some existing codes on

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1 probabilistic break codes, probabilistic fracture
2 codes. We're adding at this point some sub-critical
3 crack growth modules.

4 As Alan described, there are some issues
5 as far as indirect failures that --

6 DR. POWERS: I'm just a little confused
7 when you say the word "codes." You're not talking
8 about the SME code or anything like that?

9 MS. FAIRBANKS: No. No. No. This would
10 be programs.

11 DR. POWERS: Computer programs.

12 MS. FAIRBANKS: Programs, computer
13 programs.

14 DR. POWERS: And --

15 MS. FAIRBANKS: Modeling.

16 DR. POWERS: -- and so which ones are
17 those?

18 MS. FAIRBANKS: We're starting off
19 initially, we're just about done I think adding some
20 subcritical crack growth modules to the squirt code,
21 which is a probabilistic break code. There are a
22 number of other codes, P-squirt, PROLB, and we're not
23 really sure --

24 DR. POWERS: I'm wondering --

25 MS. FAIRBANKS: Pardon me?

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1 DR. POWERS: -- I'm wondering just which
2 of these codes predicts the cracks like in plants like
3 Summer and places like that.

4 MS. FAIRBANKS: We have to add that in.
5 Jumping a little bit ahead, the --

6 DR. POWERS: How about the cracks that we
7 have not seen today but will appear next year?

8 MS. FAIRBANKS: Jumping a little ahead
9 again, those are things that are we going to consider,
10 and they are difficult to do. A year ago nobody would
11 have thought we would be having to add in some BWSCC
12 modules; Summer occurs, and we're going to be doing
13 that.

14 We're not far along, not far enough along
15 yet to have that done, and if we look back
16 historically, we do see that new degradation
17 mechanisms do arise, some more significant than
18 others, but there is a history.

19 You know, we have a little interesting
20 plot, about every seven years there's something new.

21 DR. POWERS: Yes.

22 MS. FAIRBANKS: And so I don't think
23 anyone would feel comfortable in risk-informing this
24 without accounting for some possible future
25 degradation mechanism. How we're going to approach

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1 that we haven't quite settled yet, but that's
2 certainly one thing that's going to be incorporated
3 into this work.

4 MR. KURITZKY: And I think also the point
5 that -- of course, we definitely need to focus on, but
6 also, each of these clear mechanisms shows up, you
7 know, I think one time Mike Mayfield showed a slide
8 that showed like every seven years a new mechanism
9 shows up that they hadn't thought of before.

10 But in all cases these mechanisms that
11 have shown up, we don't have a LOCA so far, knock on
12 wood, and we'd identify the mechanism and then we do
13 some analysis of it. We come up with some type of
14 response or something that's implemented to try and
15 control it.

16 And so we've managed to avoid having a
17 LOCA. So in fact, yes, we do need to consider that
18 there could be other mechanisms that are going to crop
19 up and get us as time goes on.

20 But we also, you know, keep in mind that
21 once that mechanism -- unless that mechanism shows up
22 and it acts fast enough that we end up with a LOCA
23 condition right away -- we'll evaluate it and try and
24 address it so that, you know, corrective actions will
25 be taken to minimize its impact on the LOCA frequency.

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1 That's just one other thing we need to consider.

2 MS. FAIRBANKS: That's something that we
3 really think, is considering our input, too, with LOCA
4 frequency for the LOCA/LOOP.

5 DR. POWERS: It sounds like, if I follow
6 your logic, we should get rid of these things. I
7 mean, you say we got a lot of band-aids, and we don't
8 really need band-aids, because nothing ever results in
9 a LOCA. So why worry about it?

10 MR. KURITZKY: Like I say, with the band-
11 aids, your band-aids is what -- the corrective actions
12 that come up when we discover these things, we need
13 those band-aids. That's what keeps the LOCA frequency
14 low.

15 If we didn't put these -- if primary
16 -- crack and popped off and we just said, well, that's
17 a new mechanism, okay, very -- that's good, let's keep
18 going the way we're going, then I would expect to see
19 an increase in that LOCA frequency.

20 I'm not saying we wouldn't see one now
21 anyway because of this mechanism, but the idea that we
22 find it, now we address it, we put in corrective
23 actions to minimize it.

24 So you wouldn't expect to see, even if
25 there is going to be some delta in the LOCA frequency,

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1 it wouldn't be of a magnitude as if you just let the
2 thing go off on its own and didn't address it. So
3 there's some kind of self-correcting or self-
4 modulating type of mechanism there.

5 MS. FAIRBANKS: Also shows that as we're
6 approaching this we're looking at all of the different
7 type of crack growth modules to incorporate axial,
8 circumferential and surface cracks. They will all be
9 incorporated into the modeling.

10 We had a -- as I said earlier, we had a
11 meeting to convey this approach to industry, and right
12 now we're trying to support PRAB to the best we can
13 with our knowledge and our plants, that we're using it
14 in development of our break frequency and pipe size
15 diagrams to support the --

16 DR. POWERS: What is PRAB again?

17 MR. KURITZKY: PRA -- it's probable --

18 MS. DROUIN: That's us. What Carolyn is
19 getting there is that --

20 DR. POWERS: I thought it was a code for
21 a second.

22 MS. DROUIN: -- our technical work on the
23 reliability side, we're supposed to be finished, you
24 know, early in the spring time frame. We don't want
25 to move forward with a recommendation and then say a

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1 month or six months later they come in on their long-
2 term work and the frequency numbers that we're using
3 are totally not in agreement with them.

4 So we're trying to have some kind of
5 convergence here between what they're doing on the
6 large pipe break size versus what we're trying to do
7 on the reliability.

8 MS. FAIRBANKS: And it is a complex issue,
9 because in the approach for this we're even at the
10 initial point of deciding which pipe break sizes we're
11 going to look at, which lines those would be on, what
12 is the -- what are the operating conditions, what are
13 the environments for that size of diameter, which
14 degradation mechanisms would be potentially involved
15 in those.

16 And so you're not necessarily going to get
17 a curve when you're looking at the break size versus
18 frequency. I think that is really just wrapping up
19 where we are at this point. We are pursuing this --

20 MR. BONACA: Just to understand a little
21 better, just to know.

22 MS. FAIRBANKS: Okay.

23 MR. BONACA: For example, clearly, I mean,
24 you have a whole issue of crack growth and development
25 in two different size breaks, depending, you know, I

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1 think there is a time parameter there. I mean, you
2 have a crack initiation result.

3 Now, are you looking also at how a seismic
4 event could result in a certain break size, given that
5 you have an identified crack?

6 MS. FAIRBANKS: Yes.

7 MR. BONACA: For example, there is some
8 event where you have a crack or multiple cracks and
9 now you do have a seismic event, and so you will be
10 looking at that?

11 MS. FAIRBANKS: Yes. We'll be looking at
12 all the modes.

13 CHAIRMAN SHACK: It's more difficult than
14 it is in the PTS case, though, where, you know, you
15 sort of assume that the only flaws you have to worry
16 about are due to fabrication. You know, when you
17 allow flaws to suddenly appear --

18 MR. BONACA: Right.

19 CHAIRMAN SHACK: -- and to grow, life gets
20 a great deal more difficult than the --

21 MS. FAIRBANKS: And repair welds, many
22 things are going to come --

23 CHAIRMAN SHACK: Yes.

24 MS. FAIRBANKS: -- up to complexity.

25 CHAIRMAN SHACK: But I guess in your case,

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1 though, I mean, the frequency you need to get rid of
2 a large break LOCA as a design basis accident is
3 really probably a whole lot lower than you need --
4 although I guess you want to use the most realistic.

5 I mean, it's not as though you're going to
6 just stick a sort of a conservative estimate, because
7 you can move on. But in reality, you could have a
8 fairly conservative estimate for the large break LOCA
9 and still be able to obtain some relief, I would
10 think, in the simultaneous LOOP, wouldn't you?

11 MR. KURITZKY: The thing -- difference
12 being is that right now, since we don't have LOCA
13 frequencies by pipe size, which is something that we
14 idealistically hope that we can maybe get in the
15 longer-term, right now we have to deal with the large-
16 break LOCA category from a PRA stance, which is
17 essentially something six inches per PWR, every six
18 inches and above.

19 So we have to make it hold for everything
20 six inches and above. In the future we may be able to
21 show that the ultimate frequency you need to get rid
22 of a design based axiom, yes, we need to be lower.

23 But you may be able to do it with, say, a
24 14-inch pipe or a 12-inch pipe, and that frequency may
25 be much lower, while the six-inch break, you know, you

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1 may give up something. So you're right. You can
2 definitely get a much lower frequency to get it out of
3 the design basis.

4 But because we can't do it by a pipe size
5 right now, we have to do it for everything that's,
6 say, six inches and above that we can't afford to have
7 too many layers of, you know, conservatism piled on
8 there to, you know, address various
9 uncertainties before we would start to run into a
10 -- we lose our flexibility also.

11 MR. BONACA: Although you mentioned before
12 you are going to include consideration of heavy loads,
13 for example, in heavy loads then the frequencies
14 associated with a procedural violation of some type is
15 a measured one, perceive that, you know, it's -- I
16 think it's more likely that you have that happening
17 than certainly you have just a mechanistic double-
18 ending break. So that may drive up your frequency
19 quite a bit.

20 MR. KURITZKY: Well, except that it's not
21 just a question of having heavy load drop. It has to
22 be -- the operations have to be taking place during
23 power. You have to be doing something that's inside
24 the containment where you're over --

25 MR. BONACA: I'm talking about maybe

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1 you're -- you know -- you're in shutdown conditions.

2 MR. KURITZKY: Yes, for the -- oh, for a
3 shutdown.

4 MR. BONACA: You haven't removed the head
5 yet. You have the fuel there and whatever. You're
6 moving some heavy load and, you know, a heavy load
7 have enough to do damage.

8 MR. KURITZKY: Yes. In fact, at shutdown,
9 that's one of the -- like I mentioned before -- that's
10 one of the things we're really struggling with right
11 now because of all types of -- the drained elements or
12 LOCA initiates that could have occur at shutdown.

13 MR. BONACA: You know, that could drive
14 your frequency there, because I mean, that's a
15 procedural violation of some type.

16 MR. KURITZKY: Something we have to
17 consider.

18 MS. FAIRBANKS: I think we can move along.

19 MS. DROUIN: Move along?

20 MS. FAIRBANKS: No other questions.

21 MS. DROUIN: Okay. Well, at this point
22 we've gone through the four different areas covered by
23 50.46 and tried to give you an update and status of
24 where we are at. Just going back to what we had said
25 in the SECY in terms of our schedule, we had for the

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1 evaluation model and the acceptance criteria that that
2 technical work would be done, you know, on or before
3 July 2002.

4 That work right now is still on schedule,
5 and as you've seen, you know, we're deviating a little
6 bit from what we said in the SECY in terms of what we
7 would do there. On the risk-informed alternatives to
8 the reliability requirements, our work there is due in
9 April.

10 It's going to be very tight to us trying
11 to meet that schedule, a lot of issues there we're
12 still trying to --

13 MR. KURITZKY: Oh, that's 2002? I thought
14 it was 2003.

15 (Laughter)

16 MS. DROUIN: On the definition of the
17 break size.

18 DR. POWERS: I just have to interject.
19 One of the commissioners has bet me that he will not
20 have to vote on this during his term of office.

21 MR. KURITZKY: How many years do they have
22 left?

23 DR. POWERS: If I told you that I'd reveal
24 which commissioner it was, but several.

25 MS. DROUIN: You mean, for the break size?

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1 DR. POWERS: He said he would not have to
2 vote on any revision to 50.46 in his term of office.

3 MS. DROUIN: Well, if he doesn't vote,
4 then he, you know, we can't go forward with that break
5 size. I mean, he's kind of set the -- he's stacked
6 the deck -- yes.

7 CHAIRMAN SHACK: He said it would never
8 come to him to vote. Looks like -- I mean, we're
9 still working on the SECY. The vote is a long way
10 down the road.

11 (Laughter)

12 MS. DROUIN: Yes.

13 DR. POWERS: I think I'm going to owe him
14 some money here.

15 CHAIRMAN SHACK: But the most substantive
16 thing that's changed since 133 is the skepticism about
17 the possibility of relief for the K curve.

18 MS. DROUIN: Yes.

19 CHAIRMAN SHACK: I mean, you were more
20 optimistic in 133 than you are --

21 MR. KURITZKY: Right.

22 MS. DROUIN: Correct.

23 CHAIRMAN SHACK: -- from today's
24 presentation.

25 MS. DROUIN: Correct.

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1 CHAIRMAN SHACK: But everything else is
2 more or less following, which you laid out --

3 MR. KURITZKY: Right.

4 CHAIRMAN SHACK: -- in 133.

5 MS. DROUIN: That's correct. But you
6 know, our technical work on 50.46 is not tied to any
7 commissioner's vote. It's the rulemaking. So -- but
8 we plan to have all of our technical work done as we
9 laid out in 133. The public has been very interested
10 in this program, followed it closely.

11 We have had a lot of meetings with the
12 various stakeholders. We can -- we plan to continue
13 having a lot of meetings with the stakeholders. We
14 just have listed a couple there that's happened back
15 in August on the LOCA frequencies.

16 We had another one on the LOCA and new
17 frequencies. We just had a second one in October. We
18 plan to have another one at the end of November. So
19 I mean, almost on a monthly basis you can see we're
20 meeting with the stakeholders on this program.

21 They've been following it very closely,
22 giving us a lot of good data, also working with us.
23 So on that note, that kind of sums up where we're at
24 on the status for 50.46.

25 CHAIRMAN SHACK: You want to make any

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1 comments? Okay.

2 MS. FAIRBANKS: No comments.

3 SECRETARY HORN: We were scheduled to have
4 a presentation from NEI, Tony -- Mr. Angelo, but he's
5 had other commitments and so can't make it today. And
6 I think we're done with the formal presentations.
7 Final comments from members of the
8 subcommittee?

9 MR. BONACA: I think it was an informative
10 presentation, particularly when it came down to the
11 Appendix K tradeoffs that are really in the Appendix
12 K model, and then for which we need the credit,
13 really, from the K-8 curve.

14 I mean, that was quite a bit of
15 information. I think that that was quite valuable.
16 I don't have any other specific comments, except it
17 may be a long time before we have that relief, and
18 this work seems to be --

19 CHAIRMAN SHACK: Where's that low-hanging
20 fruit?

21 MR. BONACA: Yes.

22 MR. KURITZKY: Drying up.

23 MR. BONACA: And I thought it was in
24 general a very good presentation.

25 DR. KRESS: I thought so, too, and RP --

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1 it looks like Option C on that Appendix K is probably
2 the best one, plus continuing with the action plan to
3 get that additional information. I worry about using
4 frequencies to eliminate the LOCA/LOOP combination,
5 because I've been considering this a defense in depth
6 type of approach.

7 For sabotage and other things, I think
8 there are other ways you can get LOCA/LOOPS at the
9 same time, but I haven't thought enough about it to
10 get a firm position on that.

11 MS. DROUIN: One of the things I didn't
12 say and we tend to forget about our framework
13 document, but we do follow the framework very closely.
14 And the framework does not allow us, regardless of
15 what the numbers say, to violate those six elements of
16 defense-in-depth.

17 DR. KRESS: That's true, yes.

18 MS. DROUIN: So you know, we tend to talk
19 a lot about the numbers and we tend to, you know, not
20 verbalize so much the framework, but everything does
21 pass through that framework and you cannot violate one
22 of those defense-in-depth elements, regardless of what
23 the numbers tell us.

24 DR. KRESS: I guess we're supposed to
25 decide on what to do about the full committee?

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1 CHAIRMAN SHACK: No. I don't think we had

2 --

3 DR. KRESS: We don't.

4 CHAIRMAN SHACK: -- planned to have a
5 presentation to the full committee.

6 MR. MARKLEY: Just a Subcommittee report.

7 CHAIRMAN SHACK: Just a subcommittee
8 report.

9 DR. KRESS: Okay. Good.

10 MR. BONACA: You know, just to interject
11 on the issue of LOOP. I mean, I agree that's an issue
12 of defense-in-depth that makes you uneasy when you
13 think about eliminating it if you really want to cover
14 all the bases.

15 But one of the big challenges of the
16 licensees is really the frequent start of the diesels,
17 you know, cold and the wear of the diesels, and also
18 the very strict and demanding requirements imposed on
19 a lot of systems like, you know, HVAC and so on and so
20 forth.

21 I mean, does it mean that you -- I mean,
22 could we possibly have still a design capability for
23 LOCA and LOOP with less demanding requirements imposed
24 on the equipment from a perspective of testing?

25 Couldn't you look at the risk significance

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1 of reducing some of the tests imposed on the equipment
2 that really are the driving force right now for the
3 licensees on requesting some relief?

4 MR. KURITZKY: Well, I think in regards to
5 that, I mean, most plants' technical specifications
6 have already been changed so that that fast start of
7 the diesel --

8 MR. BONACA: Yes.

9 MR. KURITZKY: -- only has to be done --
10 used to be done once a month, but it's down to, I
11 think, once every six months.

12 MR. BONACA: That's true.

13 MR. KURITZKY: Assuming you pass it. So
14 there has been some relief in that regard already.
15 What it comes down to is do you still have to have
16 your diesel designed and your equipment designed to
17 come up at a certain time.

18 And that's governed by what kind of flow
19 rates -- you know -- what kind of flow rates have to
20 break and how quickly you have to get water back in
21 the core cylinder. And how big a break you're going
22 to consider and what the frequency of that event is,
23 you know, determines the time when that diesel has to
24 come on board.

25 But as far as the testing, I think most

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1 plants I think already have managed to reduce that,
2 you know.

3 MR. BONACA: I've not seen, but some of
4 the systems like the HVAC system and the time you need
5 to draw a vacuum in the enclosure buildings, I mean,
6 that's stuff that is tremendously demanding on the
7 plants and on the equipment.

8 And so anyway, but that's just a thought
9 that one could also determine the risk increase
10 associated with the relaxation of some of the
11 requirements, and they may find that you can still
12 have a high expectation of success of a LOCA and LOOP,
13 you know, coping with both of them by imposing less
14 restrictive requirements.

15 I agree with the -- on the start of the
16 diesel. That's one thing that has been done. But
17 again, many of the other systems have not been relaxed
18 at all, their testing.

19 MR. KURITZKY: That's something we can
20 look into.

21 CHAIRMAN SHACK: Well, I guess, you know,
22 when I -- I'm not as concerned as Tom is about the
23 defense-in-depth, because when I looked at the
24 proposed changes I don't see that those really affect
25 your defense-in-depth very much.

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1 You know, if you were proposing to remove
2 some equipment, but the kind of changes I foresee, at
3 least from this part, I think eliminating the large
4 break LOCA as a design basis accident could have a
5 more substantive impact than what one would consider
6 defense-in-depth. But this part doesn't seem to me to
7 impact it as much.

8 MS. DROUIN: Well, you may have some PWRs
9 out there who would like to get rid of their
10 accumulators, and they could.

11 CHAIRMAN SHACK: Under this.

12 MS. DROUIN: Under this.

13 MR. KURITZKY: Well, so far we have to
14 wait and see, but it doesn't even look like they're
15 going to get too much in that regard, because most of
16 the IPEs or the PRAs are going to correct the
17 accumulators for the smaller breaks, also, what's
18 called medium breaks.

19 And so therefore, you may not -- from a
20 reliability point you still may not make the grade.
21 But it's possible that maybe for A, if you have a
22 spare accumulator, you know, that you may be able to
23 relax the allowed out of time on it.

24 But again, whether or not somebody takes
25 something out of a plant or whether this gets

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1 relaxation in their technical specifications, I think
2 we're going to have to decide, the staff will have to
3 decide whether or not -- you know -- even if the
4 numbers come out that show that you could do that, we
5 have to decide whether or not that meets the defense-
6 in-depth filter or whether or not we're just
7 comfortable with that.

8 And we may want to put some kind of
9 limitations on that, some kind of restraints.

10 CHAIRMAN SHACK: Dana?

11 DR. POWERS: I guess I opened the Pandora
12 with the sabotage concern, the defense-in-depth, and
13 I think I still wrestle with defense-in-depth and what
14 we're -- where it is and how it is in the regulations
15 and how far it goes.

16 I come back to the earlier presentation,
17 I look forward to seeing what comes out of these
18 studies on the oxidation of clads and your
19 circumstances. And it looks to me like what -- after
20 a lot of complications of phenomenological discussions
21 -- that the basis idea that you will only go after the
22 17 percent oxidation and replace it with an
23 embrittlement criterion seems like a pretty good idea
24 to me.

25 I mean, I feel sorry for those that have

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1 to demonstrate that they have retained ductility,
2 because I think that's a much harder analytic tool
3 than just showing that you don't hit 17 percent
4 oxidation using Baker-Just kinetics than in a fairly
5 simple temperature transient.

6 But I think it's a much more defensible
7 thing and the challenge that the industry would face
8 in showing that the oxidation kinetics of every type
9 of clad that came along was bounded by Baker-Just
10 might prove as much of a challenge as the calculation
11 of ductility.

12 But I guess it's -- I mean, I think before
13 you finalize on this we just have to wait for the
14 experimentalists to get their act together and get
15 some data, and it takes a lot of data.

16 CHAIRMAN SHACK: Other comments?

17 MS. DROUIN: I have a question. You know,
18 we were asked last time, you know, to keep the ACRS
19 informed, you know, of the status. I look down the
20 road to the future of, you know, where our next
21 milestones are and, you know, the technical work on
22 the reliability parts to be done at the end of April,
23 the acceptance criteria and evaluation model in July.

24 My question is to, when would you all be
25 interested in seeing us again, and would it be at the

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1 Subcommittee level, the full committee level?

2 DR. POWERS: You know, my initial
3 reaction, of course, Mary, is the committee is always
4 delighted when you want to come talk to us because you
5 always have something interesting to tell us, but I
6 think that really it's up to you.

7 And I think you've got a good strategy
8 here that you're trying to pursue and I think it's
9 when you think you have enough substance in there to
10 get some opinions instead of some speculations and
11 questions --

12 MS. DROUIN: Okay.

13 DR. POWERS: -- that we want to hear. And
14 I would suggest this is before the full committee
15 because everybody has a stake in this. And so you
16 want to ask not only for a time, but enough time so
17 that you can -- you're not rushed in getting your
18 points across.

19 So don't let them short-change you on
20 time, in other words. But I think it's really up to
21 you because you know your schedule and the various
22 challenges. It's when you think you've got enough to
23 -- this to mark some point on it, rather than any
24 -- rather than judging on the calendar list, judge
25 based on the progress of the work.

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1 MS. DROUIN: No. No. I agree and I
2 didn't know if there was --

3 DR. POWERS: Sure.

4 MS. DROUIN: -- something here in
5 particular that you wanted to hear back again on, but
6 absolutely, when we feel we've got --

7 DR. POWERS: Your current milestones sort
8 of suggest something like April or May --

9 MS. DROUIN: Yes.

10 DR. POWERS: -- when you've finished the
11 reliability. But obviously, if you're not there,
12 you're not there.

13 MR. BONACA: And the other thing, the
14 other criteria I would use is if you feel there is
15 some surprise for us. For example, today I think was
16 a very valuable presentation because at least for me
17 I thought that the decay heat curve was a low-hanging
18 fruit, and now I've been, you know, educated on that.

19 And I think that was an important time to
20 hear about that. Otherwise, we would be still
21 proceeding in our mind with the thought that, here it
22 comes, you know.

23 MS. DROUIN: And that's why we felt it was
24 important to come now.

25 MR. BONACA: Yes.

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1 MS. DROUIN: Because we were deviating
2 from what we had in the SECY, and what we had told you
3 guys in our letter.

4 DR. POWERS: I guess one of the real
5 problems that the NRC will face, Mario, is just that
6 lots of people think that decay heat curve is a
7 "gimnee." I mean, I've even characterized it as the
8 "gimnee."

9 MR. BONACA: Yes.

10 DR. POWERS: And there's going to be --
11 they're not going to have had the benefit of the
12 discussions that we went through and so they're going
13 to persist in taking that.

14 I'm wondering if maybe you shouldn't think
15 seriously about formulating that into a paper that you
16 could give to -- before the ANS or some body like that
17 and try to socialize the opinion to at least in some
18 sense take the weight off your back, because you're
19 going to have a lot of people says, ah, NRC, they'll
20 never change this.

21 I mean, you're just -- it's going to be
22 conventional wisdom and maybe you ought to reach out
23 a little bit to the -- at least the technical
24 community and advertise that position.

25 MR. BONACA: I think that's an excellent

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1 recommendation because I thought that the presentation
2 that you provided, Steve, it was outstanding in that
3 sense. I think it was very pointed.

4 It showed some of the effects and really
5 was a good -- you know -- I mean, you come out of it,
6 you can ask some pointed questions to that, but then
7 you come up with an understanding of what the issues
8 are.

9 And I think that that would be valuable
10 because I think there is -- in my judgment there is a
11 widespread belief that that's an easy tradeoff and how
12 come the NRC's not moving on this.

13 MR. BAJOREK: By the way, a lot of those
14 figures that I did show, we're intending to put that
15 in a OCONEE paper, submitting that at the end of the
16 month.

17 DR. POWERS: You know, that's not -- I
18 mean, that's the kind of forum where you need to
19 socialize these ideas and what-not and put it before
20 the technical community. If they find fault with it,
21 of course, you learn something.

22 But if you're of sound position, then they
23 learn something. So I mean, there's no loss here.

24 MR. KING: We'll take a commitment to do
25 that, figure out the right forum and the right

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1 vehicle.

2 DR. POWERS: Yes, you know, because
3 otherwise, you get this very unfair accusation because
4 people just haven't seen that sort of stuff.

5 MR. KING: Right.

6 DR. POWERS: They haven't thought about it
7 as much as you have.

8 CHAIRMAN SHACK: Yes. I mean, in July you
9 just sort of had a general statement that, you know,
10 you have to consider the compensation non-
11 conservatisms, but now you have actually something
12 fairly specific, and you know, I think it makes it a
13 much more substantive case than saying, there may be
14 non-conservatisms that won't be bounded.

15 DR. POWERS: And it gives the model
16 builders some grist to think about, too. They may
17 find that, well, you're talking about RELAP having
18 some less than desirable features perhaps in the code.
19 So maybe people developing models can think about it.
20 We'll see.

21 MR. BONACA: The other thing which is
22 significant here is that so many of the comparisons
23 were based on calculations performed by licensees.

24 DR. POWERS: Sure.

25 MR. BONACA: And so those are facts,

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1 really, and not speculation on the part of the staff,
2 really. It's coming out of presentation and some
3 meters provided by the licensees.

4 CHAIRMAN SHACK: If there are no
5 additional comments we can adjourn the Subcommittee
6 meeting.

7 (Whereupon, this ACRS/ACNW Joint
8 Subcommittee meeting was concluded at 12:09 p.m.)

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Docket Number: (Not Applicable)

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were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.



Pippa Antonio
Official Reporter
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