1 CHAIRMAN APOSTOLAKIS: Yeah.

2 MS. DROUIN: Okay. I'm Mary Drouin with
3 the Office of Research. And today I'm here to give
4 the committee a status of where we are in terms of our
5 update on Regulatory Guide 1.174. Part of that is
6 also a status in the plan for endorsing the PRA
7 standards. For example, the ASME PRA standard, which
8 is going to be coming out public very imminently and
9 the industry program, particularly in the NEI-00-02,
10 which is the Peer Review Certification Program.

11 We're here today not just to, of course,
12 give you a status, but, as always, we solicit and
13 welcome the committee's input on our work. Because as
14 we go through, we're going to go into detail what our
15 plan is beyond updating Reg Guide 1.174. And so we're
16 in the midst of formulating this plan right now.

17 A lot of the basis for a plan -- before we
18 get into it and where we are on the Reg Guide -- is
19 that I think it's very important that we spend just a
20 few minutes going back historically and why we are
21 where we are today. And this had a lot of input into
22 some of the decisions we made in terms of our update
23 and how we plan to endorse the standard.

24 If we go back to April 18th of 2000,
25 that's when we received direction from the Commission

1 that said the staff should provide its recommendations
2 to the Commission for addressing the issue of PRA
3 quality until the ASME and ANS standards have been
4 completed, including the potential role of an industry
5 peer certification process.
6 So a lot of that got started. And we went
7 through a very intensive effort. And we issued
8 SECY-0162, that I know the ACRS looked at. And we
9 actually received comments from the ACRS on that
10 document.
11 But if you look at 162, what I've put here
12 are four of the major things that the staff committed
13 to in that SECY document, which are very important in
14 terms of how we decided to update Reg 1.174 in our
15 plan for endorsement of the standards.
16 First of all, one of the things that was
17 in SECY-0162 is that we went through and we identified
18 the scope and the minimal technical attributes at a
19 functional level that were necessary to ensure that
20 the PRA is capable of providing certain results. And
21 we listed those results, like core-damage frequency
22 LERF, what the dominant contributors are out of a PRA
23 on both a relative and absolute basis. And all of
24 that information was contained in that Attachment 1 to
25 SECY-0162.

1 Also in that document we had indicated to
2 the Commission that, if appropriate, the staff would
3 endorse them, meaning the standards, in an updated
4 Regulatory Guide 1.174 -- but what's also important --
5 or elsewhere to support other risk-informed
6 activities. Also, we indicated in that document that
7 during our endorsement we may take exception of
8 provide additional criteria in those places where we
9 thought the standard or the industry program was not
10 sufficient.
11 And lastly, that the information that was
12 contained in SECY-0162, particularly the two
13 attachments, that we would include those in the update
14 of Reg Guide 1.174. And the basis for including that
15 in there, because at the time I thought was to endorse
16 the standards in the updated Reg Guide 1.174.
17 We did receive an SRM from that SECY. And
18 the main points that came out on this SRM is the
19 Commission did tell us to proceed forward. They
20 wanted timely resolution to this. And that we should
21 expand our discussion on further examples. In fact,
22 we received a similar comment from the ACRS, the
23 examples that were in Attachment 2, that if we could
24 do more in that area, that would be good.
25 But that's all I was going to go in terms

1 of background, and then I'll get right into where are
2 we in terms of our status of Reg Guide 1.174.
3 We did issue a draft update of 1.174 and
4 SRP Chapter 19 in June of 200, and we went out for
5 public review and comment. That update, there were
6 four major changes that were included in that update.
7 The first one was, where we had new,
8 unforeseen hazards, we would potentially ask for more
9 information in that area. Also, in regards to
10 increasing in power level and fuel/burnup, there was
11 some concern in terms of their impact on LERF, and
12 that we may need to provide some additional guidelines
13 there.
14 MEMBER ROSEN: Is there something missing
15 from that Number 2? "Levels above megawatt thermal,"
16 it says.
17 MS. DROUIN: Oh, sorry; 3,800 I believe
18 was --
19 MR. CUNNINGHAM: Okay.
20 MS. DROUIN: Also included in the update
21 is, we took that information from Attachment 1, which
22 was identification, a description of the minimal
23 technical attributes. That was added to the Reg Guide
24 and to the SRP. And also, the information from
25 Attachment 2, which was a discussion on example

1 applications using risk insights in the
2 decision-making process.
3 MEMBER ROSEN: Can you say something quick
4 about how you picked that number? 3,800 I mean.
5 MS. DROUIN: No. This is not an area that
6 I was involved in. But let Mark answer that.
7 MR. CUNNINGHAM: This is Mark Cunningham.
8 Traditionally, there's been an implicit,
9 unofficial limit to the allowable reactor power for
10 lightwater reactors that's been floated around the
11 Commission. And that was 3,800 megawatts. It's not
12 a legal restraint or anything like that. But it's
13 been the presumed maximum legal power that --
14 MEMBER ROSEN: So it's a legal thing,
15 really, not so much impact on LERF. I mean, because
16 nothing happens between 3,800 and 3,801 to LERF.
17 MR. CUNNINGHAM: That's correct. The
18 interest was, if you wanted to go to 4,000 or
19 something like that. At some point, the LERF
20 criterion would be affected. And this was putting a
21 proviso in for public comment that we may need to
22 revisit that if you went substantially above 3,800.
23 You're right. If it went to 3,801 or 3,860 or
24 something like that, we don't expect it would change.
25 MS. DROUIN: If you look at the second

1 sub-bullet there, it does indicate that it's not
2 expected to have an effect. But there is some -- from
3 my understanding, there are some experts out there
4 that aren't necessarily in agreement, so this is still
5 a topic under discussion.
6 MEMBER ROSEN: Well, that's not what the
7 second bullet says, Mary. I beg to differ. It says,
8 "increases in fuel/burnup beyond 40,000 megawatts."
9 So it doesn't talk about the power level.
10 MS. DROUIN: You're right. You're
11 correct. You're correct.
12 MR. CUNNINGHAM: The concern was -- in
13 effect, the original concern was the combination of
14 perhaps going to higher powers, plus burnup, plus the
15 potential in there for use of mixed-oxide fuel. So a
16 combination of several things that led to the concern
17 about LERF.
18 MEMBER ROSEN: Okay. Thank you.
19 CHAIRMAN APOSTOLAKIS: Now, in the
20 discussion of example applications using these
21 insights in the decision-making process, are you the
22 staff prepared to ask the industry to do an
23 uncertainty analysis, the standard uncertainty
24 analysis, in all applications, considering that as
25 part of the risk insight?

1 MS. DROUIN: If you look at Reg Guide
2 1.174, there is a discussion there on certainty, and
3 they are suppose to address uncertainties. The level
4 at which you're going to address the uncertainty is
5 not going to be the same on every application.
6 CHAIRMAN APOSTOLAKIS: But the propagation
7 of uncertainty is due to uncertainties in failure
8 rates and frequencies of initiating events. It's sort
9 of a routine kind of thing now with the computer
10 programs that are available.
11 Why don't we ask everybody to do that?
12 And then the rest of it can be addressed as
13 appropriate.
14 CHAIRMAN APOSTOLAKIS: When it comes to
15 your parameter uncertainties, the standard right now
16 does ask for them to do that.
17 CHAIRMAN APOSTOLAKIS: In all
18 applications?
19 MS. DROUIN: Well, the standard doesn't
20 get into applications. It's application-independent.
21 CHAIRMAN APOSTOLAKIS: But I remember
22 there were three columns. In one column they said,
23 mean values are good enough. That's not true anymore?
24 MS. DROUIN: The middle column of the
25 standard, which is your best practice, does ask them

1 to do that.

2 CHAIRMAN APOSTOLAKIS: To do uncertainty?

3 MS. DROUIN: Yes.

4 CHAIRMAN APOSTOLAKIS: Okay. Wonderful.

5 MEMBER KRESS: Mary, before we leave this

6 slide, I just now got through reading Number 2 under

7 your second bullet. And the second sub-bullet under

8 there, what's the basis for saying that "increases in

9 fuel/burnup are not expected to have an appreciable

10 effect on LERF guidelines"?

11 MS. DROUIN: Again, I'm going to turn this

12 back over to Mark. You're out of my area of expertise

13 on this one.

14 MR. CUNNINGHAM: In effect, what the

15 committee's getting at is the same issue that was

16 raised in public comment, that this is a rather vague

17 type of -- perhaps we need to do this if you go above

18 this. And it wasn't very well founded as to why

19 3,800, why 40,000, and that sort of thing. And Mary

20 will come back later to how we're dealing with that

21 public comment.

22 We got the same comments. And I think

23 we've decided we're going to take an action to be much

24 more definitive about this, that say we'll do some

25 work to say, is there any reason to believe that the

1 LERF criteria in 1.174 would be compromised if we went
2 substantially above these things. We're putting the
3 burden back on us in effect.
4 MEMBER KRESS: I don't even like the way
5 it's stated, because, of course, it's going to be an
6 effect if you go beyond -- you meant to say
7 substantially beyond 70,000 or something?
8 MR. CUNNINGHAM: Yes. Yes, exactly.
9 MEMBER KRESS: Well, you'll need to come
10 up with some level of burnup where you think the LERF
11 criteria ought to be corrective.
12 MR. CUNNINGHAM: Yeah, that's right.
13 MEMBER KRESS: That's the idea.
14 MR. CUNNINGHAM: And in effect, that's
15 what we're doing. We're going to take the
16 responsibility back on ourselves to do that sort of
17 calculation, rather than have this sort of vague
18 guidance out there that licensees, perhaps, wouldn't
19 know what to do with, or probably would not know what
20 to do with.
21 MEMBER KRESS: Are we going to take
22 advantage of the PIRT that's undergoing?
23 MR. CUNNINGHAM: Yes. That's the expert
24 panels, the rest of that --
25 MEMBER KRESS: Oh, that's what you mean.

1 That's what you're talking about.

2 MR. CUNNINGHAM: That's right. That's a

3 veiled reference to the PIRTs that have been going on.

4 Yes, sir.

5 MEMBER KRESS: Okay. I appreciate that.

6 MEMBER ROSEN: I think you've said all the

7 right words now. But licensees who are at 3,800

8 megawatts -- and I know one in particular -- will need

9 to know ahead of time what they're about to run into

10 if they want to increase their power level. What are

11 the additional requirements implied by these bullets?

12 MR. CUNNINGHAM: Yes. And, again, that

13 was the type of comment we got, and it's a legitimate

14 comment. And we're going to have to resolve that

15 separately. And again, given what we know about LERF,

16 we don't expect if they went from 38 to 39 --

17 MEMBER KRESS: Before you leave this slide

18 --

19 MS. DROUIN: It's the same slide.

20 MR. CUNNINGHAM: But we need to clarify

21 that.

22 MEMBER KRESS: I have one more comment on

23 this business of LERF and 1.174. 1.174 doesn't seem

24 to deal with sites that have multiple units on it,

25 more than one plant. It's my view that LERF is a site

criteria. And that 1.174 ought to recognize that, and talk about the effect of multiple units on a site in terms of your LERF criteria that you're going to use in 1.174. That's a comment you need to think about.

MR. CUNNINGHAM: You're right --

MEMBER KRESS: In multi-unit sites, it ought to have some influence on your LERF criteria.

CHAIRMAN APOSTOLAKIS: Which is really relevant to PBMR.

MR. CUNNINGHAM: Understood -- advance reactors are --

CHAIRMAN APOSTOLAKIS: No, but it's the same idea.

MR. CUNNINGHAM: Oh, I understand. Yes.

CHAIRMAN APOSTOLAKIS: You have 10 modules there, I mean, you can't expect the criteria to be the same as if you had one.

MR. CUNNINGHAM: Yes.

MEMBER KRESS: And if you had more than one reactor on the site, you couldn't expect the same LERF criteria.

CHAIRMAN APOSTOLAKIS: Yes.

MS. DROUIN: Continuing with the same discussion, all I've shown on the next slide is the comments we did receive in these four areas in terms

1 of the unforeseen hazards, we didn't receive any
2 comments from the public. And as the discussion's
3 been going on, you aren't surprised by the comments we
4 got. We know that there was no justification for it.
5 We know we needed to provide -- if we have that in
6 there, to provide additional step guidance.
7 And then we also, in terms of the
8 information from 162, the two major comments we got is
9 that there was inadequate explanation of discussion
10 for the purpose and use of the information,
11 particularly, as it pertained to the information from
12 Attachment 1, which got into the minimal technical
13 attributes, and also a lot of comments we got that
14 this was the inappropriate document to include that
15 information in.
16 So based on that, where we are in terms of
17 the update for Reg Guide 1.174 in those four areas, is
18 that in terms of endorsing the PRA standards and the
19 Peer Review Program is that we would endorse that
20 elsewhere in a different document and not in Reg Guide
21 1.174. So our plan at the moment is to issue Reg
22 Guide 1.174 with three of those changes. And one of
23 them is still iffy. We have some work to do to
24 determine whether or if we're going to be doing it.
25 First, in terms of the unforeseen hazard,

as I said, we've received no comments on that, so that part of the updates to Reg Guide 1.174 would remain. In terms of SECY-0162, the information from Attachment 1, which is the minimal technical attributes, that information has been stripped out. But we are leaving in the information in terms of the examples.

In terms of the increase in the power level and fuel/burnup, as Mark indicated, we still have some more discussion ongoing to determine if we will keep that in there; and if we do, to what extent to how we will have it in the document. So the decision hasn't been made yet on that particular item.

MEMBER ROSEN: Mary, your first bullet, I would have expected that to say, "Endorse industry standards/Peer Review Program," rather than "or," since the Peer Review Program is embedded in the standards.

MS. DROUIN: I'm sorry. That is a typo. That should not be an "or," it's an "an."

MEMBER ROSEN: It should be?

MS. DROUIN: That's an "an." Thank you.

MEMBER ROSEN: Okay. Now I'm happy.

MS. DROUIN: It's not an "or."

MEMBER ROSEN: Right. The Peer Review Program is part of the industry standard, right?

1 MS. DROUIN: Yes. Thank you.

2 MEMBER KRESS: Your first sub-bullet under
3 the second bullet, when you may call for more
4 risk-related information, do you see that as a
5 sufficient handle for you to get the information when
6 you need it? If you -- I don't know. If I had a PRA
7 that told me that the increase in risk were something
8 beyond which I'm comfortable with, then I could say I
9 need a PRA. It's a circular argument.

10 How do you make these judgments without
11 having a PRA in the first place?

12 CHAIRMAN APOSTOLAKIS: You mean the first
13 sub-bullet?

14 MEMBER KRESS: The first sub-bullet under
15 the second bullet.

16 CHAIRMAN APOSTOLAKIS: Yeah, risk-related
17 information.

18 MEMBER KRESS: Yeah. You need to know
19 what the risk implications are before you ask for the
20 risk information. I'm having trouble figuring how you
21 do this circularity.

22 CHAIRMAN APOSTOLAKIS: I'm troubled for
23 this, but for an additional reason. 1.174 is intended
24 to apply to risk-informed applications, not to general
25 applications. So I don't understand what that means.

1 MR. CUNNINGHAM: If I might, we might go
2 back a year or two in history on this.
3 This issue was subject to committee
4 meetings and a commission paper, and an SRM probably
5 a year-and-a-half or so ago. The starting point of
6 the potentially circular argument is, a licensee
7 chooses to come in with a proposed license amendment,
8 and the licensee does not choose to use risk
9 information.
10 CHAIRMAN APOSTOLAKIS: And that's what's
11 confusing me.
12 MR. CUNNINGHAM: Yes.
13 CHAIRMAN APOSTOLAKIS: Because then 1.174
14 does not apply.
15 MR. CUNNINGHAM: However, this is a
16 statement in 1.174 that said, "if the licensee does
17 not submit the information, the staff has the
18 authority to request the information on the risk" --
19 pardon?
20 CHAIRMAN APOSTOLAKIS: It's already
21 something in the books that says, if it's an issue of
22 article protection, you can do that. Does this go
23 beyond that?
24 MR. CUNNINGHAM: This is a clarification
25 of that in effect.

1 CHAIRMAN APOSTOLAKIS: So it goes beyond,
2 because this doesn't have to be article protection.
3 MR. CUNNINGHAM: I believe so.
4 CHAIRMAN APOSTOLAKIS: Oh.
5 MEMBER SHACK: So it's not new policy.
6 MR. CUNNINGHAM: This is not new policy.
7 CHAIRMAN APOSTOLAKIS: But the original
8 policy was you had to justify it in terms of article
9 protection.
10 MEMBER SHACK: Undue -- what's the word?
11 CHAIRMAN APOSTOLAKIS: Undue risk is the
12 same thing.
13 MR. CUNNINGHAM: That's right. And we
14 didn't come in prepared to go back to the discussions
15 from a year or two ago. But all of that was discussed
16 in the commission paper of a year or two ago that --
17 CHAIRMAN APOSTOLAKIS: It seems to me this
18 --
19 MR. CUNNINGHAM: You may remember Bob
20 Halep was the staff contact on that.
21 CHAIRMAN APOSTOLAKIS: I remember that.
22 And the whole thing had to do with undue risk or,
23 equivalently, article protection.
24 MR. CUNNINGHAM: Yeah.
25 CHAIRMAN APOSTOLAKIS: And now it seems

1 it's going beyond that, which is fine with me. It's
2 going in the right direction.
3 MEMBER ROSEN: I was wondering if you were
4 objecting.
5 CHAIRMAN APOSTOLAKIS: No, I'm not
6 objecting.
7 MR. CUNNINGHAM: This is an incorporation
8 of what the Commission approved about a
9 year-and-a-half or so ago into this regulatory guide.
10 CHAIRMAN APOSTOLAKIS: I'm just wondering
11 why it's here and not somewhere else. It should be in
12 the deterministic guides, regulatory guides.
13 MR. CUNNINGHAM: It may go there as well.
14 CHAIRMAN APOSTOLAKIS: You're coming for
15 this. But because of this, we want you to also do
16 this.
17 MR. CUNNINGHAM: This is not the only
18 place that this comes in.
19 CHAIRMAN APOSTOLAKIS: Ah. It's a
20 multiplicity of things.
21 MR. CUNNINGHAM: There are a multiplicity
22 of places that this guidance shows up. I believe the
23 principal place is to go over to the people who would
24 -- guidance to those people.
25 CHAIRMAN APOSTOLAKIS: You're going in the

1 right direction anyway.

2 This business of integrated

3 decision-making process, where the analysts -- not the

4 analysts -- the staff has to take into account risk

5 information, difference in depth philosophy, margins

6 and so on, we never really told them how to do that.

7 And I understand that in the revised version it's also

8 -- I mean, that you have not touched.

9 Are people comfortable about this? I

10 mean, it's so subjective it seems to me. Not that I

11 know how to do it better, but should we be trying to

12 understand a little better the whole process and go a

13 little beyond? I mean, we're just giving five boxes

14 now with arrows. And we're saying there's going to be

15 this integrated decision-making in the middle, somehow

16 taking into account the margins, somehow taking into

17 account difference in depth, and somehow taking into

18 account the risk insights.

19 Can we be a little more explicit some time

20 in the future?

21 MR. CUNNINGHAM: I think we could.

22 CHAIRMAN APOSTOLAKIS: And there is a

23 beautiful discussion on uncertainty. And then, of

24 course, the staff was not requesting uncertainty

25 estimates, but now you're saying you will. So that's

1 a good thing.

2 MR. CUNNINGHAM: The ASME standard does.

3 But, yes.

4 CHAIRMAN APOSTOLAKIS: Which is good.

5 MR. CUNNINGHAM: Yes, which is good.

6 CHAIRMAN APOSTOLAKIS: Not because I can't

7 see you disagreeing with -- let's go to a subcommittee

8 meeting if you do. But this issue of decision-making

9 --

10 MR. CUNNINGHAM: Yes. One of the issues

11 that has kind of -- well, the ACRS raised it last year

12 in their report on research, and we've been mulling it

13 around, of kind of lessons learned from these

14 decisions or similar types of decisions-- is there

15 something that could be done better or clear guidance

16 provided and that sort of thing. It's a fair

17 question. And we're formulating our research budget

18 for next year and things now. And that's one of the

19 things that's on the table-- is there value to that

20 work in that area.

21 MEMBER ROSEN: I happen to have a problem

22 with that. I think, George, what you're asking for is

23 some guidance on how to think.

24 MEMBER POWERS: I definitely need that.

25 MEMBER ROSEN: I serve on one of these

1 expert panels still, and have for a long time. And I
2 think what it is, is that it's a process of
3 integrating all of these issues --
4 CHAIRMAN APOSTOLAKIS: Right.
5 MEMBER ROSEN: -- with a lot of experience
6 and knowledge of a particular subject matter.
7 CHAIRMAN APOSTOLAKIS: But Steve, it was
8 the same thing with the senior management.
9 MEMBER ROSEN: But I wouldn't know how to
10 follow a procedure to do that.
11 CHAIRMAN APOSTOLAKIS: Well, it doesn't
12 have to be a procedure. The senior management was
13 doing the same thing, and the industry objected as it
14 being too opaque.
15 MEMBER ROSEN: Yeah. But that was in the
16 regulatory process.
17 MEMBER KRESS: Now the public's going to
18 object.
19 CHAIRMAN APOSTOLAKIS: So the more
20 transparent you make the process, the better off you
21 are.
22 I repeat, I don't know of any methodology
23 that will do this, but it seems to me that it's
24 something that we ought to be thinking about.
25 For example, all this debate we've had

1 among ourselves regarding the rationalist approach and
2 so on. That's part of what I have in mind-- let's
3 understand better the margins. Maybe one of these
4 days it will dawn upon us that we should quantify
5 those margins in terms of probabilities. And then
6 difference in depth and margins will not be so
7 different. But that's not something for tomorrow.
8 VICE CHAIRMAN BONACA: But there are some
9 rules, I guess, that come in as the stuff -- looks at
10 these things coming in, I guess. I tend to think the
11 way that Steve does.
12 CHAIRMAN APOSTOLAKIS: I'm not saying
13 these are wrong -- this is the way to do it.
14 MEMBER ROSEN: No. There are clearly some
15 rules. And you, one of the authors of the papers that
16 we've used -- hate to flatter you -- no, that's okay.
17 MEMBER KRESS: Go ahead.
18 CHAIRMAN APOSTOLAKIS: I'm above that.
19 MEMBER ROSEN: We use papers by you and
20 others on expert elicitation techniques in training of
21 the members of the panel so they know what's going on
22 when the chairman says, stop, I haven't heard from
23 you, Tom, pooling out the quiet guy.
24 CHAIRMAN APOSTOLAKIS: That's part of
25 structuring the process. Yes, all these things are

1 important.

2 MEMBER ROSEN: So it's not like these

3 panels are operating without any guidance.

4 CHAIRMAN APOSTOLAKIS: And I never said

5 that.

6 The other issue -- there's a beautiful

7 discussion -- in the original 1.174. The model

8 uncertainty, uncertainty and incompleteness. And then

9 what? I mean, it's a demonstration that somebody

10 understands these issues, but was it ever used by the

11 staff. And that's where these case studies of large

12 measurement would be enlightening.

13 Did anybody open it up and say, well, when

14 you Mr. Utility come here, look what we're saying

15 here, have you tried to do this, say something about

16 model uncertainty or incompleteness and all that? Is

17 it being used, or was it just something that was

18 placed there to show that we have good people on the

19 staff?

20 Mary, why don't you continue?

21 MS. DROUIN: Okay. Well, if we aren't

22 going to endorse --

23 CHAIRMAN APOSTOLAKIS: You are going to

24 endorse? Whoa.

25 MS. DROUIN: Let me finish my sentence.

1 If we are not going to endorse it in Reg Guide 1.174,
2 what is our plan for endorsement? And so that's what
3 we're going to talk about now.
4 CHAIRMAN APOSTOLAKIS: The standard.
5 MS. DROUIN: The standards and NEI-00-02.
6 Well, if you look at the various
7 risk-informed activities that we're involved in, you
8 will see a lot of them use PRA information in their
9 decision-making process. And that leads you that
10 there is a common element dependency. And it leads
11 into the question that the Commission keeps raising on
12 PRA quality and trying to understand or get to know
13 what is the level of confidence of the PRA results
14 that you're going to use for your insights.
15 So this is a common thread, whether you're
16 looking at Option 3, whether you're looking at
17 licensing actions using Reg Guide 1.174, tech spec
18 changes, your categorization. They all have this
19 common dependency there. And we do feel very strongly
20 that the PRA standards and that the Industry Peer
21 Review Program can help in this area in terms of
22 identifying your strengths and weaknesses.
23 So where we finally came to is that we
24 felt there ought to be this single supporting reg
25 guide and SRP to bridge that gap and answer that

1 question that would kind of cross and support all
2 these activities.
3 MEMBER KRESS: Do you envision the reg
4 guide to be binding on the SPAR models?
5 MS. DROUIN: I'm sorry?
6 MEMBER KRESS: Do you envision such a reg
7 guide that would dictate the quality of the SPAR
8 models?
9 MS. DROUIN: I do know that when we sent
10 out internally the Reg 14A. And it didn't just start
11 then. But I know that Pat did look at the SPAR models
12 to see how did they match up against the standard.
13 And there were some places that wasn't a match. And
14 my understanding is that it's his intent to correct
15 that.
16 MEMBER POWERS: Mary, the industry-review
17 approach kind of goes through and looks at a
18 licensee's PRA. And comes back and says, well, you
19 get an A here and a B here and a C here. Then it
20 says, this is good for this class of applications. Is
21 my characterization correct?
22 MS. DROUIN: They don't give an overall
23 classification for the entire PRA. They give it on a
24 -- I don't think they call it an element. They call
25 it -- I can't remember the word they use, but I'll use

1 the word "element." But on an element by element.
2 And they have like 110 elements in there that they
3 look at. And they grade it on an element-by-element
4 basis. But at the end they don't come in and say,
5 this PRA can support; they do it on the individual
6 pieces.
7 MEMBER KRESS: If you were to endorse that
8 and want to use, then, such a PRA that had these
9 grades and the various elements, and you're wanting to
10 say, now I want to use this PRA to do this with, how
11 would you make that jump?
12 MS. DROUIN: Well, that's no different --
13 that challenge there is no different than the
14 challenge we have on the ASME standard because the
15 ASME standard also has the three categories.
16 MEMBER KRESS: The three categories.
17 That's right.
18 MS. DROUIN: For any given application,
19 you do not need to have the same level of detail for
20 every element. You might have an application that's
21 just dealing with, say, ATWS. That doesn't mean,
22 then, that you necessarily have to have a very
23 detailed, robust LOCA analysis. Maybe but for some
24 other application you might need the LOCA, and you
25 don't need the ATWS.

1 So for any given application, to have that
2 vertical slice and say you need it to the same level
3 of degree is not -- so you have to look at it on an
4 element-by-element basis.
5 MEMBER KRESS: So you identify which of
6 those elements are important to your application, and
7 see what grade you got in those. Now, suppose four of
8 them were important. And one of them got an A, one of
9 them got a B, and two of them got C's? Do you take
10 the lowest, and say, since we got C's in two of them,
11 and they're important, I can't use it for this? Or do
12 you have a process for doing that?
13 MEMBER ROSEN: Let me try to answer your
14 question. Mary, just step back for a minute.
15 MS. DROUIN: Okay.
16 MEMBER ROSEN: The persons who are
17 submitting this application to the staff is the
18 licensee. He very well knows the grades he has in
19 those areas, because he's already been peer certified.
20 And what he's probably done is made some priority cut
21 on his certification and said, these five things I
22 better fix right away because I've got applications
23 that will be affected by them. And the rest of them
24 I don't care about for a while. So he's made that
25 judgment, and then improved his PRA in those areas,

1 presumably, to support the applications he has in
2 mind.
3 MEMBER KRESS: Does he have to go in and
4 get another peer review?
5 MEMBER ROSEN: No. No. But he does have
6 to come to the staff. At that point, he comes to the
7 staff and says, okay, I want to this, risk-informed
8 application. The staff says, well, let me look at
9 your peer certification. He shows them that. And he
10 shows them, presumably, what he's done to fix the
11 areas if they were in the area that have an effect on
12 his pending application. But that's the way I would
13 see the process working.
14 MEMBER KRESS: That could probably work.
15 MR. CUNNINGHAM: So the fundamental tenet
16 here is that a PRA doesn't have to be perfect in every
17 area in order to do some small thing, to do something.
18 It's very application-specific and site-specific and
19 application-dependent. And that was where the
20 industry and the staff could come together and agree.
21 Now we'll see how that plays out in implementation.
22 I think it will play out along the lines that I just
23 outlined.
24 CHAIRMAN APOSTOLAKIS: But they will not
25 come to a staff and say, you don't need to review this

element because we've got an A.

MEMBER ROSEN: No. Of course not. I mean, they can say that, but I don't think they will.

CHAIRMAN APOSTOLAKIS: The staff may choose not to pay much attention because of the A, but having an A doesn't mean much.

MEMBER POWERS: If I'm an A and a 1, and I want a power uprate, and I want to do that on a risk-informed basis; and I come in and I say, okay, well, here's my analysis of operational events with my PRA with and without this power uprate, and I don't have a fire PRA, that's going to be okay?

MEMBER ROSEN: I don't know how to answer your question.

MEMBER POWERS: Well, say yes.

MEMBER ROSEN: That's a heuristic device so you can say that's ridiculous?

MEMBER POWERS: So I can go, aha, put the risk down in a term, and the risk assessment for N01 is fire.

CHAIRMAN APOSTOLAKIS: All because you don't know it's the risk because you haven't done the PRA.

VICE CHAIRMAN BONACA: You are getting ahead of me. The application you are quoting as an

1 example, that's pretty broad. I would expect that you
2 would want to have a pretty complete PRA, if you want
3 to make statements on risk information, because it's
4 really a full licensing of the plant at the higher
5 power level.
6 CHAIRMAN APOSTOLAKIS: The point is that
7 the A, B, C's are for the licensee.
8 MEMBER ROSEN: 1, 2, 3's.
9 CHAIRMAN APOSTOLAKIS: The licensee gets
10 an A from his peers. He knows that when this element
11 is done, the state-of-the-art work, the staff is not
12 constrained. The staff can review it and say we don't
13 like it, right?
14 MEMBER KRESS: So there's no need for the
15 staff to endorse the peer review process then.
16 CHAIRMAN APOSTOLAKIS: No. Well, in
17 principle, really, no. I guess the industry wants to
18 have some feeling that whenever they're doing all this
19 effort, there is some receptivity.
20 MEMBER POWERS: Here's what I'm concerned
21 about, George. We come in and we say, those parts of
22 your scope that you've done and you've got an A on,
23 but the real issue is whether the scope is right.
24 MEMBER KRESS: You get an F on that.
25 MEMBER POWERS: Sure.

1 CHAIRMAN APOSTOLAKIS: I assume they
2 thought about that.
3 MEMBER ROSEN: That's right. Was your PRA
4 -- is it good in the areas that are important to the
5 application you're proposing. Staff will judge that.
6 And certain members of the staff -- and particularly
7 sitting in front of us -- were active in the ASME PRA
8 standard development; were you not?
9 CHAIRMAN APOSTOLAKIS: Many was active.
10 MEMBER ROSEN: Yes.
11 MS. DROUIN: I was active.
12 MEMBER ROSEN: So she has a good knowledge
13 of the PRA standard --
14 MS. DROUIN: I thought I might just have
15 one meeting where I wouldn't hear those words.
16 MEMBER ROSEN: I chose to use the words
17 "active" and "lady."
18 CHAIRMAN APOSTOLAKIS: She was the easiest
19 person on the staff --
20 MEMBER KRESS: We're not debating the lady
21 part. I mean, that goes without saying.
22 CHAIRMAN APOSTOLAKIS: But don't forget
23 those, Steve; that even if the staff along,
24 ultimately, some of these things will come before us.
25 MEMBER ROSEN: Yes.

1 CHAIRMAN APOSTOLAKIS: And we're not bound
2 by A's and B's and C's.
3 MEMBER ROSEN: No. You're not bound by
4 anything.
5 CHAIRMAN APOSTOLAKIS: The meeting is
6 getting out of hand.
7 MEMBER KRESS: It's deteriorating.
8 CHAIRMAN APOSTOLAKIS: Let's come back.
9 It's rapidly degrading.
10 MS. DROUIN: Okay. Well, let's try and
11 explain a little bit of what our vision is for this
12 new regulatory guide that we plan on putting together.
13 CHAIRMAN APOSTOLAKIS: And which we will
14 have an opportunity to review at some point?
15 MS. DROUIN: Absolutely.
16 CHAIRMAN APOSTOLAKIS: Good.
17 MS. DROUIN: When we get to the schedule,
18 you're going to see places where we've noted where
19 we'd like to come back to the ACRS.
20 CHAIRMAN APOSTOLAKIS: What is the status
21 now regarding the 1.174, Mike? Are we going to look
22 at it again, or it's out now?
23 MR. MARKLEY: Well, George, we don't have
24 a document to review right now. But the last letter
25 we wrote was July 20, 2000, and it was a Larkins

1 Graham. And the committee has no additional comments
2 or concerns on the proposed final revisions. That's
3 where we were. You basically agreed with the license
4 amendment process and using risk information when it
5 was deterministic submittal if the staff felt the need
6 to do more in terms of risk analysis.
7 CHAIRMAN APOSTOLAKIS: So what we
8 anticipate is that we may have to write another
9 Larkins Graham or something?
10 MR. MARKLEY: If and when the document --
11 CHAIRMAN APOSTOLAKIS: If and when the
12 document. Okay. Thank you.
13 Okay.
14 MS. DROUIN: Okay. In the reg guide, the
15 main body -- because we are proposing appendices with
16 this reg guide. But the main body is going to provide
17 the guidance to the licensees on how to use the
18 standards or the NEI-00-02 document, such that we
19 would have the level of confidence of the results for
20 that particular application. So it's going to go
21 through a lot of the discussion that ya'll just had in
22 trying to answer those kind of questions.
23 But given that it's telling you how to use
24 the standard -- and still at some point we need to say
25 whether we agree technically with the standard or with

1 the NEI-00-02. If, for example, the standard came out
2 and said on their initiating event analysis only look
3 at transients for your initiators, well, we would
4 disagree with that. You can't just look at
5 transients; you've got to consider all your
6 initiators.
7 So that would be an example of something
8 that would go into the appendix. And that's where we
9 would provide clarification or additional criteria so
10 that we think that the document itself is technically
11 sound.
12 So our envision is that -- for example,
13 Appendix A would address the ASME standard; Appendix
14 B, NEI-00-02. And as you know, ASME is not covering
15 the full scope. So as each of the different pieces of
16 the standards would come out, those would be added on
17 into another appendix.
18 MEMBER ROSEN: Now, Mary, I'm sure you
19 know of the OMB circular that talks about the desire
20 of the federal government to use industry consensus
21 standards.
22 CHAIRMAN APOSTOLAKIS: Yes.
23 MEMBER ROSEN: Now, here you're talking
24 about a process to not use industry-consensus
25 standards, to go beyond them.

1 CHAIRMAN APOSTOLAKIS: No. The law is
2 that industry-consensus standards should be used as
3 appropriate.
4 MS. DROUIN: As appropriate.
5 CHAIRMAN APOSTOLAKIS: And she's
6 elaborating on the "as appropriate."
7 MEMBER ROSEN: Yeah. And I'm elaborating
8 on that by saying that, certainly, the NRC staff's
9 participation was extensive and welcome, most of the
10 time. Even when it wasn't, it was still given, and
11 used, and ultimately reconciled. And I will look very
12 hard at anything that's in these appendices beyond
13 what's in the standards.
14 Now, I'm talking about the standards, the
15 industry-consensus standards, not NEI-00-02. That's
16 in a different class. But anything beyond the
17 standards -- where the staff feels it absolutely must
18 take exception to or elaborate of the standards -- we
19 really ought to be given a very hard look by NRC
20 management.
21 MS. DROUIN: And it is. You go back to
22 the letter on Reference 14A. You might have seen
23 Scott Newberry's signature, but trust me. A lot of
24 people beyond Mr. Newberry reviewed that letter.
25 Because we were transmitting here's where our concerns

1 are on this final version. So this is taken very
2 seriously in terms of if we take exception.
3 VICE CHAIRMAN BONACA: And it seems to me
4 it is a little bit of a problem, because if I remember
5 some of the early applications we saw with 1.174, some
6 of the SERs were going at length to explain why
7 something in the application was deficient, but you
8 could endorse it because of consideration of this and
9 that. It seems as if the burden was on the staff to
10 provide the reasons why the risk information coming
11 from the application was justifiable; it was
12 sufficient. So I think it would be good to at least
13 set the minimum standard of what you expect so that
14 the reviewers don't have to -- are not forced to have
15 that kind of degree of individual support of the
16 application when they come through.
17 I understand your concern, Steve. And I'm
18 only saying, some of the early applications to me were
19 not very satisfactory, the SERs.
20 MEMBER ROSEN: Well, we're all learning.
21 But I think the best possible result would be to have
22 a standard that the NRC was able to endorse without
23 qualification. And we may not get there, but we
24 really need to minimize, if we can, somehow the degree
25 to which the staff needs to put on additional

1 requirements beyond the industry-consensus standard.

2 CHAIRMAN APOSTOLAKIS: Actually, I think

3 this someone had mentioned earlier. But it's not

4 clear to me, really, what the word "endorsement" means

5 in this case. And I don't know what you guys are

6 going to do if in the future somebody comes before you

7 and says, I have done what the standard says. You

8 have endorsed it. I expect an answer from you in a

9 week. You don't have to review it. What are you

10 going to do? Are you going to say no?

11 MEMBER POWERS: That's a good answer.

12 CHAIRMAN APOSTOLAKIS: No?

13 MEMBER POWERS: The answer is no.

14 CHAIRMAN APOSTOLAKIS: So why all this

15 fight, then, about endorsement? I mean, if that's the

16 case. It's really internal to the industry document

17 telling them, look, this is what the staff expects of

18 you. But you prefer to go through a review if they

19 choose to do that.

20 MEMBER POWERS: This is an acceptable

21 method.

22 CHAIRMAN APOSTOLAKIS: But that's what I'm

23 saying. If they tell you I met all your requirements,

24 therefore, it's acceptable. Don't review it.

25 MEMBER POWERS: Well, you've got to find

1 out if they, in fact, carried out the method properly.
2 MEMBER SIEBER: Or used some other ones.
3 CHAIRMAN APOSTOLAKIS: Then you come back
4 and you say, look, for common-cause failures, you
5 really did this and should have done something else.
6 The standard doesn't say anything about that. The
7 standard says, do a common-cause failure analysis.
8 Isn't that what it says?
9 MS. DROUIN: Well, it says a little bit
10 more than that.
11 CHAIRMAN APOSTOLAKIS: It goes beyond
12 that?
13 MR. DUDLEY: Just as a matter of public
14 record, in case someone wants to look up what the
15 circular says, it's OMB Circular, A-119. But what
16 Mary's describing is really somewhat consistent with
17 how we endorse industrial standards and have for year.
18 If they're exceptions and clarifications, we usually
19 note it in the body of the supporting document.
20 MEMBER POWERS: And Steve is going to
21 scrutinize that, for these exceptions and
22 clarifications.
23 CHAIRMAN APOSTOLAKIS: Anyway, we'll have
24 to wait and see the standard itself.
25 MS. DROUIN: I mean, at this point in

1 time, whether or not we have exceptions, I can't
2 answer that. We're in the midst of reviewing the
3 final version.
4 All we are trying to show on this figure
5 is looking at it and trying to show the relationship
6 of all these different documents and activities that
7 we're talking about. If you start there at the top
8 level where you have some regulatory activity -- this
9 is not meant to be complete; this is just an
10 illustration with some examples shown there. But if
11 you have some examples -- like licensing actions,
12 categorization, Option 3. Those were the three
13 examples I picked. And if you come there across the
14 right, if I look at Option 3, 5046 right now, we're in
15 the midst of risk-informing the ECCS reliability
16 requirements. Underneath that you'll see inputting
17 into it, there will be some regulatory guide that will
18 go with that rule.
19 If you look at your licensing action,
20 somebody does something where they want to come and
21 make a change to their licensing basis, there's a
22 regulatory guide supporting that, Reg Guide 1.174. On
23 your tech specs, say they're going to do a
24 risk-informed techs spec change, there's a regulatory
25 guide.

1 So the point is, is that you got these
2 things here, but also in the decision-making process
3 for all of this is that they're using PRA information
4 as one of the inputs. And so that's where we talked
5 about there's this common element for all of these.
6 And that's why in our mind, to endorse the standards
7 in this document didn't make sense, because the
8 questions that you're dealing with are the same kind
9 of questions here and here, and potentially elsewhere.
10 And that's why we thought coming up with a single
11 regulatory guide that would feed into all of these
12 just make practically a lot more sense to us.
13 And that's where we divvied it up. This
14 is all the same guide. This is just the appendices
15 that supports that. And this would provide the
16 guidance on how to use the standards in the Peer
17 Review Program. And then if we wanted to take
18 exception or add clarification on a particular
19 standard, that would be in the appendix.
20 CHAIRMAN APOSTOLAKIS: Mary, the box on
21 the left, "Determine the confidence with which PRA
22 results demonstrate," and so on. Now, if the PRA has
23 done parametric uncertainty analysis -- parameter
24 uncertainty analysis -- essentially, what you're
25 saying there is, you're asking them to think in terms

1 of model uncertainty. How good is the PRA in other
2 words? Right? That's what you're asking them to do,
3 but not in so many words. Is that the level of, when
4 we say, determine the confidence with which the PRA
5 results demonstrate the technical attributes have been
6 met?
7 MS. DROUIN: Were needed.
8 CHAIRMAN APOSTOLAKIS: Were needed. Yes,
9 were needed. But this is really a question of model;
10 isn't it? Model adequacy?
11 MS. DROUIN: Not necessarily. I mean, to
12 me, that would also be a question of data.
13 CHAIRMAN APOSTOLAKIS: If I do a parameter
14 uncertainty analysis, and I have a scarce data, I'll
15 have a wide distribution. But I have quantified. Is
16 that sufficient to answer this requirement, determine
17 the confidence? Is this my confidence, or I have to
18 go beyond that and say, well gee, now they have used
19 an HRA model which I know is kind of soft, and maybe
20 I should be a little more cautious, without really
21 saying how cautious you're going to be?
22 MS. DROUIN: When we use the word
23 "confidence" here we aren't using this confidence in
24 the sense of your uncertainty analysis that would get
25 into your levels of confidence. That's not what that

1 --

2 CHAIRMAN APOSTOLAKIS: Well, confidence in

3 general means that. It means how uncertain are you,

4 how much do you believe, right?

5 MS. DROUIN: Yes.

6 CHAIRMAN APOSTOLAKIS: And what I'm saying

7 is that you're asking them there to reflect on the

8 whole thing. Is there a need for a structuralist

9 defense, in-depth approach? And I wonder why we don't

10 say that.

11 MR. PARRY: George, can I --

12 CHAIRMAN APOSTOLAKIS: Because that's

13 really what you're asking them to do.

14 MR. PARRY: -- can I put my two-cents

15 worth in here? This is Gary Parry from the staff.

16 I think the way to think about that box,

17 rather than to worry about the technical attributes is

18 to say, basically, it's to determine the confidence of

19 which the PRA results have shown compliance with the

20 acceptance criteria or guidelines that you're going to

21 use in the decision-making.

22 CHAIRMAN APOSTOLAKIS: It's either way.

23 MR. PARRY: And it's specific -- but it's

24 specific, though, to the PRA aspects of it.

25 CHAIRMAN APOSTOLAKIS: Right.

1 MR. PARRY: So I think you're right in
2 saying that what you're requiring here is actually
3 what we describe in Reg Guide 1.174, where we say,
4 show that the results that you have -- the conclusions
5 that you're drawing are robust with respect to the all
6 the sources of uncertainty that you can identify. And
7 that's really what that statement means.
8 CHAIRMAN APOSTOLAKIS: But it's model --
9 MR. PARRY: It's model uncertainty, and to
10 some extent incompleteness as well.
11 CHAIRMAN APOSTOLAKIS: Well, for me that's
12 model -- but you are asking to reflect on that aspect.
13 MR. PARRY: Absolutely.
14 CHAIRMAN APOSTOLAKIS: And what I'm saying
15 is that maybe it's time to start naming it, so people
16 will know that you're interested in that. And maybe
17 six years from now people will start doing something
18 about it.
19 MR. PARRY: I suspect --
20 CHAIRMAN APOSTOLAKIS: As long as you
21 don't name it, people will not be aware of it. That's
22 what you're doing.
23 MR. PARRY: I suspect the main body of the
24 reg guide will actually address this.
25 CHAIRMAN APOSTOLAKIS: Or in a footnote.

1 MR. PARRY: No. No. I think in the
2 model.
3 CHAIRMAN APOSTOLAKIS: I mean, if I do a
4 fire risk assessment -- I know some members here feel
5 that this is the perfect PRA, but even there are
6 weaknesses. Right? Dana, you agree?
7 MEMBER POWERS: There are weaknesses in
8 fire risk assessments. Sure.
9 CHAIRMAN APOSTOLAKIS: So they're doing
10 all these funny things. The domain of influence of
11 fire down there is a cone with a 35-degree angle and
12 all that. Now, nature doesn't work that way. It
13 doesn't say I'm going to burn things that are inside
14 the cone but not the ones that are outside. That's an
15 approximation. That's a model approximation, right?
16 Now, if you ask me to quantify, I don't
17 think anybody knows how to quantify that. But it
18 shakes my confidence in the results. Okay? So you're
19 asking me to think about it.
20 MR. PARRY: Right.
21 CHAIRMAN APOSTOLAKIS: So that's a model
22 uncertainty. So please name it so people will know
23 that you worry about it.
24 MEMBER KRESS: Now, which word do you want
25 to you use? "Model"?

1 CHAIRMAN APOSTOLAKIS: "Model
2 uncertainty." Not "modeling." "Model uncertainty."
3 MEMBER KRESS: You want to use "model
4 uncertainty."
5 CHAIRMAN APOSTOLAKIS: Model uncertainty.
6 MEMBER KRESS: Not some other name.
7 MEMBER ROSEN: George?
8 CHAIRMAN APOSTOLAKIS: No. Model is part
9 of our understanding.
10 MEMBER POWERS: Come up with a good Greek
11 word, would you?
12 CHAIRMAN APOSTOLAKIS: We have enough
13 problems with understanding.
14 MEMBER ROSEN: Beyond this, just quickly,
15 do you understand regulatory guides are not
16 regulations?
17 MS. DROUIN: Absolutely.
18 MEMBER ROSEN: And the standard paragraph
19 is going to go in the front of this regulatory guide.
20 It says, "Anyone caught using this will" --
21 MEMBER POWERS: Something else.
22 MEMBER ROSEN: Sure.
23 MEMBER POWERS: And as a lot of times,
24 money can come in --
25 CHAIRMAN APOSTOLAKIS: This is an

1 acceptable way.

2 MEMBER ROSEN: An acceptable way.

3 CHAIRMAN APOSTOLAKIS: Oh, you don't know

4 how many times I was told that when we were developing

5 1.174. It's an acceptable way.

6 MEMBER ROSEN: Well, this is the same --

7 I understand how difficult that is.

8 CHAIRMAN APOSTOLAKIS: It is very

9 difficult.

10 MEMBER ROSEN: But I'm thinking about --

11 I'm really thinking of an advanced reactive area.

12 Some of this may not work so well. So I don't know

13 how general this is.

14 CHAIRMAN APOSTOLAKIS: I think they have

15 LWRs in mind when they do this. Let's not try to be

16 as general as we can in everything. It's too much.

17 It's too hard. But this is really LWR.

18 MEMBER ROSEN: But my point is, that out

19 is what made -- the advance reactive people may need

20 to use them at those outs. They may not be able to

21 comply with a regulatory guide.

22 MS. DROUIN: I can tell you right now, in

23 terms of the ASME standards -- I certainly wasn't

24 involved in any discussion with ANS, and I can't speak

25 for NEA-00-02. But as part as the writing team on the

1 ASME, it was decided very clearly that this would only
2 apply to LWRs. That was a very deliberate decision
3 made up front.
4 MEMBER ROSEN: Okay. Then I'm right. I
5 guess what I'm saying is that, if the ASME standard
6 only applies to LWR, then this regulatory guide, which
7 refers to the standard, obviously, can't apply to the
8 advance reactive.
9 CHAIRMAN APOSTOLAKIS: Although the
10 standard itself, I don't see why you could not apply,
11 or most of it anyway.
12 MEMBER SIEBER: Does it say that
13 specifically in the standard?
14 MS. DROUIN: I know one version did.
15 CHAIRMAN APOSTOLAKIS: Well, the reason
16 why they might say it, Jack, is to avoid debate. You
17 know, stop thinking about future reactors; have we
18 covered everything. And I think they did the right
19 thing if they say so.
20 MEMBER SIEBER: If somebody was going to
21 buy a future reactor, and didn't know what the rules
22 were, though, I think that would put another bundle of
23 uncertainty into whether that would be a good
24 investment or not.
25 CHAIRMAN APOSTOLAKIS: I doubt that the

1 availability of an ASME standard to do a PRA would --
2 would change their purpose.
3 MEMBER SIEBER: Well, it's really a
4 philosophical question.
5 CHAIRMAN APOSTOLAKIS: No. But you see
6 why I'm saying that. They've had a lot of problems
7 proving this one for LWRs. Now, if you ask them to
8 think about future reactor applicability, they'll
9 never finish. And there is some urgency to this.
10 MEMBER SIEBER: Well --
11 CHAIRMAN APOSTOLAKIS: I mean, somebody
12 else might want to --
13 MEMBER SIEBER: I consider that a lot of
14 conceptual elements, or a conceptual design of a new
15 type reactor, would rely on some of the aspects of PRA
16 as applied to that, and whether you have to contain it
17 or not, for example. They can almost add 30 percent
18 on to the cost of the plant if you decide that that's
19 what you're going to have to do to get the PRA spec.
20 So it should be versatile enough to be
21 able to at least have some kind of an idea as to what
22 kind of regulatory space you're in when you propose a
23 new concept, it seems to me.
24 CHAIRMAN APOSTOLAKIS: I would tie that to
25 having a risk-informed licensing process. Think about

1 all that stuff there and go revisit the ASME standard,
2 and say, yeah, most of it applies. But I would think
3 that as a separate activity because of its importance.
4 MEMBER SIEBER: Okay. Thank you.
5 CHAIRMAN APOSTOLAKIS: That's what I would
6 -- I don't know. You want to think about future
7 reactors in this context?
8 MS. DROUIN: Well, I mean, I can just --
9 I can give you my personal opinion. I can also share
10 with you some of the decisions that went into the
11 standard. I mean, the decision was made that this
12 would not cover future reactors. One of the reasons
13 -- there were a lot of reasons. But one of the main
14 reasons is that this was not a standard to do a PRA.
15 This was a standard to support risk-informed
16 applications.
17 So if this were to be written as a
18 standard that you wanted to pick up, and you were
19 starting with a blank piece of paper and wanted to do
20 your PRA, a lot of this would have looked a lot
21 different. It would have --
22 CHAIRMAN APOSTOLAKIS: If the licensee was
23 to come with an application, say for the PBMR, and
24 they say, we did a PRA using the ASME standard. Even
25 if the standard says --

1 MEMBER SIEBER: It would require
2 additional review --
3 CHAIRMAN APOSTOLAKIS: Some additional
4 review.
5 MEMBER SIEBER: -- to assure its validity.
6 Exactly.
7 CHAIRMAN APOSTOLAKIS: But it would carry
8 some weight. So they did comply.
9 MS. DROUIN: Well, they could comply with
10 some of it, but some of it's just not going to be
11 applicable.
12 CHAIRMAN APOSTOLAKIS: Exactly. And they
13 will decide.
14 MS. DROUIN: Right. Okay.
15 Now, given that we have this new
16 regulatory guide, we wanted to just talk a little bit
17 about how does this fit in, in terms of -- because,
18 again, the ASME standard is just part of it. What
19 we're trying to show you is all the different pieces
20 ultimately of where we'll be down the road.
21 As you can see, the ASME was only covering
22 Level 1 and only part of a Level 2, full-power,
23 internal events, excluding fire.
24 MEMBER KRESS: Is any thought given to
25 adding a late-containment failure criteria in 1.174?

1 You know, we had that big debate over whether late
2 containment is a regulatory objective that ought to be
3 part of the licensing changes.
4 MS. DROUIN: Well, we're certainly going
5 to deal with some aspects of late-containment failure,
6 because -- we did have a meeting with NEI. And they
7 came in and was showing their interpretation of some
8 stuff out of 1150, showing that late-containment
9 failure was less than zero to your LERF.
10 MEMBER KRESS: Of course. But the point
11 is, you don't want late-containment failures either.
12 And it seems to me like there ought to be some
13 guidance in 1.174 related to late-containment
14 failures. If somebody comes in with a licensing
15 change request that significantly affects that part of
16 their protection, it seems to me that you guys would
17 think that was important.
18 MS. DROUIN: Absolutely. I don't
19 disagree. I think this is an issue --
20 MEMBER KRESS: Yeah, well, this seems to
21 me like something that ought to be discussed in 1.174
22 somewhere.
23 MR. PARRY: It's sort of there. If you
24 look closely, it's there in the concept, difference in
25 depth, from maintaining the containment function. And

1 that's the approach that's being used. And that's the
2 approach I believe is going to be incorporated in
3 NEI-00-04 to address things to like containment
4 systems.
5 MEMBER KRESS: Yeah. I would have rather
6 seen some -- we've got something called LERF, large
7 early. I would like to see something called
8 late-containment failure or LCF, and have a guideline
9 on it that's numerical and deltas on that. Another
10 one of your created darkness charts.
11 MEMBER ROSEN: Now, what distinguished
12 early from late is late means after the implementation
13 of moving people out of the way.
14 MEMBER KRESS: Sure.
15 CHAIRMAN APOSTOLAKIS: Basically.
16 MEMBER ROSEN: Basically. So when you
17 crack to the adequate-protection standard, protection
18 of the public's health and safety, the public are
19 already gone. So now you've got a whole different set
20 of issues.
21 MEMBER KRESS: You've got two safety
22 goals. One of them deals with prompt fatalities and
23 one of them deals with latent fatalities. This is a
24 latent fatality issue. It's also a land contamination
25 issue. And in NRC has that within their regulatory

1 objectives.

2 MEMBER ROSEN: I agree with you. With

3 respect to the land contamination issue, clearly we're

4 on the same page.

5 MEMBER KRESS: Yeah. And there ought to

6 be some criteria in 1.174 that deals with that.

7 MEMBER ROSEN: We're not arguing. All I'm

8 saying is that there's a whole different set of

9 considerations in order to develop --

10 MEMBER KRESS: Oh, yeah. You've got to

11 have new guidelines, new deltas, new metrics.

12 MEMBER ROSEN: New metrics, new

13 guidelines, thresholds, et cetera.

14 MEMBER KRESS: But it seems to me like

15 1.174 is where they belong. It deals with changes to

16 the licensee basis. And these are things you're

17 interested in preserving, or preserving adequately.

18 And it's always bothered me that there's nothing much

19 in there with respect to that, other than words like

20 "you will also meet all the other regulations," and

21 things like that. You can construe that to have some

22 meaning. It seems to me that it ought to be in there

23 explicitly. But that's just my opinion.

24 MEMBER SHACK: It's included more

25 explicitly in the framework document.

1 MEMBER KRESS: Oh yes.

2 MEMBER SHACK: I don't see why you

3 couldn't bring that right into --

4 MEMBER KRESS: Yeah, the framework

5 document definitely has it. And that would be a good

6 place to look to see how maybe to incorporate it in

7 here.

8 CHAIRMAN APOSTOLAKIS: And there's no need

9 for a standard for Level 3 PRA because it's done so

10 well, right?

11 Okay. Shall we go on, Mary? Twelve?

12 MS. DROUIN: This one just shows right now

13 what the status of these documents are. ANSI has

14 voted for the standard for ASME. So that should be

15 coming out imminently in the next couple -- they've

16 got to go through a check-editing process, but it's on

17 the way out the door is the point. They're on

18 schedule.

19 NEI-00-02. We met with them because our

20 initial review, they had asked us to review it. But

21 in the context of Option 2 applications only, we

22 received a letter in December from NEI asking us to

23 expand our review to all applications. We are in the

24 midst of doing that. We plan to have preliminary

25 comments back to them in March and final comments in

1 May. But that's still a preliminary schedule.

2 ANS. Their schedule right now is to have

3 a fire published standard by the end of December of

4 this year for low-power shut down. That's a year

5 away. In terms of the fire, they're only right now

6 putting together their writing team for the standard.

7 So there's no schedule right now that's established

8 for the fire part of it.

9 MEMBER ROSEN: Mary, could I ask a

10 question of our staff? I don't remember seeing

11 NEI-00-02. Has it been distributed to the ACRS?

12 MR. MARKLEY: We reviewed it about a

13 year-and-a-half ago.

14 MEMBER KRESS: It wasn't 02 then, was it?

15 MR. MARKLEY: Yes, it was.

16 MEMBER KRESS: Was it?

17 MR. MARKLEY: Yeah.

18 MEMBER KRESS: I thought it was 99-02.

19 MEMBER ROSEN: I guess I wasn't in the

20 loop at that time. Would you see about getting me a

21 copy?

22 MEMBER POWERS: You may be right, Tom.

23 But it's a 0002. That I know. And all members of the

24 Fire Protection subcommittee have several copies of

25 it.

1 CHAIRMAN APOSTOLAKIS: And the one that
2 applies to Option 2 is 0004.
3 MEMBER ROSEN: Right.
4 CHAIRMAN APOSTOLAKIS: What happened to 3?
5 MEMBER ROSEN: They only do even numbers.
6 MEMBER POWERS: Let me ask you a question,
7 Mary. You're a knowledgeable student of
8 risk-assessment culture in this country.
9 Have there been enough prior PRAs done?
10 Has there been enough debate within the academic
11 community to write something like a standard?
12 MS. DROUIN: Personally, I think there is.
13 Is it going to be the ultimate standard? No. But I
14 don't think you have to have every "i" dotted and "t"
15 crossed before you can start writing a standard, in my
16 opinion.
17 CHAIRMAN APOSTOLAKIS: I guess the problem
18 is that we don't even know where the i's are; let
19 alone dot them.
20 MEMBER POWERS: It seems to me that -- I
21 think I'm not in an unusual situation of planting
22 myself in total agreement with the chairman here, that
23 whereas in PRA for normal operational events, lots of
24 people do them. And there are big conferences held
25 often in lovely hotels. One of the best, of course,

1 is in Beverly Hills, I believe, and set a new standard
2 by which such conferences were held in which people
3 debate various aspects --
4 CHAIRMAN APOSTOLAKIS: That was a Beverly
5 Hills standard.
6 MEMBER POWERS: Beverly Hills standard,
7 right. And it's been through a crucible of technical
8 discussion of some magnitude. Whereas, in the area of
9 fire PRA, I find, first of all, less, and that that
10 debate has largely been in the hands of those with a
11 probablistic bent, and that my friends and
12 acquaintances in the fire protection community have
13 not weighed in to this discussion, whether
14 phenomenologically things are about right; whether
15 this cone that Dr. Apostolakis, should be 35 or 37
16 degrees.
17 That kind of interchange -- I question
18 whether that kind of technical debate, discussion,
19 what not, has taken place to the point that you could
20 write a standard with any confidence, that it would
21 put useful constraints and guidance on the writers of
22 a fire PRA.
23 MS. DROUIN: Well, I think when you write
24 any standard, I mean, I think it's obvious you've got
25 to have the right people in there to get a decent

1 standard. And you want to make sure that you get a
2 good cross-cut of all the different aspects with the
3 different knowledge and the different variance and
4 expertise involved in the process.
5 MEMBER POWERS: So will this writing group
6 have probabilists or will it have fire protection
7 people, or will it have it both?
8 MS. DROUIN: I hope it would have both, in
9 my opinion.
10 CHAIRMAN APOSTOLAKIS: I think it should
11 have also people who understand fire phenomena. I
12 mean, there is a whole community out there. I don't
13 think they call themselves fire protection people.
14 MEMBER POWERS: That's right.
15 CHAIRMAN APOSTOLAKIS: It's fire safety
16 scientists or engineers, familiar with all the
17 experiments that have been done, the correlations that
18 have been developed. These are extremely important
19 people to be represented in an effort like this.
20 MS. DROUIN: I don't disagree. I have no
21 say so who's on this writing team.
22 CHAIRMAN APOSTOLAKIS: We understand.
23 MEMBER ROSEN: I do.
24 CHAIRMAN APOSTOLAKIS: We understand.
25 MEMBER ROSEN: I'm on the Steering

1 Committee.

2 CHAIRMAN APOSTOLAKIS: Oh, okay.

3 MEMBER ROSEN: So I'm listening.

4 MS. DROUIN: But I think it's critical

5 that you get all these --

6 CHAIRMAN APOSTOLAKIS: I mean, it would be

7 a big mistake if you have only the PRA types and fire

8 protection types.

9 MEMBER ROSEN: Well, we're just getting

10 started. I'm speaking now for the ANS-RISC Committee,

11 Risk-Informed Standards Committee.

12 CHAIRMAN APOSTOLAKIS: Oh, just like the

13 Option 2 risk?

14 MEMBER ROSEN: Yeah. It's called the

15 RISC, which I'm on.

16 CHAIRMAN APOSTOLAKIS: So you were

17 categorized.

18 MEMBER ROSEN: And what we're trying to do

19 is put together a team now to write this. So it's

20 helpful to have these thoughts.

21 MEMBER KRESS: I would spell it R-I-S-K.

22 MEMBER ROSEN: It's a committee, and you

23 don't spell committee with a "K."

24 CHAIRMAN APOSTOLAKIS: Ms. Drouin, let's

25 move on.

1 MS. DROUIN: Okay. We're very close to
2 being done. I just have one more slide after this
3 one.
4 Some other related efforts that are
5 ongoing, but they're a part of all of this. You've
6 probably heard about it. I know you haven't seen
7 anything. But we have been working on what we call a
8 data handbook that is to compliment the ASME, the
9 standards that are ongoing. And this handbook is
10 getting more into -- it's a methods book, covering the
11 sources and methods for doing your data, covering
12 initiating events, components, failure rates, and
13 equipment, non-recovery probabilities. The thing I
14 want to point out is it's not covering common cause,
15 because there is a separate document that the NRC has
16 produced. So we aren't trying to replicate work
17 there.
18 MEMBER KRESS: I think it's a great idea,
19 by the way.
20 MS. DROUIN: Thank you.
21 The date there, though, for July. Sorry,
22 that's a typo. That should have been August.
23 Another effort that's also ongoing to
24 support the standards effort, is when you go and you
25 look at Reg 1.174, also the standard. The ASME

1 standard refers to NUREG 6595 as an acceptable
2 approach for LERF. It's the document that gets them
3 -- how to do a simplified LERF. But it only covers
4 full power. We're in the midst of updating that to
5 also cover low-power shut-down conditions to support
6 the standards effort. And we plan for that to go out
7 in August of this year.
8 MEMBER KRESS: Can we get it before it
9 goes for public review?
10 MS. DROUIN: You will receive it when it
11 goes out for public review and comment. Yes.
12 MEMBER KRESS: At the same time? Yeah.
13 Okay.
14 MS. DROUIN: So in wrapping up, this is a
15 tentative, preliminary schedule we've put together.
16 We did have a public meeting on Tuesday. In fact, the
17 schedule -- because of information we got from the
18 public meeting, we revised the schedule as you see it
19 today. It might go through some more revisions.
20 That's why we're just saying it's preliminary. We've
21 met with ACRS today.
22 But right now what we're thinking about is
23 that in March we will have a SECY that goes forward to
24 the Commission. Now, that date, though, is firm in
25 terms of the SECY for transmitting the updated Reg

1 Guide 1.174. That will go forward. Also attached to
2 that SECY would be the plan for our endorsement of the
3 standards in the industry peer review, which we've
4 talked about today.
5 We also were thinking at that time -- we
6 have been reviewing NEI-00-02 for all applications in
7 submitting preliminary comments to NEI at that time.
8 One of the reasons that the comments wouldn't be final
9 is one of the things we did learn at the public
10 meeting is that NEI is working on a document that
11 would show the differences between NEI-00-02 and the
12 standard. And we felt having that information, and in
13 terms of our review of it, would be very important.
14 So we were changing the schedule to try and integrate
15 that in there.
16 So we were saying preliminary comments in
17 March, and then going final comments to NEI-00-02 in
18 May. Give them time to come back to us with their
19 response. And then in July we would go forward to
20 release the draft reg guide, plus the appendices. So
21 we would have two appendices at that time-- Appendix
22 A which would address the ASME standard, and Appendix
23 B which would address NEI-00-02, and, of course, our
24 SRP.
25 At the same time, we would go out with our

1 draft version of the data handbook and a draft of
2 NUREG-CR-6595, Rev. 1.
3 MEMBER KRESS: What's the status of that?
4 Has it been started?
5 MS. DROUIN: The status of what?
6 MEMBER KRESS: The NUREG CR-6595, Rev. 1.
7 MS. DROUIN: We started it about six
8 months ago. So it's been in progress.
9 MEMBER KRESS: Is there some sort of a
10 rough draft available?
11 MS. DROUIN: Not at this point, not enough
12 to --
13 MEMBER KRESS: Would there be one
14 available by, say, April? I would really love to see
15 that, even though it's draft and rough and not been
16 approved, et cetera. If I could get one. But it
17 would have to be in April. It would be too late to
18 get it after that. I have a reason for wanting to
19 look at it.
20 MS. DROUIN: I don't know what our
21 position is. I mean, in terms of coming, to have it
22 to a form to show the ACRS, I hesitate to say --
23 MEMBER KRESS: No, I don't want it for --
24 this is not for the ACRS; this is for me. Just for
25 personal use. For my edification.

1 MS. DROUIN: Well, we can talk off line on
2 that.
3 MS. DROUIN: He promises not to share with
4 us.
5 MEMBER KRESS: Yeah. I promise not to
6 even let them know what it is.
7 MS. DROUIN: Okay.
8 MEMBER ROSEN: Mary, what is the title of
9 NEI-00-02?
10 CHAIRMAN APOSTOLAKIS: It's the peer
11 review document; isn't it?
12 MEMBER KRESS: Yes, the peer review --
13 CHAIRMAN APOSTOLAKIS: The peer review
14 process.
15 MS. DROUIN: It's a long title. You know,
16 Steve, I apologize. I just don't remember.
17 MEMBER ROSEN: But it's a --
18 CHAIRMAN APOSTOLAKIS: Something like
19 that. Industry guidelines for peer review.
20 MEMBER ROSEN: It's the one that lays out
21 the peer review process.
22 MS. DROUIN: Yeah. It's the Peer Review
23 Certification Program.
24 CHAIRMAN APOSTOLAKIS: And up until now,
25 it has been the only document that addresses the issue

1 of quality PRA, right? No, ASME had not been
2 approved. The only document out there -- because I
3 know the foreign organizations are using N-00-02 to do
4 peer reviews, because that's the only thing that's
5 available.
6 MEMBER ROSEN: Right. But the substance
7 of it, before it was called NEI-00-02, was part of the
8 BWR Owners Group.
9 MS. DROUIN: Is the BWR Owners Group.
10 CHAIRMAN APOSTOLAKIS: That's right.
11 Well, that was a long time ago.
12 MS. DROUIN: They're essentially the same.
13 Okay. In August we were planning on
14 coming back to the ACRS --
15 MEMBER POWERS: You'll come alone.
16 CHAIRMAN APOSTOLAKIS: Well, we aren't
17 really meeting in August.
18 MEMBER KRESS: We won't be here.
19 CHAIRMAN APOSTOLAKIS: You can come.
20 MEMBER POWERS: It's a terrific meeting.
21 You'll get no objections, and your presentation will
22 go very quick.
23 MS. DROUIN: Well, then, I love that idea.
24 I know when he had talked, the schedule
25 looked differently then.

1 MEMBER ROSEN: Yeah, that's June.

2 CHAIRMAN APOSTOLAKIS: June?

3 MR. MARKLEY: Yes, she's changed it to

4 August.

5 CHAIRMAN APOSTOLAKIS: Now when you say

6 ACRS, you mean the full committee, right? You don't

7 mean the subcommittee?

8 MEMBER KRESS: We could have a

9 subcommittee.

10 CHAIRMAN APOSTOLAKIS: PRA subcommittee?

11 MS. DROUIN: No. I think in August we

12 were talking subcommittee.

13 CHAIRMAN APOSTOLAKIS: Subcommittee?

14 MEMBER KRESS: Oh. Well, that's possible

15 then.

16 MR. MARKLEY: She's sliding the June

17 subcommittee back to August.

18 MS. DROUIN: Yes.

19 CHAIRMAN APOSTOLAKIS: We have

20 subcommittee, if that's what you'd like. We're trying

21 to avoid it.

22 MEMBER KRESS: We're trying to avoid it,

23 but we do.

24 MEMBER POWERS: We only have subcommittee

25 meetings in August when we know that Professor

1 Apostolakis is in Greece.

2 CHAIRMAN APOSTOLAKIS: Yes.

3 MEMBER ROSEN: But he's not. He's in

4 Crete.

5 MR. MARKLEY: Would late July do okay?

6 MS. DROUIN: We'll get back with you.

7 We'll work something out.

8 Anyway, in our October -- sorry. Back to

9 August.

10 CHAIRMAN APOSTOLAKIS: Yes?

11 MS. DROUIN: We're also planning very

12 quickly after releasing these documents for public

13 review, is having a workshop to walk people through

14 the documents. This is a lot of information we're

15 going to be putting out. If it was just the reg

16 guide, that would be -- but we have the reg guide.

17 Just to show you. Here's the data handbook; it's a

18 thick document. You know, we're going to have NUREG

19 CR-6595. So a lot of information. So we really

20 thought having a workshop and walking everyone through

21 these documents was going to be very important.

22 MEMBER POWERS: Why don't we instead of

23 having the subcommittee meeting in August just go to

24 their workshop?

25 CHAIRMAN APOSTOLAKIS: That's an idea.

1 MS. DROUIN: That's --

2 MEMBER ROSEN: It probably be more useful.

3 CHAIRMAN APOSTOLAKIS: It also increases

4 the presence of ACRS members to meetings.

5 Is the workshop going to be in Washington?

6 MS. DROUIN: No decisions have been made,

7 but I would like to think so.

8 MEMBER POWERS: Or Las Vegas, someplace

9 like that.

10 MEMBER ROSEN: In August?

11 MEMBER POWERS: Yeah.

12 MEMBER ROSEN: 412 degrees?

13 MEMBER POWERS: It's 112. What's wrong

14 with that? Relatively cool.

15 CHAIRMAN APOSTOLAKIS: There's a

16 suggestion by your vice chairman here.

17 VICE CHAIRMAN BONACA: What about Crete?

18 MS. DROUIN: Anyway, in August, we're

19 talking about a 60-day public review and comment

20 period. And then hopefully come October, we would

21 have all the comments back and hopefully time to go

22 through them and understand them, and come to a

23 resolution, and have another public meeting at that

24 point to share what our position is on the comments.

25 And then come December, have a SECY that would

1 transmit this to the Commission for release.

2 CHAIRMAN APOSTOLAKIS: Very good.

3 MEMBER KRESS: Very good.

4 MS. DROUIN: So that's --

5 CHAIRMAN APOSTOLAKIS: Any questions for

6 Ms. Drouin?

7 Well, thank you very much, Mary.

8 MEMBER KRESS: Thank you.

9 MS. DROUIN: Thank you very much.

10 CHAIRMAN APOSTOLAKIS: We'll see you in

11 August.

12 MS. DROUIN: Right here.

13 CHAIRMAN APOSTOLAKIS: We'll be back at

14 3:10.

15 (Whereupon, the foregoing matter went off

16 the record at 2:53 p.m.)

17 CHAIRMAN APOSTOLAKIS: Okay, we're back in

18 session.

19 The next item on the agenda is the PTS

20 Technical Bases Reevaluation Project. Dr. Ford, would

21 you be kind enough to lead us through this?

22 MEMBER FORD: George, this is a good

23 engineering project. It was --

24 MEMBER POWERS: How can it be a good

25 engineering project, when it's got epistemic and

1 aleatory --

2 (Laughter.)

3 MEMBER POWERS: -- ain't no fire.

4 MEMBER FORD: The last time we heard --

5 the full committee heard about this project was about

6 16 months ago. Last month, the materials subcommittee

7 had a full 1-1/2 days briefing on the progress on

8 this, and you will find it very exciting.

9 However, we only got two hours, and

10 therefore we're going to restrict comments to

11 technical basis for changing the frequency of through-

12 wall quick cracking. Discussions on things such as

13 acceptance criteria, that will be covered in a meeting

14 in May. So --

15 MEMBER POWERS: What is that --

16 MEMBER FORD: -- I'll pass it on to Ed at

17 this point, Ed Hackett.

18 CHAIRMAN APOSTOLAKIS: I would like to --

19 I was -- oh.

20 MEMBER POWERS: You said, what part was

21 going to be deferred to --

22 MEMBER FORD: The discussions on, for

23 instance, changing acceptance criteria due to

24 containment failure, source terms, etc. That will be

25 put off until May.

1 CHAIRMAN APOSTOLAKIS: And I would like to
2 see a recent example of model uncertainty
3 quantification in an HRA. I looked at the viewgraphs
4 from the subcommittee, and I'm not sure I found the
5 answer.
6 MR. HACKETT: Why don't I go ahead and
7 read off a few things while we're working through
8 this.
9 First off, just to introduce the table,
10 I'm Ed Hackett, and I'm Assistant Chief of the
11 Materials Branch in the Office of Research. To my
12 right is Alan Kolaczkowski, and he's an expert in
13 probabilistic risk assessment from Sandia National
14 Laboratories.
15 To my left immediately is Mark Kirk, who's
16 also in the Materials Engineering Branch. And his
17 expertise is in probabilistic fracture mechanics.
18 And also, Dave Bissett from the Simsab
19 Branch in Research is with us also, and his expertise
20 is thermal hydraulics. So that's trying to represent
21 -- you know, get the key disciplines aligned here for
22 you so we can go through this.
23 It looks like we're close on slides here.
24 In addition to that, I can reference that
25 there's -- these are the front people, particularly

1 speaking for myself, for what's a fairly large team of
2 people at NRC in general, including NRR, including our
3 contractors, and also including the industry.
4 This has been kind of a first for us to do
5 this on as participatory a basis as we have with the
6 industry, and I think that's something that's really
7 worked very well for us.
8 The other thing I just mentioned that's
9 been very key to this has been the backing. We've
10 had, especially from our senior management in the
11 Office of Research, particularly my division director
12 Mike Mayfield, who's taken this on with a sort of
13 personal vengeance -- those of you know Mike, you know
14 what that means it brings to a project. And also, a
15 shift tonight. So, we've had a lot of support, is the
16 bottom line.
17 I guess we'll go ahead and go to the next
18 slide.
19 I really wanted to do three things for you
20 today, and maybe I'll start by addressing a comment
21 George made in the opening. This is a very condensed
22 version of a presentation or series of presentations
23 that we did about a month ago for the subcommittee,
24 where we tried to walk through the uncertainty
25 treatment in the project that I believe was almost 180

1 slides. So, you'll see a much condensed version of
2 that today.
3 I don't know if we'll get to exactly what
4 Professor Apostolakis was looking for. If we don't,
5 we'll try and cover that some way. But we'll make a
6 good stab at that, and Alan especially will be here to
7 address the human reliability aspects.
8 But, just a couple of quick things because
9 I don't want to belabor, you know, my opening here.
10 The overall project status -- we started this, as some
11 of you remember, in 1999. There have been a lot of
12 challenges along the way, both technical and
13 otherwise, and still continue to be. Also, schedule
14 challenges.
15 I mentioned the industry participation
16 that's been key to this thing. We expect right now
17 that the tech basis will complete this year in 2002,
18 and we will do sort of a parallel handoff with NRR to
19 initiate rulemaking activities. So hopefully later
20 this year is -- that's part of the plan right now.
21 The second bullet there is, we're going to
22 be, in this presentation, giving you results and
23 insights from analysis of Oconee Unit 1, which was the
24 first of four plants that are being evaluated in the
25 process. I guess I'll emphasize up front that these

1 results are preliminary. They also look, in our
2 opinion, pretty good at this point, but we'll get to
3 that in a minute. But they are preliminary. We're
4 still working through finalizing that.
5 And then, a key part of this is describing
6 the modeling process and the uncertainty
7 quantification, particularly in the three areas of
8 PRA, thermal hydraulics and probabilistic fracture
9 mechanics. I appreciate the help we got previously
10 with the subcommittee. There was some good dialogue
11 there and some good comments, and it probably glazed
12 over the members by the end of a day and a half worth
13 of PTS.
14 One of the things we talked about in the
15 way of some business aspect -- with Dr. Ford, we
16 talked about the last time that we would probably be
17 looking for a letter from the committee this time
18 around. If nothing else -- it's been a long time. I
19 think Dr. Ford, when he led off the subcommittee
20 meeting, had indicated that the last time there had
21 been formal correspondence I think was about a year or
22 a year and a half.
23 MEMBER FORD: October 20, 2000.
24 MR. HACKETT: Okay. So probably at this
25 point, we're -- it would be appreciated to have a

letter from the committee.

I sat in this morning when you guys were grilling Shook and Sam and company. And Shook said you guys were up to speed on this, so I'm hoping that's the case.

We'll go to the next slide, which is -- what I wanted to do here -- we had a day and a half the last time with 180 slides, so we came up with our emergency summary slide, just in case. It's not quite an emergency here yet today.

MEMBER ROSEN: I hope you change the title.

MR. BESSETTE: We did.

MR. HACKETT: Oh, you did. Well - never mind. I still had "emergency summary slide".

So, also we translated to try and give it to you guys up front, where this is heading in plain language space. The transients are obviously --

MEMBER WALLIS: That's a wonderful development -- plain language space. Please do it some more.

MEMBER POWERS: But Graham, if you look, the end sentences were prepositions -- God help us. This is all --

MEMBER WALLIS: This is all one sentence.

1 It's all one sentence.

2 MEMBER POWERS: If this is plain language,

3 we're in trouble.

4 MEMBER WALLIS: That's what plain language

5 is. Plain language does end sentences with a

6 preposition.

7 MR. HACKETT: You should have seen the

8 other slide.

9 MEMBER WALLIS: I think it's the only

10 thing I can listen to.

11 (Laughter.)

12 MEMBER KRESS: I think it's written in

13 Tennessee.

14 (Laughter.)

15 MR. HACKETT: But we do have Terry Dixon

16 on the project.

17 MEMBER KRESS: Oh, that's where it came

18 from.

19 MR. HACKETT: I don't know if we have

20 Terry on the phone today; probably not. But Terry's

21 been another key member of this project at the

22 Oakridge laboratory. But I guess these kind of speak

23 for themselves. I won't necessarily go over those

24 point by point.

25 The last point, though, on the cracks --

1 our colleagues in the industry wanted me to make sure
2 to say we are actually seeing more cracks as a result
3 of -- or, I should say defects by virtue of the
4 analyses that we've done, but they are more benign and
5 not as large as we'd assumed before with the Marshall
6 distribution. You'll hear some more about that.
7 The four bullets that you see there are
8 fairly consistent with what we figured would be the
9 expectations on this project when we went into it, so
10 we're happy to see the vector's in the right
11 direction.
12 MEMBER POWERS: I haven't got a clue what
13 the second one means. Round operators --
14 MEMBER WALLIS: It's all one big sentence
15 with commas in it.
16 MR. HACKETT: It is all kind of -- I'll
17 apologize for it. The English is not precise, I
18 suppose. But it's --
19 MEMBER WALLIS: That's because it's plain.
20 (Laughter.)
21 MR. HACKETT: Because it's plain. It's
22 colloquial and plain.
23 MEMBER POWERS: Well, it's confusing. A
24 round operator --
25 MR. HACKETT: We were paraphrasing from --

1 we were paraphrasing from a summary that Bob Hardees,
2 our industry colleague, did to the Water Reactor
3 Safety Meeting about two years ago. Really, it's in
4 the presence or having operators that performed better
5 than we gave them credit for because we didn't give
6 them any credit previously.
7 MEMBER ROSEN: In plants with operators,
8 though.
9 MR. HACKETT: There are a lot of ways to
10 make the English better, yes.
11 CHAIRMAN APOSTOLAKIS: Can we move on to
12 the second or third slide. This one creates more
13 discussion than it deserves.
14 (Laughter.)
15 MR. HACKETT: Let's go to "Project
16 Status". This is the one you'll see replicated
17 throughout the presentation. The approach -- and this
18 has been discussed with the committee several times
19 now. The approach is really broken into the three
20 primary technical areas: PRA and event sequence
21 analysis, thermal hydraulics and probabilistic
22 fracture mechanics.
23 What we've tried to capture down in the
24 matrix there is to show you where we are, and we're
25 about done with Oconee. It's -- in all the boxes,

1 it's listed as "draft", but that should be about to go
2 final this month. The other ones are pretty much
3 where you see them. There's work beginning in all the
4 other areas for the other plants. And again, the
5 schedule challenges are to have a lot of that done by
6 basically the middle of this year --
7 MEMBER ROSEN: I'm going to interrupt you.
8 I have read all this and all that. And the main
9 question I come up with is, what are you doing here?
10 Where are you going with all of this?
11 MR. HACKETT: We'll get to that today.
12 And I guess, depending on the information that's
13 you've had, where you are going -- to cut to the chase
14 is a revised 10 C.F.R. 50.61 that will be less
15 restrictive than it is now, hopefully, is where the
16 thing's heading at the moment.
17 I might as well jump to the next slide.
18 That said, there's plenty of work
19 remaining to get there -- to Dr. Rosen's question.
20 One of the things that Dr. Ford focused on the last
21 time in terms of work remaining is QA, quality
22 assurance, for the project. We have work going on in
23 QA, in all three key areas, and there were some
24 comments from the subcommittee meeting on that.
25 The internal events analyses are really

1 the thing that's going to create a lot of the schedule
2 challenges for us in getting those done on time, and
3 that's for the remaining plants -- primarily,
4 Palisades, Beaver Valley and Calvert Cliffs.
5 Another issue came up -- and we'll get
6 into this to some greater degree, too. Because the
7 initial risk --
8 MEMBER WALLIS: Remind me -- these are
9 only CE plants, is that it?
10 MR. HACKETT: They're not. Actually, they
11 represent all the --
12 MEMBER WALLIS: So, why just these plants?
13 Why not all plants?
14 MR. HACKETT: A couple of reasons, and you
15 get to one of the key questions in terms of
16 generalizing this thing. We attempted to replicate
17 the work that was done before in the 1980s on the --
18 MEMBER WALLIS: Because these are typical
19 plants for covering all the major categories in the
20 plants.
21 MR. HACKETT: Covering the major and
22 triple-S vendors -- BNW Combustion, Westinghouse --
23 MEMBER WALLIS: And if these are okay, you
24 decide the others are okay, is that the idea?
25 MR. HACKETT: We're going to try and make

1 that argument. And that's not going to be easy,
2 either. But that's -- resource-wise, that's going to
3 be one of our constraints.
4 MEMBER FORD: But Ed, you might also point
5 out that two of them, Oconee and Calvert Cliffs, are,
6 according to the (inaudible) regulations, fairly safe.
7 MR. HACKETT: They are.
8 MEMBER FORD: Whereas, Palisades and
9 Beaver Valley are not.
10 MR. HACKETT: Palisades and Beaver Valley
11 -- just to get into that, by the current criteria in
12 10 C.F.R. 50.61, Palisades and Beaver Valley are okay
13 to the end of their current licenses, but they're just
14 right there at the end of those licenses. In those
15 cases, it's 2011 and 2016, if I remember right, so we
16 do have some time here before anyone is impacted, even
17 in the current license period.
18 With the extended license period, we could
19 get into probably a bit of debate or discussion over
20 which plants may or may not be impacted. But the
21 bottom line is, we have some time to deal with this.
22 MEMBER KRESS: The previous study just had
23 Oconee and Calvert Cliffs and Monticello?
24 MR. HACKETT: The previous study had
25 Oconee, Calvert Cliffs and H. B. Robinson.

1 Unfortunately, we were not able to get -- the Robinson
2 plant had some difficulties with participating, so we
3 picked up Beaver Valley instead.
4 The external risk piece is an interesting
5 piece for us. We are just getting to addressing that
6 now because we have -- right now with Oconee, one of
7 the things you'll see is, we think we're a couple of
8 orders magnitude down in the overall risk from where
9 we thought we were, which is a good outcome. But that
10 also necessitates that we consider the impact of
11 external events on the risk contribution.
12 The good news is, we have a funded task
13 underway with Alan at Sandia that we're hoping is
14 going to have some results probably this spring
15 timeframe somewhere. So, that work will be under way.
16 The last piece is the integration of this
17 whole thing with regard to the risk criteria. And
18 there, we also have -- we're not prepared to discuss
19 that in detail today, but we have some work in
20 progress that's to result in a SECY paper, again,
21 about the March, April time frame that's going to lay
22 out the staff views on the risk criterion for the --
23 MEMBER WALLIS: Is this going to lead to
24 a reg. guide or something?
25 MR. HACKETT: There are two pieces.

1 There's -- the main piece, of course, would be a
2 revision to the rule itself, to 10 C.F.R. 50.61.
3 There's an associated regulatory guide, which is
4 1.154, which takes you into the plant-specific case.
5 Right now, if it goes the way we're seeing
6 things are going right now, we may end up with a
7 situation where it might not be worth the resources to
8 re-do the reg. guide. If the screening criteria is
9 relaxed to a great enough degree, it might be that
10 nobody would ever engage with that reg. guide. They
11 haven't yet either, so I think that's one of the
12 things we're going to have to look at in resource
13 space.
14 MEMBER KRESS: Let me ask you about the
15 second bullet; I wasn't at the second subcommittee
16 meeting. We have these plants that are being
17 irradiated, the vessels, and going on with time. And
18 they have these transients occasionally, but not very
19 often, and thermal shocks, for example. And so, your
20 answer (inaudible) was, the vessel's going to survive
21 at a certain level of risk over its lifetime. It
22 would seem to me like external events don't enter into
23 that picture.
24 MR. HACKETT: We're hoping it's a very
25 small contribution. I think --

1 MEMBER KRESS: Can't you almost rule it
2 out before you start by looking at frequencies?
3 MR. HACKETT: -- I'll defer to Alan on
4 that one.
5 MR. KOLACZKOWSKI: I think it's a little
6 difficult to do, the reason being that external
7 events, as we all know, can have common cause types of
8 effects, wherein in the internal -- as a 'for
9 instance' -- where maybe you're worried about a
10 turbine bypass valve staying open and therefore
11 starting to cool the plant, and then the operator does
12 or does not throttle, etc., they're pretty much
13 independent actions.
14 But you could imagine -- take a fire, for
15 instance causing hutch shorts in such a way that not
16 only does it force the TBV to stick open but it also
17 shuts down the reactor coolant pumps. And now you,
18 first of all, with one single event -- granted at a
19 lower frequency -- but now one single event has caused
20 multiple things to occur. A cool-down effect -- and
21 you've shut down the reactor coolant pumps because you
22 affected the circuits nearby, and now you're also
23 introducing the possibility of stagnation on top of
24 the event that normally would have been another
25 independent failure.

1 So, I think just on the surface, you can't
2 just say, well, external events, we don't have to
3 worry about.
4 MEMBER KRESS: Okay. I can see the
5 possibility of the fire being one, but I think I would
6 rule out earthquakes and floods and tornadoes, just
7 right off the bat.
8 MR. KOLACZKOWSKI: We certainly have some
9 insights. For instance, Calvert Cliffs has a current
10 PRA that has PTS involved along with the rest of the
11 PRA, the normal station blackout and all these other
12 sequences.
13 If their analysis is any indication, it
14 looks to them that, from an external event point of
15 view, the two that you need to worry about are fires
16 and internal floods. Now their results, just taken on
17 the surface, do suggest that external events do not
18 contribute as much as internal, but that's something
19 we want to check out and verify.
20 But it's not necessarily, should I say, so
21 insignificant that you can just rule it out right off
22 the bat.
23 MEMBER KRESS: Thank you. That helps.
24 MR. HACKETT: I guess what I'd say in
25 closing this opening piece, I guess what I'd like to

1 focus on -- we're going to go into giving you the
2 results and insights from Oconee. But I think the
3 focus really needs to be on the modeling process and
4 quantification on the uncertainty, which is really
5 what we tried to do in detail at the day-and-a-half
6 meeting.
7 So, we're going to try and keep that
8 focus. If we don't, let us know. We may need more
9 time to do that. If we need to come back, we'll do
10 that. But that's going to be the focus.
11 With that, I'll hand it off to Mark Kirk
12 to --
13 MR. KIRK: Do you want to do the Oconee
14 part now?
15 MR. HACKETT: Yeah. We might as well do
16 the Oconee part now.
17 MR. KIRK: Okay. You've seen this graphic
18 before. This just orients you in terms of the various
19 steps in the process that PRA defines the sequences
20 and the sequence frequencies. That feeds into TH,
21 which gives us pressures and temperatures to run
22 through the PFM model, which generates conditional
23 probabilities of vessel failure that are then
24 mathematically in mind with the sequence frequencies,
25 to give us an estimate of the yearly frequency of

1 through-wall cracking, complete with uncertainties.

2 MEMBER KRESS: The PFM analysis has inputs

3 that are like fluence --

4 MR. KIRK: Oh, yeah. Yes. Yes.

5 MEMBER KRESS: -- and crack size and

6 growth rates and things like that?

7 MR. KIRK: That's right. There's a whole

8 host of details under this, and we'll get to expanding

9 that later. That's absolutely right.

10 Just in terms of -- and I think this will

11 get to that -- some of the higher level things in each

12 of these analyses. In PRA, we start off with

13 something on the order of 10,000 sequences, just for

14 reasons of --

15 MEMBER WALLIS: It says there are 100,000.

16 MR. KIRK: 100,000.

17 MEMBER KRESS: That has to do with the

18 number of crack sizes you have?

19 MR. KIRK: Number of what?

20 MEMBER KRESS: Crack sizes.

21 MR. KIRK: No. Number of possible

22 initiating events in the plant.

23 MR. KOLACZKOWSKI: Number of scenarios --

24 just various combinations of valve sticking open/not

25 sticking open, both on the primary/on the secondary,

1 operators doing things/operators not doing things.
2 You look at all the possible combinations. Right now,
3 we've modeled something like 100,000 different
4 scenarios that could lead to overcooling.
5 MEMBER KRESS: Okay.
6 MR. KIRK: But in order to make the
7 computation tractable, that has to get partitioned
8 down into something on the order of a hundred
9 different bins that somehow, by the process that we go
10 through in PRA and in SAPHIRE, that represent these
11 hundred-thousand sequences.
12 MR. KOLACZKOWSKI: Dave over there doesn't
13 want to have to run 100,000 RELAP runs.
14 SPEAKER: I can't imagine why not.
15 MEMBER KRESS: When you -- you bin these
16 by similar consequences and add up the frequencies?
17 MR. KIRK: Basically, yes.
18 MEMBER KRESS: Okay.
19 MR. KIRK: And when we get into more of
20 the details about how the computation's being done.
21 Alan will be describing these more. But just, again,
22 to get the high points, in this analysis we use the
23 most recent data coming out of the plants, give credit
24 where credit is due for recent training and
25 procedures, and as I said, human reliability credit,

1 as appropriate.

2 That then feeds into the thermal hydraulic

3 analysis where, for the particular case of Oconee, we

4 had approximately 150 transients for which we actually

5 performed RELAP runs. Of those, approximately 50 of

6 them just got based on an inspection of the --

7 pressures and temperatures got screened out, meaning

8 they never got passed on to PFM. You could just look

9 at the transient and tell that it was adequately

10 benign, that it was really not a PTS precursor.

11 Of the remaining 100, approximately half

12 of them then fell into the base case and half of them

13 got used to assess --

14 MEMBER FORD: Sorry. Did you -- I know

15 more than you just were saying. I just want people to

16 be aware that there were quantitative criteria as to

17 which ones you threw out.

18 MR. KIRK: Yes. Yes, certainly.

19 MEMBER FORD: I did have more on a certain

20 Delta T in a certain time.

21 MR. KIRK: That's right.

22 MEMBER FORD: Anything above that was

23 chucked out.

24 MR. KIRK: The criteria for falling into

25 screened, not further considered, was based on some

1 very conservative, deterministic, probable -- I'm
2 sorry -- fracture mechanics calculations. And we, in
3 a sense validated those criteria because, of course,
4 having screened things out, some things weren't
5 screened that were right on the line. When we
6 actually ran the Oconee calculations, we found that
7 those had absolutely zero contribution to the
8 conditional probabilities.
9 MEMBER POWERS: As I look at this chart,
10 you have this PRA event sequence, and that's
11 metaphysics. You can't experimentally validate that.
12 You have thermal hydraulics. That's a
13 well-established discipline. You can have models that
14 are experimentally validated for the thermal
15 hydraulics.
16 Probabilistic fracture mechanics is
17 metaphysics that has some hope of being experimentally
18 validated.
19 MEMBER ROSEN: You're just fantastic.
20 It's the same old PRA.
21 MEMBER POWERS: The interface between
22 thermal hydraulics and the probabilistic fracture
23 mechanics -- you have some model. There's some model
24 there.
25 I guess what I'm struggling with is, has

1 there ever been an undercooling event at any pressure
2 vessel, thick-walled pressure vessel that led to a
3 failure that gives you some confidence that that model
4 you had between the thermal hydraulics and the
5 probabilistic fracture mechanics was -- it was a valid
6 say?
7 MR. KIRK: In the in-service, no.
8 MR. HACKETT: In the in-service, no.
9 MEMBER POWERS: Well, experimentally.
10 MR. KIRK: Experimentally, yes.
11 MR. HACKETT: Experimentally, yes, we
12 could say a few things because you're going to the
13 issue with the deterministic aspect of this thing.
14 And there, we have the benefit of a lot of historical
15 tests that were run at the Oak Ridge Laboratory for
16 the NRC research program, where we did in fact do
17 that. And the state of the art at the time predicted
18 with varying degrees of success.
19 But most recently, we've had the NRC staff
20 and the contingent from the Oak Ridge National
21 Laboratory has been very successful in predicting the
22 behavior of these large-scale reference experiments
23 that have been run under the NESC program, the
24 European Network on Evaluation of Steel Components.
25 In fact, I think Richard Bass is the

1 principal of the HSST program for us, and the staff
2 predicted the crack behavior of the NESC One spinning
3 cylinder test in the UK, I think just about dead on.
4 And again, that's a deterministic problem, so that the
5 probabilistics get you off into the other --
6 MEMBER POWERS: Metaphysics, yes.
7 Okay. I mean, that's something that
8 people don't always recognize is that the interfaces
9 between models as a model. That has to be validated,
10 and it seems like you've taken care of that.
11 MEMBER FORD: Well, Dana, you bring up a
12 very good point, could deterministic validation of the
13 failure could, as it existed before you put all the
14 probabilistic stuff in. You mentioned one point, the
15 spinning test in the United Kingdom. What about the
16 70 other odd tests that have been done around the
17 world?
18 MR. KIRK: Recently -- the answer is, you
19 know, if you ask me to pull out a report and give it
20 to you, I can't do that right now. It certainly is
21 possible to be done and I think we need to look into
22 that because approximately a year ago, under the HSST
23 program, we asked them to summarize, like you said,
24 the 70-odd reference experiments that are well
25 documented in structural scale.

1 Certainly, it would be possible, and I
2 think necessary here, to go back and use the --
3 there's a switch in FAVOR, where you can turn off the
4 probabilistic aspects and just use it as a fancy
5 deterministic calculator and use it to predict the
6 results of some of these well-known, well documented
7 reference experiments.
8 As Ed pointed out, we've been through that
9 exercise a number of time in the past, dating back to
10 the 1980s, using FAVOR precursors, which did well
11 using technology of the time. We haven't done that
12 with the current version of FAVOR.
13 MEMBER KRESS: As I recall, Dana, there
14 was almost a museum of huge thick-walled vessels at
15 Oak Ridge with impressive cracks. The thing I
16 remember though -- I may have a faulty memory and you
17 guys can correct me here -- it was extremely hard to
18 create those vessels with the embrittlement
19 characteristics that you get from the radiation. And
20 it's also kind of hard to reproduce the thermal
21 transients that you get. You had to do some things
22 with both of them.
23 MR. KIRK: There were some things that you
24 clearly had to do in the laboratory environment that
25 you couldn't entirely mock up to simulate the full

1 scale exactly.

2 And in the case of the embrittlement, what

3 was done was actually a long series of studies that

4 were done at Oak Ridge and elsewhere to try and

5 simulate the radiation embrittlement damage with

6 changes in the treatment of the steel so that there

7 was work done there.

8 In terms of simulating thermal transients,

9 in a lot of cases, you know, things like liquid

10 nitrogen had to be used to get some of the type of

11 Delta Ts that you think you would see or had seen in

12 the operational experience.

13 MEMBER KRESS: And they had to introduce

14 artificial cracks.

15 MR. HACKETT: Absolutely.

16 MEMBER FORD: But in the spinning tests in

17 the United Kingdom, though, they didn't simulate a

18 real PTS event.

19 MR. HACKETT: That one was very similar

20 because -- the spinning cylinder test, for those who

21 aren't familiar, they generate the stresses in the

22 wall by spinning a fairly large cylinder that had a

23 flaw embedded in the wall.

24 In that case, they induced the thermal

25 shock with the water spray that's fairly severe. And

1 that crack did initiate and run, and the deterministic
2 version, as Mark said, of the FAVOR code used at that
3 time, which is not the current version of FAVOR,
4 pretty much predicted that event right on.
5 There have also been the predecessor to
6 the NESC program. NESC evaluations are still ongoing,
7 or actually there's a son of NECS. Shah's here; he
8 knows what the name of that program is. But the
9 predecessor to that was something called FALSIRE --
10 Fracture Analysis of Large-Scale International
11 Reference Experiments -- if you like acronyms. And
12 there was actually a FALSIRE 1 and a FALSIRE 2
13 program.
14 Those programs looked at these -- I don't
15 know what the number is -- 50, 60, 70 experiments that
16 were fairly large-scale, some done at Oak Ridge, some
17 done in the U.K., Japan, also Germany, I know at least
18 were participants in that study, and then, looking at
19 the international contribution, their approaches to
20 taking this thing on, too.
21 Our approach is, as Mark said, would be to
22 have used FAVOR when we had it, or the FAVOR
23 predecessors, which were VISA and VISA 2D and OCA and
24 OCA-P, which were developed at Oak Ridge. So I guess
25 the bottom line of all of this is that there has been

1 a lot of work done in that area.

2 MR. MALIK: Yes, I would like to add to

3 Ed's comments. We have a report recently put out

4 about -- as (inaudible) explained -- we have combined

5 together in a single report. And that would be aspect

6 to go over and see how many we can predict with the

7 new code. We're going to look into that. But the

8 comprehensive report gives a little bit of detail over

9 all 70. Each individually would report on it's own

10 self, and we'll be trying to see how much it can do

11 under the new code.

12 During that earlier work, we have gone

13 through with all the (inaudible) as well.

14 MEMBER WALLIS: Now, Dana asked a question

15 about whether there were experiments to back up this

16 pressure-temperature-embrittlement-cracking

17 interrelationship. And he implied that we knew

18 everything we needed to know about thermal hydraulics.

19 But are we going to hear later about the experiments

20 that back up the analysis that goes into the thermal

21 hydraulics?

22 MR. BESSETTE: Well, later, yes. Not

23 today, though.

24 MEMBER WALLIS: Not today?

25 MR. BESSETTE: Well, there's not time,

1 really, to go into --

2 MEMBER WALLIS: Is that because you don't

3 have the evidence or you just don't want to show it

4 today?

5 MR. BESSETTE: No. I think we have enough

6 evidence now.

7 MEMBER WALLIS: So you can reassure us

8 that you do know what you're doing with thermal

9 hydraulics?

10 MR. BESSETTE: We can do that, yes. I

11 think we're capable of doing that. We are able to do

12 that. We're in the position to do that.

13 (Laughter.)

14 MEMBER WALLIS: You're waiting for the

15 right moment.

16 (Laughter.)

17 MEMBER FORD: But just following on from

18 that, do we have any back-up -- maybe we're jumping

19 into what you talk about later one. But the RELAP

20 code will give you the temperature, pressure and heat

21 coefficient variations as a function of time of the

22 liquid, which you say can be corroborated with data.

23 What about the similar corroboration of

24 the material temperature, stress, biaxial and triaxial

25 stresses, as a function of time and distance? Do we

1 have that data?

2 MR. KIRK: You mean simply a validation of

3 the thermal stress analysis?

4 MEMBER FORD: Correct, as a function of

5 variations of residual stress?

6 (Comments off-mic.)

7 (Laughter.)

8 MEMBER FORD: Well, I know, but everybody

9 keeps on saying that's an easy kind of exercise to do,

10 but has anyone validated it?

11 MEMBER SHACK: Well, there've been a lot

12 of thermal analysis tests that tell you know how to do

13 thermal analysis. You convert them into stress.

14 MEMBER KRESS: I don't think that's -- but

15 the question about the thermal hydraulics and its

16 uncertainties I think is a real legitimate one because

17 I don't think you can calculate these things as RELAP.

18 You use RELAP to set up -- to tell you

19 when, in a thermal hydraulic sequence, you want to end

20 up being stagnant. And then you use something else to

21 calculate the thing, don't you? You don't use RELAP

22 from there on, do you?

23 MR. KIRK: Well, FAVOR calculates its own

24 stress field, and we don't take that from RELAP. I

25 mean, RALAP will give you a temperature -- wall

1 temperature, but we don't use that wall temperature.
2 MEMBER SHACK: Yeah -- but you're right.
3 If you've got temperature and pressure, you can feed
4 it in. But to get that temperature and pressure, you
5 don't use RELAP, do you? That was my question.
6 MR. BESSETTE: We provide the boundary
7 condition at the vessel inner wall, but not the
8 conditions within the vessel.
9 MEMBER WALLIS: No, you give an H in a
10 heat transfer coefficient temperature, and the
11 pressure is the pressure of the volume.
12 MEMBER KRESS: And that comes from RELAP?
13 MR. BESSETTE: Yes.
14 MEMBER KRESS: What ever happened to
15 REMIX?
16 MR. BESSETTE: Remix --well, we used RELAP
17 -- you've heard about 150 calculations. Those were
18 all done by RELAP. We have some supplemental
19 calculations done with REMIX, but basically REMIX was
20 created because of the concern about the plume. And
21 since we've shown that the plume is gone --
22 MEMBER KRESS: But you don't that.
23 MR. BESSETTE: We don't the supplemental
24 calculations to provide the boundary conditions.
25 MEMBER WALLIS: I think what you're saying

1 is that RELAP makes various assumptions about how well
2 mixed the nodes are, and so on. And you have done
3 separate tests to verify that those assumptions are
4 okay.
5 MR. BESSETTE: That's correct because RELAP
6 cannot model plumes.
7 MEMBER KRESS: That was basically my
8 question, how did you deal with it. And I understand
9 it.
10 MEMBER WALLIS: Then the question about
11 how well will that model the whole transient and
12 whether or not it predicts its stagnation right is a
13 big question, isn't it?
14 MR. BESSETTE: That is the big question.
15 That -- you are correct.
16 MEMBER WALLIS: And that's the question
17 you're not proposing to answer today.
18 MR. BESSETTE: We don't -- I don't have --
19 I can't show you all the evidence for that --
20 MEMBER WALLIS: There's no way you can win
21 a prize on this show today, then.
22 (Laughter.)
23 VICE CHAIRMAN BONACA: Although there have
24 been a lot of applications or views of RELAP 5 by
25 vendors in those specific applications, and they have

1 submitted a lot of comparisons to experiments to
2 justify the use, and it's been approved by the staff,
3 so there should be available information by the staff
4 on the different applications done with RELAP 5.
5 MR. BESSETTE: All the risk-significant
6 transients that have shown up in the Oconee study have
7 been LOCAS. Speaking generally, we do have quite a
8 substantial validation base to speak about with RELAP
9 for LOCAS that we can reference.
10 MR. KIRK: And I think the other piece, in
11 response to Dr. Wallis's question, is that there are
12 experiments that David had run at APEX. And I know
13 the committee got to visit out there. And I think the
14 evaluation of that in detail is still in process, and
15 there will be information obviously available.
16 MEMBER WALLIS: I was just wondering about
17 what you're going to get in our letter about thermal
18 hydraulics if you didn't tell us anything.
19 MEMBER KRESS: We may have to just -- we
20 may have to punt on that until later.
21 MR. HACKETT: I guess we'll have to wait
22 and see how David's piece of this goes.
23 MEMBER WALLIS: I don't know how you'd
24 punt thermal hydraulics.
25 MEMBER KRESS: You say, we didn't discuss

1 thermal hydraulics and we'll comment on that later.

2 MR. HACKETT: I guess in the interest of

3 getting to the key part of this thing on the

4 uncertainty evaluation, we'll try and forge ahead

5 here.

6 MR. KIRK: I think the intent here was

7 just to provide a sense of what goes in the boxes, and

8 we're going to do that in more detail later, so we'll

9 go on.

10 One question that invariably gets asked --

11 and this of course can be gone into in any level of

12 detail one would desire -- is what's changed since the

13 analyses that established 10 C.F.R. 50.61 in the mid

14 1980s. So here, we've summarized the major

15 contributions and shown at least qualitatively by way

16 of the arrows what are the things that are driving the

17 risk of vessel cracking down, shown by the green

18 arrows, and what's driving the risk of vessel cracking

19 up.

20 Again, we'll be going into more detail,

21 but just to provide a sense of -- one of the biggest

22 things in PRA is the fact that we're now discretizing

23 these hundred-thousand events into many more bins than

24 we used to. Before, there was something like a

25 countable number of bins on two hands, whereas now

1 we've got something more on the order of hundreds. A
2 hundred still sounds pretty coarse when you looking at
3 an overall population of 100,000, but in getting them
4 into those bins, we have to make a lot fewer
5 conservative assumptions, and that has a very positive
6 impact on driving the risk numbers down.
7 MEMBER WALLIS: Isn't "PRA data" sort of
8 oxy-moron?
9 (Laughter.)
10 MR. KIRK: Or perhaps a metaphysical oxy-
11 moron. I'll pass on that one.
12 We have done some things --
13 CHAIRMAN APOSTOLAKIS: What do the arrows
14 mean?
15 MR. KIRK: The arrows mean that generally,
16 considering that factor or what we've done there, the
17 green arrows indicate that it would be driving the
18 risk down, whereas red arrows indicate it's driving
19 the risk up. So, for example, in PRA we've considered
20 acts of commission. You did the wrong thing that we
21 never considered.
22 CHAIRMAN APOSTOLAKIS: I think they don't
23 necessarily indicate that that's what happened. This
24 is what you would expect --
25 MR. KIRK: In some cases -- for example,

1 external events. We haven't considered external
2 events. We would expect that it would drive it up. In
3 fact, you know *a priori* it has to drive it up because
4 you didn't consider it before. You can't drive it
5 down if you didn't consider it.
6 CHAIRMAN APOSTOLAKIS: But it may not
7 drive it up significantly.
8 MR. KIRK: It may not drive it up
9 significantly, that's correct.
10 CHAIRMAN APOSTOLAKIS: This is what you
11 would expect.
12 MR. KIRK: In some cases, they are
13 results. For example, if you look in PFM, the first
14 arrow -- these aren't scaled, also. The first arrow
15 in PFM should be huge. We've removed a significant
16 conservative bias in the toughness model in the index
17 temperature. That's resulted by itself in at least an
18 order of magnitude reduction.
19 We've recognized the spatial variation in
20 fluence, whereas before the entire vessel was burdened
21 with the peak fluence. That's a major drop. Most
22 flaws are now embedded, rather than being on the
23 surface; again, a huge drop. And those are all
24 quantifiable.
25 So, in some cases, there are expectations.

1 In other cases like external events, which we haven't
2 considered, it's an expectation.
3 MR. KOLACZKOWSKI: Mark, let me even
4 clarify further for Dr. Apostolakis. With the
5 exception of the external events arrow, every one of
6 those other ones are results.
7 MR. KIRK: That's true.
8 CHAIRMAN APOSTOLAKIS: During the
9 subcommittee, I asked a question regarding, at some
10 point, getting information for -- quantitatively a
11 (inaudible) to get a sense of what comes from the PRA.
12 Because much of that has to do with eliminating a
13 number of limiting sequences, based on critical
14 (inaudible) action and getting a sense of how much
15 you're getting from PFM, because that's more
16 thermalistic in part. And I wonder if you have --
17 MR. KIRK: We haven't got that
18 quantification at this time, but that's something
19 that's definitely a stay-tuned document, and that
20 question is clearly on everybody's mind. What our
21 current goal is, is to get through -- Ed presented the
22 status -- turn the draft on Oconee into final. And
23 then a number of questions along those lines have come
24 up that I think represent the definition of
25 sensitivity studies that we're going to be needing to

1 do to better flesh that out.

2 MEMBER POWERS: Before you leave that

3 previous slide, or maybe after you're -- if I have a

4 PWR and I operate it with higher burn-up to fuel,

5 higher burn-up, and I sustain an axial offset anomaly,

6 do I change my fluence distribution in a way that you

7 have not taken into consideration?

8 MR. KIRK: The fluence distributions -- I

9 believe the short answer is yes. The fluence

10 distributions right now -- we have fluence maps that

11 were calculated at Brookhaven, at two different

12 fluences, I believe 32 and 40 years. Those are then -

13 - the other fluences that we analyze are extrapolated

14 from those, which is to say that we're assuming that

15 the fuel loading remains the same.

16 MR. HACKETT: Yes. If the burn-up -- of

17 if we were to address mocks or something like that and

18 it was to significantly change the neutron spectrum,

19 this project doesn't address those factors at this

20 point.

21 MEMBER ROSEN: But Dana, an axial

22 significantly skewed profile due to an axial offset

23 anomaly is not something that's going to be sustained

24 for 20, 30, 40 cycles. It's something that happens

25 potentially, but then the plant says "whoops" and

1 corrects it in the next cycle.

2 So, I don't know that it has an integrated

3 effect on fluence that's -- it doesn't have a

4 substantial effect on the integrated fluence because

5 it's corrected. It's not something that's sustained

6 over the life of the plant.

7 Am I correct on that, Ed?

8 MR. HACKETT: I would think that would be

9 correct.

10 MEMBER POWERS: I'm gratified at the

11 assurances but I'd like to know what it does do to

12 your mark.

13 MEMBER FORD: I think a much bigger fate

14 would be the fluence attenuation in the pressure

15 vessel vault, which has not been qualified, as I

16 understand it.

17 MR. HACKETT: That was one of our due

18 dils. from the last meeting. It hasn't been

19 quantified in an experimental sense by taking section

20 through a wall. And indeed, it would be very

21 difficult to do that in a statistical sense to get a

22 valid comparison. But there has been a lot of

23 modeling work that went into that. It's largely the

24 work of, I guess, Professor Odet and others.

25 But you're right. That's an area that's

1 also ripe for some more work in the future because
2 we're not proposing this project changing that
3 attenuation function.
4 MEMBER SHACK: But I think there's general
5 agreement that your attenuation function is a
6 conservative one.
7 MR. HACKETT: Yes.
8 MR. KIRK: Yes.
9 MEMBER SHACK: But how can you say that,
10 Bill, if you haven't done any experiments?
11 MR. HACKETT: People have done
12 experiments. They haven't done those experiments but
13 people have measured attenuation in steel. You know,
14 there are models for this and, you know, the model
15 that they've used is I think generally considered to
16 be a conservative one.
17 MEMBER FORD: Well, I know they've done it
18 -- they've measured in stainless steels, but have they
19 done it in ferrittic?
20 MR. HACKETT: Like Bill said, it's been
21 done in a modeling sense.
22 MEMBER FORD: I guess I'm being nitpicky,
23 but the point is that it does have a big impact on the
24 rest of the crack -- the specific fluence attenuation.
25 You know, that's a big output from this overall model.

1 MEMBER WALLIS: Isn't this just simple
2 physics about how neutrons behave in steel, and it's
3 all well understood --
4 (Laughter.)
5 MR. HACKETT: It's certainly physics. I
6 think there is probably a lot of contention about the
7 simple part I guess.
8 MEMBER POWERS: The neutron, we
9 understand. It's the steel that we don't understand.
10 MR. KIRK: Well, I think to follow up on
11 Dr. Shack's point, I think -- I mean, clearly it's not
12 within the scope of this project, although many people
13 would like to, myself included, whack up a vessel wall
14 into sharpies and test it through the thickness. That
15 would be very satisfying. Unfortunately, it would,
16 you know, consume the entire RES budget.
17 But, I do think it's incumbent upon us to
18 do what Dr. Shack suggested, which is to better
19 document the common engineering assumption that the
20 Reg. Guide 199 rev. 2 fluence function is
21 conservative. Again, ask me to pull out the document,
22 I'll say, no, I can't do it. But that's something
23 we're looking into putting together because I think,
24 you know, absent the experimental proof or the right
25 answer --

1 SPEAKER: Where's Art Lowe when you need
2 him.
3 MR. KIRK: I've got a Ouija board, if you
4 need it.
5 MEMBER WALLIS: Well, maybe -- the fluence
6 to me is just what the neutrons are doing. Their
7 effect on the steel is another question.
8 MR. HACKETT: I think Dr. Lewis from NRR
9 has some comments.
10 MR. LEWIS: Yes. I think we do know a
11 little -- my name is Lambrose Lewis. I'm from the
12 (inaudible) branch. We do know a bit more than what
13 you assumed previously.
14 We've had dosimetry inside and outside the
15 pressure vessel, so we know how many neutrons go in
16 and how many get out on the other side. What does
17 change, however, is the spectrum -- namely, those that
18 are left behind and exit the other side are much, much
19 harder, as they are a much harder spectrum.
20 Therefore, they cause percolision much greater damage.
21 However, there is several DPA -- the
22 function -- which one can quantify the damage per
23 neutron as it goes through. Therefore, we do have a
24 function which tells us how much damage has been done
25 from inside out; not only the number of neutrons but

1 also how much damage they caused in that. So, there
2 is a quantifiable function that we have.
3 Now, there are some measurements on the
4 cross-sections of steels that have been exposed -- not
5 pressure vessels but other steels -- that only refer
6 to, as far as I'm aware of, to hardness. People
7 measure hardness and say, well, yeah, roughly they
8 correspond to each other. So, to that extent there is
9 some rudimentary experimental evidence.
10 MR. HACKETT: Thanks, Lambrose. That's
11 what you get when you ask some metallurgist to try and
12 answer about dosimetry, it seems, and it's helpful.
13 MR. KIRK: We just had two fairly high-
14 level slides on the current results from Oconee, and
15 I should point out that these were results that were
16 generated back in December. As with any good
17 engineering calculation -- or maybe I should just say
18 any engineering calculation -- you go through and you
19 find that there are certain things that you should
20 have done better or maybe shouldn't ought to have
21 done. So these calculations will be redone next week.
22 Having said that, I'm not sure that any of
23 the overall results will change. This takes, now, yet
24 a higher level view of the 100,000 sequences that were
25 reduced into 150 thermal hydraulic bins and gathers

1 them together yet further, because we find as a result
2 of the analysis that approximately nine or ten of the
3 individual bins contributed over 90 percent of the
4 probability of through-wall cracking.
5 Just as a class, LOCAs are contributing by
6 far the largest part. They're responsible for well
7 over 50 percent of the crack initiations. However,
8 they're not as dominant in vessel failure simply
9 because the larger the LOCA break gets, the pressure
10 drops and the crack can't go through the wall.
11 The red section and the green section
12 provide an interesting example of the effect of human
13 reliability credit. Over on crack initiation, the red
14 and the green essentially all represent the same
15 starting sequence -- I'm sorry. The red and the green
16 all represent the same starting sequence. The
17 difference between the red and the green is that in
18 the case of the red we've got a stuck open pressurizer
19 safety valve that the operator, for whatever reason,
20 didn't intervene at all, and the valve simply re-
21 closes automatically. Whereas, with the green
22 section, we've got two variants of that transient,
23 where the operator throttled HPI at different times in
24 to the transient.
25 So, in this case, in the red you've got

1 one initiating event that produces a few initiations
2 but produces a whole lot more failures because HPI was
3 never throttled, whereas here you've got two of the
4 same starting events, which produced, of course, more
5 initiations. But because the operator was of course
6 doing the right thing, it didn't get as bad in terms
7 of punching through the wall.
8 This, of course, is just one snapshot --
9 CHAIRMAN APOSTOLAKIS: So this is -- this
10 would be a matter of omission, would it not?
11 MR. KIRK: This would be -- the red would
12 be an error of omission, yes.
13 CHAIRMAN APOSTOLAKIS: That could have
14 been done reasonably well in the '80s.
15 MR. KIRK: Yeah.
16 CHAIRMAN APOSTOLAKIS: It was not? It
17 didn't included human error in those studies? Pure
18 human action?
19 MR. KOLACZKOWSKI: The general answer --
20 if you look at the 1980s work, you will find that with
21 a few exceptions, a little to no credit for the human
22 doing anything at all was in those models.
23 CHAIRMAN APOSTOLAKIS: So in your previous
24 slide with the summary of changes --
25 MR. KOLACZKOWSKI: Correct.

1 CHAIRMAN APOSTOLAKIS: -- you should have
2 -- oh, no. I'm sorry. You have it. Good.
3 MR. KOLACZKOWSKI: Generally, as you give
4 operator credit, it makes the risks go down.
5 CHAIRMAN APOSTOLAKIS: So what is the
6 number now that you use for that? Will you talk to us
7 about it later?
8 MR. KIRK: The number for what? For human
9 credit?
10 CHAIRMAN APOSTOLAKIS: Yes. That's coming
11 up?
12 MR. KOLACZKOWSKI: Yeah. I mean, we can
13 show you some examples, if that's what you want to
14 see.
15 CHAIRMAN APOSTOLAKIS: Yeah, that's what
16 I want to see.
17 MR. KIRK: All right.
18 MR. KOLACZKOWSKI: By the way, Mark, those
19 will be on some back-up slides.
20 MR. KIRK: Okay.
21 These are, of course, results at just one
22 embrittlement level. We've run the calculations for
23 a number of embrittlement levels, and what you see on
24 this plot --
25 CHAIRMAN APOSTOLAKIS: You should add more

1 information to this. It's too simple.

2 MR. KIRK: We've already removed a lot of

3 information.

4 (Laughter.)

5 CHAIRMAN APOSTOLAKIS: Ah, it depends on

6 your starting point, right?

7 MEMBER SHACK: It's only the distribution

8 of epistemic frequencies.

9 CHAIRMAN APOSTOLAKIS: He's got only the

10 95th percentile. We need superimposed upon this an

11 epistemic distribution of --

12 CHAIRMAN APOSTOLAKIS: I'm looking.

13 MR. KOLACZKOWSKI: We have it.

14 MR. KIRK: The curves here represent the

15 95th percentile of the vessel failure distribution. So

16 that's some measure of an upper bound.

17 CHAIRMAN APOSTOLAKIS: The frequency of

18 vessel failure?

19 MR. KIRK: Yes. Yes.

20 CHAIRMAN APOSTOLAKIS: Due to any -- all

21 causes?

22 MEMBER ROSEN: No, no. PTS.

23 MR. KIRK: PTS. All PTS causes, yes.

24 CHAIRMAN APOSTOLAKIS: PTS.

25 MR. KIRK: Everything. The points to take

1 away here -- as we started off by performing a
2 calculation of the Oconee Plant at -- I used to say at
3 the end of their current license period, but that's
4 not correct because NRR's granted them an extension.
5 So, at the end of their original operating license,
6 this analysis was estimating their 95th percentile
7 through wall-cracking frequencies, down on the order
8 of 1E minus ten, 1E minus 9. Relative to our current
9 risk criteria, that's about four orders of magnitude
10 down.
11 If we take that same plant and crank up
12 the fluence so that the most embrittled axial weld and
13 the most embrittled circ weld cross our current 10
14 C.F.R. 50.61 screening limits, we find out that even
15 at that level of embrittlement -- and this is perhaps
16 the more important point for purposes of revision of
17 the rule. Previously we associated -- we would have
18 thought that the plant would have gone through these
19 screening limits at 5E minus 6, whereas for this
20 plant-specific analysis at Oconee, they go through it
21 more like 5E minus 8. So, we're again two orders of
22 magnitude.
23 MEMBER SHACK: Oh, you thought your
24 scoping criteria would limit to you to your acceptance
25 criteria? That's an interesting concept. I was going

1 to say, how much margin did I expect my scoping
2 criteria to have, and the answer is none, right?
3 MR. KIRK: That would have been my answer.
4 But that's a personal view.
5 MEMBER SHACK: Oh, okay. A different
6 answer -- or a different notion of a screening
7 criteria than I normally would accept.
8 MEMBER FORD: Could you point out where
9 the 60 --
10 MR. KIRK: Sixty is just the --
11 MEMBER FORD: Next one up?
12 MR. KIRK: -- yeah.
13 MEMBER WALLIS: So, in plain language, the
14 real story is down in the orange or whatever color
15 that is --
16 MR. KIRK: Yes.
17 MEMBER SHACK: The real story is up in the
18 blue.
19 MR. HACKETT: The real story is where you
20 force it up to where the --
21 MEMBER WALLIS: But you have to force it
22 up there.
23 MR. HACKETT: Yeah. Well, that's where it
24 would be.
25 MEMBER SHACK: If the vessel is

1 embrittled. Everybody agrees that if you don't have
2 an embrittled vessel, PTS is not going to give you
3 much of a failure. The real crit is, do we have the
4 criterion to describe embrittlement.
5 MR. KIRK: That's right.
6 MEMBER SHACK: And the answer seems to be
7 that our current criterion give you a conservative
8 answer. Just how conservative it is seems to be a
9 matter of --
10 MR. KIRK: Or how conservative it needs to
11 be.
12 MEMBER WALLIS: Well, the criterion is
13 conservative by a factor of 100, but the actual
14 operation is even more conservative because you never
15 get near the criterion.
16 MR. KIRK: That's right. And the actual
17 operation for Oconee is down here. Now, we might see
18 some differences, as Dr. Ford pointed out, in the four
19 plants that we're analyzing, if you walked up to your
20 random materials person in the street and said
21 Palisades, Calvert Cliffs, Beaver Valley I and Oconee
22 I, which ones are closer to limit now? You'd say
23 Beaver Valley I and Palisades. So when we do those
24 analyses, it will be interesting to see how they
25 compare with these.

1 MEMBER FORD: Now, there are a lot of
2 assumptions in this whole process. What are you going
3 to do if you find that is not the case?
4 MR. KIRK: Well --
5 MEMBER FORD: In other words, what do you
6 throw out?
7 MR. KIRK: Well, if you made me bet some
8 of my own money right now, I would conjecture, at
9 least from a materials viewpoint, they're all going to
10 be coming in pretty close to each other because of the
11 changes that we've made. The change -- right now, we
12 think about plants relative to the PTS screening
13 criteria using the embrittlement correlation in the
14 current reg guide.
15 In these calculations, we're using, of
16 course, the updated embrittlement correlation -- and
17 I see you have that report open, so you know about
18 that. That reshuffles the deck chairs, to the point
19 that now -- I mean, certainly it doesn't make Beaver
20 Valley and Palisades, you just say, well, why do you
21 ever worry about them? But the plants move around and
22 some of them become closer to whatever the screening
23 criteria might be than others.
24 And when we look at the distribution of RT
25 NDT values in the four plants that we're looking at,

they're much more similar than we would have previously thought them to be.

MEMBER FORD: Okay.

MEMBER SHACK: Now, where would the mean be? Here's the 95th percentile. Where would the mean be? Is it a decade lower, or --

MR. KIRK: Not too much -- it's a very skewed distribution, so not too much further down.

MEMBER ROSEN: Are you going to let us in on what magical change -- shuffle the deck chairs, as you say.

MR. KIRK: We could go through that again in an immense degree of detail, but the differences between the Reg. Guide 199 rev. 2 Embrittlement Correlation and what we have now are, well, considerable.

The old correlation was essentially just an empirical curve fit to about 150 surveillance points made in the mid 1980s. Since that time, we've evolved to what I would call a physically motivated, empirically calibrated model, where we use our understanding in the physics of irradiation damage to set the functional forms and use the surveillance data to calibrate it.

So, I think the opinion of the technical

1 community would be that we've got a more robust
2 correlation now, and that it's tied to physics. And
3 what you find out is that because the old
4 embrittlement function was simply a curve fit, and a
5 very simple gross curve fit to all the data, some
6 situations were assessed more optimistically than they
7 should have been, and some were assessed more
8 pessimistically than they should have been.
9 MR. HACKETT: I guess I'd add in the
10 interest of moving on, Mark has gotten into some of
11 the PFM details. We do have at least a little bit of
12 the segment of the presentation here today on that, so
13 hopefully we'll get into some of those.
14 MR. KIRK: I think we've commented on most
15 of these. These were just a few observations that we
16 wanted to share coming out of the Oconee analysis.
17 We've already pointed out that the dominant scenarios
18 are all primary system LOCAs. The second point
19 follows from that, in that realistic accounting of
20 operator action has significantly mitigated the
21 influence of secondary system events on the total
22 failure probability in this plant. I've learned a lot
23 about PRA practice in going through this, and it's
24 been commented that we may not find this to be true in
25 the other plants.

1 One thing that I think came as a surprise
2 to many of us, but we've been able to understand, is
3 that main steam line break and steam generator tube
4 rupture, both of which were very dominant events in
5 early analyses, no longer occur, or no longer show up
6 as being dominant. That's occurring for a number of
7 reasons, perhaps most primarily being the fact that
8 those scenarios were dealt with very conservatively
9 before, and so their influence was artificially
10 elevated.
11 MEMBER WALLIS: Within the LOCAs, are
12 there big variations in the effects of different kinds
13 of LOCAs?
14 MR. KIRK: Certainly break size is a
15 factor.
16 MEMBER WALLIS: Is it a big actor?
17 MR. KIRK: Yes.
18 MEMBER WALLIS: So which LOCAs are the
19 worst?
20 MR. KIRK: Small to medium.
21 MEMBER WALLIS: Small --
22 MR. HACKETT: Small to medium.
23 MR. KOLACZKOWSKI: Yeah, small to medium.
24 MEMBER WALLIS: So, if someone came along
25 and said we should forget about large breaks, that

1 wouldn't be significant as far as PTS is concerned?

2 (Laughter.)

3 MR. HACKETT: I think it's probably

4 premature for us to say that, since I know, as Shook

5 mentioned to the committee, we were embarking on maybe

6 a couple of years worth of effort to look at

7 redefining large break LOCA. And I concur with that.

8 In this particular case, it goes fairly

9 obviously to the -- small to medium break LOCAs are

10 the ones that you're going to focus on because you

11 have the possibility for the repressurization with

12 HIPSI. And also, not to mention the stuck-open valve

13 scenarios, too -- safety relief, stuck open valve

14 scenarios.

15 MEMBER ROSEN: Did the overly conservative

16 treatment of main steam line break and steam generator

17 tube rupture lie mainly in what the operators were

18 credited with and what they were not credited with?

19 MR. KOLACZKOWSKI: There were actually two

20 effects. And I know we have some back-up slides on

21 this, but I'll try to answer it quickly, and if that's

22 sufficient, great.

23 There were two effects -- first of all,

24 you're right. They basically gave the operator no

25 credit in the '80s work, whereas, if you account at

1 all for the fact that once a severe depressurization
2 on the secondary is recognized, that once the operator
3 stops the feed to the bad steam generator, it's over.
4 'And we're finding out from the thermal
5 hydraulics that 10, 15 minutes into the accident is
6 how much time the operator has before it would even
7 begin to be what we would categorize as a challenging
8 event from a PTS standpoint. And believe me, when
9 operators have 15 minutes to do something, that's a
10 lot of time.
11 MEMBER ROSEN: And what they have to do is
12 figure out which steam generator is faulted --
13 MR. KOLACZKOWSKI: Correct.
14 MEMBER ROSEN: -- which is practically
15 screaming at them.
16 MR. KOLACZKOWSKI: Oconee also has some
17 unique indications to help them.
18 MEMBER ROSEN: -- and then trip the feed
19 to that steam generator.
20 MR. KOLACZKOWSKI: Yeah. All they've got
21 to do is recognize which one it is, stop the feed to
22 the generator, the event's over. He basically is
23 performing the same function of a main steam isolation
24 valve, if the break is downstream of the valve. But
25 of course, he's doing it a different way. He's

1 stopping the feed, rather than stopping the steam exit
2 sign.
3 MEMBER ROSEN: So he reaches up and trips
4 the feed to that steam generator.
5 MR. KOLACZKOWSKI: Yeah. I mean, it's --
6 in the case of this plant, it's -- there's a couple of
7 things. The main steam line break circuitry will
8 probably stop main feed already, automatically. But
9 even if you allow for that failure, all he's got to
10 trip the pumps. And, then if ox-feed comes on, it's
11 a one-handle action, and ox-feed is off. So, once he
12 recognizes to do it, it takes no time to do it.
13 MEMBER ROSEN: And we'll assume that he's
14 trained in that.
15 MR. KOLACZKOWSKI: Absolutely. The BNW
16 plants in particular are very sensitive to overcooling
17 because they know they've got, you know, as much more
18 sensitive plant than perhaps Westinghouse and CE,
19 where --
20 MEMBER ROSEN: Trained and drilled in the
21 simulator on it.
22 MR. KOLACZKOWSKI: Yeah. We watched -- I
23 don't know if we can get into some of this other
24 stuff, but as part of all this work and coming up with
25 the human reliability numbers, etc., we had the

1 licensee involved in coming up with these estimates.
2 we observed four to five simulated events on their
3 simulator at Oconee of overcooling events.
4 So, we got a feeling for operators, have
5 fast it can respond to certain things, what is the
6 lay-out, what are some of the problems with the
7 layout, etc. It was not just a bunch of PRA geeks
8 sitting around in an office somewhere and saying, I
9 think the human reliability number's 10(-2). We did
10 a lot more than that.
11 VICE CHAIRMAN BONACA: Why would you think
12 it would be so much plant-dependent? I mean --
13 MR. KOLACZKOWSKI: Well, in terms of this
14 particular kind of accident, as has been pointed out,
15 the key is recognizing that you've got a
16 depressurization of which steam generator it is, and
17 then just how many actions does it take to isolate the
18 steam generator.
19 VICE CHAIRMAN BONACA: Sure.
20 MR. KOLACZKOWSKI: I would say the simpler
21 those are, the more likely of success or the less
22 probability of failure. And as part of the
23 generalization step, what we're going to have to look
24 at is what are the training and typical layouts of
25 those kinds of indications at other plants? If

1 they're similar to Oconee, we would expect similar
2 results. If they're vastly different, then we'll have
3 to account for that.
4 VICE CHAIRMAN BONACA: Yeah, the reason
5 why I brought it ups is the susceptibility of the
6 steam generators at Oconee is, you know, much higher
7 than other steam generators, where you have a pot of
8 water. And so that's why. But I'm saying that the
9 expectation would be that you would find similar
10 trends in other NPRs.
11 MR. KOLACZKOWSKI: Anyway, to finish
12 answering your question, giving human reliability
13 credit is one reason why these accidents went away,
14 generally speaking. They don't completely go away,
15 but they're not among the dominant anymore.
16 And the other reason is, again, remember
17 that we mentioned that we're doing 100 to 150 bins,
18 whereas before in the early work they were using 10
19 bins. So whether it was a small steam line break or
20 a large steam line break, it got treated as a large
21 steam line break, it got treated as a large steam line
22 break in the early work.
23 So, the cooling transient was much worse,
24 etc. Just by virtue of separating those two and
25 making a small class and a large class, that by itself

1 made some of it not be as dominant because now you're
2 treating it more realistically, rather than treating
3 all breaks very conservatively. So, just the nature
4 of adding more bins made some of the conservatism go
5 away and made the main steam line breaks go away, for
6 instance. So there are actually two things that are
7 causing that to happen.
8 MEMBER POWERS: Let me return to your main
9 steam line break conclusion. In the not-too-distant
10 past, the committee has been entertained by the
11 description of a main steam line rupture. And in that
12 description, the speaker decried the ability to model
13 those events because he describe shockwaves, motions
14 of equipment and piping systems of a substantial
15 nature, if the thing really moved around on you.
16 Do you take those into account when you
17 come to this conclusion that the main steam line break
18 is not a contributor to this?
19 MR. HACKETT: I think -- let me try and
20 answer for Alan. He could probably give a more
21 precise answer because I think know what Dr. Powers is
22 referring to, which was an incident, as I recall, at
23 Turkey Point Plant, and I think the answer is now.
24 And I know, when that came up I think it
25 was presented as part of the steam generator action

1 plan, resolution of the DPO. In that case, there were
2 some potentially very significant distractions to the
3 operators that I don't believe we accounted for.
4 MR. KOLACZKOWSKI: Actually, if that's
5 what we're really getting at, I know when we came up
6 with the human reliability numbers that we decided to
7 use for failure of operators to, let's say, isolate
8 the faulty steam generator, that was one of the
9 contexts that we considered.
10 We said, you know what? There could be a
11 major distraction out there; maybe they're finding out
12 their best buddy was just killed in the accident, etc.
13 Wouldn't that affect, potentially, the human
14 probability of isolating because he's at least
15 momentarily distracted with, let's say, other issues
16 that he finds equally important. In fact, we tried to
17 consider that in our quantitative assessment for human
18 reliability.
19 MEMBER POWERS: Well, then how about just
20 the mechanical loads on the vessel?
21 MR. HACKETT: Yes. In that case, I guess
22 I'd say a couple of things. It's interesting. I
23 didn't know the points that Alan was making prior to
24 that. In the case that I think that Dr. Powers was
25 referring to, there were significant motions of

1 associated structures, and then I believe sonic booms,
2 things of that nature, referred to.
3 And it sounds like your opinion would be
4 that that is something that, despite that, these
5 operators and training that they received would still
6 enable them to do the isolation and mitigate the
7 situation effectively.
8 MR. KOLACZKOWSKI: Yes, if the question
9 you're getting at is, are there new things added to
10 this scenario now that create some kind of new LOCAs
11 out in the secondary side that can't be isolated or
12 something like that, well, then clearly the answer
13 would be no. But again, if the major crux of your
14 concern is, did we consider it at least in the
15 operator response, I would say, yeah, we tried to do
16 so.
17 MEMBER POWERS: I'm more interested in the
18 mechanical response.
19 MR. KOLACZKOWSKI: Yeah, if you're worried
20 about pipe whipping and the effect on the other
21 equipment, etc., obviously I would have to say that we
22 didn't think about that on the PRA side.
23 MR. HACKETT: I think as I understand the
24 concern that was voiced as -- again, this is a mixture
25 of things in the steam generator area.

1 I don't believe that that would result --
2 some of the concerns that were voiced were things like
3 oscillation of the steam generator tubes and potential
4 for fatigue damage and so on. I don't believe any of
5 that would result in any additional overcooling that
6 would impact the reactor vessel.
7 MEMBER POWERS: How about shockwaves
8 traveling through the steel affecting the crack
9 propagation?
10 MR. HACKETT: Again, as far as -- I would
11 see that that could affect the steam generator and the
12 steam generator shell could affect and probably would
13 affect the steam generator. I would not think there
14 would be a huge impact -- no pun intended -- on the
15 reactor vessel. And again, this is intuitive on my
16 part. I don't have any analysis to back that up, nor
17 have any been conducted that I'm aware of.
18 MEMBER POWERS: I guess that until you
19 have some substantiation, I'd be cautious about the
20 conclusion.
21 I think you're probably on better grounds
22 on your steam generator tube rupture, but until we
23 understand better what these dynamic effects -- sonic
24 booms, things like that -- are on the main steam line
25 break, I'd be cautious about the conclusion.

1 VICE CHAIRMAN BONACA: That's why I was
2 asking the relative contribution because there is a
3 question -- again, I mean, from the defense in-depth
4 set point the reliance on operator action has to be
5 examined because you're going to give a lot of credit
6 to the vessels.
7 MR. HACKETT: Good point.
8 MEMBER FORD: Ed, just looking at time, I
9 guess we'd better move ahead.
10 MR. HACKETT: Yes. I guess what I was
11 going to say, we've already effectively handed off to
12 Alan, so we'll just let Alan continue with the main
13 topic here, which is the uncertainty treatment with
14 PRA HR --
15 MEMBER POWERS: Possibly being a
16 controversy associated with --
17 MR. KOLACZKOWSKI: No. There couldn't be
18 any controversy.
19 First of all, to start this subject off,
20 let's keep in mind what the PRA part of this is trying
21 to do and what its contribution is to the overall
22 analysis. I tried to succinctly describe that here
23 with this bullet.
24 What the PRA is really trying to come up
25 with is the frequencies of a wide range of

1 representative plant responses, which we'll call
2 scenarios, that are each described by some set of T-H
3 curves, which will describe the pressure, temperature,
4 heat transfer coefficients of the resulting scenario -
5 - as the result of mitigating equipment successes and
6 failure, as well as operator actions that result in
7 various degrees of overcooling of the reactor vessel
8 downcomer (phonetic) wall.
9 So, really, if you think about it, there's
10 just two things that we're really trying to -- that
11 the PRA part is trying to address. What are the
12 scenarios? And, what are the frequencies of those
13 scenarios? When you start getting into that, there
14 are really two sources of uncertainty. There are
15 modeling uncertainties in trying to represent what are
16 the plant scenarios of interest, and then ultimately
17 there's uncertainty associated with the frequency of
18 each one of those modeled scenarios.
19 Let's go to the next slide.
20 From the modeling standpoint, again, just
21 think of the fact that each scenario is really a
22 collection of events. It starts with initiating
23 event, then the systems do certain things. Certain
24 ones work; certain ones don't. Operators do certain
25 things right or wrong. That collection of events ends

1 up resulting in some sort of a scenario.

2 As I told you, we have something like

3 100,000 scenarios or something modeled in this PTS

4 model. One of the things we had to introduce, because

5 the operator plays such a key role in when the

6 challenge ends or at least get mitigated to some

7 extent, etc., that we had to look at various timings

8 of operator action. Obviously, as the event starts

9 and the downcomer (phonetic) wall begins to cool down,

10 if the operator takes an action five minutes into the

11 event, that leads to a very different challenge than

12 if he waits to take that action 20 minutes into the

13 event.

14 So, we actually had to take many of the

15 actions and put into the model -- and we picked

16 certain discrete points to look at, of operators

17 taking actions ten minutes into the event, 20 minutes

18 into the event, etc., and therefore had to come up

19 with probabilities of each one of those.

20 CHAIRMAN APOSTOLAKIS: So these times are

21 sequence dependent?

22 MR. KOLACZKOWSKI: yes.

23 CHAIRMAN APOSTOLAKIS: I mean, you don't

24 have a 10-, 20-minute --

25 MR. KOLACZKOWSKI: Necessarily over

1 everything, no.

2 CHAIRMAN APOSTOLAKIS: Could you give us

3 an example of this now?

4 MR. KOLACZKOWSKI: Yes.

5 CHAIRMAN APOSTOLAKIS: How did you get the

6 -- pick any example you want -- the probabilities for

7 this?

8 MR. KOLACZKOWSKI: Probably what we ought

9 to do -- now the one that is dominant --

10 CHAIRMAN APOSTOLAKIS: It's not in your

11 main presentation.

12 MR. KOLACZKOWSKI: It won't be here,

13 George, but to try to answer your question, one of the

14 most dominant scenarios is a transient where by a

15 safety relief valve when the pressurizer gets demanded

16 -- it sticks open.

17 CHAIRMAN APOSTOLAKIS: Yes.

18 MR. KOLACZKOWSKI: It stays open for a

19 while, and as the pressure comes down it finally re-

20 closes.

21 CHAIRMAN APOSTOLAKIS: Yes.

22 MR. KOLACZKOWSKI: That's an extremely

23 challenging event for the operator because once the

24 SRV re-closes -- you've got to remember, a high-

25 pressure injection's probably on full at this point

1 because the SRV at Oconee is big enough that he needs
2 about all the HPI that he can put in. He's not
3 necessarily throttling it yet. And suddenly the SRV
4 re-closes, so the system begins to refill, of course,
5 right away and the pressure goes up through the roof.
6 And we're talking over minutes of time. It's not very
7 long.
8 In talking with the Oconee operators and
9 training staff, they acknowledge this is an extremely
10 challenging event for the operator to catch because
11 he's also not allowed to throttle HPI until he meets
12 certain criteria -- five degrees sub-cooling and
13 roughly a hundred inches in the pressurizer.
14 Well, a the sub-cooling comes back up
15 after the SRV is re-closed, and the level starts
16 coming back up, etc., believe me, you go through that
17 sub-cooling and that level real, real fast. And
18 before he knows it, he's got 50 degrees sub-cooling
19 and the pressurizer level's up through the top of the
20 pressurizer.
21 We recognized that that event was
22 happening so fast, George, was that we did was we
23 said, okay, this is an action where we ought to come
24 up with a probability for the operator failing to HPI,
25 one minute after reaching the throttling criteria; ten

1 minutes after reaching the throttling criteria; and
2 then we said, or, we're going to assume that if he
3 doesn't do it by ten minutes, he never does it.
4 And so, we came up then with recognizing
5 what indications would there be? What did the
6 procedures tell him to do? How is he trained? Etc.
7 We came up with probabilities of the operator failing
8 to throttle at one minute after reaching the
9 throttling criteria, ten minutes, or then we assume
10 never, as opposed to a slower transient, or maybe, as
11 I mentioned, a main steam line break -- w e don't even
12 get concerned until ten minutes. So we didn't even
13 choose our first time until ten minutes into the
14 event.
15 CHAIRMAN APOSTOLAKIS: Right.
16 MR. KOLACZKOWSKI: So the times were
17 dependent on which scenarios we were looking at.
18 CHAIRMAN APOSTOLAKIS: As they should be.
19 Now, this evaluation of the probability,
20 this was done by asking experts, describing the whole
21 thing -- that's what you say in one of the slides on
22 the separate meeting.
23 MR. KOLACZKOWSKI: Yes. Oconee was done
24 in the following way. NRC contractors got together.
25 We talked about the context of each scenario -- I know

1 you've heard this from another project that I won't
2 mention.
3 CHAIRMAN APOSTOLAKIS: That was my next
4 question.
5 MR. KOLACZKOWSKI: We talked about the
6 qualitative context, etc. What's going on? What are
7 the indications doing? Where are we in the step?
8 Remember, we had observed certain simulations, so we
9 had some idea, how long does it take operators to get
10 to certain steps, and things of that nature. What if
11 an instrument has failed? How much would that add as
12 a confusion factor? We may want to put that on the
13 tail-end of our distribution. We talked about a
14 number of contexts.
15 Contractors then get together and made an
16 estimate with regard to a mean and an uncertainty
17 bound on the failure probability.
18 CHAIRMAN APOSTOLAKIS: (inaudible).
19 MR. KOLACZKOWSKI: I'm sorry?
20 CHAIRMAN APOSTOLAKIS: All (inaudible).
21 MR. KOLACZKOWSKI: Yes. And there, we
22 limited it to four different values. We said .5, .1,
23 .01 or .001. That had some quantitative definitions
24 associated with it.
25 MEMBER ROSEN: What were those numbers?

1 MR. KOLACZKOWSKI: .05, .1 --

2 MEMBER ROSEN: No, no. What are those

3 frequency --

4 MR. KOLACZKOWSKI: Those were the failure

5 probability of the human to take that action at

6 whatever time we were looking at.

7 MEMBER ROSEN: Yes.

8 MR. KOLACZKOWSKI: We then took that

9 information -- after we quantified all the human error

10 events in the model, we then provided that to Oconee

11 and actually went back down to Oconee and spent the

12 day with their training and operator staff, and we

13 said what do you think? We tried to calibrate them in

14 probability and so forth, because they also

15 understand, this is likely to happen or this is not

16 very likely to happen.

17 MEMBER ROSEN: right.

18 MR. KOLACZKOWSKI: And you have to ask

19 them, well, what does not very likely mean? Does that

20 mean one in a thousand crews would fail, or one in ten

21 thousand, or one in a hundred. So there was a little

22 bit of a calibration that had to go on.

23 But nevertheless, we got through that and

24 then we asked Oconee for their comments. They

25 provided comments on our human error probabilities.

1 I would say that they agreed with probably 50 percent
2 of them. The other 50 percent -- generally, they did
3 not have too much in the way of major problem with
4 most of our means. In some cases, they thought our
5 upper bound was too high.
6 MEMBER ROSEN: They claimed to be not as
7 good as you thought they were?
8 CHAIRMAN APOSTOLAKIS: No.
9 MR. KOLACZKOWSKI: No. They generally
10 claimed to be a little -- to be better. The worst
11 crew would be better under the worst conditions.
12 Quite frankly, we agreed with them on a
13 few cases but in other places we held our ground and
14 said, no, we still think that the range is this wide
15 because of the following reason.
16 In other words, Oconee had a change to
17 basically review our human error probabilities,
18 provide their input to that. And to some extent we
19 changed things; to some extent, we didn't.
20 CHAIRMAN APOSTOLAKIS: I think that what
21 you describe is reasonable.
22 Now, maybe it's not related to this
23 project, but we have been told several times that
24 ATHENA is being implemented this year in a very
25 successful way in the PTS project.

1 MR. KOLACZKOWSKI: That's in Palisades.

2 CHAIRMAN APOSTOLAKIS: What -- so you

3 didn't do it for Oconee?

4 MR. KOLACZKOWSKI: Well, I explained what

5 we did for Oconee, which is kind of going along the

6 lines of where ATHENA was trying to get to. Remember

7 now, it still relies on expert elicitation. In this

8 case, the experts were the NRC contractors, but then

9 Oconee did a review.

10 In the case of Palisades, we've already

11 done our first cut at the human error probability of

12 the Palisades PTS model. In that case, we did it

13 differently. We actually went up to the plant. In

14 three to four days, we had three licensee trainers and

15 one operator crew member as experts, and then we had

16 two NRC contractors who actually had five experts, and

17 we together went through contacts, etc., developed

18 probability, got them calibrated, developed

19 probabilities.

20 And in that case, we did not limit it to

21 the .5, .1, etc. We actually asked for a complete

22 distribution -- a one percentile, a 25 percentile, a

23 50 percentile, etc.

24 So I guess I would say, as we keep trying

25 to apply ATHENA and where it is going better and

1 better each time, we're getting more rigorous, and in
2 the case of Palisades, we actually wrote down
3 everything about the context -- which ones are
4 aleatory uncertainties, which ones are epistemic?
5 We're trying to keep doing this better and better as
6 it goes, but again, the underlying quantification
7 mechanism is an expert elicitation process.
8 CHAIRMAN APOSTOLAKIS: So in the case of
9 Oconee, then, you did not use ATHENA.
10 MR. KOLACZKOWSKI: I would you say we kind
11 of use it.
12 CHAIRMAN APOSTOLAKIS: You didn't. What
13 you just described is what competent HRA analysts or
14 anyone in the world would do. They understood the
15 situation and then they said, this is our best
16 judgment. Now we try -- you know, what do you think,
17 and so on. I mean, there's nothing --
18 MR. KOLACZKOWSKI: That's true.
19 CHAIRMAN APOSTOLAKIS: -- I'm not trying
20 to put it down. It's just that it's --
21 MR. KOLACZKOWSKI: No. That's true.
22 CHAIRMAN APOSTOLAKIS: I understand that
23 now.
24 So, the other thing I have to understand
25 is modeling. Now, by the way, this is human error of

1 omission because they don't throttle.

2 MR. KOLACZKOWSKI: For the most part --

3 oh, yeah. The ones I've been talking about are like,

4 failed to isolate a steam generator. That's an

5 omission. Failure to throttle is an omission.

6 CHAIRMAN APOSTOLAKIS: Is that a

7 commission error or something?

8 MR. KOLACZKOWSKI: We did find one or two

9 commission errors that we modeled, such as

10 inadvertently tripping reactor coolant pumps when you

11 don't want to.

12 CHAIRMAN APOSTOLAKIS: Okay.

13 MR. KOLACZKOWSKI: That tends to make

14 things more stagnant. And we did look at conditions

15 that operators might get fooled into thinking that

16 they should do that, and we tried to quantify those.

17 CHAIRMAN APOSTOLAKIS: And you -- through

18 the same process of evaluating it and so on?

19 MR. KOLACZKOWSKI: The same process. Now,

20 you also find that the procedures do cause acts --

21 I'll call them acts of commission that will worsen a

22 PTS event by procedure. But it's because they're

23 trying to prevent core damage. They're trying to

24 prevent undercooling.

25 As an example, say you have no feed to the

1 steam generators at all. Well, what they're supposed
2 to do is depressurize the plant in sort of an
3 emergency mode, open up all the turbine bypass valves
4 and try to get condensate into the steam generator.
5 Well, when you do that, it cools down the plant.
6 That's a procedure-driven commission. It's not an
7 error in the sense --
8 CHAIRMAN APOSTOLAKIS: Right. So how did
9 you handle that?
10 MR. KOLACZKOWSKI: We handled that and
11 basically said, well, he's going to do that. So, for
12 all practical purposes, that's close enough to a 1.0
13 probability that that's what's in the model. He will
14 do what his procedures tell him to do. It turns out,
15 it's worse for PTS, but that's handled in the model.
16 CHAIRMAN APOSTOLAKIS: Okay. So now we
17 have to find another example of modern uncertainty
18 that's not related to human errors.
19 MR. KOLACZKOWSKI: But there are some.
20 CHAIRMAN APOSTOLAKIS: Yeah, and I'd like
21 to see how you quantify those.
22 MEMBER WALLIS: Do the thermal hydraulics
23 people give you ways to predict uncertainties,
24 modeling of thermal hydraulics? Oh, you've -- there
25 must a more logical way to do it than that.

1 CHAIRMAN APOSTOLAKIS: There are
2 uncertainties.
3 MR. KOLACZKOWSKI: Oh, yes. I mean, the
4 T-H uncertainties are handled in a different way.
5 Now, they end up potentially affecting our model.
6 Let me give you an example. Actually, it
7 will address some of the things that are in the
8 presentation anyway, so -- again, the SRV's stuck open
9 and re-closes. We don't know when it's going to re-
10 close. If it re-closes very quickly into the
11 accident, again, it's relatively benign from a PTS
12 standpoint. If it re-closes very late in the accident
13 and then this sudden repressurization happens, much,
14 much worse.
15 So what we did was, we took the possible
16 continuum of when the valve could re-close. And I'll
17 grant you, this is very crude, but we basically said
18 we're going to discretize out into two points. It re-
19 closes at 6,000 seconds in to the event or it re-
20 closes 3,000 seconds into the event. And we can get
21 a little bit into why we picked those particular
22 times.
23 CHAIRMAN APOSTOLAKIS: The reason why you
24 use seconds is because it's thermal hydraulics?
25 MR. KOLACZKOWSKI: That's right. As soon

1 as you go to RELAP, everything's in seconds, rather
2 than minutes or hours.
3 MEMBER ROSEN: If it says minutes, you're
4 in HRA.
5 (Laughter.)
6 MR. KOLACZKOWSKI: Or, HRA is in minutes.
7 That's correct.
8 MEMBER WALLIS: These are uncertainties in
9 the inputs to RELAPs. They're uncertainties in the
10 RELAP itself.
11 MR. KOLACZKOWSKI: Yes. That's a whole
12 other issue that Dave can address to some point here.
13 But I'll just point out that what we did was we then
14 did was discretized the time into two times and ran
15 thermal hydraulic runs for the 3,000-second case and
16 the 6,000-second case, and then ran those through the
17 fracture mechanics code to see how different the
18 results would be, and treated that as basically an
19 aleatory uncertainty.
20 We don't know when it's going to re-close.
21 We're going to say there's a 50-percent chance it
22 closes around 3,000 seconds and there's a 50-percent
23 chance it closes around 6,000 seconds. That's trying,
24 if you will, capture the aleatory uncertainty in when
25 is it going to close.

1 CHAIRMAN APOSTOLAKIS: Then you have a
2 epistemic on the 30 percent.
3 MR. KOLACZKOWSKI: But then you have
4 epistemic on the 30 percent as to what the frequency
5 of that --
6 CHAIRMAN APOSTOLAKIS: You did that, too?
7 MR. KOLACZKOWSKI: That is correct. Yes.
8 CHAIRMAN APOSTOLAKIS: And that was,
9 again, by calling expert people?
10 MR. KOLACZKOWSKI: Yeah. You had the HRA
11 uncertainty, which I described. You had the
12 uncertainty of initiating event frequency, the
13 uncertainty of failure probability --
14 CHAIRMAN APOSTOLAKIS: -- But I meant, for
15 the timing of vessel re-closure.
16 MR. KOLACZKOWSKI: Yes. You called people
17 to get those distributions. I mean, it was an expert
18 opinion kind of --
19 MR. KOLACZKOWSKI: Yes, but in this case,
20 as I said, it was a pretty crude one. We just said,
21 we're going to discretize all the times into two
22 times; 3,000 seconds and 6,000 seconds.
23 MEMBER ROSEN: The fact of the matter is,
24 the only thing that knows when it's going to re-close
25 is the valve.

1 MR. KOLACZKOWSKI: That's correct. And
2 it's purely random. It's not an epistemic
3 uncertainty.
4 MEMBER ROSEN: It depends upon how it was
5 set up and how old it is and what it's commission is,
6 and maybe 20 other things.
7 MEMBER FORD: Could I again -- I assume
8 you don't want to go much beyond five.
9 MEMBER ROSEN: We're having a lot of fun.
10 CHAIRMAN APOSTOLAKIS: This is stuff we
11 have to understand. I mean, there's --
12 MEMBER FORD: I know, but there's also a
13 whole lot on thermal hydraulic uncertainties, too.
14 CHAIRMAN APOSTOLAKIS: But I thought they
15 were not going to discuss thermal hydraulic
16 uncertainties.
17 MR. HACKETT: That's one of the things we
18 may need some guidance on, given the time, because we
19 were shooting towards five, too, for everybody's sake,
20 I guess, and Alan has --
21 MR. KOLACZKOWSKI: Let me go to the last
22 line.
23 CHAIRMAN APOSTOLAKIS: That's an excellent
24 idea.
25 MR. KOLACZKOWSKI: Let me just go to the

1 last line -- the one after that.

2 MEMBER POWERS: We'll make sure that you

3 don't make your time limit. You have listed down here

4 operator actions were treated as random events, but

5 they would seem to have a strong covariance with the

6 initiating event and the mitigating successes or

7 failures. Is that true?

8 MR. KOLACZKOWSKI: Yes, that's true. I

9 mean, I guess to say that they're purely random,

10 that's not the case. Obviously, training and

11 procedures direct certain kinds of actions, and so you

12 would expect to see them as more prevalent, that is

13 true. But, yes. You're right.

14 MEMBER POWERS: And later on in the slide,

15 you say you used Latin hypercube sampling, and that

16 means, ipso facto, you have a variance there.

17 MR. KOLACZKOWSKI: Yes.

18 MEMBER POWERS: If you're going to turn

19 around and use the 95-percent confluence bound on

20 these.

21 MR. KOLACZKOWSKI: No.

22 MEMBER POWERS: That means you much have -

23 - well, I mean, you present everything in 85

24 percentiles that I've seen.

25 MR. KOLACZKOWSKI: Yeah, but we gave the

1 entire resulting uncertainty distribution to the PFM
2 folks.
3 MEMBER POWERS: Yeah, but in the end
4 they're going to come up with a 95 percentile that
5 they're going to show us, right?
6 MR. KOLACZKOWSKI: Well, that's what
7 they're shown you but they can show you the whole
8 distribution if we so desire.
9 MEMBER POWERS: But you haven't got tails
10 in the distribution right, because you used Latin
11 hypercube sampling. Your details are all short
12 compared to the real details.
13 MR. KOLACZKOWSKI: Yes --
14 MEMBER POWERS: Your distributions are all
15 peaked. That's what Latin hypercube sampling does for
16 you.
17 MR. KOLACZKOWSKI: Yeah. It makes a
18 process more efficient. I don't know if I agree --
19 MEMBER POWERS: -- you get a narrowing of
20 the distribution any time you use a Latin hypercube
21 sampling.
22 MR. KOLACZKOWSKI: Not being a
23 statistician expert, I've got to think about it. Yes
24 -- but, okay, if you're suggesting that we ought to go
25 and also use Monte Carlo or something?

1 MEMBER POWERS: Monte Carlo will do the
2 same thing for you; it just doesn't it as bad.
3 (Laughter.)
4 MR. KOLACZKOWSKI: Well, we can certainly
5 use other sampling techniques.
6 MEMBER POWERS: You can sample until you
7 turn blind. You'll still end up with narrow
8 distributions relative to what you'd have if you went
9 to an infinite sample distribution. You've got to
10 have some measure of how bad you are.
11 MEMBER FORD: And to help you with your
12 timing, Bill, are you agreed that you have no
13 questions on the PFM?
14 MEMBER SHACK: No. I think that's rocket
15 science compared to the rest of this.
16 (Laughter.)
17 MEMBER FORD: So you don't have to do
18 anything on PFM?
19 CHAIRMAN APOSTOLAKIS: Is PFM an accepted
20 approach by the experts? Is that something that's
21 been validated?
22 MR. KOLACZKOWSKI: Yes.
23 MR. KIRK: Yes.
24 MEMBER FORD: There's a whole lot of
25 questions I have, which will be --

1 MEMBER SHACK: Well, there's PFM and
2 there's PFM. I mean, what part of PFM are we talking
3 about? The probability or the fracture mechanics?
4 MEMBER POWERS: But as a discipline, not
5 only is it relatively well established, some of the
6 gentlemen involved in this study were part of those
7 that established it.
8 MEMBER FORD: Really? So, why don't we
9 concentrate on this last slide and on then on the
10 thermal hydraulic --
11 MR. HACKETT: All right.
12 MR. KOLACZKOWSKI: I just want to point
13 out that ultimately, what is being provided to the
14 fracture mechanics part, the T-H part, essentially the
15 output of the PRA part is -- and actually it's coupled
16 with the T-H.
17 Imagine that what's being provided as a
18 set of T-H curves, which of course are developed from
19 the thermal hydraulics portion of this, that
20 correspond some scenarios that we say -- okay, these
21 scenarios are indeed representative of this particular
22 set of T-H curves. And then, what's the frequency of
23 that bin when you add up all the scenarios that are in
24 that bin? What does the frequency of that bin look
25 like?

1 We described that frequency via histogram
2 that then went on to the fracture mechanics people,
3 who then sampled this histogram for a given sequence,
4 and then of course sampled across all the sequences
5 that cause overcooling.
6 When you're sampling across all the
7 sequences, you're essentially addressing, if you will,
8 the aleatory uncertainty and all the ways overcooling
9 an occur. Then when you sample from the individual
10 frequency histogram, you're trying to address the
11 epistemic uncertainty in that frequency, when you go
12 and ultimately develop the uncertainty in the PFM
13 results.
14 So again, what's being provided here as a
15 bin, a frequency, and that frequency for that bin is
16 being described by a histogram, and of course you're
17 doing that for some number of scenarios.
18 CHAIRMAN APOSTOLAKIS: Now, there's an
19 interesting comment in one of the viewgraphs from the
20 subcommittee meeting. It said that there were
21 situations where uncertainty types were mixed. And I
22 was wondering how you guys handle that. That was
23 slide 64, Current Toughness and Embrittlement models.
24 MR. KIRK: We fixed that.
25 CHAIRMAN APOSTOLAKIS: You fixed that.

1 You separate it.

2 MR. KIRK: We separated it.

3 CHAIRMAN APOSTOLAKIS: And how did you do

4 that? I mean, was there --

5 MR. KIRK: I forgot my wizard's hat.

6 (Laughter.)

7 MR. KIRK: We want to do that? I mean, we

8 may as well --

9 CHAIRMAN APOSTOLAKIS: They were in the

10 embrittlement model?

11 MR. KIRK: Yes.

12 CHAIRMAN APOSTOLAKIS: I would expect them

13 to be there.

14 MR. KIRK: What we did was we used a

15 process, which is shown here -- apparently, I can't

16 get my slide show working any more -- whereby we use

17 physical models to help to identify -- well, we took

18 apart the process to identify where the uncertainties

19 are, and then we referenced our non-toughness data,

20 which is what mixed the uncertainties, to real

21 toughness data to help us to separate out the aleatory

22 and epistemic parts so that we could treat them

23 separately. So then, each of the major variables in

24 the toughness model -- the index temperatures, the

25 toughest variables themselves, were individually

1 identified as being aleatory or epistemic.

2 CHAIRMAN APOSTOLAKIS: When you say either

3 one or the other, you mean situations where one

4 dominated the other?

5 MR. KIRK: Yes. And in reality, one

6 dominated. For example, in the toughness variables

7 themselves, the K1-c and K1-a, were dominantly

8 aleatory, and so we propagate those uncertainties as

9 distributions of the models, whereas the index

10 temperatures were predominantly epistemic. So those

11 are sampled.

12 MEMBER KRESS: Let me see if I understand

13 your uncertainty on the frequency again. You don't

14 have to go back to the slides; I'll just ask the

15 question.

16 You have identified something like

17 several, a hundred thousand sequences. You've binned

18 it into 150. So each of those bins has a lot of

19 sequences in it, and somehow each of those sequences

20 in that bin has associated with it a frequency, and

21 you convert that into a histogram. Where did the

22 frequencies come from in the first place?

23 MR. KOLACZKOWSKI: Because a scenario is

24 a combination of events, they're essentially a

25 multiplication of initiating event frequency, time-

1 certain failure probabilities of certain equipment,
2 time-certain failure probabilities of operator
3 actions, each of which has a mean and uncertainty,
4 etc., so you end up --
5 MEMBER KRESS: So you took all hundred
6 thousand of these and got their --
7 MR. KOLACZKOWSKI: Well, no, because of
8 course what you find out is that among a hundred
9 thousand sequences, there are 500 that really matter.
10 You've got to remember that we threw some sequences
11 because --
12 MEMBER KRESS: Okay, so that histogram may
13 have -- for each bin, they have several hundred
14 sequences in it?
15 MR. KOLACZKOWSKI: Some may be as many as
16 that. Some may be as few as just a few sequences. It
17 just depends.
18 MEMBER KRESS: Now, the frequency of this
19 sequence is -- that histogram you had.
20 MR. KOLACZKOWSKI: Yes.
21 MEMBER KRESS: Was that just the
22 initiating event frequency, or --
23 MR. KOLACZKOWSKI: No. That's ultimately
24 -- imagine that, if you will, as to all the sequences
25 that are in that bin mushed together to get what is

1 the frequency of that bin and the uncertainty in that
2 bin.
3 MEMBER SHACK: It's sort of the frequency
4 of the thermal hydraulic event associated with that
5 bin.
6 MR. KOLACZKOWSKI: Yes.
7 VICE CHAIRMAN BONACA: So there's specific
8 trend, pressure temperature.
9 MEMBER SHACK: The depreciating
10 frequencies have all been narrowed down, and you're
11 coming up with eight. What you're really getting is
12 a frequency of a thermal hydraulic event.
13 VICE CHAIRMAN BONACA: Right. All the
14 bunches of sequences in the bin will have a pressure
15 temperature behavior that resembles the one that
16 you're --
17 MEMBER SHACK: And he's got an epistemic
18 distribution because all of his frequencies -- in
19 fact, he doesn't have any number. He's got a
20 distribution for each of his frequencies. He's got a
21 probability that something will happen, but each of
22 those probabilities has an epistemic distribution.
23 MEMBER KRESS: And he takes the mean of
24 those?
25 MR. KOLACZKOWSKI: Well, ultimately it

1 calculates the mean. We don't really pass the mean
2 necessarily along, although we could. We provide --
3 the resulting distribution goes to the PFM folks. If
4 they want to know what the mean is, they can figure it
5 out, but we give them the whole distribution.
6 MEMBER POWERS: What you send to them is,
7 in fact, a histogram, right?
8 MR. KOLACZKOWSKI: That is correct. We
9 send them the histogram.
10 MEMBER POWERS: And I think that because
11 you send them a histogram, what they get is an
12 artificially narrowed distribution.
13 MR. KOLACZKOWSKI: I've taken your note on
14 that. We will do some other sampling techniques and
15 see how much it changes.
16 CHAIRMAN APOSTOLAKIS: Now I'm curious.
17 You have all these -- I mean, you said earlier that
18 the dominant model uncertainty was quantified using
19 expert judgment and that was one of the most --
20 MR. KOLACZKOWSKI: For example, when the
21 SRV re-closes.
22 CHAIRMAN APOSTOLAKIS: -- and so on. So
23 if I go now to the early slide that showed -- yes, the
24 preliminary results for Oconee 1, and you recognize,
25 or you conclude, that there are orders of magnitude --

1 the current results are four orders of magnitude lower
2 after 40 years of operation, two orders at the current
3 screening -- yes, exactly.
4 And knowing that a lot of this stuff
5 really depends on expert judgment, if I were a
6 structuralist, I would ask myself, what if I'm wrong.
7 And I would leave Regulatory Guide 1.154's criteria
8 alone because if I'm wrong, I'm wrong -- right? So,
9 would Dr. Powers agree with this kind of thinking?
10 MEMBER POWERS: No. This is not one where
11 I'll go along with you.
12 CHAIRMAN APOSTOLAKIS: I'm a structuralist
13 and I recognize that they've done an excellent job,
14 but my goodness, they depend on expert judgment a lot,
15 and experts have been wrong.
16 MEMBER POWERS: They certainly have a
17 history of being wrong more often than they are right.
18 That is absolutely true.
19 CHAIRMAN APOSTOLAKIS: So I'm scared now.
20 I want to be a structuralist.
21 MEMBER POWERS: Okay. You're going to be
22 a very conservative structuralist.
23 CHAIRMAN APOSTOLAKIS: Oh, now we have a
24 new classification.
25 MEMBER FORD: But George, surely, now

1 you're arguing about what that risk criteria should
2 be.
3 CHAIRMAN APOSTOLAKIS: No, I'm not arguing
4 with them. I'm arguing with him.
5 MEMBER FORD: Oh, okay.
6 MEMBER SHACK: You're still arguing over
7 the frequency. We haven't even gotten to the risk
8 criteria.
9 MEMBER FORD: That's my point. Let's my
10 point.
11 MR. KOLACZKOWSKI: George, we're trying to
12 be risk-informed.
13 CHAIRMAN APOSTOLAKIS: But if I'm a
14 structuralist defense in-depth (inaudible), then I'm
15 not risk-informed.
16 VICE CHAIRMAN BONACA: Well, no but if a
17 structuralist wants to know what the consequences are,
18 then --
19 CHAIRMAN APOSTOLAKIS: And then say, what
20 if you're wrong and goes back --
21 VICE CHAIRMAN BONACA: Well, no, he tries
22 to be reasonable.
23 CHAIRMAN APOSTOLAKIS: Oh.
24 MEMBER POWERS: That's why we have a
25 containment building.

1 (Laughter.)

2 MEMBER FORD: I'm trying to get through by

3 five o'clock here, George, and we've got all the

4 thermal hydraulic stuff here.

5 CHAIRMAN APOSTOLAKIS: That would mean

6 it's just too much work --

7 (Laughter.)

8 MEMBER POWERS: It's a well-established

9 science.

10 CHAIRMAN APOSTOLAKIS: It's a well-

11 established science.

12 VICE CHAIRMAN BONACA: Oh, yes. Cracks

13 propagate, then it could be trouble.

14 MR. BESSETTE: I'll try to go quickly

15 through thermal hydraulics.

16 MR. KOLACZKOWSKI: Yeah, you're going to

17 try.

18 CHAIRMAN APOSTOLAKIS: Let me understand

19 this. You said earlier in answering a question that

20 we will not discuss thermal hydraulics today. What is

21 --

22 MEMBER FORD: I said we wouldn't discuss

23 the criteria today.

24 CHAIRMAN APOSTOLAKIS: No, no, no.

25 MEMBER SHACK: Just the fundamental

1 verification of the RELAP code today.

2 MR. BESSETTE: Yes. We wouldn't talk about

3 the general validation of RELAP, overall assessment

4 work.

5 MEMBER SHACK: This now assumes that RELAP

6 works.

7 MR. BESSETTE: Yes. This assumes that

8 RELAP has some connection with reality.

9 (Laughter.)

10 CHAIRMAN APOSTOLAKIS: It says, RELAP 5

11 Internal Model Uncertainty.

12 (Laughter.)

13 CHAIRMAN APOSTOLAKIS: So you recognize

14 the uncertainties.

15 MR. BESSETTE: So we were faced with --

16 first of all, we tried to classify what we were

17 dealing with. And so, we categorize things into

18 events, sequence modeling and mapping, just basically

19 trying to determine what bins we're dealing with.

20 We realized early on that what was

21 dominating the outcome, or the uncertainties, in these

22 events was not the physical remodeling of RELAP but

23 rather the definition of the sequences. And there, we

24 worked a great deal with the PRA people.

25 So, my breaking down the sequences into

1 finer bins, we were getting much better -- you know,
2 a greater return on our --
3 CHAIRMAN APOSTOLAKIS: I don't understand.
4 I'm confused now.
5 MEMBER WALLIS: I think what you're saying
6 is there's much more uncertainty in the PRA modeling
7 than there is in the RELAP.
8 MR. BESSETTE: That's right. If you
9 strain the sequence a little bit, you can get
10 significantly different outcome, in terms of does the
11 operator act or not act, does the valve open or not
12 open. It's much greater determinant to these key
13 factors of temperature and pressure than the physical
14 models within RELAP. So, we put a great deal of effort
15 into expanding and defining the bins. That's one thing
16 we spent a great deal of time on.
17 Then you get into the use of RELAP itself,
18 and again, we can categorize that according to the
19 uncertainty in the hundreds of physical and empirical
20 models that comprise RELAP and basically in the
21 preparation of the input deck, how you model the
22 plant.
23 The first category of this thing is, we
24 treated -- we tried to decide what are the dominant
25 modeling features of RELAP that would affect the

1 answer. With regard to the latter, we simply tried to
2 model the plant as best we could using standard
3 practice of globalization --
4 MEMBER WALLIS: How do you put numbers on
5 that say RELAP 5 Internal Model Uncertainties?
6 MR. BESSETTE: Well, what we do is we go
7 through it like a PIRT process. We go through a PIRT
8 process to try to identify the most important physical
9 models and the most important boundary conditions that
10 would affect the things we're concerned with, which is
11 temperature and pressure. So, we tried to decide that
12 we have a proper list to do our sensitivity studies.
13 CHAIRMAN APOSTOLAKIS: Didn't you get some
14 expert opinion or recitation by (inaudible)
15 MEMBER WALLIS: That's what it is.
16 MR. BESSETTE: We did that. We had
17 available -- two prior PIRTs that were done for
18 perforized thermal shock -- one at the time of Yankee-
19 Rowe and one for H.B. Robinson.
20 CHAIRMAN APOSTOLAKIS: But the PIRTs do
21 not quantify uncertainty, do they?
22 MEMBER WALLIS: No.
23 MR. BESSETTE: The PIRTs, no. The PIRTs
24 simply list things that are thought to be most
25 important.

1 CHAIRMAN APOSTOLAKIS: So you went to
2 experts after that to get probabilities, to do what
3 Alan did, or you did not do that?
4 MR. BESSETTE: So, for each thing you think
5 is important, then you decide how much you want to
6 arrange it.
7 MEMBER WALLIS: So you arrange things like
8 correlations? Do you put a fudge factor on heat
9 transfer correlation or something?
10 MR. BESSETTE: That's right.
11 MEMBER WALLIS: Well, I can understand
12 doing that work, but I don't know how you get this
13 Internal Model Uncertainties in RELAP because of the
14 way it, itself, is structure. It has certain
15 conservation laws that no one ever seems to question
16 the way they're formulated. But they lead to
17 uncertainties because they are great simplifications
18 of what's actually happening.
19 MR. BESSETTE: Well --
20 MEMBER SHACK: One example might be this
21 break flow calculation. That's sort of one explicit
22 way you treated a model uncertainty, isn't it? You
23 got that one?
24 MR. BESSETTE: We lost you.
25 MR. BESSETTE: This is the list we came up

1 with. On the left-hand side, we have the
2 uncertainties -- the dominant uncertainties in terms
3 of the boundary conditions of the analysis. That's
4 things like break size, break location, decay heat,
5 the temperatures of the --
6 CHAIRMAN APOSTOLAKIS: So these were
7 treated --
8 MR. BESSETTE: These were each --
9 everything that you see on this list here was treated.
10 MEMBER WALLIS: But there's nothing here
11 about the code itself. Well, the right-hand side
12 related --
13 MEMBER WALLIS: If you put a heat transfer
14 coefficient, you put it into this big machine called
15 RELAP, there's nothing here about how uncertain RELAP
16 itself is because of the way it's built.
17 MR. BESSETTE: Well, you know, I think
18 there you're going back to the question of the
19 relationship between RELAP and reality -- things like
20 flow regime maps and conservation equations, which
21 rely on a much broader --
22 MEMBER WALLIS: But you can quantify that,
23 too, by comparison with date. That's what we make
24 people do at CSAU.
25 MR. HACKETT: I think Dr. Wallis is

1 exactly right. Jack Rosenthal was here at the last
2 meeting with the subcommittee, and I'm certainly no
3 expert in this area, but I think he assured us that
4 the RELAP -- I'm sure Dr. Wallis knows this -- has
5 been extensively benchmarked by experiments, and --
6 MEMBER WALLIS: I'm sorry, but that sort
7 of benchmarking usually consists of people looking at
8 data and saying, well, the line isn't too far from the
9 data. We're in a more sophisticated world now. We
10 actually want quantitative measures of those
11 uncertainties.
12 MR. HACKETT: That's correct.
13 MEMBER SHACK: One thing they did when
14 they made the presentation to the subcommittee was --
15 just take the break flow as one example. There are
16 various models for the break flow.
17 CHAIRMAN APOSTOLAKIS: Where is that?
18 What are you looking at?
19 MEMBER SHACK: It would be page 51 of the
20 big viewgraph package that you have.
21 CHAIRMAN APOSTOLAKIS: The big viewgraph,
22 from the subcommittee meeting.
23 MEMBER SHACK: From the subcommittee. And
24 so the different break flow models gave you different
25 flow rates. The way they handled that was essentially

1 to vary the break flow area. You know, you can either
2 have a different -- for a given break flow area, you
3 can have a different break flow model but instead,
4 because you can't do that all that handily, they took
5 one model and varied the break flow rate.
6 MEMBER WALLIS: I understand all that, but
7 there's this -- the assumption is that the machinery
8 of RELAP is deterministic and exact once you put these
9 various uncertainties and --
10 CHAIRMAN APOSTOLAKIS: But the question
11 is, if they do that -- they say they varied the break
12 area by 30 percent to account for model differences.
13 Was there a probability assigned, then, to the
14 different curves?
15 MR. KOLACZKOWSKI: George --
16 CHAIRMAN APOSTOLAKIS: That's the issue
17 here.
18 MR. KOLACZKOWSKI: The answer is, we
19 varied those by the amounts that we decided.
20 CHAIRMAN APOSTOLAKIS: Right.
21 MR. KOLACZKOWSKI: And then basically we
22 did a run -- well, suppose it's 30 percent greater;
23 suppose it's 30 percent less.
24 CHAIRMAN APOSTOLAKIS: Right.
25 MR. KOLACZKOWSKI: If we found that it

1 wasn't going to make much difference in the
2 temperature or pressure or heat transfer coefficient
3 response, in fact it was entirely dropped.
4 CHAIRMAN APOSTOLAKIS: Okay.
5 MR. KOLACZKOWSKI: Only if it was making
6 a big change, then we went through this more -- as you
7 say, a process of saying, okay, let's capture that
8 uncertainty, let's weight it by some expert opinion,
9 etc. And that was done on a few variables that seemed
10 to really matter.
11 CHAIRMAN APOSTOLAKIS: Okay. All right.
12 All right. But that's what --
13 MR. KOLACZKOWSKI: I think that one of the
14 things that Dave was trying to get at, which is fine,
15 is that the things that really matter are more when
16 the operator does the action; probably not
17 uncertainties in the actual RELAP code.
18 MEMBER WALLIS: These aren't internal
19 modeling uncertainties in RELAP, though.
20 MR. KOLACZKOWSKI: Sorry.
21 MR> WALLIS: These are not internal
22 modeling uncertainties in RELAP itself.
23 MR. KOLACZKOWSKI: No, although -- and
24 again, these are surrogates in some cases to try to
25 get at what those uncertainties might be.

1 CHAIRMAN APOSTOLAKIS: but you did try to
2 quantify some of the internal model uncertainties --
3 MR. KOLACZKOWSKI: Yes.
4 CHAIRMAN APOSTOLAKIS: -- even though the
5 operator actions dominate.
6 MR. KOLACZKOWSKI: Yes.
7 CHAIRMAN APOSTOLAKIS: Okay.
8 MR. BESSETTE: So we go through these
9 multi-step -- we go through the operator uncertainty
10 and --
11 CHAIRMAN APOSTOLAKIS: So the general
12 approach was, you know, identify -- not only here but
13 in the full project -- identify what's important and
14 then subjectively, through expert judgment and
15 dissertation, assign --
16 MR. KOLACZKOWSKI: Do the uncertainties on
17 the things that were important enough to do it on, and
18 not on everything.
19 MR. HACKETT: I think that one of the
20 things we mentioned at the subcommittee meeting that
21 we didn't mention at the start of this -- of course,
22 that treatment is not equal across the disciplines.
23 In some cases, we had the benefit of a lot more rigor
24 and a lot more data; in other cases, we didn't.
25 CHAIRMAN APOSTOLAKIS: Well, presumably

1 that's reflected on the uncertainties.

2 MR. HACKETT: Yes.

3 CHAIRMAN APOSTOLAKIS: okay. I think we

4 understand. At least I understand.

5 MEMBER WALLIS: Well, I don't understand,

6 though.

7 (Laughter.)

8 CHAIRMAN APOSTOLAKIS: All right. Ask

9 away.

10 MR. RANSOM: Just one quick question --

11 CHAIRMAN APOSTOLAKIS: Please identify

12 yourself.

13 MR. RANSOM: Victor Ransom.

14 When you plot the temperature versus time,

15 is that the code link temperature in the affected

16 loop?

17 MR. HACKETT: It should be the downcomer

18 temperature.

19 MR. RANSOM: Well, then I'm wondering how

20 you have four loops presumably mixing together, and

21 then in RELAP 5 these are all mixed into a one-

22 dimensional downcomer. That wouldn't give you the

23 worst-case temperature that you might see at the

24 entrance of the code link to the downcomer. I'm

25 wondering, how did you account for that effect?

1 MR. BESSETTE: Well, we -- our focus is on
2 the temperature in the downcomer in the region
3 adjacent to the core. What we found was that by the
4 time you get down there, things are pretty well mixed.
5 We don't see a lot of circumf- --
6 MEMBER WALLIS: Azirmuthal.
7 MR. BESSETTE: -- azirmuthal variation.
8 MR. RANSOM: That would surprise me. I
9 would think you'd find the maximum temperature and
10 overcooling near the entrance of the *code link that's
11 affected.
12 MR. BESSETTE: Yes, but we don't care about
13 that so much. It's not that temperature we're focused
14 on. Our focus is on the downcomer temperature.
15 MEMBER SHACK: It's the worst temperature,
16 but the vessel is tough up there, so you have to look
17 where the vessel is brittle.
18 MR. RANSOM: Okay.
19 MR. KOLACZKOWSKI: You have to go down
20 significantly lower, where the fluence is high and the
21 embrittlement is happening.
22 MR. RANSOM: So you attempt to use the
23 mass mean temperature, I guess, at that point, huh, in
24 the downcomer?
25 MR. BESSETTE: Yes. We supply a single

1 temperature boundary condition to the fracture code.
2 MEMBER WALLIS: Do you give it
3 uncertainties?
4 MR. BESSETTE: That's the -- that was the
5 uncertainties --
6 MEMBER WALLIS: But you don't give
7 uncertainties based on sort of input parameters, not
8 the way the code works itself?
9 MR. BESSETTE: Well, we try to do both. We
10 try to take into account both things like temperatures
11 of the safety ejection water.
12 MEMBER WALLIS: Well, there's nothing
13 there that says that modeling of conservation laws in
14 RELAP contributes uncertainty.
15 MR. BESSETTE: Other than when the
16 treatment of the --
17 MEMBER WALLIS: That leads to
18 uncertainties.
19 MR. BESSETTE: Yes. So we did consider
20 that.
21 MEMBER WALLIS: Well, you say they were
22 validated. That's not a measure of uncertainty.
23 MR. BESSETTE: What we validated is when
24 the assumption -- did not contribute significantly to
25 --

1 MEMBER WALLIS: Well, you've got to say
2 how much uncertainty it contributes, and the
3 validation should end up in a measure of uncertainty,
4 which is quantitative, not --
5 MR. KOLACZKOWSKI: Dave, go to the slide
6 that has six, seven and eight on it -- Uncertainty,
7 two out of three.
8 I mean, what they did was, they ran a
9 whole lot of cases, which is what's trying to be
10 illustrated on the left-hand side. Different break
11 flows, different -- summer or winter -- whatever,
12 which, granted, is not directly getting at some of the
13 code on certainties but is trying, in a surrogate way,
14 address some of that.
15 MEMBER WALLIS: I understand what's you've
16 done, but if you'd run a different code, you know, a
17 different structure, a different way of handling
18 conservation laws, one-dimensionality -- on these,
19 you've got different answers, irrespective of all this
20 stuff. That's sort of what I'm getting at. It's
21 something which I don't think the Agency knows how to
22 handle yet.
23 MEMBER KRESS: One of the things they do,
24 Graham, is they take situations which they know
25 analytical solutions, and then they run the code to

1 see how well it does it. And it gives you a little
2 bit of confidence that the code, as a structure put
3 together, is doing something correctly. That doesn't
4 lead to quantification of what you're talking about,
5 but it gives you a little more confidence, if they do
6 enough of that with enough known results.
7 But I agree with you. If you used a
8 different code to do all this, you'd get a different
9 result, but it may not be that much different.
10 MR. BESSETTE: Of these 150 calculations,
11 we did run five -- the selected five of them were ran
12 on TRAC. Well, you can say, well, TRAC is not a
13 different code, but we got similar results.
14 MR. HACKETT: I guess I'd interject at
15 this point and --
16 CHAIRMAN APOSTOLAKIS: Regarding the
17 transients you use, I saw LOCAs and steam line break
18 becoming -- I know the French have had a concern about
19 cooldown in a low-power and shutdown condition, where
20 you have repressurization. And they. in fact, are
21 making planned changes for that. Have you looked at
22 those kind of scenarios?
23 MR. KOLACZKOWSKI: Yes. And in fact,
24 among the low power, that same SRV re-closure event
25 is, again, a pretty bad event.

1 CHAIRMAN APOSTOLAKIS: Okay.

2 MR. KOLACZKOWSKI: Of course, you're being
3 helped by the fact that the portion of the year that
4 you're at low power is a lot less, so it tends to
5 drive the frequencies down. But nevertheless, yes,
6 it's included in the model, and in fact it's among our
7 results.

8 MR. HACKETT: I guess what I was going to
9 say is, I guess we'd need, at this point, maybe to
10 take an action that -- we're suffering, obviously,
11 here from trying to condense an awful lot into too
12 short a time frame. It's probably overly ambitious.
13 I apologize for that. I think we need to come back
14 and at least address the thermal hydraulics area in
15 greater detail in a separate meeting, if we don't want
16 to hold people over who have other obligations.

17 MEMBER FORD: I agree. The purpose of
18 this meeting was to just get a feeling as to whether
19 you're going the right direction and whether there are
20 any fundamental errors in the way that you're
21 proceeding. And I've got a draft letter going on
22 those lines.

23 If we do have outstanding question that
24 seem to be relating on the uncertainty aspect, maybe
25 we've got a different meeting to address those

1 specific issues.

2 MR. HACKETT: We'll be glad to so that.

3 MEMBER FORD: Do you have a summary slide

4 to --

5 MR. HACKETT: We have a plain-language

6 summary.

7 CHAIRMAN APOSTOLAKIS: Oh, the plan

8 language.

9 MR. HACKETT: Or the lack of plain

10 language.

11 CHAIRMAN APOSTOLAKIS: We've seen that.

12 (Laughter.)

13 MR. HACKETT: You've seen that. In case

14 we had had an emergency in the day and a half, we had

15 this prepared. To go to Dr. Rosen's point, where is

16 this all going, where we're hoping this is going at

17 this point is, we have a lot of work to do, is the

18 bottom line. We have three more plants to analyze, an

19 awful lot of runs of a lot of codes to do, a lot of

20 integration.

21 I think that one of the questions came up

22 is, once we get all these four plants, we need to make

23 the sort of quantum jump to generalizing that result

24 to the whole PWR fleet. So we have a fair bit of work

25 ahead of us, I think it's fair to say. and probably

1 at the -- I'd be willing to go so far as to say, end
2 of the summer time frame, we might be in a position to
3 have a lot of that done and be ready to speak to that
4 in a more generalized sense. In the meantime, we're
5 happy to come back and hit any one of these in more
6 detail.
7 MEMBER FORD: If I could make a suggestion
8 --
9 MEMBER ROSEN: You didn't answer my
10 question, exactly. My question was, when you're done
11 with all of that, what do you do? Do you propose a
12 Notice of Proposed Rulemaking to amend 50.61.
13 CHAIRMAN APOSTOLAKIS: Your microphone --
14 MEMBER ROSEN: My question was, at the end
15 of all that, do you go to a proposed rulemaking to
16 address revisions to 50.61?
17 MR. HACKETT: Yes. I'm sorry. I started
18 rambling there and didn't close that loop. The
19 schedule that we're proposing right now, that we're
20 still in some debate with amongst the management, is
21 that we would have a technical product that's the
22 technical basis that's the result of all this work
23 we're talking to you about here in about the November
24 time frame, at which point we would that hand that
25 product off to NRR.

1 NRR has already budgeted resources to
2 initiate rulemaking on a revised 50.61. We would
3 continue some of the technical work to finalize that
4 in parallel, and we would be working closely with NRR.
5 That, in and of itself, as you know, is probably two-
6 to three-year process in and of itself.
7 MEMBER FORD: If I could make a
8 suggestion. In the shorter term -- i.e., the next
9 three months --
10 MEMBER POWERS: Peter, you have to use
11 your microphone, just like everybody else.
12 MEMBER FORD: Aye, but he understands me.
13 He comes from the right country.
14 MEMBER POWERS: And you come from the
15 North, which is considered somewhat less than
16 civilized.
17 MEMBER FORD: If I could make a
18 suggestion. I think the subcommittee -- we had a full
19 one and a half days and we went into a lot of detail;
20 maybe not quite so much detail in some of the thermal
21 hydraulics and the PRA. But I think that we've got
22 enough of a background to write an informative letter
23 for EDO tonight, or in the next couple of days.
24 But I do suggest that within the next two
25 months, we do have a subcommittee meeting with the PRA

1 and thermal hydraulics people to go over the
2 outstanding questions. I don't think, quite honestly,
3 they're show stoppers, but I do think that it could
4 give us some useful advice.
5 MEMBER WALLIS: Could I say something
6 about thermal hydraulics here?
7 MEMBER FORD: Yes.
8 MEMBER WALLIS: I think that these codes
9 like RELAP, historically, have been validated by
10 looking how assumption and so on affect figures of
11 merit for court damage, such as peak clad temperature.
12 And we had all these justifications that RELAP's okay
13 because you can change all these assumptions and peak
14 clad temperature doesn't change.
15 But we're not talking about peak clad
16 temperature. We're talking about temperature in a
17 downcomer, and I don't quite know how well RELAP's
18 been validated for that, so that's the sort of thing
19 I will ask at the next meeting when we talk about
20 thermal hydraulics.
21 MEMBER FORD: Okay. I'll pass it back to
22 you, George.
23 CHAIRMAN APOSTOLAKIS: Thank you, Peter.
24 When I see a slide like this, I'm
25 wondering if we're doing this again 20 years from now.

1 Where do you think your successors will say, this and
2 this and this is better or worse than we thought it
3 was? "Thought" meaning what you think now. Where is
4 your major uncertainty here that might be revised? I
5 mean, your colleagues of 20 years ago were doing also
6 a good job at the time, right?
7 MR. HACKETT: Actually, I guess maybe some
8 combination of us can answer that. I can speak to a
9 few pieces at least, and there I'll give credit to our
10 predecessors. I think 20 years ago, it was recognized
11 that the flaw density and distribution was a major
12 player in this thing, with the work that came out of
13 the U.K. with the Marshall Committee. They did a
14 tremendous body of work on that. They did as good as
15 they could at the time.
16 They did as good as they could at the
17 time. We've had a lot of resources brought to bear on
18 that, since -- where we've cut up reactor vessel
19 welds, for instance -- and we've seen what flaws are
20 there that's helped refine this thing and make it more
21 accurate.
22 But that's been a huge impact on this
23 project because previously we were assuming from the
24 Marshall Distribution there were some very large
25 flaws, and we didn't know what else to do at the time

1 in fracture mechanics, so we put them all on the
2 surface. A huge conservatism in the project -- that's
3 just --
4 CHAIRMAN APOSTOLAKIS: But they knew that
5 it was a major concern?
6 MR. HACKETT: They did. That was one that
7 I think that the folks sitting around back in the
8 early '80s would have said -- in fact, when I read the
9 Marshall Report, they said, don't use this for very
10 long. Unfortunately, we did. We didn't have the
11 wherewithal to get the research done in as timely a
12 fashion as we like.
13 But one of their cautions was, you know,
14 we're pretty far out on a limb here, so don't be
15 utilizing this ten years from now, and we were. So,
16 we're only getting to that point now, so we're late
17 but I think we've finally gotten there in the right
18 way, and that's just one example. I think there are
19 many in the --
20 CHAIRMAN APOSTOLAKIS: But the cooldown
21 rates were the same. I mean, everybody knew 20 years
22 ago that they were excessive and I don't know why, in
23 fact, it wasn't questioned further. I mean, there was
24 no operator action to intervene. there was nothing
25 that --

1 VICE CHAIRMAN BONACA: -- going forever
2 until simply the system couldn't cool down anymore.
3 MR. HACKETT: Good point, too. The other
4 ones we're familiar with, at least speaking in the PFM
5 area, the material -- we've made some assumptions that
6 the material I think frankly was probably a lot more
7 embrittled than it really is, in general terms.
8 There were some conservatisms that came
9 out of the foundations of ASME code, Sections 3 and
10 11, and I think we're find out that they were indeed
11 conservative, that these materials are, on balance,
12 significantly tougher than we've given them credit
13 for, and we now have the science and the refinements
14 in fracture mechanics to bring some more accuracy to
15 that area. And that's not the only area.
16 MEMBER POWERS: And it seems to me that
17 what you're saying -- and correct me if I'm wrong --
18 is that we've researched these vessel materials and
19 their irradiation to the point that we have a
20 satisfactory understanding of that material?
21 MR. HACKETT: I think that's always a good
22 question because I don't want to shoot our research
23 program in the foot.
24 (Laughter.)
25 MR. HACKETT: We have been challenged --

1 Dr. Powers knows this, I'm sure -- we have been
2 challenged as to why we're still looking at vessel
3 materials 30 years after we initiated the project at
4 Oak Ridge. And the answer to that is, of course, it's
5 a dynamic situation. We didn't know at the time that
6 project was initiated what a bad actor copper was in
7 welds. We didn't know what synergisms of manganese
8 and nickel. So, there are things that have changed
9 over time and valid reasons to continue to work.
10 I think, you know, for those of you
11 familiar with this technology S curve, we're way up on
12 the curve when it comes to understanding the material
13 behavior, if not on a plateau, very close to it. So,
14 we are, I think, at some point reaching a level of
15 diminishing --
16 MEMBER POWERS: A point of diminishing
17 returns where maybe that -- resources could be
18 redirected toward more 00
19 MEMBER ROSEN: This is a conclusion about
20 the heavy section steel technology program?
21 (Laughter.)
22 MEMBER KRESS: All right.
23 MEMBER ROSEN: Or are you moving towards
24 this?
25 MEMBER POWERS: Something -- redirect

1 those resources to something more useful, like --

2 MEMBER ROSEN: ATHENA --

3 MEMBER POWERS: understanding ATHENA --

4 right.

5 (Laughter.)

6 MR. HACKETT: That said, I feel it

7 incumbent on my position to make a plug for the HSST

8 program, or should I say what remains of it, in

9 reflecting that in the RES budget. The HSST program

10 funding has declined significantly, I think exactly

11 for that reason.

12 At one point, the committee will probably

13 remember that was a major multi-million dollar effort

14 where we were doing a lot of testing of large-scale

15 specimens. The effort now is on the order of $4- to

16 $500,000 per year that's mainly aimed at analytical

17 and advanced fracture mechanics. so, I think that has

18 been reflected in the RES budget, and in our budget

19 assumptions. It's a lesser effort than it used to be.

20 MEMBER KRESS: Yeah, but you didn't really

21 answer George's questions. What you said that I heard

22 was that these are the things in the original --

23 CHAIRMAN APOSTOLAKIS: Right.

24 MEMBER KRESS: -- that we knew were bad,

25 and now we've improved that. Twenty years from now,

1 what is going to be the theme?

2 MR. KIRK: I think you'll probably many of

3 the same things. For example, we've, you know --

4 MEMBER KRESS: You can improve these

5 further.

6 MR. KIRK: Further improve -- I mean, Ed

7 correctly pointed out that we've gotten significant

8 benefit from our advanced understanding of fracture

9 mechanics.

10 Having said that, you know, I know there's

11 a factor in the simulation right now, where we've got

12 an uncertainty programmed in -- I can show you the

13 equation -- of 180 degree Fahrenheit on the transition

14 temperature, that if you made a more direct

15 measurement of the vessel, which is -- it's possible

16 to do it today but it's simply not practical to

17 require it of the licensees.

18 But if you made a more direct measurement

19 and had the stated knowledge that you could ensure

20 that that more direct measurement adequately

21 represents the material in the vessel, you could take

22 that 180-degree uncertainty and turn it off.

23 So, there's a fairly substantial and I

24 think quantifiable benefit that one could derive from

25 going from what is certainly a more state of knowledge

in fracture mechanics, but still predominantly empirically based to one that's more driven by the physics, so that we know the origin of these uncertainties. And I'm sure there are examples in other areas. But I suspect that the answer is, again, you know, more of the same.

MR. HACKETT: I think also, to elaborate on that, based on these advancements in all three of these areas, one of the things to look forward to with the next generation with the advanced plants is, I don't think we need a PTS rule for those plants. So probably -- I mean, and there are our colleagues --

MEMBER KRESS: They're going to control the chemistry in the vessel and stop the fluids.

MR. HACKETT: -- our colleagues in the Navy who have been doing this and had the advantage to build new machines, they know how to do it.

CHAIRMAN APOSTOLAKIS: Are you requesting a letter?

MR. HACKETT: Yes. I think what we talked about with Dr. Ford was a letter at least indicating generally, you know, how the committee felt about the key areas would be indicated.

CHAIRMAN APOSTOLAKIS: Okay. Any other comments from the members?

1 (No response.)

2 CHAIRMAN APOSTOLAKIS: Thank you very

3 much, gentlemen.

4 MR. HACKETT: Thank you.

5 MR. KIRK: Thank you.

6 CHAIRMAN APOSTOLAKIS: I suggest we take

7 a short break this time and then come back and discuss

8 a few things of great importance. How about 5:30,

9 we'll be back.

10 (Off the record at 5:21 p.m.)

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CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: ACRS 489th Meeting

Docket Number: (Not Applicable)

Location: Rockville, Maryland

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

Pippa Antonio
Official Reporter
Neal R. Gross & Co., Inc.

ACRS/ACNW Meeting with EDO and Program Office Directors

Office of Nuclear Material Safety and Safeguards Activities/Issues

Martin J. Virgilio, Director
Office of Nuclear Material Safety and Safeguards
February 7, 2002

Overview of NMSS On-Going and Future High Priority Activities/Issues

- High Level Waste Issues:
  - Repository Program
  - Transportation Issues
- Decommissioning and Site Cleanup
- Initiatives to Risk-Inform NMSS Regulatory Approach
- Confirmatory and Anticipatory Research

2

High-Level Waste Repository Program

- Prepare for DOE license application
  - YM review plan
  - risk-significant issues and insights from new information
  - technical issues associated with system performance
- Realistic key assumptions of performance assessment
  - selection of models and parameter ranges based on risk insights

3

High-Level Waste Repository Program (cont'd)

- Realistic assessment, data needs, continuing analysis, tests and experiments
  - sensitivity analysis, conservatism, and uncertainties
  - consistency in treatment of uncertainties
- Probe KTIs and challenge differences between DOE and NRC
  - examine assumptions and approaches
  - achieve resolution of KTIs
- Capitalize on experience gained by others (e.g., international experience) in repository performance
- Pursue stakeholders involvement to enhance public confidence

4

Transportation Issues

- Increased national attention on spent fuel (SF) transportation
- NRC review of SF transportation package performance in severe, beyond design basis, accidents
- National Academies - National Research Council - Board of Radioactive Waste Management planned SF transportation study
- NRC planned transportation vulnerability studies following 9/11 terrorist acts

5

Decommissioning And Site Cleanup Issues

- Decommissioning guidance consolidation
- Stewardship
- Funding
- Institutional control
- Dose modeling
- Partial site release
- Increase realism in staff evaluations
- LTR relationship with other regulatory issues

6

Initiatives to Risk-Inform NMSS Regulatory Approach

- Integration of case studies results and lessons learned for potential application to other cases across NMSS activities
- Development of risk metrics and goals (safety goals) appropriate for risk-informing the materials and waste regulatory activities (with RES)
- Develop training programs/coursework
- Support risk-informed approaches to NMSS office activities and develop initiatives

7

Confirmatory and Anticipatory Research

- Performance confirmation of repository
  - ensure a regulatory program that will maintain a breadth of activities to probe DOE plans, assumptions, and conclusions
  - assure long-term performance
  - ensure continuity/consistency in regulatory oversight
- Anticipatory research in support of waste management program and NMSS user need

8

United States Nuclear Regulatory Commission

ACRS/ACNW MEETING WITH EDO AND PROGRAM OFFICE DIRECTORS

Ashok C. Thadani, Director
Office of Nuclear Regulatory Research

February 7, 2002

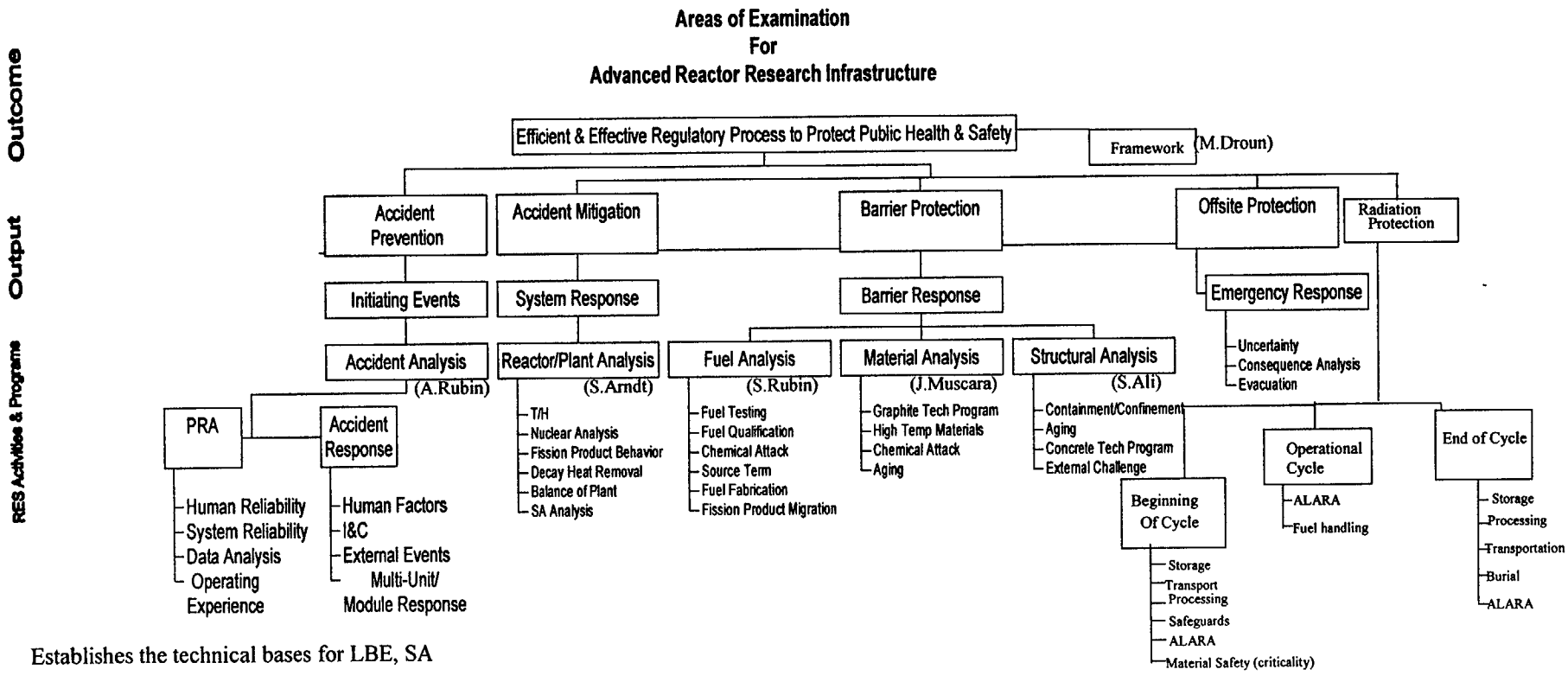
RES Major Issues 2002 -2004

- Advanced reactor designs
- Risk-informed initiatives
- Fuel behavior
- Thermal hydraulic codes
- Material engineering issues
- Waste Issues
- 9/11 followup activities
- Coordination of research

Advanced Reactor Designs

- Future plant licensing regulatory framework
- Research plan for advanced reactors
  - PBMR, GT-MHR, AP-1000, IRIS
  - Draft for comment in 2/02
  - Brief the ACRS in 4/02

Draft



I. Establishes the technical bases for LBE, SA

II. Establishes the technical bases for reactor test programs, equipment qualification

III. Establishes the technical bases for Fuel/material test programs, codes & standards

IV. Establishes the technical bases for EP decision making

V. Establishes the technical bases for regulating radioactive material

02/05/02

Risk-informed Initiatives

- RIRIP update
- PRA quality in risk-informed activities
- Technical basis for revisions to the PTS rule
- 50.44 and 50.46
- Human reliability analysis research plan
- PRA models and enhanced unreliability and unavailability PIs for ROP

Fuel Behavior

- Source term for MOX and high burnup fuel
- Effects of burnup and corrosion on existing fuel rod licensing models
- PBMR fuel performance and qualification planning
- Effects of burnup and corrosion on fuel rod licensing models for M5 and ZIRLO advanced cladding material
- HTGR fuel research

Thermal Hydraulic Codes

- Thermal hydraulic codes development and consolidation
- Severe accident codes development and consolidation - OECD experimental results
- Develop analytical tools for reviewing advanced reactor designs

Engineering Issues

- Technical basis for revisions to the PTS rule
- Material analysis for high temperature and graphite (advanced reactors)
- Stress corrosion cracking
- Digital I & C research
- Steam generator research
- Advanced reactor issues

Waste Issues

- Dry cask research
- Package Performance Study
- Review of radionuclide transport research plan and projects
- HLW storage and transport associated with advanced reactor designs

Coordination of Research Activities

- SECY-99-281 defines RES role
- Confirmatory research (user need)
  - support licensing, inspection and oversight
  - coordinated through regular division level meeting
  - RERB is enhancing coordination between the offices through improved user need process
- Anticipatory research
  - prepare for future regulatory challenges
  - seek recommendations for anticipatory research from NRC and external stakeholders
  - periodic briefings to provide updated research results
- Joint arena briefings with other program offices

Overview of Risk-Informed Regulation Implementation Plan

Presentation to
Advisory Committee on Reactor Safeguards

Mark Cunningham, RES
Frank Gillespie, NRR
Stewart Magruder, NRR
Lawrence Kokajko, NMSS

February 7, 2002

1

Overview of Presentation

- Overview of the new IP format and content
- Reactor arena activities
  - Major initiatives and challenges
  - Approach for identifying new areas to be risk-informed
- Materials and Waste arena activities
  - Important issues and upcoming milestones
  - Plan for identifying new areas to be risk-informed
- Next actions

2

Background: Plan Development

- RIRIP was initially developed as a response to:
  - 1995 NRC PRA Policy Statement
  - 1999 GAO recommendation to "develop a comprehensive strategy" for risk-informing NRC regulatory activities

3

Background: Plan Development

- Plan was first released in March 2000 (after an outlined strategy had been submitted to the Commission)
- In response to March 2000 release, Commission expressed need for:
  - Internal communications plan
  - Identification of staff training requirements
  - Discussion of potential impediments to progress of risk-informed regulation
- A more complete plan was re-released in October 2000

4

Background: Commission Comments

- Commission provided comments January 2001:
  - more clearly indicate activity priorities
  - provide a more detailed communication plan
  - identify resources and tools needed
  - address how performance-based regulatory approaches will be integrated into the process of risk-informing regulations
  - identify critical path activities
  - Identify activities with cross-cutting dimensions

5

Background: Response to Comments

- To reflect 2001 Commission comments, current RIRIP incorporates:
  - Activity priorities, determined by implementing offices
  - General and specific discussions of communications activities
  - Identification of resources (FY01 and FY02), tools and critical path items for each activity
  - Discussions of performance-based aspects, where applicable
  - Identification of cross-cutting activities

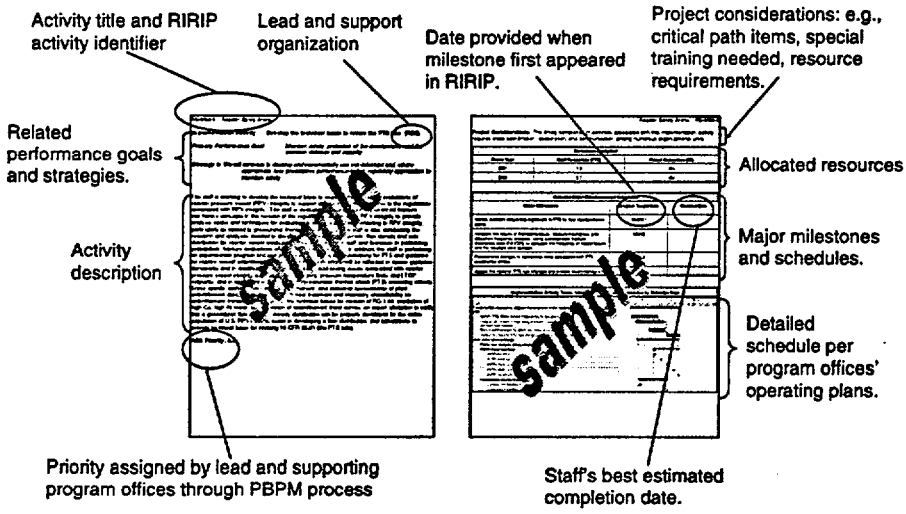
6

Content and Format

- Two primary sections:
  - Part 1: general discussion of risk-informed regulation
    - Relevance to Policy Statement and Strategic Plan
    - Guidelines for identifying "candidate" requirements
    - Factors to consider in risk-informing
    - Communication plans and training programs
  - Part 2: Descriptions of staff activities, including identification of cross-cutting activities
    - Activities tied to Strategic Plan: relevant performance goal(s) and strategy(ies) identified
    - Organized into two chapters:
      - Reactor Safety
      - Materials Safety and Waste Safety
    - Activity descriptions have several components:

7

Format: Activity Descriptions



8

Reactor Safety Arena

- Major Risk-Informed Initiatives
  - Technical Specifications
  - Reactor Oversight Process
  - Option 3
  - 10 CFR 50.69 (Option 2)
  - PRA Standards

9

Reactor Safety Arena

- Key Challenges
  - 10 CFR 50.69
  - 10 CFR 50.46
  - Risk-Informed Environment
  - Convergence of Rulemaking Program With Risk-Informed Processes

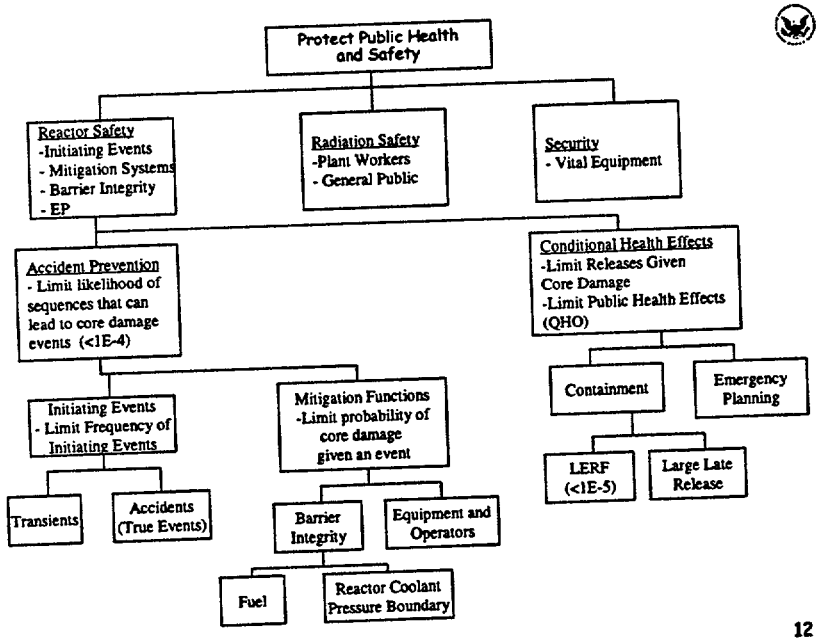
10

Reactor Safety: Risk-Informed Rulemaking Program

Goals:

1. Move forward with risk-informed regulation such that the regulatory structure converges with our risk-informed processes to the extent practical.
2. Apply following principles:
   - Consistency with defense-in-depth philosophy
   - Maintenance of sufficient safety margins
   - Consistency with intent of Safety Goal Policy Statement

11



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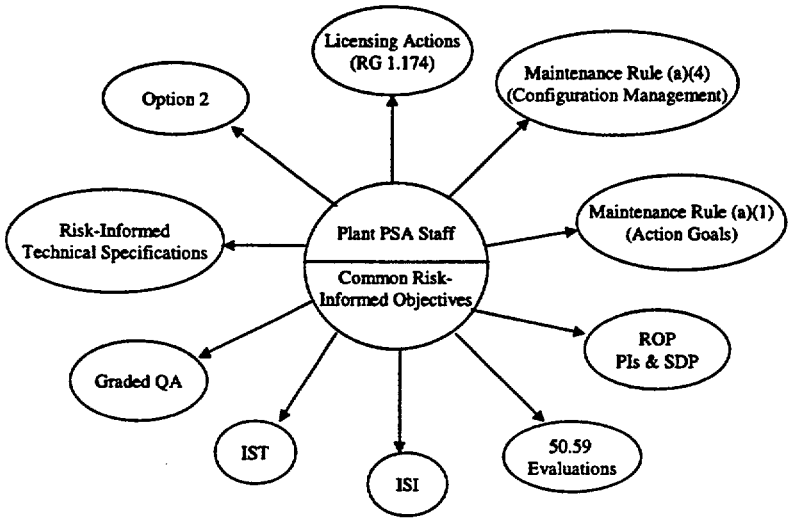

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Materials and Waste Arenas

- RIRIP presents 3-phase approach for risk-informing the Materials and Waste arenas
- Phase 1
  - Develop screening considerations and initial guidance
  - Conduct case studies
  - Develop proposed first draft of safety goals
  - Initiate staff training
  - Continue with ongoing risk-informed activities
- Phase 1 completed December 2001

14

Materials and Waste Arenas

- Phase 2 - underway
  - Identify and characterize materials/waste regulatory program areas
  - Develop matrix of completed and current risk-informed activities in each program area
    - Compare each against screening considerations
  - Use matrix-approach and insights from case studies to identify future risk-informed activities
    - Within program areas
    - Across program areas (cross-cutting activities)

15

Materials and Waste Arenas

- After Phase 2
  - Identify subset of future activities for near-term implementation
  - Prioritize risk activities within existing PBPM process
- Phase 3 - Implement activities (ongoing)

16

Materials and Waste Arenas

- Issues
  - Development of safety goals
  - Identification of cross-cutting issues
    - Evaluation of risk levels across program areas
  - Development of upper-level training
  - Continue in parallel with ongoing risk-informed initiatives and activities

17

Materials and Waste Arenas

- Upcoming milestones - Arena-wide
  - Issue final Screening Considerations and Implementation Guidance (March 2002)
  - Complete Phase 2, identifying future risk-informed activities (April 2002)
  - Continue to investigate and develop safety goals

18

Materials and Waste Arenas

- Upcoming milestones - Program-specific
  - FCSS: Revision to Inspection Manual Chapter 2604, Licensee Performance Review (March 2002)
  - IMNS: Report to Commission on the nuclear medicine pilot program conducted using a risk-informed, performance-based Temporary Instruction (March 2002)
  - SFPO: Proposed rule to risk-inform the Part 72 geological and seismological siting/design requirements (March 2002)
  - DWM: Consolidate and risk-inform decommissioning guidance
    - (Final Volume 1(August 2002); Draft Volume 2 (June 2002))

19

Next Actions

- Identifying additional Reactor Arena areas to be risk-informed
- Updating plan (June)
  - New activities
  - Improving display of interactions
  - Improving usability as a management and communications tool

20