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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

December 19, 2007

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on December 19, 2007, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

This transcript has not been reviewed, corrected and edited and it may contain inaccuracies.

1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

5 + + + + +

6 SUBCOMMITTEE ON RELIABILITY

7 AND PROBABILISTIC RISK ASSESSMENT

8 + + + + +

9 MEETING

10 + + + + +

11 WEDNESDAY,

12 DECEMBER 19, 2007

13 + + + + +

14 ROCKVILLE, MARYLAND

15 + + + + +

16

17 The meeting was convened in Room T-2B3 at

18 the Nuclear Regulatory Commission, Two White Flint

19 North, 11545 Rockville Pike, at 8:30 a.m., George E.

20 Apostolakis, Chairman, presiding.

21 MEMBERS PRESENT:

22 GEORGE E. APOSTOLAKIS Chairman

23 SAID ABDEL-KHALIK Member

24 J. SAM ARMIJO Member

25 DENNIS C. BLEY Member

1 MEMBERS PRESENT: (cont'd)

2 MARIO V. BONACA Member

3 MICHAEL CORRADINI Member

4 OTTO L. MAYNARD Member

5 WILLIAM J. SHACK Member

6 JOHN D. SIEBER Member

7 JOHN W. STETKAR Member

8

9 CONSULTANTS TO THE ACRS PRESENT:

10 THOMAS S. KRESS

11 GRAHAM B. WALLIS

12

13 NRC STAFF PRESENT:

14 MARY DROUIN

15 GARETH PARRY

16 JOHN MONNINGER

17

18 ALSO PRESENT:

19 JOHN LEHNER

20 DOUG TRUE

21 TIMOTHY WHEELER

22 KEN CANAVAN

23 DON VANOVER

24

25

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

2 (8:31 a.m.)

3 CHAIRMAN APOSTOLAKIS: The meeting will
4 now come to order.

5 This is a meeting of the ACRS Subcommittee
6 on Reliability and Probabilistic Risk Assessment. I
7 am George Apostolakis, Chairman of the meeting.

8 Members in attendance are Said Abdel-
9 Khalik, Sam Armijo, Dennis Bley, Mario Bonaca, Mike
10 Corradini, Otto Maynard, Bill Shack, Jack Sieber, and
11 John Stetkar. Also in attendance are ACRS Consultants
12 Tom Kress and Graham Wallis.

13 The purpose of the meeting is to discuss
14 draft NUREG-1855, "Guidance on the Treatment of
15 Uncertainties Associated with PRAs in Risk-Informed
16 Decisionmaking." The Subcommittee will gather
17 information, analyze relevant issues and facts, and
18 formulate proposed positions and actions, as
19 appropriate, for deliberation by the full Committee.

20 Dr. Hossein Nourbaksh is the Designated
21 Federal Official for this meeting.

22 The rules for participation in today's
23 meeting have been announced as part of the notice of
24 this meeting previously published in The Federal
25 Register on November 30, 2007. A transcript of the

1 meeting is being kept, and will be made available as
2 stated in the Federal Register notice.
3 It is requested that speakers first
4 identify themselves, use one of the microphones, and
5 speak with sufficient clarity and volume, so that they
6 can be readily heard.
7 We have received no written comments or
8 requests for time to make oral statements from members
9 of the public regarding today's meeting.
10 We will now proceed with the meeting, and
11 I call upon Ms. Mary Drouin to begin.
12 MS. DROUIN: Thank you, George. Before we
13 get started, I'd like to turn it over to our manager,
14 John Monninger.
15 MR. MONNINGER: Good morning, Professor
16 Apostolakis and fellow ACRS members. I'm John
17 Monninger. I'm the Deputy Director for the Division
18 of Risk Analysis within the NRC's Office of Nuclear
19 Regulatory Research.
20 I want to thank you very much for this
21 opportunity today to brief you and inform you on our
22 work relating to the development of NUREG-1855. This
23 is a very important project for the NRC, for both the
24 Office of Research and the program offices such as NRR
25 and NRO.

1 In looking through this report, or past
2 staff interactions with the ACRS, you will note that
3 this is a followup or this is a result of one of the
4 ACRS's recommendations back in 2003. The notion of
5 the treatment of uncertainty, or the importance of the
6 treatment of uncertainty, is recognized in both
7 deterministic analysis and is also recognized that it
8 is needed for risk analysis also.
9 As I mentioned, this is a joint project
10 with the Office of Research and the Office of Nuclear
11 Reactor Regulation. Supporting us is both Sandia
12 National Labs and Brookhaven National Labs, so we have
13 tried to pull together all of the available expertise
14 in developing this guidance document.
15 With that, we look forward to your
16 comments and recommendations from today's meeting.
17 And with that, I will turn it back over to Mary.
18 MS. DROUIN: Thank you, John. At the
19 table with me are three of the other primary authors.
20 To my left is Tim Wheeler from Sandia National Labs.
21 To my right is Gareth Parry with the Office of NRR,
22 and John Lehner from Brookhaven. Another primary
23 author to the document is Jeff LaChance, but
24 unfortunately he couldn't be here today. But I did at
25 least want him recognized.

1 This document has gone out for public
2 review and comment, then to the ACRS, but it was very
3 early on in the beginning of the work. And so this is
4 I think your all's first opportunity to really see
5 what we've done. I look tremendously forward to your
6 all's input to this document.
7 CHAIRMAN APOSTOLAKIS: When is the public
8 comment period ending?
9 MS. DROUIN: March 28th.
10 CHAIRMAN APOSTOLAKIS: So --
11 MS. DROUIN: We went out --
12 CHAIRMAN APOSTOLAKIS: Yes, go ahead.
13 MS. DROUIN: We went out for a substantial
14 period for public review and comment than we normally
15 do. You know, normally we go for 30, maybe 60 days.
16 We went for more on this, because we think this is an
17 important piece of work. We think there is a lot in
18 here to understand, so we really wanted to give the
19 public substantial time to really get into the
20 document.
21 You're going to hear this afternoon, and
22 you'll hear through today, because this has also been
23 a collaborative effort with EPRI. And there is pieces
24 of our document where we are relying on the EPRI work
25 and vice versa.

1 CHAIRMAN APOSTOLAKIS: So when do you
2 think will be a good time for you to come before the
3 full Committee? After you respond to the public
4 comments?
5 MS. DROUIN: I am going to get into that
6 towards the end of the slides.
7 CHAIRMAN APOSTOLAKIS: All right.
8 MS. DROUIN: We do want to come back. And
9 so when is the appropriate time in terms of the public
10 meetings and everything we're going to have?
11 CHAIRMAN APOSTOLAKIS: Right.
12 MS. DROUIN: Etcetera.
13 MR. KRESS: When you speak of
14 collaborative effort with EPRI, does that mean you'll
15 just read their report, or do you meet with them and
16 discuss things, or how does that work?
17 MS. DROUIN: Oh, we've had very extensive
18 meetings, one on one, several.
19 MR. KRESS: With the prime authors of the
20 EPRI report.
21 MS. DROUIN: Yes. We shared each other's
22 work.
23 MEMBER BLEY: Mary, one last thing before
24 you get into the presentation. I'd really appreciate
25 it if all of your speakers -- and I'll ask the others

1 as well -- if you can give us a sense as you go
2 through as to what's different with your document form
3 the two EPRI documents, and how they are
4 complementary, and how you see them all fitting
5 together.
6 MS. DROUIN: We're going to try and do
7 that.
8 MEMBER BLEY: Okay, thanks.
9 MS. DROUIN: It was already our intent.
10 So hopefully we will succeed in doing that for you.
11 Okay. You know, we are here to share the
12 approach. What our intent is to do is to walk you
13 through the document, chapter by chapter, and explain
14 what's in it. So I know I don't have to tell you,
15 stop any time and ask questions. But we're here to
16 get your input on this. I mean, this is the first
17 time. It is a draft. And even though it's not a huge
18 document in terms of number of pages, the information,
19 though, I think in it is somewhat complex and subtle
20 and can be difficult to communicate.
21 What you see here -- they don't have the
22 chapter numbers, but we're going to go through, as I
23 said, the chapters. And when you look at this, you
24 know, I mean, we're going to give a little bit of an
25 introduction. What we've tried to do is in this --

1 Chapter 2, which is the overview, to try and give an
2 overall picture of it, and then get into the details.
3 We thought it was very important for the
4 reader to kind of understand the context before we get
5 into the depths of the technical guidance in this
6 document. So let's just try and get started.
7 MR. WALLIS: Could you explain to a naive
8 member of the public what you mean by "uncertainty"?
9 I mean, if you had to explain it to somebody who
10 didn't have a technical background, how would you
11 explain what you mean by "uncertainty"?
12 MS. DROUIN: We have a whole chapter on
13 that.
14 MR. WALLIS: Yes, I know. But, I mean,
15 just how would you explain to somebody?
16 MS. DROUIN: Can we not wait until we get
17 to that part of the presentation?
18 MR. WALLIS: I guess we could. I was just
19 wondering if -- okay.
20 MS. DROUIN: Because I think it's a very
21 valid question.
22 MR. WALLIS: Because I think that what you
23 mean by it, it affects the way in which you answer the
24 question in the report. Do you want a measure of it
25 or something? Or what -- well, go on. We'll get into

1 it I guess later on. It would just help me to see --
2 this is the problem we have with uncertainty, this is
3 how we're going to deal with it. But anyway, go
4 ahead. Go ahead.
5 MS. DROUIN: Okay. Thank you. The
6 treatment of uncertainties has always been an issue,
7 something that the Commission has been addressing,
8 maybe not well but has always wanted to deal with.
9 And we've dealt with it in different ways. You go all
10 the way back to just the PRA policy statement, and in
11 there it talks about the treatment of uncertainty is
12 an important issue for regulatory decisionmaking.
13 You can go back to 1999 I think when the
14 Commission came out with their White Paper and talked
15 about the risk-informed approach, you know, needs to
16 explicitly identify and quantify the sources of
17 uncertainty. So as we started moving into PRA, and
18 looking at the risk associated from your -- I'm sorry,
19 the uncertainties associated with the risk analysis,
20 you know, the uncertainties became much more prevalent
21 in determining how to deal with them in our risk-
22 informed decisionmaking.
23 Prior to that, you know, we have the
24 safety margins and stuff like that that dealt with the
25 uncertainties or the unknowns. Now, as we move into

1 the uncertainties associated with risk, it demanded
2 more attention than just dealing with safety margins.
3 MR. WALLIS: Now you are talking -- I'm
4 sorry. You're talking about understanding. I think
5 some scientist once said that until you can put
6 numbers on something you don't have an understanding.
7 Is that your approach in this document?
8 CHAIRMAN APOSTOLAKIS: Which, in fact, it
9 was a consultant.
10 MS. DROUIN: I don't think you have to
11 have numbers to necessarily --
12 MR. WALLIS: Well, describing is not
13 understanding, is it? I mean --
14 MS. DROUIN: I don't think you have to
15 have quantitative numbers to understand --
16 MR. WALLIS: You don't?
17 MS. DROUIN: -- the uncertainty.
18 MR. PARRY: Basically, I think in terms of
19 understanding, what we mean is understanding where the
20 uncertainty originates and what its impact is on the
21 result. Some of that could be qualitative, some of it
22 could be quantitative.
23 MR. WALLIS: Presumably, it's desirable
24 where possible to make it quantitative?
25 MR. PARRY: Particularly where you need to

1 understand its significance, yes.

2 CHAIRMAN APOSTOLAKIS: Now, the first

3 paragraph on your slide, though, says that it should

4 be quantitative, right? Even the bounding analysis is

5 some quantitative analysis, so you are agreeing that

6 it's really quantitative. I mean, 1.174 says that.

7 MS. DROUIN: I mean, ultimately, when

8 you're making a risk-informed decision, and you're

9 using quantitative results, you certainly want to know

10 how the uncertainty is impacting those quantitative

11 results.

12 CHAIRMAN APOSTOLAKIS: So in that sense

13 it's quantitative.

14 MS. DROUIN: In that sense, yes, you know.

15 Okay. And what's important about this

16 slide is that, you know, this document is here to

17 support -- we view the NUREG-1855 as a support

18 document. Now, this isn't just all of them, but, you

19 know, here were three we thought significant documents

20 when you talked about risk-informed decisionmaking,

21 that this NUREG is intended to support, you know, Reg.

22 Guide 1.174, the PRA standards.

23 This is a critical document that it's

24 supporting, because when you look at the PRA standard,

25 the PRA standard, if you remember it, just tells you

1 what to do. It doesn't tell you how to do it. And so
2 the PRA standard is telling you, you know, you have to
3 identify your sources of uncertainty, and you need to
4 characterize them. And that's as far as the standard
5 goes.
6 So our work, and I think particularly the
7 EPRI work, is picking up at that point to give the
8 user that guidance in a sense of how to meet the PRA
9 standard.
10 MEMBER CORRADINI: So just to get back to
11 the questions of -- so that's really the key focus of
12 1855 is just to repeat what you said, which is to --
13 with the standard's words give a user guidance within
14 the context of the PRA?
15 MR. PARRY: Within the context of using
16 the PRA results to make decisions.
17 MEMBER CORRADINI: Okay. Excuse me. I'm
18 sorry.
19 MR. WALLIS: Well, how about the output
20 from the PRA? Output from PRA is usually a number,
21 like 10^{-6} or something. What is the output in terms
22 of uncertainty?
23 MS. DROUIN: Well, when you look at your
24 PRA and you have your output of $1E^{-6}$, you know,
25 associated with that, you will have your parameter

1 uncertainties associated with that.

2 MR. WALLIS: Is this a plus or minus? Is

3 it a percent, or is it -- what is the output measure

4 of uncertainty?

5 MR. PARRY: I think we'll be getting into

6 that.

7 MR. WALLIS: Are you going to tell us

8 that?

9 MR. PARRY: Yes. And also, I'd like to

10 suggest that it's not just a number that we focus on.

11 It's also what constitutes that number, and that --

12 where that number comes from. So I think we're going

13 to cover all of that in the subsequent discussions.

14 MR. WALLIS: As long as you get to my

15 bottom line at the end.

16 MR. PARRY: We probably will.

17 MR. WALLIS: This thing I described it,

18 how do you -- what's your output that you tell

19 somebody --

20 MR. PARRY: Yes.

21 MR. WALLIS: -- this is the uncertainty,

22 and, you know --

23 MR. PARRY: We will get to that.

24 MS. DROUIN: Right. As I said, we are

25 going to -- we have -- before we even get into the

1 decisionmaking part, we have three chapters where each
2 of them go through the different types of uncertainty
3 and how to deal with them. So you just bear with us.
4 I think John already spoke to this. You
5 know, this was another impetus of why we started the
6 program. The ACRS was very interested in this, and,
7 you know, wrote two letters to us. We did respond
8 that we were going to come back and deal with coming
9 up with a guidance document on the treatment of
10 uncertainty. So let's just kind of get to the
11 beginning.
12 Okay. Risk-informed decisionmaking, you
13 know, is an integrated process that -- usually risk
14 insights, and so since you're using risk insights you
15 have to be aware of the uncertainties associated with
16 those, both your epistemic and your aleatory. But
17 this document is primarily dealing with, of course,
18 the epistemic and then getting into your parameter,
19 your model, and your completeness, which we're going
20 to discuss in more detail.
21 But we're trying to provide guidance on
22 how to treat those various uncertainties in your
23 decisionmaking. And in order to do that, and to
24 achieve that objective, we think what we have to focus
25 on in this document is to provide guidance on the

1 understanding of the uncertainties associated with the
2 PRA -- you know, what the impact of these
3 uncertainties are on the results of the PRA, and then
4 understanding the uncertainties in the context of the
5 decisionmaking.
6 These we think are three critical issues
7 that have to be dealt with. And if we don't deal with
8 these issues, then trying to address the overall
9 objective of guidance of how to treat the
10 uncertainties in your decisionmaking, you won't be
11 able to get there.
12 So these three --
13 CHAIRMAN APOSTOLAKIS: Understanding,
14 though, is not good enough. Understanding and what to
15 do, right? I mean, you want people to understand, but
16 also you give them guidance what to do.
17 MS. DROUIN: Yes, right.
18 CHAIRMAN APOSTOLAKIS: Because, you know,
19 anybody can say, "I understand it."
20 MS. DROUIN: But all we're saying is that
21 in order to know what to do --
22 CHAIRMAN APOSTOLAKIS: Oh, you have to
23 understand.
24 MS. DROUIN: -- you have to understand
25 these things up front and --

1 CHAIRMAN APOSTOLAKIS: This is very
2 interesting. I mean, isn't that sort of self-evident?
3 But anyway, I know what -- I know where you're coming
4 from.
5 MS. DROUIN: You know what, George? You
6 would think it was. It would be interesting, when you
7 start talking with people that they don't have that.
8 CHAIRMAN APOSTOLAKIS: Oh, I'm with you.
9 MR. PARRY: And I think the focus we are
10 really making is that uncertainties are really only
11 important when you actually try to use the results.
12 So it's really in the context of the decisionmaking
13 that --
14 CHAIRMAN APOSTOLAKIS: I believe the ACRS
15 over the years has emphasized that point, right, that
16 you should --
17 MR. PARRY: Yes.
18 CHAIRMAN APOSTOLAKIS: -- focus on the
19 impact of uncertainties --
20 MR. PARRY: Right.
21 CHAIRMAN APOSTOLAKIS: -- on
22 decisionmaking. Otherwise, it's just an exercise.
23 MR. PARRY: Right.
24 MS. DROUIN: Exactly.
25 MR. PARRY: Exactly.

1 MR. WALLIS: I'm a little puzzled because
2 many engineers use tools without understanding them.
3 CHAIRMAN APOSTOLAKIS: But here they have
4 to understand.
5 MR. WALLIS: The important thing, first of
6 all, is to figure out what you're trying to do with
7 the tool. But anyway, go ahead.
8 MR. KRESS: Your second sub-bullet, the
9 red ones, I quite often have viewed uncertainties as
10 a result of the PRA. It's one of the results.
11 CHAIRMAN APOSTOLAKIS: Yes.
12 MR. KRESS: I was a little confused about
13 the way it's worded, the impact on the results. I
14 thought it was a result, properly done PRA, but maybe
15 I'm confused there.
16 MR. PARRY: I think that's semantics.
17 MR. KRESS: Yes, it's semantics I guess.
18 MS. DROUIN: I do think that is semantics,
19 because within your PRA you have uncertainties, and
20 what kind of impact those uncertainties have, because
21 by the fact that it's an uncertainty doesn't mean that
22 is the answer. Another answer could give you -- could
23 change the ultimate results of the PRA. So, yes,
24 those --
25 CHAIRMAN APOSTOLAKIS: But the results --

1 MS. DROUIN: -- in and of themselves are,
2 if you want to call those results coming out of the
3 PRA, yes.
4 MEMBER BONACA: So it's the conclusion you
5 can draw --
6 MR. PARRY: Yes.
7 MEMBER BONACA: -- from the PRA, very
8 specific engineering study you're performing.
9 MR. PARRY: Yes, that's really the third
10 bullet. It's the impact on the decisionmaking, that
11 impact, right.
12 CHAIRMAN APOSTOLAKIS: I think the second
13 sub-bullet could be the impact. The first and the
14 third aren't good enough.
15 MR. PARRY: Well, I think the second sub-
16 bullet needs some -- it's really trying to understand
17 -- what we're trying to get at -- and you'll see that
18 in the way we discussed it -- we're trying to look at
19 the origin of the uncertainty, how is that manifested
20 in the structure of the PRA model.
21 CHAIRMAN APOSTOLAKIS: Why don't you say
22 that? Because this is not --
23 MR. PARRY: This is a viewgraph, so, I
24 mean, I think we say it differently in the report.
25 MS. DROUIN: Well, let me put it this way.

1 We use those same words in the report, but there are
2 several paragraphs that go into the discussion of
3 that. But, again, you know, we would welcome any
4 comments to --
5 CHAIRMAN APOSTOLAKIS: I think the comment
6 from Tom really is that you should not give the
7 impression that the uncertainties are different from
8 the results of the PRA. And if you read it literally,
9 that's what it means. And I know you don't mean that,
10 but just rewording it. Okay.
11 MS. DROUIN: But before we move on, let me
12 -- I just want to talk to that for a second, not that
13 particular sentence but the point of what you're
14 trying to make. And I will say it is something that
15 we have struggled with. As the authors of the report,
16 we are so close to it that I do feel that this
17 document may suffer somewhat from the language in it.
18 That doesn't necessarily always convey the
19 exact meaning, so we do welcome those kinds of
20 insights as you read the report, to give those to us.
21 CHAIRMAN APOSTOLAKIS: I think Dr. Wallis'
22 comments come from that perspective, from the
23 perspective of an informed member of the public,
24 right? Mary just said that we are also --
25 MR. WALLIS: From IT at one time.

1 (Laughter.)

2 CHAIRMAN APOSTOLAKIS: Let's continue.

3 MS. DROUIN: Okay. The scope and
4 application of our document, you know, is focusing on
5 the use of the PRA insights and its results and ways
6 to address the associated uncertainties. And because
7 of that, the guidance, we want to make it very clear,
8 is limited to addressing uncertainties associated with
9 the use of the risk model results. It's not dealing
10 with uncertainties outside of the PRA, but strictly
11 with uncertainties coming from the PRA model.

12 The other two is that, you know, we're
13 trying to be consistent with NRC policy statement and
14 the Regulatory Guides 1.174, the national consensus
15 standard, and other industry-related work. We think
16 that this is -- we put this on the slide because we
17 thought this was very important, because just to have
18 the document out there in and of itself, that we're
19 trying to tie into these things and support, because
20 this is where the applications are occurring from this
21 other pieces of work. So this has got to be
22 consistent, be able to support those other regulatory
23 guides, etcetera.

24 CHAIRMAN APOSTOLAKIS: Well, you also want
25 to be consistent with the existing state of the art.

1 MS. DROUIN: Yes.

2 CHAIRMAN APOSTOLAKIS: You don't want to -

3 - this document is not intended to advance the state

4 of the art, right?

5 MR. PARRY: Right.

6 MS. DROUIN: Right. Okay. So how was

7 this report organized? Now, I just quickly -- very

8 quickly walked you through, you know, Chapter 1 and

9 the introduction. You know, that gets into the

10 objectives and the scope and application.

11 Chapter 2, which we're going to get into

12 next, is supposed to be a high-level summary of the

13 overall approach, so that before you're getting into

14 the details you have the complete picture of what this

15 document is to be about. And then, we start

16 submerging you, when you get to Chapter 3, into the

17 actual details.

18 MR. WALLIS: Okay. Chapter 2, you talk

19 about Reg. Guide 1.174, and you have various

20 principles, two of which are defense-in-depth and

21 safety margins, which are mentioned at various times

22 in the report. There was no connection ever made in

23 this report with these principles.

24 There's no indication that the PRA

25 uncertainties helped you evaluate in any way the

1 safety margin or defense-in-depth. I think you ought
2 to try to do that.
3 MR. PARRY: I'm not --
4 MR. WALLIS: Because you have safety
5 margins because of uncertainties. You have defense-
6 in-depth because of uncertainties. There must be a
7 connection of some sort. So they're all just lost in
8 the report.
9 MR. PARRY: It's somewhat tenuous, though,
10 the connection. The PRA cannot really -- the way
11 we've treated it in here is to say that defense-in-
12 depth and safety margins are essential because of the
13 things that we really don't know about. And if we
14 don't know about them, they are not going to be in the
15 PRA model. So they are treated as -- and that's the
16 reason why we still have them in our principles of
17 risk-informed decisionmaking. The PRA is just one
18 aspect of that decision.
19 So we're focusing in this document on the
20 stuff that we know that we've put in the model, the
21 stuff that we know that we haven't put in the model --
22 MR. WALLIS: Can I tell you something
23 about safety margins? When you do a full analysis of
24 mechanics, like failure of -- a mechanical failure of
25 something, by doing a statistical analysis of

1 uncertainty you can tell how to impose safety factors
2 or whatever. I mean, safety margin is often derived
3 from a study of uncertainties, and you can --
4 MR. PARRY: But we don't do that --
5 MR. WALLIS: -- do something with a PRA in
6 that regard, I'm sure.
7 MR. PARRY: We typically do not, but --
8 MR. WALLIS: You're not doing it.
9 MR. PARRY: No.
10 MR. WALLIS: You dismiss that as a
11 possibility, right?
12 MR. PARRY: Well, the -- we work on the
13 basis of the design basis of the component.
14 MEMBER SIEBER: Actually, if you look at
15 the history, defense-in-depth and safety margins came
16 long before PRA became a useful tool. And they were
17 put in there because they didn't -- just because of
18 the uncertainty principles that are expressed in this
19 paper now.
20 And in a deterministic sense, you didn't
21 know whether you did the problem right or not. They
22 put margin in. You didn't know whether you
23 characterized the problem or even addressed the
24 problem at all, so you put defense-in-depth in. I
25 think that's where it comes from.

1 MR. WALLIS: Well, let me give you an
2 example. I'm sorry to interrupt. When you come up
3 with a number, you're going to say later on you use
4 the mean value, right? Mean value of 10^{-6}. That's
5 what you tell the Commission, tell the public, that
6 the risk associated with a reactor is 10^{-6} CDF per
7 year.
8 If the uncertainty in that goes to -- and
9 it could range because of your uncertainties from 10^{-5}
10 to 10^{-7}, and if the 95th percentile gives you 10^{-5} or
11 something you might say, "Because of defense-in-depth
12 and safety margins, we are going to require that the
13 95th percentile meet some criteria." That is a
14 measure of safety margin to me.
15 MR. PARRY: Well, we could do that.
16 MR. WALLIS: Very clear.
17 MR. PARRY: That's not the way our
18 decision criteria are set up.
19 MEMBER BLEY: Can I -- something is
20 bothering me about the conversation. It seems to me
21 maybe you are putting too fine an edge on what is in
22 the PRA and what's not in the PRA. In the PRA, you
23 have success criteria. Many of those were set
24 originally by various sensitivity studies and
25 uncertainty examinations of -- to let you set success

1 criteria so that you know they will cover the whole
2 range under which you are applying them.
3 So I think there is some of the kinds of
4 thinking that could go into margins in what we do in
5 PRA, and the idea that you could use some of that to
6 help in setting margins is something that maybe has a
7 place in this report. Putting it out because it's not
8 done in PRA seems a fine line that is going to come
9 back to bite you later on somewhere.
10 MS. DROUIN: I don't think it's -- whether
11 or not, you know, you all want to -- us to expand the
12 scope of what we intended to do, you know, we can take
13 that under advisement and under consideration. That
14 was not part of the scope of what we were trying to
15 do.
16 Now, it's certainly something we can look
17 at, and we can consider, and it may well be that we
18 should expand the scope to that. But right now that
19 was not part of the scope of our piece of work. We
20 weren't trying to deal -- you know, we had a very
21 narrow scope, and just that narrow scope, in and of
22 itself, you know, was complex.
23 MEMBER BLEY: I understand. But let me
24 make one statement on that, and then we can go on, as
25 far as I'm concerned. George may have something else.

1 The way the scope is limited to the reader in this
2 area is that it's applied to what is in the PRA, and
3 that's a definition of the scope that I think means
4 different things to you folks than it does to me as a
5 reader. And I think it isn't sufficiently clear in
6 the report exactly what that scope is.
7 CHAIRMAN APOSTOLAKIS: And I agree with
8 that, but also I think you can make a connection by
9 referring to what Jack Sieber said. I mean, the
10 original defense-in-depth and the safety margin
11 concepts were developed to handle uncertainty.
12 Now, the PRA comes. The question is: is
13 it replacing those? No. Why not? Well, first of
14 all, PRA does not include the margins, right? And we
15 have tried to urge the staff to quantify those, and I
16 guess NRR objects. So what does PRA quantify? It
17 quantifies only a redundancy. If you have a one out
18 of two or one out of three system, yes, the PRA will
19 show a difference.
20 So I think these insights will be
21 important to put -- and then, you have the extra
22 problem, of course, of the unknowns, so you want to
23 have defense-in-depth, to maintain some defense-in-
24 depth because of that.
25 A nice discussion on these things I think

1 would place the whole thing in context, and it would
2 be useful I think.
3 MEMBER SIEBER: I think it goes further
4 than that, though, George because if you have margins
5 set in a deterministic way, you know, I really don't
6 know what the effect is. My success criteria -- you
7 know, something may be successful and not be operable,
8 believe it or not. And what the PRA does is give you
9 some idea as to how valid the margin really is.
10 And I think that fine tunes the
11 regulations or fine tunes the opportunity to regulate
12 without piling on, so to speak.
13 CHAIRMAN APOSTOLAKIS: Now, the issue of
14 margins is kind of a sensitive thing, because as I
15 said PRA really does not get into it. I mean, we are
16 given the success criteria and the PRA analyst works
17 against those. But the redundancy is done very well.
18 MR. PARRY: And remember, the other thing,
19 too, about PRA models is we don't deal with partial
20 failures. I mean, our components fail or they don't
21 fail.
22 CHAIRMAN APOSTOLAKIS: Sure.
23 MR. PARRY: It's a very disparatized
24 approach to looking at things, and we do it within
25 certain boundary conditions. So I think what I'm

1 hearing is a suggestion maybe we should be pushing the
2 state of the art a little bit in this area.
3 CHAIRMAN APOSTOLAKIS: No, no.
4 MR. PARRY: And I don't think we should be
5 doing that.
6 CHAIRMAN APOSTOLAKIS: I think what Graham
7 Wallis said fits very well within your earlier
8 statement that you want to look at the whole thing
9 within the decisionmaking process. If the
10 decisionmaking process has two boxes that say defense-
11 in-depth and safety margin, then maybe you can bring
12 those into the discussion, too, rather than focusing
13 only on the PRA element.
14 We are not asking you -- no, we're not
15 asking you to advance the state of the art, but
16 statements like the discussion of the last three or
17 four minutes would help I think.
18 MR. KRESS: Well, the quantification of
19 the uncertainty in distribution is a way to arrive at
20 the mean. And I was looking somewhere in there in
21 your discussion on acceptance guidelines. Just why
22 the Commission, for example, thought the mean was the
23 appropriate choice. Maybe it is. Apparently, they
24 thought so. But I didn't see any discussion on that
25 at all.

1 MR. PARRY: I believe it's in there.

2 MR. KRESS: Is it in there?

3 MR. PARRY: Yes.

4 MEMBER SIEBER: Yes, it's a different --

5 CHAIRMAN APOSTOLAKIS: We'll come to that.

6 MR. KRESS: I thought I read it was the

7 appropriate choice because the Commission said so.

8 MR. PARRY: No, no. There is also a

9 discussion of the various options that we looked at,

10 and it's in Chapter 7 I think maybe.

11 MR. KRESS: Yes. You noted the various

12 options, but you never said why the mean was the right

13 option to choose.

14 CHAIRMAN APOSTOLAKIS: Well, we'll come to

15 that, won't we?

16 MR. WALLIS: I'm sorry. I think this is

17 really -- this really is important, though, because

18 when decisions are made in the public arena people

19 don't -- you know, there's a question about PRA

20 results. And so when someone says, "Oh, 2 times 10^{-5}

21 is less safe than 1 times 10^{-5} in the PRA," people

22 will say, "We don't really believe that, because there

23 are so many uncertainties in the PRA."

24 If you really want to assure me that

25 something is safer than something else, I want a

1 factor of 10. That really reflects the uncertainties
2 in the PRA, and it reflects a safety margin. It's
3 inherent in the way people think about PRA, because it
4 is questionable what the results -- you know, how they
5 should be interpreted. People look for big safety
6 margins, and how far the PRA prediction is from what's
7 acceptable.
8 MR. PARRY: What we're trying to do in
9 this document is in fact to put the PRA results in
10 context given the uncertainties that we have and the
11 way that we construct the model. And it's part of the
12 information that goes to making a decision, and it's
13 only part of the information. It's not the -- we're
14 not risk-based.
15 MEMBER CORRADINI: So if I may --
16 MS. DROUIN: Can we go to this figure
17 that's up on the screen?
18 MEMBER CORRADINI: Before we go to the
19 figure, Mary, I guess I'm listening -- since I'm not
20 a practitioner in this, and I've listened to all you
21 guys who are practitioners, and you didn't have a
22 reaction to Dennis' comment and I'm kind of curious
23 what your reaction is, because I thought -- what I
24 thought he said was he'll accept your assumption that
25 you're going to do uncertainty or investigation of

1 quantifying or qualitatively understanding uncertainty
2 within the context of the PRA. But how you view it
3 and how he reads it are different.
4 So I'm kind of curious, if there is a
5 disconnect there, even if we allow you that this is
6 the way you guys are going to do it, it sounds to me
7 like people could misunderstood that.
8 So I'm -- I think I understand where
9 Graham is going, and you can agree or not agree to go
10 there, because that's not within your context, I'm
11 kind of curious what your reaction is to Dennis'
12 point, because I -- I'm trying to learn through all of
13 this.
14 MS. DROUIN: Can you repeat what your
15 point was, Dennis, please?
16 MEMBER BLEY: That's probably difficult.
17 (Laughter.)
18 MS. DROUIN: I thought we answered that.
19 MEMBER BLEY: No, it was -- it wasn't a
20 question. It was -- the way the conversation has gone
21 so far this morning has a lot to do with how you've
22 defined your scope. And a lot of the definition of
23 scope has to do with exactly what's meant -- how we're
24 looking at uncertainties within the PRA model.
25 I've taken that -- as I read it, I took

1 that a little more broadly than you did, and that
2 raised some questions. So my statement was I don't
3 think you've defined the scope up front in a way that
4 makes it unambiguous to the reader. Just saying we've
5 limited it to what's in the PRA, you have to go a
6 little further than that.
7 MS. DROUIN: Okay. But what is that
8 you're looking for that you -- why you think it's
9 ambiguous?
10 MEMBER BLEY: Well, I --
11 MS. DROUIN: Because I don't -- I don't
12 know what --
13 MEMBER BLEY: -- I began with the point of
14 you're saying you don't -- I drew an analogy -- at
15 least it was an analogy for me -- between the way one
16 sets success criteria in the PRA and these issues of
17 margin, in that when you do them, if some -- George
18 said somebody gives them to you. I don't know who the
19 heck gives them to you, unless you're just copying
20 them from a previous PRA.
21 But in the initial looking, you had to do
22 a fair number of sensitivity studies and some
23 uncertainty analysis to decide where to break your
24 success criteria, how to apply them, and how to make
25 sure the way you set them covered the full range of

1 events that were within that definition.

2 So that was a bit of this kind of

3 sensitivity looking and looking at the range of

4 things. From that, I could infer that you could do

5 some of the things that Jack talked about earlier.

6 You're saying, no, that's clearly out of the scope,

7 because we're only looking at what's in the PRA. So

8 I --

9 MS. DROUIN: Well, your success criteria -

10 -

11 MEMBER BLEY: -- I see it a little

12 differently.

13 MS. DROUIN: But your success criteria,

14 Dennis, is part of the PRA, and that is one source of

15 uncertainty that will show up. So since it's in the

16 PRA, it will be part of this document in the sense

17 that's a source of uncertainty.

18 MR. WALLIS: It won't push off?

19 Westinghouse tells me that two pumps will cool the

20 core rather than three, and you just accept that.

21 Then, it may well be there's a lot of uncertainty in

22 that success criteria depending upon the other

23 situations.

24 CHAIRMAN APOSTOLAKIS: It is a common

25 practice to question the success criteria, though.

1 Let's be honest here.

2 MR. PARRY: For some of -- yes, for feed-

3 and-bleed it certainly is.

4 CHAIRMAN APOSTOLAKIS: So in selective

5 cases --

6 MEMBER BLEY: And early on for LOCA

7 success it was. I mean, there were lots of --

8 MR. PARRY: Even now for LOCA success.

9 MS. DROUIN: If I translate your question,

10 your question really will be that when we get to that

11 part of the document that gives the guidance of how

12 you determine what are your sources of uncertainty, I

13 mean, that's what your real question is is whether or

14 not the document does that to the extent that it

15 should, such that you will be able to identify that as

16 a source of uncertainty.

17 MEMBER BLEY: And I guess since you've

18 been able to do those kind of things -- and I'll look

19 forward to seeing the discussion of those -- if I were

20 the decisionmaker making decisions about this plant,

21 and you had a PRA that had been done and I wanted to

22 wonder if the margins we've set for this plant are

23 reasonable in one area or another, and asked you,

24 "Gee, is there anything from the analysis in the PRA

25 that could help me understand that better?" why

1 wouldn't you be able to do some of that? Why is that
2 outside of scope?
3 MR. PARRY: What margins are you talking
4 about, Dennis? Can you define an example of one?
5 Because I'm really not seeing it right now.
6 MEMBER BLEY: Well, he could do the
7 Appendix K, but that's -- you could ask that one, but
8 probably they haven't looked at that one hard enough,
9 I'm pretty sure. But that would be one example.
10 If it -- is it limited to Level 1 PRA? I
11 forget what you said in the document.
12 MR. PARRY: Level 1 and LERF.
13 MEMBER BLEY: And LERF.
14 MR. PARRY: Yes.
15 MEMBER CORRADINI: Oh, so it is Level 2.
16 MS. DROUIN: Just as it pertains to LERF.
17 CHAIRMAN APOSTOLAKIS: Can we come back to
18 these questions when the staff talks about specific --
19 MS. DROUIN: Yes, because I really think
20 that your question is more into --
21 CHAIRMAN APOSTOLAKIS: -- aspects, because
22 I think at this point we have exhausted --
23 MS. DROUIN: -- do we have the guidance
24 sufficient to get into some of those things, and
25 should it?

1 CHAIRMAN APOSTOLAKIS: Yes, we'll come to
2 that.
3 MS. DROUIN: Now, you may not be
4 completely happy with what you see here, and I'm not
5 trying to punt, but this is where the NRC in the EPRI
6 work are merging/melding, and it's in the
7 identification of the sources of the model
8 uncertainty.
9 MEMBER BLEY: I'll think more about the
10 margin issue, but when it -- the margin question was
11 cut off, that that's clearly outside our scope. I
12 wasn't sure why, and I have to think more about
13 particular margins, so go ahead.
14 MS. DROUIN: Well, when we talk about
15 that, we're talking about -- when you come back here
16 to, you know, your principles for risk-informed
17 decisionmaking, you know, and this is the figure that
18 shows up, you know, of course in Reg. Guide 1.174.
19 What we're trying to point out here is that when you
20 look at the different principles, you know, with
21 principle 1 saying, you know, you have to meet your
22 current regulations, you know, keep defense-in-depth,
23 maintain safety margins, your risk-informed analysis,
24 monitor performance.
25 Now, we've sanitized these to be more

1 broad and not specific to an application of 1.174.
2 But what we're trying to point out, which I can't do -
3 - right there.
4 (Laughter.)
5 MEMBER BLEY: It's upside down and
6 backwards or something. It's kind of hard to --
7 MS. DROUIN: But anyway, the box there
8 that's, you know, bolded a little bit more, which is
9 the risk-informed analysis, that's the context of this
10 work. You know, we aren't dealing with the other
11 principles. We're dealing with the uncertainties
12 coming out of that risk-informed analysis as an input
13 to your risk-informed decisionmaking.
14 CHAIRMAN APOSTOLAKIS: But you can't
15 ignore the other two boxes. In fact, in some place I
16 recall your saying, "Under these circumstances,
17 compensatory measures would be required."
18 MS. DROUIN: Right. And --
19 CHAIRMAN APOSTOLAKIS: You are invoking
20 defense-in-depth there.
21 MS. DROUIN: Yes. When you get into
22 Chapter 7, Chapter 7 deals with principles.
23 CHAIRMAN APOSTOLAKIS: We'll do it when we
24 come to Chapter 7. I think this is too high level.
25 MR. PARRY: But just to put the context of

1 this report, though, we really are dealing with
2 uncertainties in the PRA model as an aid to helping
3 the licensees and ourselves understand how to meet the
4 ASME standard when we're doing a PRA in the context
5 of --
6 CHAIRMAN APOSTOLAKIS: So now you are
7 changing it. I thought you said it was in the context
8 of decisionmaking.
9 MR. PARRY: How we treat uncertainty in
10 the context of decisionmaking using the ASME standard
11 to support the claim that the PRA you're using is
12 technically adequate. That's a long statement.
13 CHAIRMAN APOSTOLAKIS: Yes, but it's --
14 MR. WALLIS: In the model, you have these
15 branches where you go this way or that way depending
16 on various success criteria. Success criteria are
17 probably part of the model.
18 MS. DROUIN: They are part of the model.
19 MR. WALLIS: So uncertainties in the
20 success criteria are part of the uncertainty.
21 MS. DROUIN: We just agreed to that.
22 MR. WALLIS: Well, I didn't see it.
23 MEMBER SHACK: But you do have this thing
24 about consensus models where you sort of throw away
25 uncertainties once you've decided on the consensus

1 model.

2 MR. PARRY: We do, but let's get to that.

3 CHAIRMAN APOSTOLAKIS: Are we going to

4 come to all of these questions?

5 MS. DROUIN: Yes.

6 MR. PARRY: Yes.

7 CHAIRMAN APOSTOLAKIS: Okay. Right now,

8 let's go on. What is this top diagram doing there,

9 with the sacred top diagram?

10 MS. DROUIN: I'm sorry?

11 (Laughter.)

12 CHAIRMAN APOSTOLAKIS: The top diagram is

13 something we all know.

14 MS. DROUIN: Yes.

15 CHAIRMAN APOSTOLAKIS: It has been

16 reviewed --

17 MS. DROUIN: Yes.

18 CHAIRMAN APOSTOLAKIS: -- to death. And

19 then, you are adding on the same slide a bunch of

20 boxes. What is that? The bottom part, what is it?

21 MS. DROUIN: That should be a familiar

22 figure, again, also. And what we were trying to say

23 is that in the decisionmaking process, you know, we

24 are dealing with -- when you see it come out of the --

25 perform a risk-informed analysis, which is one of the

1 principles of your risk-informed decisionmaking, is
2 that you've got your deterministic part and you have
3 your probabilistic part, and we're assessing the
4 uncertainties coming out of the probabilistic analysis
5 as input into your integrated decisionmaking. It
6 wasn't supposed to be any more complicated than that.
7 CHAIRMAN APOSTOLAKIS: Yes. Again, that
8 sends the wrong message, that after you do the
9 probabilistic analysis you assess the uncertainties.
10 And some members object to that.
11 MEMBER STETKAR: And that's wrong.
12 CHAIRMAN APOSTOLAKIS: The uncertainties
13 are part of the probabilistic analysis.
14 MEMBER BLEY: And your text says that.
15 MS. DROUIN: Right.
16 MEMBER BLEY: But the picture doesn't.
17 CHAIRMAN APOSTOLAKIS: The picture
18 doesn't.
19 MEMBER BLEY: So it's a comment on the
20 artwork on the figure and --
21 MS. DROUIN: Do you want that arrow going
22 certain ways?
23 MEMBER BLEY: The uncertainty is an
24 overview on all of those three pieces. It doesn't
25 flow as something that gets tacked on after the PRA,

1 please. And your text says that, but --

2 MS. DROUIN: Yes.

3 MEMBER BLEY: -- I hate to see that

4 figure, because the figures will float around.

5 MR. WALLIS: Well, Mary, the arrows all go

6 in one direction here. If this were designed for --

7 I would say it ends up at five, so I want you to

8 define in Chapter 1 what kinds of things the

9 decisionmaker needs to know in terms of uncertainties.

10 Define it at the beginning, and then it should be

11 clear that the document leads to giving him what he

12 needs. And I'm not quite sure that you do that. You

13 talk all these are forward -- about understanding

14 things and so on. But what is it the guy at the end

15 really needs to know?

16 MR. PARRY: I think what he needs to know

17 -- and I think we say that here -- is that he needs to

18 know that the results that we're using for the PRA to

19 assist in making the decision, that he can have

20 confidence in the decision -- in meeting that decision

21 that says that the risk-informed analysis says that

22 the risk impact is --

23 MR. WALLIS: He's going to ask you, how

24 confident do I need to be? And how do I measure my

25 confidence? He's going to ask you questions like

1 that.

2 MR. PARRY: All right.

3 MR. WALLIS: And you're going to have to

4 say, "These are the kinds of questions he's asking me.

5 Now I've got to supply an answer to his question."

6 MR. PARRY: And that's what we're trying

7 to do.

8 MR. WALLIS: Okay. Could you maybe --

9 just advice about how I would write the report. But

10 think about it a bit.

11 MS. DROUIN: Let's go ahead and go to

12 slide number 11. This is getting to the document at

13 this point, because it seems like you guys want to get

14 into the details.

15 CHAIRMAN APOSTOLAKIS: Yes, we do.

16 MS. DROUIN: You don't want any -- so

17 let's just --

18 MEMBER BLEY: One short comment on

19 Chapter 2. You jump into the kind of uncertainty we

20 can deal with is epistemic, and here's the things

21 we're looking at, kind of out of the blue when I come

22 to it, without defining the aleatory part and that

23 you're not doing it. Just a comment on how the

24 presentation goes. It just -- all of a sudden there's

25 epistemic and no aleatory, and it leaves me wondering

1 why. I figure out that that's not part of your
2 charter, but it -- it didn't flow.
3 MEMBER SIEBER: You are required to use
4 the words, though.
5 MR. PARRY: Okay. Let me talk about
6 Chapter 3, right?
7 MS. DROUIN: Yes. I mean, I'm a little
8 bit hesitant, but -- because I don't feel like we've
9 really kind of explained how this whole thing is put
10 together. But let's just start jumping into it. So
11 go ahead.
12 CHAIRMAN APOSTOLAKIS: Are you going to
13 tell us how it was put together? I mean, it's your
14 presentation.
15 (Laughter.)
16 PARTICIPANT: That's not evident.
17 (Laughter.)
18 MS. DROUIN: Thank you very much for that
19 statement. I didn't have --
20 CHAIRMAN APOSTOLAKIS: Standing Committees
21 on slide 10. That is how you put everything together.
22 MS. DROUIN: Oh. I think at this point
23 let's move to Chapter 3.
24 MR. PARRY: Okay. What we've tried to do
25 in Chapter 3 is to really set the scene for what it is

1 we're dealing with in terms of uncertainty. So the
2 first thing we try and do is to define what we mean by
3 a PRA model, which is the subject of this report, and,
4 in particular, to try and characterize what -- try and
5 explain the essential characteristics of the PRA
6 model. Not to go in great detail, but to go
7 sufficiently to support the remainder of the report.
8 As a result of that, then we want to focus
9 on what are the types of uncertainties that result out
10 of trying to create a PRA model, so that we can set
11 the scene for the remaining chapters, which tell you
12 how to deal with those types of uncertainties.
13 Go on to the next.
14 So what we do in the first part of
15 Chapter 3 is -- just to put the thing in context is to
16 just remind people that PRA is a model, and that all
17 models are approximations. And this is important
18 because there are different understandings of what we
19 mean by "uncertainty."
20 Some of them -- and we're trying to make
21 the distinction between things that arise because of
22 the approximations that we're making, and things that
23 arise because we -- a function of our state of
24 knowledge. So the statement we're making is that if
25 you're going to use a PRA model to help you make

1 decisions, then you need to understand exactly what
2 that model does.
3 That means you've got to understand the
4 scope and the level of detail that's inherent in the
5 model you've constructed, and you've got to
6 understand, too, that this is a model that has --
7 we're looking at rare events.
8 It's not a model that you can validate or
9 verify. It's -- and we know that there are
10 uncertainties on how to model the phenomena and the
11 equipment behavior that we have to model in the PRA.
12 The last -- well, the last of the second
13 order of bullets on this slide says the scope and
14 level of detail are at the discretion of the analyst.
15 To some extent, that's true. But to a large extent,
16 if an analyst tries to build a PRA model and meet the
17 ASME standard, for example, then he is going to have
18 a certain defined level of detail. It's going to be
19 detailed enough that the dependencies are modeled
20 correctly, for example.
21 But it doesn't tell you how many systems
22 you need to model to address a specific function. So
23 if you're in a boiling water reactor, for example, you
24 have all sorts of low pressure systems. This standard
25 does not tell you that you have to include all those

1 systems. It's really up to the analyst to decide how
2 many he decides to --
3 CHAIRMAN APOSTOLAKIS: But, Gareth, this
4 sub-bullet gives the impression that there is a lot of
5 arbitrariness there. Isn't it better to say that the
6 scope and level of detail are dictated by the needs of
7 the decisionmaker?
8 MR. PARRY: Yes, actually. And that --
9 CHAIRMAN APOSTOLAKIS: That really is the
10 accurate statement. The decisionmaker --
11 MR. PARRY: And that is exactly what we
12 state in the --
13 CHAIRMAN APOSTOLAKIS: I'm sorry?
14 MR. PARRY: That is what we state in the
15 report. This is --
16 CHAIRMAN APOSTOLAKIS: Why are you trying
17 to mislead us with the slides? This is the second
18 time you are saying the slide --
19 MR. PARRY: Actually, I'm not really done
20 listening to --
21 CHAIRMAN APOSTOLAKIS: You want to see if
22 we are paying attention?
23 (Laughter.)
24 MEMBER BONACA: The text has some of the
25 same message, and you get a message that there is a

1 level of arbitrariness, that, you know, you get a
2 sense that -- and it probably is true, that, you know,
3 in most --
4 CHAIRMAN APOSTOLAKIS: No, it's not true.
5 MEMBER BONACA: -- the model built by
6 another individual could have -- what bothered me was
7 that it could have significantly different results,
8 and that's really what bothered me.
9 MR. PARRY: Okay. But that's -- but what
10 we do say in there is that we don't expect those
11 differences to lead to major differences in the
12 results, because the fact is that if you are going to
13 build it according to the standard then you do have a
14 certain amount of --
15 MEMBER BONACA: In fact, at some point you
16 get to that point there.
17 MR. PARRY: Right.
18 MEMBER BONACA: As I was reading, however,
19 I really had a sense that -- I said, well, there is no
20 -- so I think that maybe if --
21 CHAIRMAN APOSTOLAKIS: If it is
22 decisionmaker -- decisionmaking focused, the whole
23 thing, I think you should say that here, too.
24 MR. PARRY: I think in the text we do say,
25 in fact, that the level of detail is determined --

1 that you need is determined by the decision you are
2 trying to make using the PRA.
3 CHAIRMAN APOSTOLAKIS: Why not say it in
4 the slide, too? It's not at your discretion.
5 Now, the direct verification issue, I know
6 where you're coming from, but I think you should
7 elaborate a little more and say, you know, we are
8 looking at the past experience of 30, 35 years. The
9 accidents or the incidents that we have seen are in
10 the PRA one way or another. Maybe not the details,
11 but they are included.
12 The AEOD, or the former AEOD, is doing all
13 of this analysis over the years with Idaho, and
14 unavailabilities of safety systems or the
15 unavailabilities in the PRA. You know, there is -- I
16 mean, it's not as bad as it may sound.
17 MR. PARRY: This is a lesson that I should
18 have learned from my past appearances here.
19 (Laughter.)
20 I shouldn't write anything on viewgraphs,
21 because you focus on the words that are there rather
22 than the message that we're trying to do in the
23 report. Let's move on to the next slide.
24 MR. KRESS: Well, let me ask you a
25 question.

1 MS. DROUIN: We have to -- can I jump in?

2 MR. KRESS: Go ahead.

3 MS. DROUIN: I mean, if you look at the

4 report, the report does say the analyst constructing

5 the PRA model determines its scope and level of

6 detail. And you have to understand, it's an iterative

7 process. When the analyst is first developing the PRA

8 model, he doesn't know all of the different

9 applications. And he is going to make a decision on

10 the scope and level of detail.

11 Then, the decisionmaker comes in and the

12 PRA scope and level of detail may not be sufficient to

13 support, and then you have a decision to make. You

14 know, now do you expand the PRA so that it does cover

15 that? Can it go to the scope and level of detail?

16 The decisionmaker needs to make -- I mean, it --

17 CHAIRMAN APOSTOLAKIS: But what's the PRA

18 I will be talking about? The PRA that is actually

19 used in a decision.

20 MS. DROUIN: That's right.

21 CHAIRMAN APOSTOLAKIS: Because I have seen

22 over the years, you know, especially people who want

23 to be critical, they pick a number from some exercise

24 how bad it did, and say, "Well, there is no basis for

25 this. The whole thing is garbage."

1 The real question is: has any responsible
2 decisionmaker, like the Nuclear Regulatory Commission,
3 has it ever made any decisions using those garbage
4 numbers? And the answer is no.
5 So it really has to be repeated all the
6 time that it's decisionmaking that drives the needs of
7 the model. Anybody can do something according to a
8 PRA. That's not a PRA in the sense that we are
9 talking about here. It's a PRA that will actually be
10 used to make a decision.
11 MS. DROUIN: But all I'm trying to say is
12 that the initial decision when you've got that blank
13 piece of paper, and you're going to create your PRA
14 model, you don't know the decisions that are going to
15 be used with that model.
16 CHAIRMAN APOSTOLAKIS: But the ASME model
17 -- standard tells me that there will be a Category 1,
18 Category 2, so you have some idea.
19 MS. DROUIN: No, no. The category --
20 MR. PARRY: Not the level -- well, not to
21 the level of detail in terms of how many systems you
22 take credit for, for example. Well, no, it -- we
23 address that.
24 CHAIRMAN APOSTOLAKIS: Jack?
25 MEMBER SIEBER: I think one of the

1 weaknesses is in the model uncertainty. For example -
2 - I can give you a couple of examples. One of them is
3 a pump that is supposed to perform to deliver water to
4 a certain vessel under certain pressures and
5 temperatures and flows. That pump may be degraded,
6 and from an operability standpoint it's considered
7 inoperable.
8 And at the other end of that, we don't
9 know for certain what the conditions truly are that
10 the pump is pumping into. So that represents -- if
11 you just say, "If it's operable, then it's a success.
12 If it has a failure probability, that means it's not
13 operable and it fails." Those things are too simple
14 in order to make a discrete decision about, for
15 example, can you supply water to the core under
16 accident conditions.
17 And I think that this document, even
18 though it's designed as a -- to me it's an overview
19 kind of a document, it touches on these things. But
20 if a plant manager assigns somebody to do the PRA, and
21 then he turns around and says, "I want to make
22 decisions based on that," it very well could be that
23 neither the plant manager or the PRA person knows the
24 intricacies of how to model certain events in the
25 plant.

1 CHAIRMAN APOSTOLAKIS: Well, yes, that's
2 true.
3 MEMBER SIEBER: On the other hand -- and
4 so there may come under 1.174 decisions about whether
5 it's okay to modify the plan. And to me that's -- you
6 know, I think the state of the art has to have
7 standards that are more concise and more complete than
8 what this document, and also what the PRA standards
9 are.
10 CHAIRMAN APOSTOLAKIS: But my point is
11 that when the plant manager, in fact, wants to make a
12 decision using that model, that's when these questions
13 come up. That's when some of the analyses that the
14 staff is proposing under model uncertainty could be
15 done, some sensitivity work, if this or that, and to
16 me that is that PRA.
17 It's the tool that is used by somebody to
18 make a decision, because before that, you know, it's
19 just an analysis that is sitting there waiting to be
20 used by somebody.
21 MR. PARRY: Actually, when we get to
22 slide 14, you'll see the statement that --
23 CHAIRMAN APOSTOLAKIS: Okay. So this is
24 now 13?
25 MR. PARRY: We'll go to 13, and then we'll

1 get to that point again.

2 MS. DROUIN: Okay.

3 MR. KRESS: Let me ask you a question

4 before you get there, Gareth. It's a simple question.

5 CHAIRMAN APOSTOLAKIS: Unlike the other --

6 MR. KRESS: Yes. They're complicated.

7 MS. DROUIN: Tom, you have a simple

8 question?

9 MR. KRESS: Okay.

10 MS. DROUIN: We'll raise the flag.

11 MR. KRESS: Be wary when a Tennessean says

12 this is --

13 (Laughter.)

14 I'm a decisionmaker, and I want to make a

15 decision involving the mean of a CDF. I've got a PRA

16 of limited scope. It doesn't have seismic, it doesn't

17 have fire, and it doesn't have low-power shutdown, and

18 I've got a CDF out of it.

19 Now, what my -- my decision is involving

20 the mean value of a CDF. Now, how do I take these

21 missing elements, translate them into some sort of an

22 uncertainty, and move my -- how do I know how to move

23 my mean to a different value? Is this not discussed

24 in the report.

25 MR. PARRY: If you don't do an analysis,

1 you can't say anything about it.

2 MR. KRESS: Well, you --

3 MR. PARRY: We discuss a little bit what

4 you do if you don't have those analyses, and you can -

5 - it wouldn't be a good example for your case. You'd

6 have to restrict your decision to the information that

7 you know.

8 MR. KRESS: What I do know is people have

9 made estimates of the effect of fire and estimates of

10 low power and shutdown. And these are -- these are

11 some sort of estimate on the effect on the means for

12 specific plants. I have information, and is there a

13 way to --

14 MS. DROUIN: I don't think that you can do

15 an estimate of how those things may affect that mean.

16 You just can't. But what you can do, and what we get

17 into in that chapter on completeness, is you can use

18 information in terms of what effect that may have on

19 your risk in terms of bounding it. But in terms of

20 the impact on that number for your Level 1 CDF, I

21 don't see where --

22 MR. KRESS: That may be the question. If

23 I can use these and say that -- I can change my mean

24 to a value that I know bounds it, then that's --

25 MR. PARRY: Yes, we do discuss that.

1 CHAIRMAN APOSTOLAKIS: There is a
2 discussion on completeness.
3 MR. PARRY: Okay.
4 MS. DROUIN: But I'd like to come back and
5 say something about the standard in all of this. The
6 standard tells you, you know, what to do, and it goes
7 to a certain level of detail. But the standard
8 recognizes that the scope and level of detail, as
9 dictated through their requirements, may not be
10 sufficient for every application that's out there, and
11 that's the whole purpose of Chapter 3.
12 And it's not until -- so that's what I'm
13 saying. A priori, when you are doing your PRA and
14 establishing that level of detail, you may not have
15 established a level of detail adequate enough for a
16 particular decision you're making. And Chapter 3
17 walks you through how you come and make that
18 determination.
19 CHAIRMAN APOSTOLAKIS: Chapter 3 of this
20 report?
21 MS. DROUIN: Of the standard.
22 MR. PARRY: Of the standard.
23 CHAIRMAN APOSTOLAKIS: ASME standard.
24 MR. PARRY: Yes.
25 CHAIRMAN APOSTOLAKIS: Yes.

1 MS. DROUIN: So, I mean, ultimately the
2 decisionmaker, you know, is going to have a need he's
3 going to have to have fulfilled. But 99 percent of
4 the time that comes after, you know, he already has
5 the PRA model.
6 CHAIRMAN APOSTOLAKIS: So I think it would
7 be helpful in the introductory part of the report to
8 state which PRA you are talking about. You are
9 talking about a general model that may have a number
10 of applications, right? Rather than the PRA that will
11 be used for a specific application.
12 MR. PARRY: No, I don't think so. I think
13 we are talking about a PRA model that is being used
14 for the -- what we're really talking about is the use
15 of PRA results in decisionmaking. If that means that
16 you have to go back and refine the model, then that's
17 what you'd have to do. We are really talking -- what
18 we are really addressing here is how you use the
19 results in decisionmaking, and how the uncertainties
20 in the results affect that decisionmaking.
21 MS. DROUIN: Well, we do get into -- and
22 you'll see in the words -- you know, we talk about the
23 base PRA. And maybe we need to expand more. But when
24 we talk about the base PRA, that's the PRA you're
25 starting with.

1 CHAIRMAN APOSTOLAKIS: That's what I mean.
2 MS. DROUIN: You may refine --
3 CHAIRMAN APOSTOLAKIS: For individual
4 decisions. So this is more --
5 MS. DROUIN: That's right.
6 CHAIRMAN APOSTOLAKIS: -- like when -- in
7 the -- about 20 years or so ago, you know, like
8 various companies would do the PRA for Seabrook, the
9 PRA for Indian Point. I don't think they had a
10 specific decision in mind. They did the PRA --
11 MS. DROUIN: Exactly.
12 CHAIRMAN APOSTOLAKIS: -- and that's what
13 you're talking about.
14 MS. DROUIN: That's what I'm talking
15 about.
16 CHAIRMAN APOSTOLAKIS: And a specific
17 decision you may go back and question some success
18 criteria or do something more on human error, and so
19 on.
20 MEMBER BLEY: But once you do that, if you
21 follow that process, you've got a new base.
22 MS. DROUIN: Then you have a new base.
23 CHAIRMAN APOSTOLAKIS: For that decision.
24 MS. DROUIN: For that decision.
25 MEMBER BLEY: Well, if you've extended the

1 scope of the PRA, you've now got a new PRA. If you've
2 actually had to -- if you didn't just do a bounding
3 analysis, but you went back and expanded your PRA to
4 cover the issue.
5 MS. DROUIN: That's true. You have
6 created a new base PRA model, yes.
7 MEMBER BLEY: But you'd probably keep --
8 MEMBER SIEBER: There is nothing that
9 makes you do that except your own sense of
10 professionalism.
11 MEMBER BLEY: And your desire to apply it
12 to a particular --
13 CHAIRMAN APOSTOLAKIS: Well, and the
14 state-of-the-art changes, you know. That's why
15 people, you know, you see PRA Rev 3, you know, over
16 the years. It's updated.
17 MEMBER SIEBER: My impression may be
18 wrong, but when PRAs first came out, if you tracked
19 individual plants, the risk has declined and I think
20 it has declined because the PRAs have become more
21 sophisticated and the modeling has become better.
22 CHAIRMAN APOSTOLAKIS: That's a
23 significant contributor, but also there have been
24 other changes in the plants themselves.
25 MEMBER SIEBER: Yes, there at the plant

1 and --

2 MR. PARRY: And as you add the different

3 scope items like fires, the PRA -- the CDF goes up

4 again. So it's --

5 MEMBER SIEBER: Yes, right.

6 MR. PARRY: -- it's a mixed bag.

7 MEMBER SIEBER: Yes, but that's

8 explainable.

9 MEMBER CORRADINI: I have a different

10 question. So when I read Chapter 3, is it -- is the

11 audience for this somebody who is doing PRAs and needs

12 to understand the context you want the PRA to be done

13 in? Or is it -- the audience somebody that is

14 learning to -- beginning to learn the PRA process?

15 CHAIRMAN APOSTOLAKIS: This is not a

16 tutorial, is it?

17 MR. PARRY: It's not a tutorial, no.

18 MEMBER CORRADINI: So it's basically for

19 those that are using it.

20 MR. PARRY: Yes.

21 MS. DROUIN: Yes.

22 MEMBER CORRADINI: For experts.

23 MR. PARRY: Right.

24 MEMBER CORRADINI: Okay.

25 CHAIRMAN APOSTOLAKIS: Okay. Let's go on.

1 MR. WALLIS: Wait a minute, wait a minute,
2 wait a minute. You've put something up here. An
3 accident sequence is simplified discretized
4 representation.
5 MR. PARRY: Yes.
6 MR. WALLIS: How much uncertainty is
7 introduced by discretization? I mean, the idea that
8 one pump or two works or doesn't work? It's a big
9 simplification, right?
10 MR. PARRY: Yes.
11 MR. WALLIS: There must be some
12 uncertainty introduced by the very fact that you're
13 discretized.
14 MR. PARRY: That's why --
15 MR. WALLIS: Do you know how to handle
16 that type of uncertainty?
17 CHAIRMAN APOSTOLAKIS: Let the man speak
18 for just a minute.
19 MR. WALLIS: Do you know how to handle
20 that type of uncertainty?
21 MR. PARRY: That's the whole point of --
22 MR. WALLIS: Is there a technology when --
23 you can't treat one and a half pumps, apparently. Or
24 can you go back to the PRA and say, "We redesigned the
25 model, so we can treat one and a half pumps working,

1 not just one or two"?

2 MR. PARRY: No, we don't-- we don't do

3 that.

4 MR. WALLIS: So how do you estimate what

5 you lose in terms of precision by discretization?

6 MR. PARRY: I think what we do is we learn

7 to live with the lack of precision. And the whole

8 point of, really, this slide and the first bullet is

9 that, in fact, it's a recognition that the PRA model

10 is not the complete model of all of the --

11 MR. WALLIS: Well, I'm not asking that.

12 I'm asking, how do you estimate or measure the

13 uncertainty associated with this?

14 MR. PARRY: And that's why I'm going to

15 try and tell you that we really do not --

16 MR. WALLIS: Do not, okay.

17 MR. PARRY: In the sense that

18 discretization tends to be somewhat conservative,

19 right, we lump things together in terms of like if --

20 for example, if we had a -- group initiating events,

21 we don't treat each initiating event separately; we

22 group them.

23 And the rules for grouping them are that

24 you group them so that things that are subsumed within

25 the group have the dominant -- the dominant

1 contribution of that group comes from the things that
2 bound the consequences of the initiating events that
3 are absorbed within that group.
4 MEMBER CORRADINI: Can you say that again,
5 please?
6 MR. PARRY: I'll try to.
7 (Laughter.)
8 MEMBER CORRADINI: It looks like you tried
9 to formulate -- so I want to make sure I understand.
10 MR. PARRY: The way we do grouping is to
11 make sure that something that's grouped into that
12 group does not have a worse --
13 MR. WALLIS: You are being conservative.
14 So being conservative isn't the same thing as
15 understanding uncertainty. To be conservative is sort
16 of philosophy.
17 MEMBER SIEBER: Well, you're blowing by.
18 Uncertainty --
19 MR. PARRY: Okay.
20 MR. WALLIS: All right.
21 MEMBER SIEBER: -- comes through an
22 answer.
23 MR. PARRY: Would you hold off and let me
24 try and talk through this? Because it is a
25 significant point, and it relates to -- it has

1 ramifications throughout a lot of the stuff that we've
2 been discussing outside of this context, in particular
3 in combining the results from different scope items.
4 Okay?
5 So all we're saying here is: what is the
6 PRA model? Well, first of all, it's the second
7 discrete accident sequences, right? With success
8 criteria that are stated quite -- it's either one pump
9 or it's two pumps. It's things like that.
10 Another thing that we have to recognize,
11 because it's relevant later on, is that this model has
12 -- it's a nested set of models, if you'd like. Right?
13 You build accident sequences, and the way you quantify
14 the probability of the function lost for those
15 functions that appear on the event tree is through
16 models like fault trees. Those at the bottom have
17 basic events in them.
18 So we have lots of models for these
19 different basic events. So it's a nested set of
20 models that's essentially probabilistic.
21 Okay. When you construct a model, right,
22 you make certain assumptions. And we've been very
23 careful to try to make the distinction between
24 assumptions that are related to the scope of the PRA
25 model or the level of detail. Now, and those that

1 relate to model uncertainty, okay?

2 The ones that relate to the level of

3 detail are the types of things that you are talking

4 about. Okay? And a lot of those things are

5 conservative assumptions that we've built into the

6 model. So we have to recognize that some of the

7 results we are producing are conservative.

8 So that's the distinction we're trying to

9 make there. We're trying to talk about things that

10 are really -- they're done to make the model

11 tractable. There are other things that we --

12 assumptions we make because, well, maybe we're not --

13 we don't have a detailed understanding of some of the

14 phenomena, so we have to make assumptions of how we

15 are going to model those. Those are different, and

16 those are the types of things that probably we're

17 going to go after in this document.

18 There are other things in this -- when

19 you're characterizing the PRA model, which we wanted

20 to talk about which was scope. And by "scope," in

21 this context we mean what risk metrics is it dealing

22 with? And in our case it's typically dealing with CDF

23 and LERF, but it could be dealing with a complete

24 Level 2, we could be doing a Level 3.

25 But, really, in this document we're

1 focusing on CDF and LERF. And I believe that's the
2 focus of the EPRI work, too.
3 The other elements of scope are things
4 like the plant operating space. Currently, we are
5 really focusing on full-power operations, and that is,
6 again, the focus of the EPRI work. Eventually we will
7 get to doing things like low power and shutdown, but
8 that's a little way off.
9 The other aspect of this is: what
10 initiating events are -- I think a term we have
11 actually been crafting these days is hazard groups,
12 which relates to, for example, are we dealing with
13 internal events? Are we dealing with external events,
14 such as earthquakes, high winds? Are we dealing with
15 internal hazards, like fires or floods? Okay. So the
16 scope is determined by these three assets, if you'd
17 like.
18 Now, if we can flip to the next --
19 MEMBER CORRADINI: So can I just ask a
20 clarification?
21 MR. PARRY: Yes.
22 MEMBER CORRADINI: Yes, that's very
23 helpful. So to go back to the one that you're not
24 doing, which is the one on the level of detail, which
25 is inherently conservative --

1 MR. PARRY: No, not the level of detail.
2 Well --
3 MEMBER CORRADINI: I'm sorry.
4 MR. PARRY: -- the discretization.
5 MEMBER CORRADINI: Discretization, excuse
6 me.
7 MR. PARRY: Well, it's related to level of
8 detail I guess.
9 MEMBER CORRADINI: Okay. But just for my
10 understanding, then, you know it's conservative
11 because you've done some sort of calculations so that
12 you know -- you think two pumps are going to perform
13 like this, but there is uncertainty in how they
14 perform, so you're going to cut the line here and
15 start a failure above -- above the thing.
16 So in some sense you've already built in
17 a calculation, or you've done a sensitivity to know
18 where you draw the lines.
19 MR. PARRY: No, that -- okay, that --
20 MEMBER CORRADINI: I mean, isn't that what
21 you mean?
22 MR. PARRY: No, that's not quite what I
23 mean.
24 MEMBER CORRADINI: Well, that's part of
25 what you mean. I mean, what you're saying is I could

1 have half a pump, which means instead of pumping a
2 300 gpm I'm going to pump 150 under these weird
3 conditions, but I'm going to call that a failure. So
4 I have the pump curve, and the pump curve behaves like
5 this. And if it doesn't put out with this delta P and
6 at this flow rate, I'd call it a failure.
7 So I've done some sort of calculation and
8 manipulation and decided that conservative -- you use
9 the word "conservative," which I think is what I
10 understood it to mean, which is above this point it's
11 a binary. It's go/no-go. And I need two of those to
12 make it work, and I have only one of them. It doesn't
13 work.
14 MR. PARRY: Right.
15 MEMBER CORRADINI: So is that -- I'm going
16 back to where he started.
17 MR. WALLIS: Well, this goes on forever.
18 I think this is good, but the bottom line is, when you
19 tell me the CDF is 10^{-6}, because you've got
20 conservatives in there, you're really telling me it's
21 less than 10^{-6}.
22 MR. PARRY: Right.
23 MR. WALLIS: Is that what the conclusion
24 should be?
25 MR. PARRY: Let me --

1 MR. WALLIS: Is that it? Because of these
2 conservatisms, it should be less than --
3 MR. PARRY: We're going to get into a
4 discussion at some point, if we get there --
5 (Laughter.)
6 -- that will -- one of the things that
7 you, as an analyst, have to provide to the
8 decisionmaker is a characterization of the results
9 that you have. If you believe it's conservative
10 because of the way that you constructed the model,
11 then you need to be able to say that. If it's
12 conservative and still allows the decision to be made,
13 then I think we've done enough.
14 If it's conservative and it creates a
15 question as to whether the decision should be made,
16 then one solution is to refine the model. And that's
17 one of the options that you have.
18 CHAIRMAN APOSTOLAKIS: If the
19 discretization is judged to be too gross -- for
20 example, LOCA -- then people question it and the PRA
21 is changed. That's why there is a small LOCA, there
22 is a medium LOCA, there is a large LOCA. In some
23 PRAs, there is an excessive LOCA.
24 So there is a lot of thinking that goes
25 into this discretization. But now to say, you know,

1 this particular pump, what exactly does "failure"
2 mean, and does it supply the actual number of gallons
3 per minute, I would say that's a detail that really
4 doesn't affect the conclusions much.
5 MR. PARRY: I think you're right, and I
6 think yours is a better example of how --
7 CHAIRMAN APOSTOLAKIS: Yes. The
8 initiative events -- the LOCAs, for example, I think
9 is a good example --
10 MR. PARRY: Yes.
11 CHAIRMAN APOSTOLAKIS: -- where the
12 discretization was revisited because of the physical
13 and chemical, whatever, reaction of the plant to
14 various LOCAs. So now, let's not forget that you also
15 have the failure data, because at some point you will
16 use a failure rate for that one.
17 So, you know, when they tell you that,
18 yes, over the last 152 tests it failed two times, you
19 usually don't have a way of finding out what they
20 actually mean. I mean, they probably mean that they
21 didn't supply the gpm that you needed. But exactly
22 what the number was and this -- I mean, this is lost
23 in the detail, and I don't think that that's an
24 important topic.
25 MEMBER BLEY: But you kind of hit on the

1 key I think, and I think it's covered in here, if I
2 look around. But it isn't -- doesn't hit me right off
3 the bat. And an easy one to stay with is the
4 discretization for me.
5 When you look at your results, if you're
6 getting major contributions from those place where you
7 set up the discretization and it's clearly the source
8 of the problem, the source of -- if it's a high
9 number, whatever, larger contributor, it's almost
10 incumbent on you to address that, or at least, as
11 Gareth said, to present it to the decisionmaker.
12 As I read Chapter 3, it kind of left me
13 with that as a gap. As I read later things, I see
14 ways to fix that gap. And I'm just wondering if, you
15 know, the report needs something up front to say you
16 can address these. These are addressed in --
17 CHAIRMAN APOSTOLAKIS: One other --
18 MEMBER BLEY: But I think that's a key
19 thing.
20 CHAIRMAN APOSTOLAKIS: All right. One
21 other thing that is I think outside the scope of your
22 work, but it's something that has bothered me over the
23 years. Every time we talk about the limitations or
24 the approximations that a PRA does, we seem to lose
25 sight of the fact that if you didn't do this, you

1 would do something much worse.

2 When he puts up there, you know, the

3 accident sequences, and so on, it's a PRA that

4 introduced the accident sequences. In the traditional

5 system, we have those stylized design basis events,

6 and we don't really even both to look at these things.

7 See what I'm saying? That we -- sometimes we tend to

8 focus on the details, and we're missing the big

9 picture that this is a tremendous advance. the fact

10 that you are developing these sequences, in fact

11 thousands of them, is really a great benefit of doing

12 a PRA.

13 Now, whether, you know, I have modeled a

14 pump failure exactly, as Mike says, is the line here

15 or somewhere else, in my view that's a detail that

16 really doesn't matter. When it matters is, in the

17 LOCA example we are actually taking action.

18 MEMBER SIEBER: But that is consistent

19 with the old -- the deterministic way of doing

20 business. If the pump didn't achieve a certain

21 pressure and a certain flow, the pump was inoperable,

22 and that didn't take into account the fact that it

23 might have fulfilled its mission. You had to take it

24 out of service, overhaul it, do whatever you have to

25 do.

1 CHAIRMAN APOSTOLAKIS: Good.

2 MEMBER SIEBER: And so if anything, PRA

3 can give you a little bit more latitude.

4 CHAIRMAN APOSTOLAKIS: Exactly.

5 MEMBER SIEBER: But I'm convinced that the

6 only thing worse than PRA, as far as decisionmaking is

7 concerned, is deterministic methodology.

8 CHAIRMAN APOSTOLAKIS: Good. Let's move

9 on. Let's move on. This is a good point.

10 MR. WALLIS: This has been a very good

11 discussion, but I'm not sure that it is conservative

12 because you've got things down the road. I mean,

13 you're saying the pump works or it doesn't work.

14 That's fine, to be conservative about that. But then,

15 the operator has to make decisions down the road based

16 on what he sees. And if the PRA tells him the pump is

17 working or not working, what the plant is doing is

18 giving him symptoms which may indicate the pump is

19 partially working.

20 Now, his decision based on what he sees

21 may be worse than it would be if he really knew it was

22 not working. Do you see what I mean? I mean, if the

23 PRA says it's not working, then the operator knows

24 what to do. If there are mixed symptoms, because it's

25 sort of partially working, or intermittently working

1 or something, this may lead to bad decisions by the
2 operators. It's not clear that you are being
3 conservative when you assume it's yes or no.
4 MS. DROUIN: But the operator wasn't
5 saying that you -- that it was ultimately conservative
6 to the overall result. That decision, in and of
7 itself, is a conservative decision, but it doesn't
8 mean that as -- it translates through, because you've
9 got many other decisions that you're going to be
10 making in developing that PRA model that could offset
11 that conservative aspect in the model.
12 MR. WALLIS: Yes, that's right. It could
13 offset it, right. So you don't really know they're
14 conservative.
15 MS. DROUIN: That's right.
16 MR. WALLIS: Thank you.
17 MEMBER BONACA: Yes. I think Graham is
18 right. I mean, in deterministic analysis when you do
19 a LOCA, you don't do it to see what really a transient
20 looks like. You do it to determine whether or not
21 your ECCS is sufficient, if it's adequate, all that
22 kind of stuff.
23 So you have a very different goal. In
24 this particular case, you are trying to predict
25 events, etcetera, so you may have some ambiguous

1 scenarios out there. But I don't think that, then,
2 they will be significant to the results, because you
3 do have a spectrum of evaluations that covers the
4 bound.
5 CHAIRMAN APOSTOLAKIS: Okay. Why don't we
6 move on to --
7 MR. PARRY: Let me add just a little bit
8 to that, though, what Graham was talking about.
9 Again, another aspect I think of what we call
10 discretization or simplification is that we tend to
11 make assumptions in the PRAs like that when a system
12 is demanded -- we don't model the real time at which
13 things occur in the sense that, you know, pump A might
14 fail 10 hours into the incident.
15 We tend not to do that. We tend to say,
16 "Okay. I'm going to assume the pump failed, and it
17 failed at time T equals zero," which sort of tends to
18 put a premium on the time for response for the
19 operator, for example. But you're right in the sense
20 that partial information and misleading information
21 could lead the operators to make errors of commission,
22 and that is an omission in current PRAs that we
23 recognize.
24 So there is that aspect, and that's one of
25 the issues of completeness that we in fact recognize.

1 MEMBER SIEBER: But that's not as
2 significant as it may appear to us, because the
3 operating procedures are totally deterministic. And
4 they take the worst-case event, and they add margin to
5 the extent that they can.
6 MS. DROUIN: Right.
7 MEMBER SIEBER: So you can mess up your
8 PRA, and the operators are still going to do the same
9 things they did before. The only thing that is
10 different is that he makes an error in following his
11 procedures, or her procedures.
12 CHAIRMAN APOSTOLAKIS: Okay. Slide 14.
13 MR. PARRY: Okay. Wait a minute. No, no,
14 go back. 14.
15 CHAIRMAN APOSTOLAKIS: Let's go back to
16 slide 5.
17 MR. PARRY: No.
18 (Laughter.)
19 MR. PARRY: There's one thing we didn't
20 discuss, and there's an important thing that --
21 CHAIRMAN APOSTOLAKIS: What is it we did
22 not discuss?
23 MR. PARRY: Okay. All right. So we
24 mentioned level of detail. We don't go -- we won't
25 belabor that point, but I will put the second -- point

1 you to that second bullet is that -- on the second
2 part of that and it's "and driven by the projected use
3 of the PRA." Okay? That's the level of detail that
4 is -- which is --
5 CHAIRMAN APOSTOLAKIS: Which is what I
6 said earlier.
7 MR. PARRY: It's what we discussed.
8 Okay. But this is relevant for the next
9 topic, which is combination of results. And this is -
10 - this is a subject formerly known as aggregation.
11 This is when you take the results from, say, an
12 internal events PRA and a fire PRA and a seismic PRA,
13 and try and meld them into one single result.
14 It's very important to recognize that the
15 models for these different scope items are going to
16 vary in levels of detail and conservatism, vary in
17 lots of different ways. I'm talking about fire
18 analysis, for example. They use different screening
19 approaches for determining which of the fire --
20 physical analysis units are going to be addressed in
21 detail. And there are different levels of
22 approximation.
23 Okay. And the message we want to get
24 across in this is that it's not simply -- you can't
25 just simply add the results from different PRAs and be

1 happy with it. You have to understand the pedigree of
2 all of those different parts. And this is I think
3 particularly important if you think -- this is a
4 little off topic, but getting into the -- moving into
5 the area where we're going to be doing NFPA 805.
6 A lot of the licensees are going to be
7 transferring to NFPA 805. They are going to be
8 building fire PRA models to do that. Those fire PRA
9 models, they will be perfectly adequate for NFPA 805.
10 But if they, then, try and use them in something like
11 Tech Spec Initiative 4B, they may find that, in fact,
12 they don't have enough level of detail, and that the
13 conservatism that has been put in the model to deal
14 with 805 is going to come back and bite them.
15 So it's an -- the message we're trying to
16 get across here is that, really, that you have to be
17 very careful. And actually, it's probably even worse
18 in fires, because you might be -- for different
19 physical analysis units you might have different
20 levels of detail in one versus another, even though
21 they perhaps contribute the same to core damage
22 frequency.
23 But we'll come back to that a little later
24 on, because that's important for --
25 MEMBER BONACA: I have a question. You

1 know, here again, you have a bullet where you talk
2 about the discretion of the analyst. So when I was
3 reading that in the text, I got an impression that you
4 may have significant differences based on the choice
5 of the analyst that he may make or not make, and I
6 don't believe that.
7 But one thing that was occurring to my
8 mind was that you in PRA have looked at SPAR models of
9 a lot of plants for which there are already PRAs, and
10 they have compared those PRAs. You have adapted them.
11 You have come up with certain results.
12 MR. PARRY: Right.
13 MEMBER BONACA: It would be interesting at
14 some point, if not part of this document, but maybe as
15 part of this document, too, to have an appendix that
16 brings up some of the lessons learned. Have you seen
17 an enormous variability of results, for example, or
18 conclusions from an approach where you have different
19 analysts using different models doing the same
20 analysis to come up with a model and reach certain
21 conclusions? Because you have also conclusions drawn
22 from these comparisons.
23 I think there is a mention somewhere in
24 the report, in fact, that what -- I think it would be
25 valuable for us to understand it.

1 MR. PARRY: Okay. I think -- but that --
2 it's true that I think we have to recognize the two --
3 there are two different aspects of that. One is, if
4 they're using different models -- like, for example,
5 if they're using different models for success
6 criteria --
7 MEMBER BONACA: Yes.
8 MR. PARRY: -- that's a model uncertainty
9 issue in the way we characterize it here. Level of
10 detail would be more, for example, as I mentioned,
11 does a person modeling a boiler water reactor, does he
12 take credit for enhanced CRD flow versus somebody who
13 doesn't? Because typically the core damage frequency
14 for boiling water reactors is pretty low.
15 Adding in the CRD flow from many sequences
16 is not going to make a big difference. And I think
17 the point that we're trying to make in this is that we
18 don't expect those level of detail type of issues to
19 create significant details, differences between the
20 different models. Certainly, not when compared with
21 differences in the determination of success criteria,
22 for example, which can make big differences.
23 MEMBER BONACA: Yes, my question was
24 whether, in a sense, that at some point maybe outside
25 of this effort here, it would be interesting to know

1 the lessons learned from the problem where you have --
2 you have 70 models out there that you are comparing.
3 MR. PARRY: Doug wants to make a comment.
4 CHAIRMAN APOSTOLAKIS: State who you are,
5 please.
6 MR. TRUE: Yes. Doug True, Engineering,
7 one of the EPRI contractors working on the industry
8 side of things. There has been some good work done in
9 comparing the SPAR models with industry models, and
10 there were a set of insights developed and documented
11 by research on that topic. And that was actually part
12 of the input to the work we've been doing to help try
13 and identify areas of model uncertainty that we should
14 be aware of in application.
15 So we've brought it into our document and
16 incorporated those in our work.
17 MEMBER BONACA: What document are you
18 referring to?
19 MR. TRUE: I think actually Pat may need
20 to answer that, but there was -- I was part of the
21 MSPI benchmarking work that you guys did. Is that
22 when you did it, Pat? Yes. And then, there was a RIC
23 presentation that Pat gave in 2005, '06.
24 CHAIRMAN APOSTOLAKIS: This year.
25 MR. TRUE: This year, '07, 2007.

1 MEMBER BONACA: Could we get a copy of
2 that?
3 MR. TRUE: The RIC presentation?
4 MEMBER BONACA: Yes.
5 CHAIRMAN APOSTOLAKIS: RIC is -- yes, we
6 can get it. I'm a little -- I'm sorry.
7 MEMBER BONACA: I want to elaborate on
8 that just --
9 CHAIRMAN APOSTOLAKIS: I'm a little
10 concerned we are spending too much time on
11 generalities, and I really want to focus on specific
12 guidance that --
13 MR. WALLIS: I wanted to ask about -- you
14 brought up aggregation, which I think is an important
15 issue here. If I have these internal events for
16 seismic, if I knew something about the bias and
17 uncertainty associated with each one of them, I might
18 know something about how to put them together. Are
19 you going to end up with some measure of bias as well
20 as uncertainty in your uncertainty discussion here?
21 MR. PARRY: No, not -- not --
22 MR. WALLIS: Because I think we have the
23 sort of feeling that the five PRAs were all -- they
24 are too pessimistic by a factor of 10 or something.
25 But is there some way to estimate that better than

1 just in a gut feeling?

2 MR. PARRY: No, and I don't -- I don't

3 think that that is our intent.

4 MR. WALLIS: Isn't that a big part of the

5 uncertainty is in the bias of these --

6 MR. PARRY: If the result that you're

7 getting from the PRA doesn't help you make a decision,

8 then you're going to have to do something about that

9 bias.

10 MR. WALLIS: But you don't have any

11 measure of it, or any --

12 MR. PARRY: No, you can't -- until you

13 redo -- until you refine the model, you will not have

14 an estimate.

15 CHAIRMAN APOSTOLAKIS: So as I say, we are

16 spending too much time on high-level questions. If we

17 could -- I really want to get into the specific

18 guidance --

19 MR. PARRY: Okay.

20 CHAIRMAN APOSTOLAKIS: -- parameters,

21 models, and risk-informed decisionmaking. So if --

22 please, if you have questions, maybe you can try to

23 ask them when the actual guidance is discussed,

24 because, you know, we can talk forever about the high-

25 level stuff.

1 MR. WALLIS: But they never mention bias
2 in there.
3 CHAIRMAN APOSTOLAKIS: But we can raise it
4 when it comes to models, for example. But in that
5 context, I think it will be more meaningful.
6 MR. PARRY: Okay. The next slide, I'll go
7 through it very quickly.
8 MEMBER SIEBER: Well, let me just say a
9 couple of words about screening. Screening is
10 slide 14.
11 MS. DROUIN: We are already on 15.
12 (Laughter.)
13 MEMBER SIEBER: Whatever.
14 CHAIRMAN APOSTOLAKIS: What's the
15 question?
16 MS. DROUIN: I'm sorry.
17 MEMBER SIEBER: No, I asked you to say --
18 MR. PARRY: Oh.
19 MEMBER SIEBER: Because you can screen --
20 if you have a lot of moderate things, you can reach a
21 threshold where you can screen them out in
22 combination, and you can --
23 MR. PARRY: Well, I think what it was
24 referring to here, really, was not so much screening
25 things out as using screening approaches to determine

1 how much detailed analysis you would do. It's really
2 -- it's really a screening to determine a level of
3 detail is what I was referring to here.
4 So you'd keep the result in, but you'd
5 know it would be a conservative result, even though it
6 might be quite low.
7 MEMBER STETKAR: Gareth, let me ask you
8 about that, because unfortunately, George, I have to
9 apologize, but there isn't much detail in the rest of
10 the slides. So since you brought up screening, what
11 I wanted to ask is, since you're writing a document in
12 let's say the year 2008, is the purpose of this
13 document to provide guidance for the state of the art,
14 let's call it, in risk assessment technology, let's
15 say early 1990s as applied to existing PRAs for
16 existing nuclear powerplants in the United States? Or
17 is it a document that is supposed to be used by PRA
18 practitioners, for example, in the year 2009? Let me
19 ask you that first.
20 MR. PARRY: I don't see why not.
21 MEMBER STETKAR: Okay. Screening, then,
22 and your approach to screening is all wrong, because
23 you -- you emphasize very strict, absolute numerical
24 quantities throughout the document. I see $1E^{-6}$, I see
25 $1E^{-7}$, which have developed a methodology in the United

1 States.

2 MR. PARRY: But wait a minute.

3 MEMBER STETKAR: Wait, let me finish.

4 Those screening criteria are completely invalid when

5 I see results for newer designs that publish total --

6 total core damage frequencies on the order of $1E^{-7}$

7 from all contributors.

8 MEMBER SIEBER: They did a better job of

9 screening.

10 MEMBER STETKAR: Okay. It's just a point

11 that when you're writing this document, you should be

12 extremely sensitive when you discuss screening, and

13 especially sensitive when you emphasize the use of

14 absolute numerical values, because people are going to

15 use that. People are going to refer to this document

16 in the year 2010 and say, "NUREG-1855 says I don't

17 need to worry about this, because I can show it's less

18 than, you know, $9E_{-7}$ or something."

19 MR. PARRY: I don't think they're reading

20 that correctly, John.

21 MEMBER STETKAR: Okay.

22 MR. PARRY: And maybe you're not reading

23 it correctly either, because I think that -- we don't

24 talk criteria in here. We don't put screening

25 criteria as criteria. We put them as examples of

1 things that have been used.

2 When we're talking about the acceptance

3 guidelines -- and the examples we use in here are from

4 Reg. Guide 1.174 -- they are there for examples, but

5 those guidelines are for operating reactors for making

6 license amendments. There is a discussion going on as

7 to whether that should apply to new reactors.

8 MEMBER STETKAR: Okay.

9 MR. PARRY: That's a different issue.

10 We're not proposing this as the criteria that you use.

11 We're trying to demonstrate how you make a decision

12 given that those are the criteria that you have been

13 given.

14 MEMBER STETKAR: Granted. And I recognize

15 that. But to be somewhat provocative, the problem is

16 that when -- the problem is that when people look at

17 examples that are cited, they tend to take on a life

18 of their own. And I didn't see enough cautions.

19 I recognize what you're trying to do, and

20 what you're trying to do, when I read the words, is

21 fine. The problem is all of the examples -- there are

22 not enough cautions in there to say that when you

23 apply these types of screening decisions you need to

24 do it within the context of whatever models, analyses,

25 and things that you have in hand.

1 In other words, it's a relative decision,
2 and your examples are drawn from, you know, let's say
3 early '90s thought processes with those kinds of
4 numbers.
5 CHAIRMAN APOSTOLAKIS: Okay.
6 MR. PARRY: Just recognize that. That's
7 only the point I'm trying to make.
8 CHAIRMAN APOSTOLAKIS: Can you go to
9 slide 16?
10 MS. DROUIN: It's Chapter 6.
11 CHAIRMAN APOSTOLAKIS: Slide 16, please.
12 MS. DROUIN: Let me --
13 CHAIRMAN APOSTOLAKIS: We don't need to
14 know what parameter uncertainty is. Can we go to like
15 slide 16? I really want the discussions to be later
16 on when you talk about various specific things,
17 because this can take forever.
18 MS. DROUIN: Right. No, we'll jump to
19 Chapter 4. My question is, George, when were you
20 planning on a break? Do you want to do a break before
21 we get into Chapter 4, or go to Chapter 4 --
22 CHAIRMAN APOSTOLAKIS: We can do it now.
23 MS. DROUIN: I'm asking --
24 CHAIRMAN APOSTOLAKIS: This sounds like a
25 good time, so we'll break until, what, 10:25.

1 (Whereupon, the proceedings in the
2 foregoing matter went off the record at
3 10:07 a.m. and went back on the record at
4 10:25 a.m.)
5 CHAIR APOSTOLAKIS: Okay. We are back in
6 session. There is a request to move to Chapter 5 now
7 because one of the presenters is catching a plane, and
8 then we'll go back to Chapter 4. I hope it's not
9 Mary. Mary always stays to the bitter end. Okay. So
10 you guys tell us about model uncertainty.
11 MS. DROUIN: Okay. Tim Wheeler is now
12 going to take over from Sandia. Tim is the one that
13 has to leave at noon time, and since it looks like
14 there's a good probability that we won't finish by
15 noon, we want to make sure that Tim can get through
16 his presentation.
17 CHAIR APOSTOLAKIS: Okay.
18 MR. KRESS: What's the uncertainty on
19 that?
20 CHAIR APOSTOLAKIS: Guys, let's go.
21 Please.
22 MR. WHEELER: Thank you very much, and I
23 think according to the instructions of the Chairman
24 this morning at the beginning of the meeting, I should
25 introduce myself. I'm Timothy Wheeler from Sandia

1 National Laboratories.

2 Chapter 5 entitled "Model Uncertainty", is
3 a chapter where we talk about identifying sources of
4 uncertainty in the PRA model in the context of the
5 application for which the PRA is going to be used.
6 And then identify what are those sources of
7 uncertainty that could be key to the decision being
8 made, meaning what parts -- what sources of
9 uncertainty could influence the decision for which the
10 PRA is being used. And with that, I'll go to the next
11 slide and let Mary and Gareth talk to the definitions.

12 MS. DROUIN: Yes. Before we get into the
13 actual parts of Chapter 5 and the Model Uncertainty,
14 one of the things that we felt was very important
15 before we get into this four-step process that you see
16 on page 5-1, the figure that shows the four steps of
17 trying to identify and characterize your key sources,
18 we thought it was very important that we talk about it
19 in the document, and provide some definitions.

20 The reason for this is that this was a
21 problem that came out of the standard, and people
22 understanding what is meant by a source of
23 uncertainty, and by a key source of uncertainty. And
24 if you look at the PRA standard right now, the
25 standard in terms of Rev 1 tells you to identify, and

1 then you have to do some analysis, sensitivity studies
2 on your key sources of uncertainty.
3 Well, that's almost an impossible task to
4 accomplish, because then you're trying to find what
5 you mean by "key", and it's just almost impossible to
6 bound what you mean by that. And you really need to
7 do that in the context of the application. It's what
8 is key in terms of what could influence your decision.
9 Therefore, what could influence the acceptance
10 criteria that you're using, so key really becomes
11 important in terms of an application.
12 In terms of the standard and what you can
13 do there on your base PRA, now we're going back to the
14 base PRA, not the PRA that you may use for your
15 decision, there's just no way, and it becomes, as I
16 said, very difficult to identify what your key sources
17 are. And you really don't need to do that for your
18 base PRA.
19 What you really need to do for your base
20 PRA is know what the sources of uncertainty are, and
21 what are their potential impacts. And I don't mean
22 from a quantitative perspective. Understanding it, is
23 this source of uncertainty going to change your
24 accident sequence? Is it going to change your success
25 criteria? Is it going to change what your initiating

1 events are? So understanding where your sources of
2 uncertainty are, and how they could influence the
3 model, not the degree to which, or the extent, but
4 just where they would influence is what you really
5 need to know from the base PRA.
6 So we have been having a lot of
7 discussions on this. We had a public meeting, and in
8 the public meeting among the NRC staff, and with the
9 stakeholders we came up with these definitions that
10 you see on this slide and the next slide, trying to
11 get to the point where key is in the context of the
12 application. In terms of the base PRA, you're
13 concerned about what are the sources, and what could
14 they potentially influence. So these are very
15 different definitions than what you will see in the
16 current standard.
17 The other important definition was what is
18 meant by a consensus model.
19 MR. WALLIS: Are you going to talk about
20 what you mean by "source of model uncertainty", or are
21 you just going to flash up this slide?
22 MS. DROUIN: No, we're just giving you the
23 definition. When we get into the steps, we --
24 MR. WALLIS: This is an interesting
25 definition, because it's a workable definition, but

1 the consensus may itself have uncertainties in --

2 MS. DROUIN: Absolutely.

3 MR. WALLIS: So what do you about that?

4 The model that people have consensus about cannot be

5 a very good representation of reality.

6 MR. PARRY: That would typically be

7 reflected, though, in the parameters of the model.

8 They migrate.

9 MR. WALLIS: We have this in thermal

10 hydraulics all the time, and none of the models is

11 particularly good. So there's uncertainty no matter

12 what you agree to.

13 MS. DROUIN: Of course there's

14 uncertainty. We're not saying there isn't.

15 CHAIR APOSTOLAKIS: In the old days when

16 we were using the COMPBRN code for fire analysis, we

17 all knew it had uncertainties, so what we did is an

18 uncertainty factor, do it on the model itself. And

19 then you also propagate the parameter --

20 MR. WALLIS: But they don't do that. They

21 don't seem to --

22 CHAIR APOSTOLAKIS: Well, we'll come to

23 the guidance, but the important thing at this point is

24 to recognize that even if there is a consensus model,

25 there may be uncertainty.

1 MR. WALLIS: Then we're going to ask later
2 what you --
3 CHAIR APOSTOLAKIS: The only reason it's
4 consensus is because the only one, nobody else has
5 developed an alternative.
6 MS. DROUIN: Not necessarily. No, that's
7 not true.
8 CHAIR APOSTOLAKIS: Not always, but in
9 this case, that was the case. That's what I'm saying.
10 It's not the consensus in the sense that there are
11 five models and everybody says number three is the one
12 we go with. There may be situations where you have
13 only one model, and you have uncertainty.
14 MS. DROUIN: There could be situations --
15 yes, where you only have one model.
16 CHAIR APOSTOLAKIS: That's what I'm
17 saying.
18 MS. DROUIN: But there are -- we're just
19 saying there's also cases where there's more than one.
20 CHAIR APOSTOLAKIS: Absolutely.
21 MS. DROUIN: But this is the one everybody
22 has chosen to use.
23 CHAIR APOSTOLAKIS: So, yes, there is
24 model uncertainty. So we'll come to the guidance at
25 some point.

1 MS. DROUIN: Right. And we aren't saying
2 because it's a consensus model, you don't have
3 uncertainty. But the point is, is that when you have
4 a consensus model, you can screen something out
5 because it's a consensus model.
6 CHAIR APOSTOLAKIS: Another example, a
7 recent example is heat transfer coefficient equations.
8 You're going to different medium, and it's not clear
9 that the old ones apply, and you run a few
10 experiments. You see the uncertainties. And,
11 ultimately, it's a matter of judgment, what you do
12 about it. So, yes, there is one model, but there may
13 be uncertainty about it. And that's not covered by
14 the parameters, parameter uncertainty in the model.
15 MS. DROUIN: That's correct.
16 CHAIR APOSTOLAKIS: The model itself may
17 be biased or whatever.
18 MR. PARRY: But if we all agree that we
19 could live with that bias, then we don't use -- the
20 point we're making, I think, is that if we all agree
21 to that model, whether it's biased or not, and that is
22 the model we will use in our decision making, then we
23 don't have to do alternative --
24 CHAIR APOSTOLAKIS: But you --
25 MR. PARRY: That's all we're saying.

1 CHAIR APOSTOLAKIS: Then you have to put
2 uncertainty of the predictions of that model.
3 MR. PARRY: If there uncertainties on the
4 predictions of that model, we would include them.
5 Right.
6 CHAIR APOSTOLAKIS: Yes.
7 MR. PARRY: Yes.
8 MR. WALLIS: And then there's this thing
9 about it's known to have an effect. I'm not sure how
10 you know. There's only one model, the choice has an
11 effect. So, again, there could be sources of
12 uncertainty with one model. You don't really say what
13 you mean by an effect. I guess you're going to get
14 into all this, are you?
15 MS. DROUIN: Yes.
16 CHAIR APOSTOLAKIS: Yes. There is several
17 slides on this issue, so let's --
18 MS. DROUIN: We just wanted to up front,
19 to let you know that there were key things that were
20 causing some problems because of the definitions, and
21 we have tried to correct those definitions. We're
22 just trying to give you a little bit of the history of
23 why it was important that these definitions -- that we
24 come to a consensus on the definitions.
25 CHAIR APOSTOLAKIS: Right.

1 MR. PARRY: We do define what we mean by
2 "effect" by that parenthetic example.
3 MS. DROUIN: Yes. Okay. Given that, now
4 we're going to go back and walk you through. And
5 you'll see how these terms play out through the
6 process.
7 MR. WHEELER: So at a high level, the
8 process for identifying which sources of uncertainty
9 are key to the decision being made in the application,
10 basically, again, high level, four steps. You have to
11 identify your sources of uncertainty. You want to --
12 step two says perform qualitative analysis, and it is
13 that, but it is also more than that, as we'll get into
14 in details. It's identify then the context of your
15 application so that you are appropriately evaluating
16 the sources of uncertainty within the proper context
17 of the decision to be made.
18 Perform qualitative analysis. Let's pick
19 the low hanging fruit while we can, and then move to
20 a quantitative screening analysis, which is
21 fundamentally based on potentially conservative
22 quantitative evaluations of those parts of the PRA
23 that are relevant to the uncertainty issues. And if
24 you can screen issues out based on a potentially
25 conservative quantification, and that's an easy step

1 to further reduce the set of uncertainty issues that
2 are potentially key. But then, ultimately, issues
3 that have not been able to be screened out easily,
4 either qualitatively or quantitatively, must be
5 evaluated through a realistic sensitivity analysis to
6 ultimately determine if they do, indeed, constitute
7 key sources of uncertainty.
8 So in step one, as we said, it's very
9 critical to identify your sources of uncertainty,
10 basically three steps. You must identify the source
11 of uncertainty, and then also characterize them so
12 that we understand exactly how they influence the PRA,
13 and what parts of the PRA they influence. And then
14 execute a qualitative screening on this set. And
15 towards the issue of characterization, PRA model can
16 affect basic events, it can affect logic structure of
17 the PRA, or it can affect both.
18 So, as this diagram shows, what's
19 important here is what we want to show, too. As you
20 see the horizontal flow of a process, this document is
21 more of a process-related document. And a lot of the
22 specificity is going to be developed in conjunction
23 with working with EPRI, where a lot of the specificity
24 of specific types of sources of uncertainty, things
25 like that. We're working with EPRI to coordinate with

1 them that there'll be more specificity in their
2 documents.
3 But in identifying potential issues of
4 model uncertainty and related assumptions, one source
5 is the PRA itself, because the ASME standard directs
6 that sources of uncertainty be identified in the PRA.
7 So if the PRA has been performed according to the
8 standard, there should be a good jump-start right
9 there in identifying sources of uncertainty. But in
10 addition to that, the NUREG recommends doing
11 literature research, or as we've said, we're working
12 with EPRI to ensure that --
13 CHAIR APOSTOLAKIS: Who is doing all this
14 analysis? When you say on the left, for example,
15 identify sources of model, who is doing the
16 identification, the analyst, the peer reviewers, both?
17 MR. PARRY: Both, but the owner of the PRA
18 should have the primary responsibility.
19 CHAIR APOSTOLAKIS: So this is at the very
20 end after you go through the process of --
21 MR. PARRY: Really should be doing it all
22 along, but I guess --
23 CHAIR APOSTOLAKIS: Well, no. But what
24 I'm going to see is the very end, the final result.
25 And then the owner of the PRA will say --

1 MS. DROUIN: The owner of the PRA --

2 CHAIR APOSTOLAKIS: -- this is what I have

3 done.

4 MS. DROUIN: Because it's part of the

5 standard that -- it's part of your documentation when

6 you look at the standard, is to document all your

7 sources of uncertainty, so that should be an outcome,

8 or a product from your PRA based on the standard.

9 CHAIR APOSTOLAKIS: There will be some

10 help, I hope. I mean, I think I have seen tables with

11 model uncertainties that are fairly common.

12 MS. DROUIN: Right. This is where we're

13 interfacing --

14 CHAIR APOSTOLAKIS: We'll talk about it?

15 Good.

16 MS. DROUIN: With EPRI. And, as Tim said,

17 what we're doing in this chapter is we're laying out

18 the process with the result coming out of Chapter 5,

19 is here are the key sources of uncertainty related to

20 your application. Now but starting out over here,

21 you're starting with trying to identify up front in

22 step one all your sources of uncertainty. So we laid

23 out the process, and where we're interfacing and

24 showing on this figure here is EPRI has laid out a

25 generic list of the sources of uncertainty with a PRA.

1 CHAIR APOSTOLAKIS: Who's going to tell
2 me, and when, what to do with this model uncertainty?
3 You've gone through the process. I have identified -
4 MS. DROUIN: That's going to come in
5 Chapter 7.
6 CHAIR APOSTOLAKIS: So we're going to
7 discuss it today?
8 MS. DROUIN: Yes.
9 CHAIR APOSTOLAKIS: Okay. Let's go on.
10 MR. WALLIS: Can I ask you something now?
11 Are you describing here something which is well-
12 established, developed, state-of-the-art? Do people
13 do all this stuff now?
14 CHAIR APOSTOLAKIS: No.
15 MR. WALLIS: We do not? Do we know how
16 well it works, is my question. I mean, this is laid
17 out. Do we know how well it gets done?
18 MS. DROUIN: I think that where I would
19 say it's not well done is the documentation. I would
20 say yes, it's -- in order to -- I mean, we know where
21 the sources of uncertainty -- we know how to identify
22 the sources of uncertainty. We know how to do that.
23 What people don't do a good job, is documenting them.
24 MEMBER BLEY: Can I put it a little
25 different way? This is in the PRA standard, and the

1 PRAs are being reviewed against the standard by
2 industry, have you seen if those reviews have
3 identified that these sources of model uncertainty are
4 actually identified?
5 MR. PARRY: Maybe we ought to let Ken
6 answer that.
7 MR. CANAVAN: Well, the first question --
8 this is Ken Canavan from the Electric Power Research
9 Institute. The first question was, has it been tried?
10 There's been two pilots of the process that was
11 originally identified, and the process has changed a
12 bit as a result of some of those lessons learned
13 through some of those pilots. So I think, has it been
14 tried? Well, yes. And we've learned a lot --
15 MR. WALLIS: This is in the process of
16 development.
17 MEMBER SIEBER: It's part of the standard,
18 though. Right?
19 MR. CANAVAN: The two pilots were
20 completed on the first process, and the process is
21 being refined, and we'll probably need to pilot it
22 again.
23 CHAIR APOSTOLAKIS: But individual studies
24 ----- I mean, NUREG 1150 actually did handle in the
25 Level II Analysis, model uncertainty through expert

1 opinion. Right? And taking the linear combination.
2 But individual studies have done some of this. In
3 fact, John and Dennis have a paper out, something you
4 did with Dave Johnson.
5 MEMBER BLEY: A long time ago, yes.
6 CHAIR APOSTOLAKIS: Yes, a long time ago.
7 MEMBER BLEY: Yes.
8 CHAIR APOSTOLAKIS: And there are other
9 papers, too, but on a grand scale, I don't think you
10 can pick up a PRA and see all this stuff in there.
11 Now the pilots may be that, but they are pilots.
12 MR. CANAVAN: Yes.
13 CHAIR APOSTOLAKIS: They are not part of
14 it.
15 MS. DROUIN: I agree, but I don't think
16 it's because it's a lack of not knowing how to do it.
17 It's just a lack of documentation. People haven't
18 systematically --
19 CHAIR APOSTOLAKIS: I think it's more than
20 that, Mary.
21 MEMBER STETKAR: I think it's more than
22 that.
23 CHAIR APOSTOLAKIS: It's more than that.
24 MEMBER STETKAR: It's a lack of
25 sensitivity to the --

1 CHAIR APOSTOLAKIS: Exactly.

2 MEMBER STETKAR: The analysts don't --

3 CHAIR APOSTOLAKIS: Yes.

4 MEMBER STETKAR: -- when they develop the

5 models.

6 MS. DROUIN: That's right, but it doesn't

7 mean that they don't know how.

8 MEMBER BLEY: That's a fine point, because

9 if they don't document it, once they've moved on, it's

10 kind of lost, and it has to be --

11 MS. DROUIN: I don't disagree. I don't

12 disagree. But it's not that we need to go out and

13 develop methods, and develop tools because we don't

14 know how to do it. It's just that we don't

15 systematically, as we're doing the PRA, as we're

16 developing our model, say okay, here's a source of

17 uncertainty. It's a lack of -- I like John's word,

18 it's a lack of sensitivity. I mean, to me, that's

19 sensitivity and then documentation. It's not a lack

20 of ability.

21 CHAIR APOSTOLAKIS: Nobody said it was

22 stupid, if that's what you mean.

23 MR. PARRY: It really is a lack of

24 awareness that -- I think people make assumptions

25 without really recognizing --

1 MEMBER STETKAR: No one has ever told an
2 analyst when he sits down, he or she sits down to do
3 a systems analysis that you should put into writing,
4 I, today made this decision because, but I could have
5 made a different decision because. I mean, nobody
6 ever -- they may think that, but nobody ever --
7 (Simultaneous speech.)
8 CHAIR APOSTOLAKIS: Say of academic
9 interest, so I really want to get down to the
10 guidance, guys. I really do want to do that. Are you
11 telling me on individual issues what to do? I can
12 appreciate the understanding part, I appreciate
13 process, but at the very end, somebody has to tell me
14 what to do. I really believe that's important. So,
15 Tim, please go on.
16 MR. WHEELER: Okay. Anyway, as we said in
17 this process, when you have identified your
18 uncertainty, it's also very important, and this is, I
19 think, be propagated through the whole chapter, is you
20 want to understand how it affects the PRA, what were
21 the assumptions made in the development of this part
22 of the model? Was data used, what were the data
23 issues, was expert judgment used, how does it impact
24 the PRA, does this simply affect certain specific
25 basic events, or could it affect the selection of

1 initiating events, or the entire structure of the PRA
2 by introducing new accident sequences, or
3 restructuring the event trees?
4 And then, as we said before, qualitative
5 screening on the basis of things, such as consensus
6 models, and if you were to look back at our definition
7 of consensus models in this document, it says it's a
8 model which basically the NRC has accepted. So,
9 therefore, as Gareth said, there is no need for the
10 applicant, or for the licensee who is applying to the
11 NRC, to further justify their use of that consensus
12 model.
13 CHAIR APOSTOLAKIS: Is there a better word
14 for consensus? There ought to be a better word.
15 MEMBER SIEBER: Proved.
16 CHAIR APOSTOLAKIS: Proved is stronger.
17 Is it stronger, there's other --
18 MEMBER SHACK: Well, they need to agree on
19 the definition of consensus model, which they haven't
20 done yet.
21 CHAIR APOSTOLAKIS: They have.
22 MEMBER SHACK: Well, no. The EPRI one is
23 significantly different.
24 CHAIR APOSTOLAKIS: Oh, but Mary presented
25 the definition.

1 MEMBER SIEBER: If you're applying for a
2 risk-based application of a regulation, I don't think
3 the staff would accept the fact that I've got all my
4 friends in Missouri and Kansas to agree with my model,
5 so it's a consensus model. I think the staff's
6 approval is what's key.
7 MR. WHEELER: And it's my understanding
8 that the definition of consensus model in this
9 document speaks to that.
10 MEMBER SIEBER: Okay.
11 MR. WHEELER: Gareth, did you want to
12 respond to that?
13 MS. DROUIN: Oh, sorry. We were talking.
14 MR. WHEELER: Oh. Do you want to rephrase
15 the question, or restate the question?
16 MEMBER SIEBER: It wasn't a question.
17 MR. WHEELER: Okay. I think that the
18 consensus model as we identified it here implies the
19 NRC accepts it as a consensus model.
20 MEMBER SIEBER: That's right. That's what
21 makes the consensus.
22 MS. DROUIN: Yes.
23 MR. PARRY: For that application.
24 CHAIR APOSTOLAKIS: But as long as you say
25 that there is uncertainty about it, I'm not too

1 unhappy.

2 MS. DROUIN: Just because it's consensus,

3 does not mean --

4 CHAIR APOSTOLAKIS: If you say consensus

5 means this is it, and we believe the results, that's

6 a different story. But if you say yes, this is the

7 model we're going to use, but we know it has

8 uncertainty, and maybe there is -- then I think it's

9 okay.

10 (Simultaneous speech.)

11 MR. PARRY: It has to be characterized.

12 CHAIR APOSTOLAKIS: Okay. Okay. I think

13 this is high level, too. Let's go to the next slide.

14 MR. WALLIS: Can you put it in perspective

15 for me? Does model uncertainty change the CDF by a

16 factor of 10 or something? How significant is it?

17 CHAIR APOSTOLAKIS: No, they're going to

18 tell us that when they talk about Chapter 7, she said.

19 Right?

20 MR. WALLIS: How significant is model

21 uncertainty? When I think about a number --

22 MS. DROUIN: Chapter 7 brings all the

23 pieces together, and how you use the pieces.

24 MR. WALLIS: But it doesn't tell you how

25 important it is. Is this a factor of 10, or 100 on

1 the PRA? What is it?

2 MR. PARRY: The importance is judged by

3 whether it changes the decision you're trying to make.

4 MR. WALLIS: I know, but that's a

5 generality.

6 CHAIR APOSTOLAKIS: It could be five, it

7 could be two, it could be 100. I mean, Gareth is

8 right. It really depends on whether it affects the

9 decision. Slide 20, whatever.

10 MR. WHEELER: Step --

11 MS. DROUIN: Oh, you did it. Sorry.

12 MR. WHEELER: All right. After the first

13 step of identifying the issues and doing the consensus

14 model qualitative screening, the next step is, it's

15 important -- you need to understand the context of the

16 application for which you're using this, because

17 that's very important, because many of the uncertainty

18 issues may have absolutely nothing to do with the

19 application at hand. So the point here is you can

20 further filter or screen out many of the uncertainty

21 issues that are identified in the PRA, simply because

22 they're not relevant to the application at hand.

23 An example may be if there's an

24 application to increase the allowed outage time for a

25 diesel generator, then you need only focus on those

1 parts of the PRA that involve loss of off-site power,
2 because that's the part of the PRA that's being dealt
3 with here.
4 But another important point is that the
5 application itself may be creating a modification, if
6 you will, to the PRA, which in and of itself is
7 introducing new uncertainty issues, so you have to
8 consider both. You have to --
9 CHAIR APOSTOLAKIS: Do you have an example
10 of that?
11 MR. WHEELER: Introducing something new in
12 the --
13 CHAIR APOSTOLAKIS: Yes, that the
14 application produces something new?
15 MR. WHEELER: I'm not sure off the top of
16 my head I can think of something. But, I mean, the
17 point is that if you're suggesting to actually change
18 some operational feature of the plant that requires
19 the applicant to actually modify or add something to
20 the PRA, you, essentially, have now, you have a base
21 PRA, and you have a modified PRA.
22 MEMBER CORRADINI: Is hydrogen igniters an
23 example? Well, I guess here's where I'm going with
24 this. When I was reading it, I was looking for an
25 example to bring forth the point. And I have to

1 admit, my major comment about all this is, it's an
2 awful lot of words with very few examples. So I go
3 back to my original question about who's the audience?
4 And you're saying it's experts. So, okay, experts
5 don't need examples.
6 CHAIR APOSTOLAKIS: No, no, no. Even
7 experts need examples.
8 MEMBER CORRADINI: But, personally, I like
9 examples, and there aren't a lot of them in there.
10 And this is --
11 MR. PARRY: One example you could think of
12 in this case would be 50.69, example. Right?
13 CHAIR APOSTOLAKIS: Right.
14 MR. PARRY: Because the impact of 50.69,
15 the reduction of special --
16 CHAIR APOSTOLAKIS: 50.69 for the new
17 members is?
18 MR. PARRY: Okay. It's the relaxation of
19 the special treatment requirement on --
20 (Simultaneous speech.)
21 MR. PARRY: Yes, based on their safety
22 significance. One of the things that we don't really
23 know how to deal with is, what is the impact of the
24 safety significance on the component reliability --
25 sorry -- what is the impact of the special treatment

1 on the component reliability? It's an unknown, so
2 that's a source of uncertainty that we would have to
3 address in the decision making, so that's one example.
4 And maybe Doug has some others, too.
5 CHAIR APOSTOLAKIS: That's a good point,
6 yes.
7 MR. TRUE: This is Doug True, again. I was
8 just going to sort of build off of Tim's example on
9 diesel generators, and allowed outage time changes.
10 That's an easy one.
11 In doing that, you might modify your PRA
12 model to refine the way you treat recovery of off-site
13 power. In the base model, you may have had a
14 treatment that was adequate, met the peer review, and
15 was fine, but when you went to go do your AOT
16 analysis, you found that it was too simplified, and so
17 you might introduce a convolution model that does a
18 more sophisticated calculation of off-site power
19 recovery, coupled with the failures.
20 That's a change in your PRA model that
21 would fall down that right-hand side of the flow
22 chart. And there are uncertainties and assumptions
23 you have to make in doing that analysis that you've
24 introduced because you've made that change for this
25 particular application.

1 MEMBER STETKAR: That's a good example.

2 CHAIR APOSTOLAKIS: Thank you. Okay.

3 Slide 29.

4 MR. WHEELER: Okay. So once you've

5 essentially put your initial set of -- in any

6 potential new course of uncertainty through two

7 qualitative filters, you now move on to a quantitative

8 screening process. And one feature that's important

9 here is the process outlined in this chapter addresses

10 both what we call cumulative or incremental acceptance

11 criteria. An example of incremental acceptance

12 criteria is 1.174, or an example of cumulative is

13 where you might be evaluating an application against

14 a maximally acceptable core damage frequency, or

15 something such as that.

16 And then, also, the method in Chapter 5

17 addresses within the context of both cumulative and

18 incremental acceptance criteria applications. The

19 fact that we have uncertainty measures, I'm sorry,

20 sources of uncertainty that could, as we spoke to

21 earlier, impact the PRA model in different ways, we

22 could have simply impacting a single basic event, or

23 an uncertainty issue which ultimately impacts the

24 model by impacting the quantification of multiple

25 basic events. It could impact the logic structure of

1 the model itself, or we could have logical
2 combinations of uncertainty issues, where, in essence,
3 there is a synergistic relationship. Whereas, the
4 combination of uncertainty measures need to be
5 considered and combined.
6 MEMBER STETKAR: Tim, let me just ask you,
7 because you skipped over the second bullet.
8 MR. WHEELER: Okay.
9 MEMBER STETKAR: And George keeps saying
10 tell me what to do. And the second bullet in the
11 NUREG tells me what to do. And it says I use a risk
12 achievement worth-type process, either on a single
13 basic event, or cumulative things. A question came to
14 mind, and, basically, determine the importance whether
15 the risk achievement worth is greater than a factor of
16 two, meaning I can potentially have a factor of two
17 increase in the core damage frequency as kind of a
18 rough quantitative screen.
19 The documentation, the report, the method
20 doesn't -- let me characterize that by saying that may
21 capture the effects of uncertainty on risk increase.
22 The methods, as I read them, do not capture any
23 effects of uncertainty on risk decrease. So, for
24 example, suppose I've applied a very, very
25 conservative assumption in my PRA, and developed a

1 model that's very, very conservative because of that.
2 And I'm willing to live with that, but it is a source
3 of conservatism.
4 If I just look at risk achievement worth,
5 it may show a relatively small risk achievement worth,
6 if it's a relatively large contributor. It may show
7 a very, very large risk reduction worth. Now the fact
8 that my risk assessment has this overriding source of
9 conservatism in it can, in fact, skew the results for
10 particular applications. I don't see any guidance in
11 this document to tell me how to be sensitive, or how
12 to evaluate potential key sources of uncertainty for
13 down-size, downward risk. Because risk achievement
14 worth just tells me could it be higher? And you say
15 well, I should certainly examine things that could
16 increase stuff. And I totally agree with that,
17 especially if I'm looking for something that says do
18 I meet certain acceptance criteria?
19 However, if I'm more interested in terms
20 of uncertainty as far as it affects my decisions about
21 a specific application, I'm equally concerned about
22 things that may be excessively conservative and
23 masking other points. And I don't see any guidance in
24 here to tell me how to identify those potentially
25 important sources of uncertainty, which would be

1 analogous to like a risk reduction worth screen.

2 CHAIR APOSTOLAKIS: So you're saying use

3 the second, possibly a second importance measure that

4 deals with --

5 MEMBER STETKAR: Right. I mean, risk

6 reduction worth screen --

7 CHAIR APOSTOLAKIS: Right.

8 MEMBER STETKAR: If you're interested in

9 plus or minus a factor of two on core damage

10 frequency, as a screen, you ought to be as sensitive

11 to the downside as you are to the upside.

12 MEMBER SIEBER: I think Reg Guide 1.174 in

13 that chart that's in there, the block chart that says

14 you can't make changes if your nominal risk at the

15 plant is high, even though the changes may be small.

16 That means, to me, that it would not be appropriate to

17 screen out model uncertainties because they would

18 appear both in the base, and in the --

19 CHAIR APOSTOLAKIS: It would be in both,

20 yes.

21 MEMBER SIEBER: -- one with the change,

22 because it does have an impact on the decision. And

23 I didn't see that discussed here.

24 CHAIR APOSTOLAKIS: Let me understand

25 this. Are you saying that I may screen out a model

1 uncertainty because of its insignificance with respect
2 to the total CDF, but it may turn out to be
3 significant to delta CDF?
4 MEMBER SIEBER: I think it's the other way
5 around.
6 CHAIR APOSTOLAKIS: The other way around?
7 MEMBER SIEBER: Yes. One may be presumed
8 to be risky because of assumptions made in the overall
9 model, but when you apply a modification and model
10 that modification with these other baseline
11 assumptions still in there, the modification may
12 result in a small delta risk, but the baseline PRA
13 might put you in a place on that chart where you can't
14 do that. You can't change it, which means --
15 CHAIR APOSTOLAKIS: See, this is the kind
16 of discussion that I'd like to have in terms of
17 specific ways of handling things. I do appreciate
18 what you have here about process, but when it comes
19 down to what to do, I think the document is not as
20 comprehensive as it is when it comes to process. And
21 I wonder how we can address that? I really want to
22 start by saying another meeting, and in the case of
23 model uncertainty, here is what you're going to do,
24 and this is why.
25 MEMBER BLEY: But there's a related issue.

1 This document in the early part says they'll refer you
2 to the EPRI documents, where appropriate. There
3 aren't many cross-references yet. You need to get
4 some of those in. It might be some of the things
5 we're looking for, we'll see this afternoon.
6 CHAIR APOSTOLAKIS: If we do, that would
7 be great. Now let me ask --
8 MEMBER BLEY: And you might refer to them.
9 I don't know if that's an intention or not.
10 MS. DROUIN: There are -- the places where
11 there are cross-references are where there is going to
12 be a cross-reference. If there's not one in here
13 because there's not -- I mean, we carefully went
14 through and identified in the document where our two
15 documents come together, and where you need to go to
16 the EPRI document.
17 CHAIR APOSTOLAKIS: You have an appendices
18 to be determined. Right?
19 MS. DROUIN: Right.
20 CHAIR APOSTOLAKIS: Let me ask, is there
21 an update to the EPRI report, or are you still
22 sticking to the 2004?
23 MR. TRUE: We're working on an update that
24 fits better with the NUREG.
25 CHAIR APOSTOLAKIS: Okay. And that will

be -- that will give guidance as to what actually --

MR. TRUE: Yes.

CHAIR APOSTOLAKIS: Okay.

MR. TRUE: And Don will explain some of that this afternoon.

CHAIR APOSTOLAKIS: Okay. Great. Great. Because I really want to -- I'm sorry.

MR. TRUE: There is a -- this is a black hole that we could fall into, so we're going to let you peek over the edge of it, and kind of look into the black hole, but we're not going to go in today. I think we would need more time, if we're going to actually step in.

CHAIR APOSTOLAKIS: So that means another subcommittee meeting.

MR. TRUE: I think -- I don't know, I can't speak for the staff, but from my perspective, I think our hope was to kind of indoctrinate you to the overall process today, and then after you've had a chance to digest the EPRI document, if you'd like us to come back, we can come back.

CHAIR APOSTOLAKIS: Okay. That's good to hear, because that was my concern about the existing NUREG. It's a little short on what to do, and it has a lot of good stuff in it, and so on, in my view. It

1 could use a good editing by somebody.

2 MR. WALLIS: Actually, this chapter is

3 full of a lot of musts, you must do this, you must do

4 that. The word "must" is used about 20 or 30 times in

5 this chapter. That's something you really have to do,

6 it must be done.

7 CHAIR APOSTOLAKIS: Yes, but I think it's

8 fair to say that the current version of the NUREG is

9 very strong with understanding, and process for

10 identifying things. There is very little on what you

11 actually do. As an example, in the case of model

12 uncertainty, the NUREG 1150 approach, the linear

13 weighted combination of various assumptions. If you

14 want to dismiss it, at least tell us that you are

15 dismissing it. You know, that kind of thing. People

16 have done things, and it would be nice to see that.

17 Maybe we'll see them in the EPRI update. That would

18 be great, too. And you guys will approve or

19 disapprove. I mean, I think that the practitioner

20 needs to know what to do.

21 MS. DROUIN: Okay. Well, I think we need

22 to talk about that a little bit more, because I'm not

23 sure now. I thought I was understanding you, and now

24 I'm not so sure.

25 CHAIR APOSTOLAKIS: Okay. Tell me what --

1

2 MS. DROUIN: That what you're looking for,
3 whether we had ever intended on doing that. In terms
4 of what we were intending was, if you go to this
5 chapter, for example, is giving the reader guidance on
6 how to identify his sources, his key sources of model
7 uncertainty in the context of an application. Then
8 when you go to Chapter 7, Chapter 7 is going to tell
9 you what to do with that information. We were not
10 intending to provide guidance on how to model your
11 uncertainties.
12 CHAIR APOSTOLAKIS: Why not?
13 MS. DROUIN: And it sounds to me like
14 you're looking for that, which was never a part of the
15 scope of this work.
16 MEMBER CORRADINI: So the scope of the
17 work is not to provide guidance.
18 CHAIR APOSTOLAKIS: Wait a minute. It
19 says treatment. What is treatment?
20 MS. DROUIN: How to treat it in your
21 decision making.
22 CHAIR APOSTOLAKIS: But in my decision
23 making, I may want to -- I look at three alternate
24 models, and I may decide to do a NUREG-1150 approach,
25 gather a bunch of experts that give me the weight.

1 MS. DROUIN: I'm not saying --

2 CHAIR APOSTOLAKIS: Aren't you going to

3 tell me -- that's up to me?

4 MS. DROUIN: No, no, no. I'm just saying

5 that that was not part of the scope here. Now we may

6 have to revisit that, but it was never part of the

7 scope of this, is all I'm saying.

8 CHAIR APOSTOLAKIS: I understand what

9 you're saying, but I think then -- it's my personal

10 view. I mean, the Committee has to decide, then the

11 scope should change. That's my view. But let's hear

12 the gentleman --

13 MEMBER MAYNARD: I was wondering if this

14 is part of this project, or something that NRR will

15 be doing later in some type of a guidance document,

16 because I didn't see a lot of guidance in this. I saw

17 a lot of these are ways of doing things, and this is

18 what could be done, or this is how you may address it.

19 At some point, it does need to come together as to

20 more guidance. This is really what we expect.

21 CHAIR APOSTOLAKIS: Maybe EPRI will do it.

22 MEMBER BONACA: And there has to be

23 tangible example, the point that Michael brought up.

24 It's very important, because, otherwise, you're left

25 with generalities.

1 MEMBER MAYNARD: But it could be done as
2 part of the Reg Guide, or it -- I mean, as part of the
3 NUREG -- or it could be a Reg Guide later. At some
4 point, though, this has to come together, I think.
5 CHAIR APOSTOLAKIS: Go ahead.
6 MR. TRUE: Yes. I mean, there's like ten
7 subjects on the table, so let me kick off --
8 CHAIR APOSTOLAKIS: Pick one.
9 MR. TRUE: I think on the example, one of
10 my comments to the staff when we first saw the draft
11 NUREG was hey, we can give you examples to help
12 eliminate these things, real examples that we've
13 actually done in past applications, that will help.
14 And we've committed to do that in the comment period.
15 So I think we can do that, and it will help move
16 things along.
17 Staff may not appreciate this, but I want
18 to go to two points that are a little bit inter-
19 related. One is John's point about you're only look
20 at the goes ups, and not at the goes downs. And the
21 other is George's point about whether you use NUREG-
22 1150 weighted probability for different assumptions,
23 or something else.
24 I think that what's inherent in the
25 process is that we're really not doing the NUREG-1150

1 approach. We're handling this through sensitivity
2 studies. And the sensitivity studies are looked at,
3 and compared to the acceptance guidelines that apply
4 to the decision that's being made. And, so, if we
5 look at, for example, the diesel generator AOT, or
6 1174 application of some other type, you're looking at
7 the delta CDF, and saying does this model uncertainty
8 have the potential to kick me above, or significantly
9 above my acceptance guideline? And, so, that's why
10 we're focused on the goes ups, is that we want to know
11 are we in an area where we could end up going over
12 through some reasonable alternative hypothesis?
13 It's true, and it was argued in the EPRI
14 work, the original EPRI work talked about going both
15 ways, but we sort of relented in the fact that really
16 it comes down to a regulatory decision, and what the
17 regulator wants to know is, is there a real potential
18 I'm going to be exceeding this acceptance guideline?
19 CHAIR APOSTOLAKIS: I mean, you're really
20 not avoiding what 1150 did. Because, as we all know,
21 sensitivity studies have a sense of arbitrariness, so
22 you are using a particular assumption. Then you have
23 to make a judgment then if that sensitivity study
24 makes sense. How likely is it? Which brings you back
25 to some sort of evaluation of the probability that

1 this is a valid --

2 MR. PARRY: We don't want to use

3 probabilities. I don't think that's -- that's not the

4 approach we're taking.

5 CHAIR APOSTOLAKIS: I really want a

6 detailed discussion on these things at some point.

7 Maybe today is not appropriate, I don't know.

8 MR. TRUE: The piece of what John brought

9 up that is important, in the context I described, the

10 1.174, 1.177 application, you're always going up to a

11 delta CDF and looking at how large is the increase,

12 and comparing to some absolute threshold. The masking

13 problem comes in ranking applications where we're

14 using importance measures, and those types of things.

15 And we've attempted to deal with that in 5069 through

16 a series of sensitivity studies where you change input

17 assumptions, and look at key areas in the model to see

18 if you are masking. And that's the only regulatory

19 application that I'm aware of that used importance

20 measures in that way. And we tried to be aware of the

21 masking problem in setting that up. So I think that

22 the way the guidance is structured is it's primarily

23 oriented towards the 1.174-type applications, where

24 you're looking at the -- always looking at the goes

25 ups, and how much higher can that go up, and not --

1 the ranking applications are a different animal, in
2 which we have different problems. And I think we
3 understand that, and Chapter 7 does a little talking
4 about that. That may need to be --
5 MEMBER STETKAR: A little bit, but it's
6 still focused on the goes ups.
7 CHAIR APOSTOLAKIS: What I want to
8 understand is, is there going to be a time when we'll
9 have detailed discussion of these approaches? There
10 has to be. Maybe not today.
11 MS. DROUIN: You know what I was thinking,
12 George, maybe a way to deal with this is -- and, as I
13 said, we're out for a three-month public review and
14 comment period -- and it seems to me that maybe the
15 best way to get the Committee's input is, we're going
16 to have to come back. But instead of us, to be
17 honest, giving you a presentation, is us just coming
18 in and listening, and you all go through the document,
19 and give us your input.
20 CHAIR APOSTOLAKIS: Well, the document we
21 have now, it's a little short on guidance.
22 MEMBER STETKAR: The other thing is,
23 there's a good --
24 MS. DROUIN: Between now and the end of
25 the public review and comment period, this is the

1 document that's out there for review.

2 CHAIR APOSTOLAKIS: I understand that.

3 MS. DROUIN: Now that doesn't mean that we

4 have to wait until the end of the public comment

5 period to start making changes, but I've taken a lot

6 of notes, and I've gotten some feedback, and I know

7 some things to do. But it would help me a lot more if

8 I sat down with the Committee, instead of doing a

9 presentation. You all walk us through and say well,

10 I didn't see this, or I didn't like that.

11 CHAIR APOSTOLAKIS: But you said it's

12 outside you scope now. And the other thing is, we

13 haven't seen the EPRI --

14 MS. DROUIN: This particular issue, I'm

15 just talking overall.

16 MEMBER STETKAR: We need one cut through

17 both of them, and decide where to go from there.

18 CHAIR APOSTOLAKIS: But it appears that

19 the update that EPRI is working on is crucial here.

20 MEMBER BLEY: Well, they've also got the

21 application guide.

22 MR. CANAVAN: Ken Canavan, EPRI. We're

23 not going to take you on a guided tour of the black

24 hole today. We're going to sort of show you the

25 methodological approach, show you an example, and then

1 give you the EPRI report in the short term. That may
2 be a month or so away, but that will -- when we give
3 you the EPRI report, it allows you to look at all the
4 issues, and is a full discussion, and has all the
5 detail.
6 The intent of the EPRI report is very
7 pragmatic. It's very guidance-oriented. It is what
8 to do, so I think what you're looking for probably
9 isn't it 1855, by design, if we're companion
10 documents, details in one that's missing from the
11 other.
12 CHAIR APOSTOLAKIS: Okay.
13 MEMBER BLEY: Ken, are you updating both
14 your documents?
15 MR. CANAVAN: We're getting into this
16 afternoon's presentation, but no.
17 MEMBER BLEY: Okay.
18 MR. CANAVAN: We're updating the
19 applications guide part.
20 MEMBER BLEY: The application guide is
21 what is being updated.
22 MR. CANAVAN: Right.
23 MEMBER BLEY: Okay.
24 MEMBER SHACK: Neither one of these, I
25 mean -- you know, a lot of us are looking for 1150

1 kind of uncertainty analysis, and I don't think we're
2 going to get that out of the EPRI documents, or this
3 document. In Tom's terms, you're going to go left to
4 right on this guidance where you need to know the
5 overall cumulative thing, some sort of bounding
6 arguments, and they're not really going to try to give
7 you an 1150 analysis. The real emphasis here is a
8 1174 kind of application, where you're kind of worried
9 about the delta CDF, and making sure you don't exceed
10 those guidelines.
11 I mean, to me, you guys are so focused on
12 cutting the problem down to a manageable size, and
13 bounding these increments in a semi-
14 qualitative/quantitative sense for 1174 applications,
15 but if somebody is expecting you to give guidance so
16 that you end up with 1150 results, I don't think
17 they're going to find it out of this document.
18 MS. DROUIN: No.
19 MEMBER SHACK: Or that document.
20 MS. DROUIN: And that was never the
21 intent.
22 MR. PARRY: That was never the intent.
23 Right.
24 MS. DROUIN: The intent is that given what
25 you have --

1 MEMBER SHACK: Well, I'm not sure that we
2 all -- you know, when we say uncertainty analysis,
3 when Tom says uncertainty analysis is a product of the
4 PRA, he means 1150.
5 MS. DROUIN: Right, which is not what we
6 mean.
7 MEMBER SHACK: Which is not what you
8 meant.
9 MS. DROUIN: No. All we mean is that when
10 you --
11 MEMBER SHACK: But we must at least
12 understand what you meant so we don't keep asking you
13 to produce what you're not meaning to mean.
14 MS. DROUIN: When you've got a decision
15 under-hand, you have some kind of acceptance criteria
16 you're using, and how are the uncertainties affecting
17 that acceptance criteria that could influence your
18 decision. And that's the boundary that we were trying
19 to do.
20 MR. WALLIS: But you're too much focused
21 on the NRC. I mean, PRAs have a problem with the
22 public. The public doesn't believe them. You've got
23 to tell them something about how confident you are in
24 the results. It's not just an internal problem.
25 Intelligent people out there are trying to figure out

1 how they should take these values that come out of the
2 PRA.
3 MR. PARRY: And how those values are used
4 in the context of making decisions.
5 MR. WALLIS: Yes.
6 MR. PARRY: Because that's what they
7 should be worried about.
8 MR. WALLIS: Not just 1174, all kinds of
9 things.
10 MR. PARRY: All kinds of decisions. And
11 we've tried to broaden it from that point of view.
12 MS. DROUIN: We have not focused this on
13 1174.
14 MR. PARRY: The reason why I think that we
15 consciously chose not to go the 1150 route --
16 CHAIR APOSTOLAKIS: I'm not -- 1150 was an
17 example, guys.
18 MR. PARRY: I understand that, but it
19 seems that some people are expecting that we're going
20 to go that way. So from a personal point of view, I
21 don't think that's very useful for making decisions,
22 because what you're going to do is, you're going to
23 weight different model results and come up with some
24 mean value.
25 Really what we're trying to do with this

1 approach is to demonstrate that for certain decisions,
2 it doesn't matter what assumption you've made. It's
3 still an acceptable decision. It's to try and give
4 people confidence --
5 CHAIR APOSTOLAKIS: I understand that. If
6 it works, you're right. But the problem is that
7 sensitivity analysis, at some point you will have to
8 tell us how likely this sensitivity assumption is.
9 MR. PARRY: No, we don't necessarily go --
10
11 CHAIR APOSTOLAKIS: Well, I'll tell you,
12 in 5069, South Texas came here and said look, even if
13 increase all the failure rates by a factor of ten,
14 we're still below the thing, so we are great.
15 Now if you are a bad guy, you might say
16 well, why not 100? Say no, no, no. That goes above
17 the -- it's no good. What tells me that a factor of
18 100 is no good?
19 MR. PARRY: Okay.
20 CHAIR APOSTOLAKIS: There must be an
21 assessment that this is an extremely unlikely
22 assumption.
23 MR. PARRY: Right. That's one way of
24 doing it.
25 CHAIR APOSTOLAKIS: And that brings you

1 back to the 1150 approach.

2 MR. PARRY: But another -- no, it doesn't,

3 necessarily. Remember, the approach that's taken in

4 5069 is a little different. Right? There's a

5 sensitivity study that's done that says I'm going to

6 assume that if the factor is five, say, and I can

7 demonstrate that the delta CDF is low enough, then

8 that's okay. But you don't necessarily justify that

9 factor five directly. What you do is you set up a

10 performance measuring criterion to make sure that that

11 factor five is never realized. So you would use a

12 different part of the risk-informed decision making to

13 validate that statement.

14 CHAIR APOSTOLAKIS: I don't think that's

15 the way it was done. I mean --

16 MR. PARRY: I think that is the way. I

17 think that is the way it was done.

18 CHAIR APOSTOLAKIS: South Texas said the

19 factor of ten, everybody said yes, that's

20 unreasonable.

21 MR. PARRY: They still have to do a --

22 CHAIR APOSTOLAKIS: It was a judgment on

23 the part of people that that's an unreasonable thing

24 to do.

25 MR. PARRY: But there's still that safety

1 net of the performance monitoring. And that is how
2 Reg Guide --
3 CHAIR APOSTOLAKIS: That's why we need
4 specifics, because this is, again, very high level
5 discussion. And, again, I'm not talking about 1150
6 that you have to do -- well, it seems it would make
7 sense to at least mention it as a way of handling
8 model uncertainty. I mean, it has been done by a
9 major study of this Agency. It was completely silent.
10 And, also, when you have a consensus model you have
11 uncertainty, don't you need some guidance how to
12 figure out what that uncertainty is? I mean, this is
13 the kind of what to do advice that I'm looking for.
14 MR. PARRY: And what we're trying to do in
15 this document is to make sure that when people use
16 these results, they present the decision maker with
17 the information that he needs to judge whether he can
18 have confidence in the results.
19 CHAIR APOSTOLAKIS: And that's part of
20 that information, in my view, unless you argue that
21 the decision maker --
22 MS. DROUIN: George, I already made a note
23 that at least --
24 CHAIR APOSTOLAKIS: Okay. I think we have
25 exhausted --

1 MS. DROUIN: -- we should go in and
2 discuss different approaches, like 1150.
3 CHAIR APOSTOLAKIS: Right.
4 MS. DROUIN: And why we have chosen the
5 approach we have chosen.
6 CHAIR APOSTOLAKIS: And how does it fit in
7 your overall scheme.
8 MS. DROUIN: Right. I agree with you.
9 CHAIR APOSTOLAKIS: That's a reasonable --
10
11 MS. DROUIN: I think that's a fair
12 comment, and I think we should do that.
13 MEMBER BONACA: I think the EPRI guidance
14 provided, however, is on target with that
15 certification, because that's really 99 percent of the
16 applications taking place today are in the direction.
17 I mean, they're applying versus 1.174, and so I think
18 this kind of additional information, I think this
19 serves a purpose.
20 CHAIR APOSTOLAKIS: But look at Slide 30.
21 MS. DROUIN: Slide 30?
22 CHAIR APOSTOLAKIS: Yes. I would call
23 this guidance for achieving a particular goal, like
24 identifying the sources of model uncertainty. I would
25 like to see something as specific as this telling me

1 now what to do with it. That's what I'm saying. And
2 I think Mary has taken a note, let's go on. Let's go
3 on. Which one is the next one?
4 MS. DROUIN: You're talking about when you
5 get to the end box, which is -- the product coming out
6 of this is ultimately here are your key sources of
7 uncertainty.
8 CHAIR APOSTOLAKIS: Right. But under --
9 you have two boxes that I see here that say screen.
10 MS. DROUIN: Yes.
11 CHAIR APOSTOLAKIS: Is that a judgmental
12 screening? What is it based on? How is it done? You
13 know, that's part of what I'm looking for.
14 MS. DROUIN: I think this is an important
15 discussion right now, because the -- what I'm hearing
16 is that when you read the document, you did not think
17 there was enough guidance explaining that box.
18 CHAIR APOSTOLAKIS: For instance, in
19 general, there is not enough guidance as to what to
20 do, certain things quantitatively.
21 MS. DROUIN: How to perform that step.
22 CHAIR APOSTOLAKIS: Quantitatively, right.
23 For example, there is a mention of taking the raw for
24 delta CDF or CDF, and so on, but is that what you're
25 recommending? That's the kind of -- you become

1 quantitative in certain parts, but other parts are not
2 quantitative.
3 MR. PARRY: That's what Section 5.4 does,
4 I think. Address that screen.
5 MS. DROUIN: No, I understand that. But
6 what George is telling us is that, if I understand
7 correctly, the guidance we have here, you're saying is
8 not detailed enough.
9 CHAIR APOSTOLAKIS: Right.
10 MR. WALLIS: You're talking about --
11 CHAIR APOSTOLAKIS: And I think some of my
12 colleagues have the same view.
13 MS. DROUIN: I'm not surprised -- I'll be
14 quite frank -- I'm not surprised by those statements.
15 CHAIR APOSTOLAKIS: Also, next time we
16 meet, I would suggest that your slides focus more on
17 this part rather than general. I mean we have seen
18 now the general approach, and so on, so zero in on the
19 real thing.
20 MS. DROUIN: You're never going to be
21 happy with our presentations.
22 CHAIR APOSTOLAKIS: Oh, no, no. I've been
23 happy many times in the past, Mary. This is a very
24 unfair statement.
25 MS. DROUIN: No, no, no. I'm talking

about what we're going to do for you in the future, because otherwise, to be frank, to give you that kind of presentation, I'd have to have 200 slides.

CHAIR APOSTOLAKIS: Well, let's wait until we hear from EPRI this afternoon, and then revisit what we're going to do in the future.

MS. DROUIN: Okay.

MEMBER SHACK: We want go into the black hole.

(Laughter.)

CHAIR APOSTOLAKIS: So where are we, which slide?

MR. WHEELER: This slide speaks to the quantitative screening step, which we've had a lot of discussion about today. But regardless of our failure to communicate the level of detail on the screening, the major point here is that at this level, at this point in time, you're doing some sort of quantitative screening based on, like I said, a risk achievement worth analysis, which reflects the fact that you're taking a potentially conservative quantification of certain parts of the PRA. And the idea here is that if you can successfully screen out uncertainty issues based on that kind of screening, then you don't have to get -- you don't have to deal with the problem of

1 trying to come up with what is an appropriate
2 alternative hypothesis, and potentially disagree
3 eternally as to what is an acceptable way to address
4 the real sensitivity.
5 But anything that does not get screened
6 out quantitatively, ultimately, one has to do a
7 realistic sensitivity analysis to determine if there
8 is an alternative, a realistic alternative hypothesis
9 that could create -- end up in a PRA result which does
10 present an unacceptable result to the regulator.
11 This flow chart is the same shape, so it's
12 still the same process flow, except that now the
13 screening really -- they're not really screens any
14 more, they are realistic sensitivity assessments of
15 the uncertainty issue. And I think given the type of
16 discussions we've had so far on Chapter 5, I think
17 that's all we need to say here on this point.
18 CHAIR APOSTOLAKIS: Okay.
19 MS. DROUIN: The only question I would
20 have is because I felt John brought up a major point
21 in terms of we looked at our initial importance
22 screening that we did focus on raw, and we didn't look
23 at risk reduction. And I'd like to get, maybe not
24 here today, but more of your insights and input into
25 that to make sure that I've understood it correctly so

1 we can appropriately address your concern, because I
2 thought you brought up a really good point.
3 MR. PARRY: But bear in mind, also, that
4 what Doug said is true, that we're really looking at
5 things, or we're butting against criteria. And I
6 think when you recognize that you have conservatism in
7 your analysis, and you're butting against the
8 criteria, then I think it's the applicant's
9 responsibility to determine whether he needs to do
10 something about that.
11 CHAIR APOSTOLAKIS: Well, the point is, I
12 think we had a very long letter a few years ago on
13 importance measures, and one of the problems we
14 identified was that because they are global measures,
15 you know, they take the whole PRA into consideration
16 when you calculate raw, they may be distorted by the
17 fact that certain parts of the PRA are done
18 conservatively. For example, seismic or fire.
19 Now one way that I remember the industry
20 went around it was to do separate -- to develop
21 separate importance measures for the internal events
22 PRA, for the fire, for seismic, and then present also
23 the global importance measures, and then draw certain
24 conclusions. And that's, for example, one way of
25 handling that.

1 MR. PARRY: That's what Doug was referring
2 to in his --
3 CHAIR APOSTOLAKIS: Yes. But this is
4 specific guidance. Now there may be more that we can
5 do now, because that was a few years ago. I don't
6 know.
7 MS. DROUIN: But I think we need to let
8 the reader know why and where, why not and where, in
9 terms of the risk reduction. We don't even speak to
10 it here.
11 MEMBER STETKAR: The real concern is that
12 -- I'll draw this picture here -- is that if your
13 total risk is characterized by the sum of a large
14 number of contributors, and if some of the more
15 important, bad use of terminology, perhaps, but some
16 of the top -- some of the big picture contributors --
17 MS. DROUIN: You've got to use the right
18 words.
19 MEMBER STETKAR: -- are driven by
20 excessive conservatism, modeling conservatism,
21 assumptions and things like that. Now if you go in
22 with a specific application and you want to show that
23 the risk increase from that application is small, and
24 small enough to be acceptable, in truth, if the total
25 risk -- a large delta on a small contributor is a

1 small change on the total, but if that total is driven
2 by uncertainties that are dominated by conservatisms,
3 that large delta on a small contributor may be a much
4 larger delta on the real total. Follow what I'm
5 talking about?
6 MS. DROUIN: Yes.
7 MEMBER STETKAR: So identifying the fact
8 that, in fact, there may be a large source of
9 uncertainty in what you call your base PRA, which is
10 the same model that you use for a particular
11 application, that that may be masking changes down in
12 the small areas where you're looking at a particular
13 application. That's my concern, that is an equal
14 concern is terms of applications in the Reg Guide
15 1.174-type application, in addition to the overall
16 understanding of the base PRA model. And I only bring
17 this up because I've seen it.
18 MS. DROUIN: Yes.
19 CHAIR APOSTOLAKIS: Mary said she wants to
20 talk to you privately. That's fine.
21 MEMBER STETKAR: Yes.
22 CHAIR APOSTOLAKIS: Okay. And, also,
23 regarding advice, you realize, as a Committee, we
24 cannot give you advice today, because you can read the
25 transcript if you want, but the Committee really

1 speaks only through the letter.

2 MS. DROUIN: Right.

3 CHAIR APOSTOLAKIS: And there is no letter

4 today. So shall we move on to Chapter 6, perhaps, or

5 back to Chapter 5? What do you want to do?

6 MEMBER STETKAR: Four.

7 CHAIR APOSTOLAKIS: Four? Yes.

8 MEMBER STETKAR: Four is easy.

9 MS. DROUIN: No, we need to move on to 6.

10 He disappears in 35 minutes.

11 (Simultaneous speech.)

12 CHAIR APOSTOLAKIS: So we're going to do

13 Chapter 6, give us quantitative guidance how to do

14 completeness.

15 MR. WHEELER: Before we start discussing

16 Chapter 6, let me ask the Committee a question. Do

17 you have similar thoughts and potential concerns about

18 6, as you did with 5, that when you read it, was it

19 too general, and there was not --

20 CHAIR APOSTOLAKIS: Yes.

21 MR. WHEELER: Okay. Then the presentation

22 is not going to help. So I think a lot of your --

23 probably your recommendations that you've asked for

24 in number 5, will --

25 CHAIR APOSTOLAKIS: Well, let me propose

1 then, you, lady and gentlemen, that maybe the rest of
2 the time should be on Chapter 7.
3 MS. DROUIN: Okay.
4 CHAIR APOSTOLAKIS: Because 7 seems to be
5 where things come together.
6 MS. DROUIN: That's right.
7 CHAIR APOSTOLAKIS: Why don't we do 7? If
8 we have time, we'll go back to -- who is doing 7?
9 MEMBER STETKAR: George, I think it might
10 be worthwhile to spend 10 minutes, no more, on Chapter
11 4, only because Chapter 4 is the only place that the
12 NUREG talks about state of knowledge uncertainty.
13 CHAIR APOSTOLAKIS: Right.
14 MEMBER STETKAR: And that is a very
15 significant difference between the EPRI document, and
16 this document.
17 CHAIR APOSTOLAKIS: So let me ask then --
18 MEMBER STETKAR: It's probably worthwhile
19 --
20 MR. PARRY: It's not a difference. We're
21 punting to the EPRI document to actually provide the
22 details.
23 MEMBER STETKAR: I sure hope you're not,
24 but let's --
25 (Simultaneous speech.)

1 CHAIR APOSTOLAKIS: This is general, guys.
2 Mary, would you like to discuss Chapter 7 first, and
3 then go back to 4, or do 4 first, and then to 7?
4 MS. DROUIN: Before I answer, can I ask
5 you a question?
6 CHAIR APOSTOLAKIS: Yes.
7 MS. DROUIN: Do you want us to finish by
8 noon?
9 CHAIR APOSTOLAKIS: Yes.
10 MS. DROUIN: Okay. Then let's go to 7.
11 CHAIR APOSTOLAKIS: Okay. But then we'll
12 reserve some time at the end to at least address the
13 issue of state of knowledge correlation.
14 MS. DROUIN: Okay. Let me just say one --
15 30 seconds on the state of knowledge. We are punting
16 to EPRI. However, if you're reading an old EPRI
17 document, we have had some concerns, and we're working
18 with EPRI to work out those technical concerns.
19 CHAIR APOSTOLAKIS: So you are not
20 dismissing the issue, then.
21 MS. DROUIN: No, no, no, no.
22 MR. PARRY: No, no, no, no.
23 MR. CANAVAN: Ken Canavan for EPRI. We'll
24 talk about that this afternoon, and you guys can chime
25 in any time you like.

1 CHAIR APOSTOLAKIS: Good. Very good.
2 Because in your earlier version, you sort of dismissed
3 it. For the record, they disagree with my statement.
4 (Laughter.)
5 CHAIR APOSTOLAKIS: Okay. Let's go to
6 Chapter 7.
7 MR. PARRY: Okay. What we're trying to do
8 in Chapter 7 is, this says to provide guidance on
9 addressing the uncertainty in the PRA results in the
10 context of a risk-informed decision. Okay. With a
11 recognition that the risk input is only one input to
12 the decision, so what we're trying to achieve with
13 this is to give the decision maker, who is going to
14 have to take this information and use it, an
15 understanding of the robustness of the risk input to
16 the decision. Okay. So that's the focus of what
17 we're trying to do.
18 MR. WALLIS: Do you have any measures of
19 this robustness?
20 MR. PARRY: Robustness is determined by
21 whether taking all the uncertainties into account, you
22 can still make the same decision. It's driven by the
23 acceptance --
24 MR. WALLIS: How does he take them into
25 account, he just looks at a whole lot of discussion?

1 MR. PARRY: That's what this chapter is
2 about. That's what I'm going to try and tell you.
3 MR. WALLIS: Okay.
4 MR. PARRY: Okay? Specifically, what
5 we're going to talk about is -- we start out by saying
6 how can you present the results of PRA uncertainty
7 analysis? We have a discussion on the way you can do
8 that. And then we use Reg Guide 1.174 --
9 MR. WALLIS: What does the decision maker
10 look for?
11 (Simultaneous speech.)
12 CHAIR APOSTOLAKIS: Let's give at least 60
13 seconds.
14 MR. WALLIS: Okay.
15 CHAIR APOSTOLAKIS: And then we'll ask.
16 MR. PARRY: What we do in the chapter is
17 we used Reg Guide 1.174 as an example of a set of
18 acceptance criteria, we want to say what these things
19 look like. And then we're going to use that as a
20 discussion tool for saying how we deal with parameter
21 uncertainty, how we deal with model uncertainty, how
22 we deal with completeness uncertainty, and to some
23 extent, also, how we aggregate results.
24 There is a section in this chapter on
25 addressing uncertainty and categorization. It's

1 pretty light. I think we need to do more work on that
2 section, but it's a recognition that there has been
3 some work done in this area. And EPRI has done quite
4 a lot of work in this area.
5 I think we were more concerned in this
6 case with how do you deal with the uncertainties in,
7 say, like an internal events PRA model in this
8 context, rather than the broader context of how do you
9 deal with when you're bringing in other scope items.
10 But I think that might be an issue that we should
11 address here. And then, finally, we add some
12 discussion on using qualitative approaches to address
13 uncertainty, as an alternate to just using the
14 quantitative measures.
15 Okay. We talk a little bit about how you
16 can present the results of PRA uncertainty analyses,
17 which is obviously dear to some people's heart here.
18 We could do it in terms of continuous probability
19 distributions on the numerical results.
20 MR. WALLIS: You've got a continuous
21 probability distribution from --
22 MR. PARRY: We don't, and that's one thing
23 we discussed, that you only do that when you have a
24 continuous distribution on the probabilities that you
25 can propagate. So we recognize that that's something

1 that we can do for parameter uncertainties. Okay?

2 CHAIR APOSTOLAKIS: And this propagation

3 can be done routinely now with the existing software.

4 MR. PARRY: With existing software. So

5 that's a recognition that we can do that.

6 CHAIR APOSTOLAKIS: Okay.

7 MR. PARRY: We can define that. But other

8 approaches are things like discrete probability

9 distributions, which has been used to address certain

10 types of model uncertainty. For example, I remember

11 back in 1984 when I did the Limerick Severe Accident

12 Risk Assessment, we used that type of distribution to

13 parameterize the seismic hazard, and the seismic

14 contribution to CDF.

15 Okay. That does require, if you're going

16 to use that, though, you have to assign probabilities

17 to the different models, or degrees of belief to the

18 different models. This is 1150.

19 CHAIR APOSTOLAKIS: 1150.

20 MR. PARRY: Okay. Personally, I think

21 that adds another dimension, another cause for

22 argument as to whether the results you're getting are

23 reasonable. We can probably beef up that in a future

24 version of the document. Okay?

25 Another approach is just to provide

1 results for different assumptions and different
2 models, as discrete representations without
3 associating a degree of belief for that particular
4 representation. And that's really the direction in
5 which we've been leaning. Otherwise, you can just
6 provide simple bounds or ranges in the results.
7 Okay. Now that's just talking about how
8 you present the results, but perhaps the most
9 important thing that we're trying to stress in this
10 document is that that is only one part of presenting
11 the results. The other important part is
12 understanding where that comes from, understanding
13 where the uncertainty comes from, so that you can do
14 something about it, and so that you can assess whether
15 it's significant to your application. And we just
16 recognize that the various tools that you use for
17 understanding the contributions to the uncertainty,
18 and the contribution to the risk are importance
19 analyses, and sensitivity analyses. We don't say much
20 more than that.
21 Okay. Now we do talk a lot about
22 comparing PRA results with acceptance criteria. Okay.
23 So we talk first -- we address, first of all, the
24 uncertainty arising from the level of detail. Okay?
25 Because this is something that -- Mario, has referred

1 to it as a degree of arbitrariness, and to some extent
2 it is arbitrary to what level of detail you put in the
3 model, but if you're going to use the model to support
4 the decision, then it's got to have sufficient level
5 of detail that you can address the issue that you're
6 trying to model. So, in a sense, this level of detail
7 thing is, to some extent, self-correcting. I mean, if
8 you don't have a hook in the model to attach your
9 cause/effect relationship to, you don't have a way of
10 addressing the issue.
11 But we do recognize that there are minor
12 differences that can occur due to the fact that, as I
13 said before, the example I gave was maybe somebody
14 didn't take credit for a CRD enhanced flow, another
15 person did. This is an issue, and we recognize it in
16 here that, in fact, this is something that we need to
17 spend a little bit more time on. I'm getting ahead of
18 myself here. I'm going to talk about that in the
19 context of parameter uncertainties.
20 The statement we make about parameter
21 uncertainties, and this relates to some of the
22 discussion we've had today, is that really the method
23 of comparison of the PRA results with the acceptance
24 criteria is very much a function of the way that those
25 criteria have been set up.

1 Our acceptance criteria or guidelines that
2 we have for the NRC, for most of our regulatory
3 applications, are declared to be you will use the mean
4 value of the propagated uncertainty distribution to
5 compare with those guidelines.
6 MR. WALLIS: This is an arithmetic mean
7 you always mean, do you?
8 MR. PARRY: I mean arithmetic mean, yes.
9 I do not mean geometric mean. Right.
10 MR. WALLIS: You don't mean sort of an
11 assessment that the probability be in the 50th
12 percentile, it's something completely different.
13 CHAIR APOSTOLAKIS: No, this is not expert
14 opinion.
15 MR. WALLIS: No, but the means -- if you
16 have an already skewed distribution, I'm not quite
17 sure what the mean --
18 MR. PARRY: Well, of our distributions are
19 kind of skewed, and the means are actually quite high
20 up there on the percentile list.
21 MEMBER BLEY: They tend not to be so
22 skewed that you can't define the mean.
23 MR. PARRY: Right.
24 CHAIR APOSTOLAKIS: Is it not the 80th or
25 85th percentile, usually?

1 (Simultaneous speech.)

2 MR. PARRY: In that range.

3 CHAIR APOSTOLAKIS: It could be way up

4 there, but, I mean, most of the time.

5 MR. PARRY: Typically, it's not. So

6 that's the approach for dealing with parameter

7 uncertainty, is typically we're going to use the mean

8 value --

9 MR. WALLIS: If you use the mean value,

10 there's no measure of uncertainty in that case at all.

11 You're not even addressing uncertainty.

12 MR. PARRY: No. Actually, that's not

13 entirely true, and I think that's where this state of

14 knowledge correlation thing actually comes into play

15 significantly.

16 MR. WALLIS: You're uncertain amount the

17 mean, is what that tells you.

18 MR. PARRY: No, no, no, no. What it tells

19 you is that the mean of X squared is considerably

20 larger than the mean of X all squared.

21 CHAIR APOSTOLAKIS: That's not what he

22 means.

23 MR. WALLIS: It seems to me the question

24 that the Commission is always asking is how good is

25 the number you're giving me? And if you're only

1 giving me the mean, you're not telling me anything
2 about how good it is.
3 MR. PARRY: The Commission has stated in
4 its criteria that it is the mean value that we will
5 compare with --
6 MR. WALLIS: How good is that?
7 CHAIR APOSTOLAKIS: You are presenting the
8 whole distribution. Let's not forget that. But in
9 terms of the criteria part of the guidelines, you are
10 expected to use the mean value.
11 MR. PARRY: Use the mean value, right.
12 CHAIR APOSTOLAKIS: Another thing that
13 very often we forget is that these guidelines didn't
14 come down from any mountain. When people defined the
15 guidelines, they had in mind the mean.
16 MR. PARRY: Right.
17 CHAIR APOSTOLAKIS: So the whole thing
18 comes together.
19 MR. PARRY: Yes.
20 CHAIR APOSTOLAKIS: Okay? It's not as if
21 something objective external to us, and we decided to
22 use the mean.
23 MR. WALLIS: So the probability of
24 stepping over the acceptability criterion is not
25 addressed at all.

1 CHAIR APOSTOLAKIS: It's consider -- if
2 the mean is below the line --
3 MR. WALLIS: If it's a very broad
4 distribution --
5 CHAIR APOSTOLAKIS: If it's very broad,
6 the staff will go back to the integrated decision
7 making process and start talking about it. There is
8 a very key paragraph in 1.174 that says as you
9 approach the line, there will be increased management
10 attention.
11 MR. WALLIS: But you don't have to
12 approach the line with the mean in order to have a
13 pretty good chance of stepping over that boundary.
14 CHAIR APOSTOLAKIS: No. If you have a
15 pretty good chance, the mean will be close.
16 MR. WALLIS: Doesn't have to be.
17 MEMBER BLEY: Well, as the distribution
18 gets very broad, the mean moves up into a higher --
19 MR. PARRY: Yes.
20 MEMBER BLEY: The broader, the further up
21 it moves.
22 CHAIR APOSTOLAKIS: That's right.
23 MR. PARRY: I think George is right, that
24 decisions that are close to the guidelines are going
25 to be much more scrutinized than --

1 CHAIR APOSTOLAKIS: This paragraph should
2 not have been a footnote. It should have been in bold
3 face letters, because it's a key paragraph. It says
4 if you're close to the line, you should expect
5 scrutiny until we both fall down from exhaustion.
6 (Laughter.)
7 CHAIR APOSTOLAKIS: And that's what's
8 happening, actually.
9 MEMBER SHACK: Sort of like an ACRS
10 meeting.
11 (Laughter.)
12 MR. PARRY: One of the things that we
13 address in this section is, in fact, maybe sort of
14 relates to -- well, it's not really your point. It's
15 more related to the fact that there are going to be
16 differences that are caused by the level of detail
17 that people put into the model. And that this raises
18 issues, if we try and treat the criteria as
19 guidelines. Okay? And this is what's happening all
20 the time in the significance determination process.
21 And people are worried that they want to sharpen the
22 pencil to either get above or below the line,
23 depending on whether they're the SRA or the licensee.
24 And there's a problem with that, I think, in the sense
25 that we have to address that fact, that minor

1 differences really do not -- they don't really
2 represent a significant impact on the risk.
3 MR. WALLIS: So it's been close to the
4 line on either side.
5 MR. PARRY: Oh, yes.
6 CHAIR APOSTOLAKIS: Absolutely.
7 MR. WALLIS: Oh.
8 MR. PARRY: Let's move on.
9 MEMBER SIEBER: It should be fuzzy lines.
10 MR. WALLIS: Now we've found out what you
11 are, we're just trying to figure out how bad you are
12 in that regard. You're happy for folks to step over
13 the line, just arguing about how far you can go.
14 Right?
15 CHAIR APOSTOLAKIS: It's very clearly
16 stated that you can be above the line and still get
17 approval.
18 MR. PARRY: Yes.
19 MR. WALLIS: So what's the criterion for
20 how far you can go over --
21 CHAIR APOSTOLAKIS: There's no criterion.
22 This is thermal hydraulics term. In our case, there
23 are no criteria, there are guidelines.
24 MR. PARRY: Okay. Let's move on, I guess.
25 In terms of the other types of uncertainty, in terms

1 of model uncertainty, that's the stuff that was
2 discussed in Chapter 5. And what Tim described is the
3 process that we're going to use to identify the key
4 sources of uncertainty for the decision maker. And
5 what our focus is here, is that what we want is that
6 the decision maker should be supplied with an
7 assessment of which of these hypotheses and our
8 assumptions, and which model uncertainties can have an
9 impact on whether the decision is correct.
10 The way we've chosen to do it is through
11 sensitivity studies. So what this would do is you
12 present the decision maker with a set of decision --
13 with a set of results relating to the different
14 models, or the different assumptions, and an
15 assessment really of the credibility of those
16 hypotheses. We're not going to put numbers on them,
17 because we don't think that that's necessarily
18 something that we can do in any realistic way.
19 CHAIR APOSTOLAKIS: But that credibility
20 guide, how do you do that?
21 MR. PARRY: Well, I --
22 CHAIR APOSTOLAKIS: Make assessment of the
23 credibility, that's a number. Now somebody has to
24 give me numbers, expert judgment, something.
25 MR. PARRY: Maybe credibility is the wrong

way of saying it. The way of saying it is probably what is the pedigree of those assumptions? Is there a reasonable theoretical basis why that is an acceptable assumption? And I think it's up to the decision maker to make that weighing of whether --

CHAIR APOSTOLAKIS: Without telling us what the weights are. That's what you're saying. Ultimately, you have to have a judgment how likely that damned thing is.

MEMBER BLEY: We're coming apart. It seems to me the way you're presenting it is judgments, and our judgments are implicit and kind of buried. You kind of don't want to do them explicitly in the way of elicitation processes. And that seems to be a place where we're not comfortable.

CHAIR APOSTOLAKIS: Yes. That's what --

MR. PARRY: Yes, but I think you try and -- do you really want to get into an argument of whether Expert A has a credibility of .5, or .1? I don't think that that's really where you want to go.

CHAIR APOSTOLAKIS: If it's a very important issue, you probably will go there.

MEMBER BLEY: Whether you set it up or not.

MR. PARRY: I'm not sure, actually. I

1 think what you would try and do is to assess whether
2 Expert A had -- whether there was reasonable --
3 (Simultaneous speech.)
4 CHAIR APOSTOLAKIS: I remember in one of
5 the rules we risk-informed, that originally in the
6 sensitivity analysis, maybe it was EPRI, I don't
7 remember, it said increase the failure rates by a
8 factor of five. Then a revision comes and says
9 increase them by a factor of two. And the question
10 was, why did the five become two? And coming back to
11 South Texas, they increase it by a factor of ten, and
12 it worked. What if it hadn't worked? They would have
13 gone down to seven? You see, you have a problem there
14 of somehow what is reasonable to do is subject to
15 discussion.
16 MR. PARRY: I agree, and you have to
17 recognize whether you can make a reasonable technical
18 argument for the basis for that sensitivity study.
19 That's what, I think, we're focusing on. But if you
20 can't rule out a hypothesis, or an assumption that is
21 going to push you over the limit, then I think as a
22 regulator, we almost have to take that as a credible
23 hypothesis, and say this is no longer an acceptable
24 criteria.
25 CHAIR APOSTOLAKIS: Even if it is very

1 unlikely.

2 MEMBER STETKAR: Even if there's only a

3 fraction of a percent probability that that kind --

4 MR. PARRY: I don't know. What does that

5 mean? What does that mean, that fraction of a

6 probability. It's not something you can measure.

7 It's your opinion. Right?

8 CHAIR APOSTOLAKIS: Yes, but we make

9 decisions based on opinion all of the time. In fact,

10 we have formalized it in this Agency, the expert

11 opinion. But let me bring another point.

12 You're addressing the issue of having

13 alternate hypotheses, and you're doing the sensitivity

14 analysis.

15 MR. PARRY: Right.

16 CHAIR APOSTOLAKIS: What, again, if you

17 have a consensus model which has uncertainty? Then

18 it's difficult to tell what an alternative assumption

19 would be. You have a computer model, RELAP 5.

20 MR. PARRY: Yes.

21 CHAIR APOSTOLAKIS: And you are trying to

22 use it now somewhere where it's not a routine

23 application, and you may have uncertainties in three

24 places. And somebody says well, I believe the

25 uncertainty because of this, is that distribution,

1 that distribution, and propagates all the
2 distributions. You can't do sensitivity analysis
3 until you do very many of them, and you start changing
4 all sorts of things. You don't have alternative
5 hypotheses --
6 MR. PARRY: I don't think that's what
7 we're talking about.
8 CHAIR APOSTOLAKIS: I know, but I'm saying
9 that that's another situation where model uncertainty
10 -- the COMPBRN Code, we always had a distribution on
11 the code itself, the results of the code. How would
12 you do a sensitivity analysis on that?
13 MR. PARRY: And how did you determine that
14 distribution?
15 CHAIR APOSTOLAKIS: By comparing with the
16 very few experimental data we had.
17 MR. PARRY: Okay. Then you have --
18 CHAIR APOSTOLAKIS: But it's better than
19 not doing it. It's better than just saying here is a
20 code, use it, when I know that the results may be off
21 by a factor of two, or factor --
22 MEMBER SHACK: Presumably, you would argue
23 that the code result really is the adjusted result.
24 I mean, you sort of build -- if you know it, you build
25 it into it.

1 CHAIR APOSTOLAKIS: So you don't do this
2 then.
3 MR. PARRY: An example of a consensus
4 model would be the Westinghouse RCCP LOCA model.
5 MEMBER CORRADINI: The what? I'm sorry.
6 MR. PARRY: The Westinghouse Reactor
7 Coolant Pump Sealed LOCA model.
8 CHAIR APOSTOLAKIS: In some cases, that's
9 not the case. I agree.
10 MR. PARRY: That's the type of thing we're
11 talking about when we're talking about --
12 CHAIR APOSTOLAKIS: I understand. I'm
13 telling you that there may be other kinds of things
14 that you may want to include. I don't dispute what
15 you're saying.
16 MEMBER CORRADINI: I don't think he wants
17 to, though. What I keep on hearing with the two of
18 you is that you want to do this, and I don't think he
19 feels it's in his scope.
20 CHAIR APOSTOLAKIS: No, no, no, no, no.
21 The difference is, I'm not doubting what they did.
22 I'm saying there are additional things that need to be
23 considered. There may be other situations where
24 people have tried to address model uncertainty in a
25 different way, that doesn't fit this approach.

1 MEMBER CORRADINI: So my question is, is
2 it within the scope of what they're after, because --
3 CHAIR APOSTOLAKIS: Well, the scope has to
4 change.
5 MEMBER CORRADINI: Okay. That's fine with
6 me. I just --
7 MEMBER SHACK: It depends on the decision
8 they're trying to make, George.
9 MEMBER SIEBER: In the case of the cooling
10 pump, what caused them to really want to refine the
11 model is the fact that the result from the simplified
12 analysis isn't quite what they wanted to get. And
13 that could -- you don't write that into this document.
14 On the other hand, I think there's a lot of decisions
15 that are made like that. I don't get the result that
16 I want, I'll work on the analysis to eliminate or
17 reduce uncertainties.
18 MEMBER MAYNARD: Yes, but I think that
19 happens all the time, and I think that's consistent
20 with this document. It's not unusual to do kind of a
21 broader scope, take a look at something, as long as
22 everything fits within that, that's fine. But when it
23 doesn't, you refine it, and I think that's a
24 legitimate approach. And that's one of the options
25 here, is to reduce uncertainty by redoing the model,

1 refining the model to some degree to remove some of
2 the model uncertainty.
3 MS. DROUIN: Right, but what I thought
4 where the disagreement is, is that what we have said
5 is that once we call something a consensus model, we
6 don't have to go and investigate an alternative
7 hypothesis. We haven't dismissed the fact that
8 there's uncertainty associated, but we aren't going to
9 investigate the alternative hypothesis.
10 MR. PARRY: That's right.
11 MS. DROUIN: But I thought you were saying
12 you didn't like that.
13 CHAIR APOSTOLAKIS: No.
14 MR. PARRY: Because the consensus model,
15 if it has uncertainty, will have a prescribed approach
16 for dealing with that uncertainty.
17 CHAIR APOSTOLAKIS: Well, let's hope so.
18 The pilots that the industry mentioned going to try to
19 implement all this? Because we really need practical
20 applications of these ideas to refine them. So Doug
21 mentioned two pilot projects. Right?
22 MR. TRUE: That was on the --
23 CHAIR APOSTOLAKIS: Oh, that was
24 different.
25 MR. TRUE: That was on the EPRI.

1 MS. DROUIN: I think this is -- I just
2 want to make sure I understood that are you agreeing -
3 - it's not clear to me that you're agreeing or not
4 agreeing with that approach. It sounds to me like you
5 still want us to pursue, even though we call it a
6 consensus, even if it's been deemed a consensus model,
7 you still want it to be -- alternative hypothesis to
8 be pursued. That's what I thought I heard you saying.
9 CHAIR APOSTOLAKIS: No, no, no. The
10 alternative hypothesis, my problem is this credibility
11 thing, that I really think -- the credibility. At
12 some point, you have to say something about how likely
13 this particular hypothesis is to be true. And Gareth
14 says that can be done judgmentally. Well, of course,
15 it will be judgment, but by avoiding numbers, I'm not
16 sure how far you can go avoiding numbers. That's what
17 I'm saying, that if we had a practical application it
18 would shed a lot of light on this.
19 MR. PARRY: I really would object to the
20 term of "likely" associated with a hypothesis.
21 CHAIR APOSTOLAKIS: Why not? Why?
22 MR. PARRY: Well, because that seems to
23 suggest that there's -- I mean, we all know that any
24 of these hypotheses is probably not the right answer.
25 What you're really looking for is an answer that is

1 not even well-likely. It's -- I don't think it's the
2 right --
3 (Simultaneous speech.)
4 MEMBER BLEY: Is it conservative in all
5 cases of interest? Is that what you're --
6 MR. PARRY: Well, it's -- in a sense
7 they're all equally likely, if they're based on some
8 sort --
9 CHAIR APOSTOLAKIS: I have had problems
10 with sensitivity analysis from day one. There were
11 some members of this Committee 30 years ago that
12 enjoyed taking some study the staff did or the
13 industry, and said look, if I change the number by a
14 factor of ten, everything changes. And I'm sitting
15 there, why are you changing it by a factor of ten?
16 You know, there is so much arbitrariness in all this.
17 MR. WALLIS: It must be a bit of
18 uncertainty, I guess. I think it could be ten times
19 as big.
20 CHAIR APOSTOLAKIS: But they never felt
21 that they had to tell us how likely that factor of ten
22 was. You have to put some rules there to the game.
23 You can't just change things and say my goodness, if
24 I change this by a factor of 1,000, the whole system
25 collapses. Well, yes, thank you.

1 MR. PARRY: We recognize that, George.
2 And I think we do mention in here that if you are
3 going to propose alternate cases for sensitivity, then
4 they have to be defendable. In some cases, though,
5 it's not necessarily defendable, and I will take 50.69
6 as an example, because in that case, you can choose to
7 say I want to make sure that things don't get any
8 worse than X, and set up a monitoring program to make
9 sure that things don't get worse than X. And if they
10 do, then you change it. That's a risk-informed
11 decision making approach.
12 CHAIR APOSTOLAKIS: I understand.
13 MR. PARRY: Which recognizes uncertainty.
14 CHAIR APOSTOLAKIS: And, in fact, we did
15 that last time with seismic, the LOCA frequencies.
16 The approach that the staff took was how large would
17 the flaw have to be for something bad to happen, and
18 they concluded it had to be so large that it was
19 really very unlikely that you would ever see that kind
20 of flaw.
21 MR. PARRY: Right.
22 CHAIR APOSTOLAKIS: And we all accepted
23 that argument, without really saying how unlikely it
24 is.
25 MR. PARRY: Right.

1 CHAIR APOSTOLAKIS: So in some cases it
2 works, in some cases it doesn't work.
3 MR. PARRY: Right. And what we're trying
4 to do is come up with a pragmatic approach that can be
5 used.
6 CHAIR APOSTOLAKIS: Okay. Let's go on.
7 MR. PARRY: Okay.
8 CHAIR APOSTOLAKIS: Completeness, how do
9 you handle completeness, multiply by five?
10 MR. WALLIS: Are you finished with --
11 MS. DROUIN: Before we go on, you may want
12 to go back, and you can give us comments later on, or
13 we can come back to it later on today. I mean, we did
14 have a small section, and maybe -- I say small,
15 because you obviously missed it. But there is
16 guidance in here that you have to justify your
17 sensitivity analyses, the ones you choose to do.
18 CHAIR APOSTOLAKIS: I read it. I didn't
19 miss it. I read it.
20 MR. PARRY: At least you agree with that.
21 (Simultaneous speech.)
22 MR. PARRY: Okay. In terms of
23 completeness, okay. The aspect of completeness that
24 we're talking about here is the completeness
25 associated with the stuff that we know that we don't

1 have in the model. Okay? Not the stuff that we don't
2 know we have in the model, because that's dealt with
3 elsewhere.
4 MEMBER BONACA: I have a question on that,
5 however. How do you deal with the CDF? I mean, CDF,
6 typically -- I mean, you're talking about -- that
7 bullet there talks about the delta CDF. Okay? The
8 delta CDF that you have.
9 MR. PARRY: Okay.
10 MEMBER BONACA: And the question I have is
11 how do you deal with the completeness in the CDF?
12 MR. PARRY: The only way you can deal with
13 it, as we say, is either you have to demonstrate that
14 the contribution that you don't have in is
15 insignificant. If the thing that you're concerned
16 about is the CDF.
17 MEMBER BONACA: Total CDF.
18 MR. PARRY: If you're worried about the
19 total CDF, you have to demonstrate that what you've
20 left out of the model is insignificant. If that's the
21 --
22 MEMBER SHACK: It doesn't change your
23 decision. You can be moving along this axis in your
24 1.174.
25 MR. PARRY: Okay. That's -- yes, 1.174

1 allows you -- I think that's --

2 MEMBER SHACK: I think that's really what

3 Mario was -- he needs to know where he is on that axis

4 before he can do it.

5 MR. PARRY: Okay.

6 MEMBER BONACA: Because, really, this

7 confusion has been there for -- we know what --

8 MR. PARRY: If your delta CDF is less than

9 10 to the minus 6, you don't have to worry about

10 whether -- I mean, that's the way the criteria are set

11 up.

12 CHAIR APOSTOLAKIS: Yes, it really doesn't

13 matter where you are on the axis, unless you really go

14 to 10 to the minus 2.

15 MR. PARRY: Yes.

16 (Simultaneous speech.)

17 MR. PARRY: 1.174. Right.

18 CHAIR APOSTOLAKIS: Another argument that

19 was used in the past is okay, they haven't done a fire

20 or a seismic, or their shutdown. They haven't done

21 their shutdown, but look, other people have. They say

22 it's comparable to the internal events, so let's

23 multiply the internal event frequency by two. Does it

24 make any difference? No.

25 MR. PARRY: But maybe just to say what

1 we're going to do about completeness. We don't have
2 any magic bullets for saying multiply things by
3 factors of two and three to allow for the fact that
4 you haven't modeled something. You have to make -- if
5 it's significant to your decision, you either have to
6 model it, or you have to show that it's not
7 significant.
8 MEMBER BONACA: There is a broken line
9 there at 10 to the minus 3.
10 CHAIR APOSTOLAKIS: What did you say,
11 Mario?
12 MEMBER BONACA: There is a broken line
13 here, an endpoint, 10 to the minus 3.
14 CHAIR APOSTOLAKIS: No, it's not specified
15 where.
16 MR. PARRY: It's not specified.
17 CHAIR APOSTOLAKIS: But, I'll tell you, in
18 terms of real life, if you look at how the NRC and the
19 industry have responded in the past, Quad Cities,
20 especially, if you go above, I would say, two or three
21 ten to the minus three for CDF, all hell breaks loose.
22 But they don't want to specify where, but I think from
23 the behavioral point of view, that's where you get
24 into adequate protection. I remember Quad Cities, the
25 guy came up with nine ten to the minus 3 the first

1 test. Boy!

2 MR. PARRY: Okay. Just in the interest of

3 speeding up, I'm not going to -- there is a section

4 there about combining results. I'm not going to go

5 into that here. Okay? Except to say that whenever

6 you're using the results, you have to understand the

7 pedigree of the results, because that plays a role in

8 how you use them.

9 And, again, I will not talk about, in the

10 interest of time, I will not talk about the

11 qualitative approaches. You can read that. There's

12 not very much written in there, but it is a

13 recognition that there are some things that we can't

14 necessarily quantify all the sources of uncertainty.

15 But what we can do is, we can compensate for them in

16 different ways.

17 I think with that, I will hopefully stop,

18 and hand back to Mary.

19 CHAIR APOSTOLAKIS: Let me ask, John, are

20 you going to be here this afternoon?

21 MR. LEHNER: Yes.

22 CHAIR APOSTOLAKIS: So we can have the

23 discussion of the state of knowledge correlation when

24 EPRI sits up there, and maybe you can participate in

25 that discussion. You can participate in everything,

1 but in particular there, since we skipped that part.
2 MEMBER BLEY: I'm going to try something.
3 One thing, you don't have to answer this now, but I
4 want to understand better this idea of the consensus
5 model, and what it takes for us not to have to look at
6 alternative hypotheses. I've gone back and re-read
7 what's in there several times now, and it raises some
8 questions for me that I'd really like to get on the
9 table later on with you.
10 CHAIR APOSTOLAKIS: Okay. Good.
11 MR. WALLIS: I have a comment.
12 CHAIR APOSTOLAKIS: Yes. Go ahead.
13 MR. WALLIS: I have a comment on Chapter
14 7. I'm not sure if I can express it very well, but
15 you seem to be going to -- when you get to this
16 decision maker, you say, well, the CDF is 10 to the
17 minus 6, but then you're going to supply this decision
18 maker with what it seems to be a huge pile of
19 paperwork qualitatively discussing all of the
20 assumptions I made, and so on, and so on. I think
21 that takes away from the credibility of the answer.
22 If you don't have a measure of how good the answer is,
23 you have to have acres of paperwork to explain all the
24 reasons you did this, that, and the next thing, and so
25 on. That takes away from the credibility of the

1 answer. You really need a qualitative measure of how
2 good the answer is in terms of a deviation of some
3 sort, or a number that says --
4 MR. PARRY: The deviation is already
5 included, because this is the -- that is the results
6 of the sensitivity study.
7 MR. WALLIS: But there are so many of
8 these.
9 MR. PARRY: There aren't that many, it
10 turns out. For specific decisions, there are probably
11 not going to be that many. It's not as big as you
12 think.
13 MR. WALLIS: Well, think about it, because
14 you seem to be asking for assessments of so many
15 things in terms of words and discussion.
16 CHAIR APOSTOLAKIS: We have faced that
17 problem in the past, as well, where the analysts tried
18 to shift some of the responsibility to the decision
19 makers, and this Committee was not too favorable to
20 that approach, because the decision maker usually is
21 not qualified to go back and work with the PRA.
22 MR. WALLIS: That's right. He wants the
23 answer.
24 CHAIR APOSTOLAKIS: And, in fact, the LOCA
25 frequencies, I was screaming all the time give us what

1 is your best result. And they said no, no, no, we're
2 not going to do that. We'll give you 15 sensitivity
3 studies. So yes, we should be careful not to ask too
4 much of the decision maker, because the decision maker
5 is --
6 MR. PARRY: Well, I think the decision
7 maker has to have the right assessment of the
8 analysis.
9 CHAIR APOSTOLAKIS: That's right.
10 MR. PARRY: And I think it's the analyst's
11 responsibility to say that given all the evidence that
12 I have, I think that --
13 CHAIR APOSTOLAKIS: This is it.
14 MR. PARRY: -- this is the right decision.
15 Right. But this -- and this is why I think it is.
16 Right? And in many cases, if the various sensitivity
17 studies still allow you to accept the decision, then
18 you're obviously pretty happy about it. It's only
19 when you get where there are clear differences, and
20 there are not many cases where they are going to be
21 like that, I don't think.
22 MEMBER BONACA: It's between the decision
23 maker and the analyst, there is also questioning going
24 back and forth. Have you considered if this happens,
25 and the answer no, we haven't considered because there

1 is no need, and the reason is, is bound by this
2 condition. And there is a lot of questioning that has
3 to take place. And oftentimes, it brings out
4 surprises.
5 CHAIR APOSTOLAKIS: Okay.
6 MS. DROUIN: I also think in looking at 7,
7 we could add in here, we don't have a discussion of
8 the form of the documentation, of what you're
9 supplying to the decision maker. And I think we can
10 add to that in this chapter.
11 MR. PARRY: Yes. Just to add to that,
12 actually, we developed an office instruction, like
13 504, which is associated with presenting the decision
14 maker with discussion of options. And part of this is
15 presentation of the uncertainties and the various
16 decisions.
17 CHAIR APOSTOLAKIS: I believe that at
18 least I would be able to make more reasonable
19 substantive comment on what you should do after I hear
20 what EPRI has to present. And maybe we can break for
21 lunch.
22 MS. DROUIN: I mean, I could wrap this up
23 now in a couple of minutes, I think.
24 CHAIR APOSTOLAKIS: What?
25 MS. DROUIN: I said I think I can finish

1 our presentation real quick.

2 CHAIR APOSTOLAKIS: I thought you

3 finished.

4 MS. DROUIN: No.

5 (Simultaneous speech.)

6 CHAIR APOSTOLAKIS: Next?

7 MS. DROUIN: I don't have to spend any

8 time on that slide.

9 CHAIR APOSTOLAKIS: All right.

10 MS. DROUIN: But I did want to talk just

11 about a minute in terms of where we're going, the

12 meetings and stuff we have planned.

13 CHAIR APOSTOLAKIS: Oh, okay. That's

14 interesting. Meeting in March, I thought it was

15 February. That's good if it's in March. That's good.

16 So you want a letter in March.

17 MS. DROUIN: Probably we'll be asking for

18 a letter. Like I said, we went out for three months.

19 Now here are some tentative dates. We picked these

20 dates because in talking particularly with EPRI and

21 other stakeholders, people's calendars were already

22 full, and there were key stakeholders that we want to

23 make sure that are going to be at these public

24 meetings, so we were trying to work around that, so

25 we've already penciled in dates. And there were two,

1 February 1st --

2 CHAIR APOSTOLAKIS: February 29th?

3 MS. DROUIN: I'm sorry?

4 (Simultaneous speech.)

5 CHAIR APOSTOLAKIS: Sorry, Mary. Go

6 ahead.

7 MS. DROUIN: That's okay. To have a

8 public meeting on February 1st, and that would really

9 be more of us presenting the -- even though the

10 document has been out there, it hasn't been out there

11 too long, and so we would want to walk through the

12 document to the public to help them in reading it.

13 Then have a second meeting, public meeting on the

14 29th, a month later, where we're now in a listening

15 mode, and the public is coming in and sharing their

16 initial views of it. So we'd like to go through those

17 two meetings before we come back to the Full

18 Committee, which would then be the 1st of March. Now

19 if you want to have another Subcommittee, maybe we

20 could work it in here.

21 CHAIR APOSTOLAKIS: I want to ask you

22 about that. Ken Canavan told us that maybe in a month

23 there will be an EPRI document. Doug?

24 MR. CANAVAN: End of January.

25 CHAIR APOSTOLAKIS: End of January. Okay.

1 So if we -- I think that's an important document for
2 us. I would hate to have to write a letter without
3 it.
4 MS. DROUIN: Us too.
5 CHAIR APOSTOLAKIS: Okay. So if we get
6 that -- let's say we get that document by the end of
7 January, we have a -- I think it's kind of tight,
8 Mary. If we have a Subcommittee meeting in February,
9 then you want the Full Committee in March?
10 MS. DROUIN: We weren't planning a
11 Subcommittee in February.
12 CHAIR APOSTOLAKIS: Well, how -- an
13 intelligent Subcommittee meeting means we have --
14 MS. DROUIN: Based on this meeting, we may
15 want to have one.
16 CHAIR APOSTOLAKIS: But we need -- I mean,
17 if we get the EPRI document the end of January, I
18 don't see how we can have a Subcommittee meeting --
19 PARTICIPANT: And we need Appendix A, too.
20 CHAIR APOSTOLAKIS: Sorry?
21 PARTICIPANT: And we need Appendix A, too.
22 CHAIR APOSTOLAKIS: We need your Appendix
23 A, as well.
24 MS. DROUIN: We hope our Appendix A will
25 be one sentence. We endorse the EPRI document.

1 (Simultaneous speech).

2 MS. DROUIN: We hope, so we have been

3 meeting with EPRI on a very regular basis looking at

4 their working, giving them our feedback, and so

5 they're very much aware of what our concerns are. And

6 so far, I think we're merging to an agreement on a lot

7 of these issues.

8 CHAIR APOSTOLAKIS: If we have --

9 MS. DROUIN: Our goal being that at the

10 end of the day we have no issues, and we can just

11 completely endorse their work.

12 CHAIR APOSTOLAKIS: If we have a

13 Subcommittee meeting say the middle of February, and

14 we have some comments on the report, and you agree to

15 change the report, you don't have time to do it. So

16 we'll come back --

17 MS. DROUIN: Before the Full Committee?

18 CHAIR APOSTOLAKIS: Yes. And we'll come

19 back in March, and say --

20 MS. DROUIN: Why would we have --

21 PARTICIPANT: The public comment is until

22 the end of February.

23 MS. DROUIN: Why would we have to change

24 the report before, prior to the Full Committee, if

25 we're in agreement with your comments, and we've

1 agreed to change it, you need to see that? You need
2 to physically see those changes?
3 CHAIR APOSTOLAKIS: Yes. We need to see -
4 -
5 MS. DROUIN: So you all have no trust --
6 CHAIR APOSTOLAKIS: No, don't say that.
7 (Simultaneous speech.)
8 MS. DROUIN: So if March is too early.
9 CHAIR APOSTOLAKIS: Mary, would it be --
10 MS. DROUIN: I, personally, don't have a
11 problem --
12 CHAIR APOSTOLAKIS: -- upsetting to your
13 schedule to have the Full Committee meeting in April?
14 Does that destroy anything, or damage it?
15 MS. DROUIN: It doesn't destroy anything
16 for me. I just need to have the support of my
17 management that we're going to --
18 CHAIR APOSTOLAKIS: Would that be a major
19 -- I mean, realistically I don't see -- I would hate
20 to have to write a letter in March that says do not
21 publish. I don't want to do that.
22 MR. MONNINGER: I guess my thought is, we
23 prepared this schedule based on our understanding of
24 the approach and the scope into this meeting. I think
25 one of the things we have to go back and think about

1 is a lot of the comments from the Committee. And are
2 we on the same scope, or are we mission creep, exactly
3 where we are on this, before really commenting on
4 this.
5 CHAIR APOSTOLAKIS: It's not an important
6 thing, but we will not have the public comments and
7 the resolution. We will not have the EPRI report. I
8 think it would be much more realistic to schedule it
9 for April.
10 MR. MONNINGER: Yes. I think we would
11 definitely want to have the most productive meeting.
12 MS. DROUIN: Yes.
13 MR. MONNINGER: And if the most productive
14 meeting means that the public comment period is over,
15 and you guys digest the EPRI document, yada, yada,
16 yada, it's much better to have a productive meeting.
17 And if that means --
18 CHAIR APOSTOLAKIS: Okay. So we'll have
19 to discuss that in the future.
20 MS. DROUIN: So we're thinking about a
21 Subcommittee then in March.
22 CHAIR APOSTOLAKIS: Something like that,
23 yes. Early March, maybe.
24 MS. DROUIN: And that's why on the bottom
25 one, I initially had May there. And I thought no, as

1 well as I know I'm going to come here, we're going to
2 get delayed, so let's put June down there, also.
3 MEMBER BLEY: You're going to have a
4 public meeting the last day of February. You won't
5 have written public comments, or not many then. Do
6 you expect you'll have some sort of a response
7 document to what you hear in that meeting that we'd
8 have before?
9 MS. DROUIN: Right, because you see -- you
10 know, I had three bullets there, a third public
11 meeting where we would then in April, and it would be
12 towards the end of April, to go back to the public and
13 say okay, we hear all the comments we've gotten.
14 Here's our response to it, and here's how we resolved
15 them. And it would give the public one last chance,
16 if there were comments that we just really disagreed
17 with the public, to let them know that prior to seeing
18 the final publication of the document.
19 MEMBER BLEY: If our meeting is Full
20 Committee early April, when do you anticipate you'd
21 have a response document in place? It would be nice
22 to see that before the Subcommittee meeting. Not
23 likely, but certainly before the Full Committee
24 meeting.
25 MS. DROUIN: With the public comment

1 ending the end of March --

2 MEMBER BLEY: It's the end of March.

3 MS. DROUIN: Well, I can change the -- it

4 hasn't been published yet. I can only give the public

5 two months. Right now we were giving them three

6 months, the end of March. And I'll tell you, with

7 speaking with all the people involved in this,

8 everybody's calendars are so loaded down --

9 CHAIR APOSTOLAKIS: Including our's.

10 MS. DROUIN: -- that to shorten the public

11 comment period is not going to serve anybody well.

12 CHAIR APOSTOLAKIS: Yes.

13 MS. DROUIN: And there's one slide,

14 because I think it's important. One piece we haven't

15 talked about, that is on our table to do. We have not

16 started this piece, but because of the complexity of

17 this document, we are anticipating developing some

18 kind of training so that when -- soon after the

19 document is issued, plan to have some training

20 courses.

21 CHAIR APOSTOLAKIS: For the NRC staff?

22 PARTICIPANT: For industry?

23 CHAIR APOSTOLAKIS: Industry, too.

24 MS. DROUIN: I mean, my view is that it

25 would be public, because this document is just not for

1 NRC. Everybody needs to understand how to use this
2 document and everything, and we've also talked to
3 EPRI. Our intent, and so I think Ken is going to talk
4 a little bit about this. But, hopefully, we -- we
5 worked together on the training thing, too.
6 MEMBER BLEY: It would be joint training
7 then.
8 MS. DROUIN: All of that has to be seen.
9 MEMBER BLEY: Okay.
10 MS. DROUIN: But I just wanted to let you
11 know there is a training aspect to this.
12 CHAIR APOSTOLAKIS: Very good. Are you
13 done?
14 MS. DROUIN: Yes. Thank you.
15 CHAIR APOSTOLAKIS: Thank you very much.
16 We'll reconvene at 1:15.
17 (Whereupon, the proceedings went off the
18 record at 12:14 p.m., and went back on
19 the record at 1:17 p.m.)
20 CHAIR APOSTOLAKIS: Back in session. Now
21 we're going to hear from the industry and who will
22 start? Ken?
23 MR. CANAVAN: I will start us off.
24 CHAIR APOSTOLAKIS: Introduce your
25 colleagues, please.

1 MR. CANAVAN: Sure. My name is Ken
2 Canavan. I'm with EPRI and with me the big guy, Doug
3 True. We brought him in case you have any real hard
4 questions and --
5 MEMBER SHACK: He'll whip us into shape.
6 MR. CANAVAN: And Don Vanover also of ERIN
7 Engineering who will be presenting the second half.
8 We're going to tag team this for you.
9 After the questions this morning, I'm
10 disappointed I only brought three people with me.
11 Three total.
12 CHAIR APOSTOLAKIS: Two.
13 MR. CANAVAN: Three total.
14 (Laughter.)
15 CHAIR APOSTOLAKIS: You have to bring
16 yourself. So you brought two people.
17 MR. CANAVAN: I wanted to take a moment --
18 CHAIR APOSTOLAKIS: The Committee cares
19 about precision.
20 (Laughter.)
21 MEMBER MAYNARD: There's a number of
22 uncertainty in the number, George.
23 MR. CANAVAN: Actually, I wanted to talk
24 a little bit about that today.
25 (Laughter.)

1 CHAIR APOSTOLAKIS: Have we lost somebody
2 there? Okay.
3 Okay, Ken, sorry.
4 MR. CANAVAN: That's okay. I wanted to
5 thank the Subcommittee for their time. I always enjoy
6 hearing the issues get discussed all the way from the
7 very theoretical all the way to the very pragmatic and
8 practical.
9 And I did want to talk a little bit about
10 uncertainty, just overall, the definition to take us
11 back a little bit. Uncertainty is sort of a -- is the
12 lack of uncertainty. It's a state of having a limited
13 knowledge of where it is not possible to exactly
14 describe where you are. For example, if I ask you how
15 long a day is, you probably would say it's 24 hours.
16 You're not correct. Actually, it's 23 hours and 56
17 minutes and I don't know the number of seconds.
18 That's why we have Leap Year. And that occurred to me
19 sitting in the back of this room that a day isn't 24
20 hours. It's 24 hours plus or minus something.
21 CHAIR APOSTOLAKIS: But from the
22 regulatory perspective, that's irrelevant.
23 (Laughter.)
24 MR. CANAVAN: This is true. But even a
25 year is 365 days, commonly accepted, but has an

1 uncertainty, obviously, because next year is Leap
2 Year, 366 days next year.
3 And I'm probably not in a unique position,
4 but at EPRI my title includes risk and it includes
5 safety. So I get to see both sides of the equation
6 and when I look at that equation I see something that
7 when we talk about safety analysis and deterministic
8 analysis, we talk about something where the
9 uncertainty is treated a certain way. That's what it
10 means to me. It means when you do deterministic
11 analysis the way you treat uncertainty is you bound
12 there. If there's an uncertainty that you're not sure
13 of, you just choose a bounding value, whatever that
14 bound may be, however high it has to be, you make it,
15 so that your convinced that you've covered the
16 situation. That's how you do safety analysis.
17 On the other hand, you see real true, hard
18 core risk analysis which is the other direction, which
19 is everything is probabilistic, even to the point to
20 where you might weight alternative theories. You
21 might propagate uncertainties of the parameters. You
22 might have everything expressed as a distribution.
23 That would be something that you could theoretically
24 use for risk-based regulation.
25 And then you have where we are. Where we

are is sort of in the middle of that. And in the middle of that is where we've done a PRA and we've tried to be as realistic as we can, but when we got to some of the harder problems we turned around and said this one is a little too hard, so we're just going to assume something that's conservative. And what you find is that, in general, the probabilistic risk analyses that we see today have some level of conservatism in them. All sequences are not time-phased, for example. They're all 24 hours long. A lot of the mission times for all the components in there are 24 hours. In some cases, most cases that will be conservative.

So having said all that, I also wanted to point to our older documents and with that I'll take us to the next -- I'll actually get into the slide presentation.

MR. WALLIS: So if you don't know how conservative you are, that would seem to be a kind of uncertainty, wouldn't it?

MR. CANAVAN: It could be expressed as an uncertainty. I would say that for the purposes of regulatory and communications with the public, you can basically say that you're bounded by that value and that's okay for safety analysis, so it should be okay

1 for the case of risk. So when you give our your
2 probabilistic number and you think you're
3 conservative, if you are using that value, then it's
4 simply that that's a bounding value of the true mean
5 without expressing what the bound is.
6 The two documents that were produced was
7 the guideline for the treatment of uncertainty and
8 risk from the applications, the technical basis. That
9 was produced in December of 2004 and in December of --
10 that was produced in December of 2004. That's what
11 I'd like to refer to as everything you ever wanted to
12 know about uncertainty and more. That document starts
13 with the phrase, "in all engineering endeavors, there
14 is uncertainty." And so it starts at the beginning
15 and takes you through all the different types of
16 uncertainty and how we, in the nuclear industry, and
17 we in probabilistic risk assessments, use and treat
18 that uncertainty or at this particular point, don't
19 treat uncertainty.
20 It lays out all the things that we were
21 going to tackle and the things that we weren't going
22 to tackle as we moved forward in our work. The next
23 document was the guideline for the treatment of
24 uncertainty and risk-informed applications of The
25 Applications Guide. This was intended to be short

1 handbook that said what to do. As a matter of fact,
2 if you read it, it really does say what to do. After
3 its publication in October of 1996 we entered a long
4 series of discussions with the NRC staff and public
5 stakeholders. We made the document public, by the
6 way.
7 CHAIR APOSTOLAKIS: 2006, for the record.
8 MR. CANAVAN: 2006, yes.
9 CHAIR APOSTOLAKIS: You said 1996.
10 MR. CANAVAN: Wow, no, 2006.
11 CHAIR APOSTOLAKIS: A decade is nothing.
12 MR. CANAVAN: Plus or minus ten. That
13 Applications Guide was intended to be very pragmatic.
14 One of the -- how that document started off was
15 representing the pragmatic portions of treating
16 uncertainty in risk-informed applications. And that's
17 a key. We're looking at the range of applications
18 that are applied, and we're looking at how we should
19 treat uncertainty in those applications. And it was
20 very pragmatic in nature. So I think when we come up
21 with an application, the thought was there was a
22 process to apply and treat uncertainty of similar --
23 to the processes that we use in other engineering
24 areas.
25 CHAIR APOSTOLAKIS: So the document, you

1 gentlemen referred to earlier is an update of one of
2 these documents or is it a new document? It's a new
3 slide?
4 MR. CANAVAN: A new document to be issued.
5 Thank you, George. I love a straight man.
6 After October of 2006, we started
7 discussions with stakeholders and the staff and this
8 Committee as well, I think, at least one time, maybe
9 not after the Applications Guide was formally
10 published, but we did meet with this Committee once.
11 The point of all these interactions was to gather
12 information. We also performed two pilots of the
13 first document. As a result of all these gathered
14 lessons learned and all discussions with the staff, we
15 felt it important to revisit some of the issues that
16 in that document. We're hoping that many of your
17 concerns that you might have, having read those
18 documents are treated in the newer version and the
19 presentations that follow are some of our early ideas
20 of what would be in the new document.
21 MEMBER SHACK: Did you give us a date?
22 MR. CANAVAN: We did, a draft of the
23 report will be provided broadly by the end of January,
24 not just to this Committee, but I think it will be a
25 broader distribution than that. I think it will be a

1 very wide distribution as a matter of fact to solicit
2 as much opinion as we can --
3 CHAIR APOSTOLAKIS: That would be a draft
4 document?
5 MR. CANAVAN: It will be a draft document.
6 We will be looking for additional feedback.
7 MR. BLEY: Will that be publicly available
8 or only --
9 MR. CANAVAN: Yes.
10 MR. BLEY: Publicly available.
11 MR. CANAVAN: It will be publicly -- the
12 draft will be made -- public is a -- in this
13 particular case it won't be on the website. Other
14 documents are currently on the website, publicly
15 available for no fee. This future document, the draft
16 that we've provided very broadly and we will not put
17 any restrictions on its distribution because it's for
18 comment. When we finalize it, there may be a
19 different situation. We may provide it to this
20 Committee and the industry, but that will be --
21 CHAIR APOSTOLAKIS: But our next
22 subcommittee meeting on the 19th I think we should
23 spend some time, if you guys agree, telling me about
24 your new document.
25 MR. CANAVAN: We would welcome that.

1 CHAIR APOSTOLAKIS: Which means you have
2 to be here. We have to decide that and we have to
3 coordinate it among you, the staff, and us. But there
4 will be, I thought we said some time in February?
5 MR. BLEY: March.
6 CHAIR APOSTOLAKIS: March. What happens
7 in February? No, in March, okay.
8 And then the Full Committee is in April,
9 yes. Because we will be waiting until the staff
10 receives the public comments, right? That's why we
11 pushed everything, because we can only comment in an
12 environment like this.
13 MR. CANAVAN: The title of the new
14 document is "The Treatment of Parameter and Model
15 Uncertainties, Probabilistic Risk Assessments." We're
16 getting a little bit more specific about what we're
17 speaking about. It's a streamlined version compared
18 to the --
19 CHAIR APOSTOLAKIS: Wait, let's talk about
20 your title. You're leaving "incompleteness" out which
21 I think is --
22 MR. CANAVAN: Correct.
23 CHAIR APOSTOLAKIS: But do you want to
24 maybe modify it a little bit to make sure that you are
25 addressing risk-informed decision making? I mean it's

1 up to you, but it's one thing to talk about how
2 perfect the PRA can become and quite another to talk
3 about how the decision is changed.
4 You don't have to --
5 MR. TRUE: No, I think it's a worthwhile
6 comment. We have two masters we're trying to serve
7 here and Don will get into this. One is support of
8 risk-informed decision making, but the other is
9 support of the utilities meeting the ASME standard.
10 It has requirements in it that they need to be able to
11 say they met and we're helping to provide that process
12 for meeting the QUE requirements which QU is the
13 modification and E is the uncertainty element
14 qualification.
15 We can broaden that to include risk-
16 informed decision making, but it needs to not only be
17 --
18 CHAIR APOSTOLAKIS: Treatment of parameter
19 and model uncertainty for PRA quality and decision
20 making. Covers both.
21 MR. CANAVAN: There has been some
22 discussion of whether or not, you know, whether or not
23 there is such a thing as an unapplied PRA model. In
24 other words, as soon as you finish a PRA, if you
25 quoted CDF to somebody, you've essentially applied it,

1 right? You've told somebody what the CDF was.

2 CHAIR APOSTOLAKIS: But it's not the same

3 thing as making a decision.

4 MR. CANAVAN: You haven't made a decision,

5 but you've communicated something. So like I said,

6 it's a very interesting discussion that we've had on

7 unapplied model.

8 MR. TRUE: On a utilities basis, it's not

9 very long after you've done that then you're using it

10 in your A4 program or maybe through other things.

11 MR. CANAVAN: You haven't found a case

12 where somebody actually did a PRA, at least in the

13 nuclear power industry where someone has done a PRA

14 and then suddenly said well, that's it. Here's the

15 CDF. I'm all done now.

16 Generally, shortly after that it gets

17 involved in all the programs and becomes an applied

18 model, even if you don't make any changes to it. And

19 therefore the base model does have some application,

20 if you will.

21 Okay, well, this is going to be a

22 streamlined version compared to the original technical

23 basis document and the applications guide, so it's

24 going to be a little bit smaller than both of those

25 documents. The intent is again to instruct PRA

1 analysts and practitioners in how to derive
2 information to appropriately handle uncertainty. The
3 interesting thing that I've noted from this morning
4 that I think is very important for us to continue is
5 that the Committee has pointed out that there's an
6 awful lot of -- all these reports could benefit from
7 a little, just a little bit of introductory material
8 and having heard the comments and thinking back on the
9 reports, I think this report would be served as well
10 by having a little bit of introductory material, at
11 least an overview, to present for example, how we're
12 trying to get -- what our goals are and how we're
13 trying to get there.
14 MR. BLEY: Ken, will the new report
15 replace the Applications Guide or will it refer to it?
16 MR. CANAVAN: Excellent, thank you. the
17 report will replace the Applications Guide, but not
18 the technical basis document. We'll go into that a
19 little bit later. There's pieces of the technical
20 basis document that we wish to keep and refer to
21 later. And that was my last bullet. That was going
22 to be -- the technical basis portion of the document
23 will be maintained as a reference material.
24 There's some important reasons for that.
25 One is we will probably reference it in this report.

1 The other is it has material that is not going to be
2 referenced in this document. So it's important that
3 that material remain available.
4 The rest of this presentation is all
5 framed around this slide. So you're going to see this
6 slide an awful lot. We have some report objectives
7 and they're listed here. They never really changed
8 much from the inception of this entire endeavor which
9 is --
10 CHAIR APOSTOLAKIS: Let me now say this.
11 MR. CANAVAN: Get it off your chest.
12 CHAIR APOSTOLAKIS: Why bother about the
13 first bullet, Ken? The codes do it routinely? Why
14 even raise the issue? You push a button and something
15 comes out. It's not extra work. And it helps you
16 update your distributions with experience from your
17 plant as you move on. You see how your risk changes
18 with experience, and plus, you satisfy people who
19 worry about uncertainty. I mean this is something
20 that maybe was real in the '80s. It's not any more in
21 my view. SAPHIRE does it. RISKMAN does it. There
22 are -- RiskSpectrum does it. CAFTA probably does it.
23 Birds do it, everybody.
24 (Laughter.)
25 MR. TRUE: What you are saying, George, is

1 absolutely true when you're talking about a base
2 model. The problem is that that base model gets
3 applied in ways that it may not be pragmatic and
4 practical to do that. For example, all of our
5 importance measures are done with point estimate
6 solutions.
7 CHAIR APOSTOLAKIS: You should be using
8 the mean values for the importance measures.
9 MR. TRUE: The importance measures don't
10 come out of the uncertainty analysis. They're
11 calculated from the cut sets.
12 CHAIR APOSTOLAKIS: Using the mean values,
13 I hope.
14 MR. TRUE: Right.
15 CHAIR APOSTOLAKIS: Right.
16 MR. TRUE: The biggest correlation is not
17 reflected --
18 CHAIR APOSTOLAKIS: I don't want to go
19 into that. I'm just saying if you don't have state-
20 of-knowledge correlation, why bother? I mean it's
21 such a trivial thing to do now. Just do it, because
22 the moment you raise the issue, people are starting to
23 say oh, I can do a point estimate. Well, yeah, all
24 right. The other problem I have is that if you are
25 dong the point estimate calculation, you're not going

1 to bother to develop distributions for the main input,
2 with the basic inputs. So you're going to say this is
3 my point estimate for an input. I don't know what
4 that means. People claim it's a mean value. I don't
5 know if it's a mean value. You see --
6 MR. TRUE: We may have a semantic problem
7 which I think we've had before.
8 CHAIR APOSTOLAKIS: Think about this. You
9 may not even want to raise the issue.
10 MR. TRUE: It's important. We have to.
11 I'll try and again explain it. I think we agree that
12 you must have mean values in the solution, right? But
13 there's also the problem of propagating the
14 distribution, addressing the state-of-knowledge
15 correlation to get a true meaning of the overall
16 result. That's one thing, and I think we generally
17 agree --
18 CHAIR APOSTOLAKIS: And the codes do it
19 routinely.
20 MR. TRUE: The codes do that, but what
21 happens when that answer is significantly different
22 than your mean-based point estimate solution that you
23 use for calculating importance measures and doing on-
24 line maintenance and all the other calculations where
25 we don't propagate distributions every single time

1 when we manipulate them all.

2 CHAIR APOSTOLAKIS: But my point is maybe

3 we should start doing that. And so I will be using

4 mean values for calculating the importance measures

5 for the --

6 MR. TRUE: I may be wrong on this, but no

7 tools I know of that give you importance measures

8 based on the state-of-knowledge correlation --

9 CHAIR APOSTOLAKIS: No, no, no. State-of-

10 knowledge correlation is important when you propagate

11 the uncertainties. Once -- then you have -- I mean

12 you're saying I will take the mean CDF with this

13 component always down, and that mean CDF when it is

14 down will be calculated rigorous propagating

15 uncertainties. No?

16 MR. BLEY: I don't think there are any

17 codes that actually do that.

18 MEMBER STETKAR: There's no code running

19 today that does that, period.

20 CHAIR APOSTOLAKIS: So what do they do?

21 MEMBER STETKAR: They just calculate the

22 point estimate total and set a basic event to true and

23 calculate a new point estimate total and divide.

24 CHAIR APOSTOLAKIS: But if you have done -

25 -

1 MEMBER STETKAR: That's the way all the
2 software works.
3 CHAIR APOSTOLAKIS: If you have done the
4 rigorous propagation, the denominated if fixed.
5 MEMBER STETKAR: But you have to do it by
6 hand is the problem.
7 CHAIR APOSTOLAKIS: No, no. It's the mean
8 value of the CDF. The problem is the numerator when
9 you put one component down. If you did the point
10 calculation there using the mean values of the
11 distributions, maybe that would be good enough.
12 MEMBER STETKAR: It may be good enough for
13 certain applications and it may be very wrong for
14 other applications.
15 MR. CANAVAN: Yes, it would depend on --
16 because what will happen the state-of-knowledge
17 affects certain cut sets and not others.
18 MEMBER STETKAR: I'll give you a great
19 example and that's the interfacing system LOCA
20 contribution, the large early release frequency. You
21 can derive tremendously different insights, whether or
22 not you use the state-of-knowledge correlation for the
23 mean --
24 CHAIR APOSTOLAKIS: But the solution is to
25 use the mean values and then maybe two years down the

1 line will have the ability to calculate the rigorous
2 mean. My problem with point estimates is you stop
3 with point estimates and I don't know what these
4 inputs are and I don't know what the output is.
5 If they have already done the rigorous
6 calculation and then they do it on the side, the point
7 calculation where the points now are the means of the
8 inputs, I probably don't have much of a problem with
9 that. I think it's not -- there may be some basis
10 where it's --
11 MR. TRUE: The ASME standard pushes you to
12 do exactly what you said which is to use mean values
13 for those point estimates. What we were trying to do
14 is address the fact that the state-of-knowledge
15 correlation can skew the mean value in trying to
16 decide when do you get out of bounds where now you
17 can't rely on those mean-based point estimate
18 calculations.
19 CHAIR APOSTOLAKIS: I agree, that's a very
20 important thing to do.
21 MR. TRUE: That's all we tried to do.
22 CHAIR APOSTOLAKIS: Okay.
23 MR. TRUE: That's all we tried to do.
24 MR. CANAVAN: That's all we tried to do.
25 That was it.

1 CHAIR APOSTOLAKIS: But you do agree that
2 in many quarters, doing a point estimate calculation
3 means just put mean point values and get something
4 out. That's not what you're saying.
5 MR. TRUE: I believe the pre-ASME standard
6 that was --
7 CHAIR APOSTOLAKIS: That was the case.
8 MR. TRUE: The way it was done. I don't
9 believe that is what happens today.
10 MR. CANAVAN: Now you need to put in the
11 distribution.
12 MR. TRUE: I look to the staff to see if
13 they --
14 MR. PARRY: That's correct.
15 MR. TRUE: I think we fixed that problem
16 through another means, so we only took on the narrow
17 objective saying when do we have to start bringing
18 back the state-of-knowledge into it.
19 CHAIR APOSTOLAKIS: For the narrow
20 objective, I fully agree with you.
21 MR. CANAVAN: That's the narrow objective.
22 And the narrow objective is actually well stated to
23 identify one point estimate solutions are not suitable
24 in light of parametric uncertainties.
25 CHAIR APOSTOLAKIS: I guess people are

1 hiding this from us. Every application I see here is
2 point. You guys say everybody is doing it, but I
3 tried to remember an application where people actually
4 -- anyway, I understand now what you're saying.
5 MR. CANAVAN: Assist utilities in
6 identifying and characterizing the sources of model
7 uncertainty. So these are the goals that Don will
8 speak to and he'll talk a little bit about providing
9 guidance for identifying the appropriate sensitivity
10 cases and what are some logical combinations of those
11 cases. And then lastly, providing some guidance for
12 interpreting the results of sensitivity cases in the
13 context of when you're doing an application. So what
14 do you do with that? What do you do with those
15 answers?
16 And one of our last bullets which is a new
17 bullet which is why it's highlighted on the screen was
18 to complement NUREG-1855 and basically have
19 connections to that document where it was appropriate
20 and make sure that we were filling in the appropriate
21 level of detail where they were referencing the EPRI
22 document.
23 This is another figure. You probably
24 remember this if you've read the other reports and
25 this was looking at the two types of uncertainty that

we're considering in the EPRI report. This all is described in the technical basis document. We're looking at the parametric uncertainty and we're looking at the modeling uncertainty. And then completeness uncertainty is dashed below and we rely pretty heavily on the various consensus standards that are being developed to provide a specific level of detail and to specify what completeness is.

In the case of the other two for parametric modeling uncertainty, I'm going to walk us through a whole bunch of that. There's been a few changes to this flow chart over the last, since you saw it in the technical basis document and we did add to the bottom here some of the sections that you will find the items described in so if were looking at the report.

What I'm going to talk to you today about is I'm going to run you through the parametric part and try and fulfill our goals on identifying when a point estimate solution is not suitable in light of parametric uncertainties. I'm not going to step you through each one of these requirements, but needless to say there are several ASME requirements with respect to the state-of-knowledge correlation and propagation of uncertainty.

1 CHAIR APOSTOLAKIS: Do all of the members
2 know what that means, by the way? It just occurred to
3 me.
4 MR. CANAVAN: No.
5 CHAIR APOSTOLAKIS: Who is the best
6 person? Ken?
7 MR. CANAVAN: I can talk a little bit
8 about it.
9 CHAIR APOSTOLAKIS: Go ahead.
10 MR. CANAVAN: I have the staff who was
11 also --
12 CHAIR APOSTOLAKIS: Or maybe you can, it's
13 up to you, guys. We need a two-minute tutorial.
14 MR. CANAVAN: Two-minute tutorial. There
15 is an ASME PRA standard. It is written a little
16 different than most other standards, but level one
17 probabilistic risk assessment applications. The
18 standard has a series of high level and supporting
19 level requirements divided by element.
20 In the area of the high level requirements
21 are very high level and describe some overview item,
22 and then the details of supporting level requirement
23 provide what you should model. So there is a
24 description of what. It's not necessarily how, it's
25 more what. An example of a supporting level

1 requirements in front of you, QU, that's the element
2 number. It stands for quantification. There are nine
3 high level requirements. QU is one of them. And then
4 a supporting level requirement A2b, basically states
5 to estimate the mean CDF from internal events
6 accounting for the state-of-knowledge correlation
7 between a event probabilities when significant.
8 Now there's different capability
9 categories. This is sort of the middle one. Then
10 there is a higher one and there is a lower one. Those
11 capability categories are related to what that
12 requirement needs to be when it is applied to certain
13 applications.
14 CHAIR APOSTOLAKIS: Mike, we have a
15 distribution.
16 MS. DROUIN: That's not correct.
17 CHAIR APOSTOLAKIS: We have a distribution
18 for the failure rate of certain kind of pumps.
19 MR. CANAVAN: Yes, I described it in --
20 CHAIR APOSTOLAKIS: This describes our
21 current state of knowledge as to where the rate is or
22 maybe it will be revealed many years later. I have
23 two of these pumps in my system and I do a Monte Carlo
24 simulation. When I pick one value for lambda, the
25 failure rate for one pump, the state-of-knowledge

1 correlation means that you should use the same value
2 for the other pump. You shouldn't sample again.
3 MEMBER CORRADINI: They are directly
4 dependent.
5 MR. CANAVAN: Yes, we'll talk a little bit
6 more --
7 CHAIR APOSTOLAKIS: That's the meaning of
8 state-of-knowledge correlation.
9 MEMBER STETKAR: We shouldn't reduce our
10 uncertainty about our understanding of the failure
11 rate of that equipment simply because we artificially
12 sample them as if they were --
13 CHAIR APOSTOLAKIS: If you correlate, you
14 have a broader distribution.
15 MEMBER STETKAR: If I actually preserve
16 the --
17 MEMBER CORRADINI: So you sample once.
18 CHAIR APOSTOLAKIS: Theoretically, this is
19 a consistent way of doing it because the state-of-
20 knowledge distribution says that there is one failure
21 rate for all these pumps, I just don't know which one
22 it is.
23 MEMBER STETKAR: If the failure rate is --
24 CHAIR APOSTOLAKIS: For all of it.
25 MR. CANAVAN: Essentially, if you have a

1 cut set or accident sequence that has two identical,
2 two pieces of equipment where the data comes from an
3 identical source, you wouldn't want to say that they
4 are independent by indicating that it is this times
5 this, X squared for example, X times X. It is really
6 something where they are actually correlated since
7 they're coming from the same data which is why it is
8 called correlation effect. There is some correlation
9 between the two. It is not 100 percent, but it is not
10 zero either. It's something in between.
11 CHAIR APOSTOLAKIS: Okay, so that's a
12 state-of-knowledge correlation.
13 MR. CANAVAN: That's state-of-knowledge.
14 I was going to discuss that on the next slide. I was
15 trying to give you a little primer about the ASME
16 standard and I misspoke about capability category.
17 CHAIR APOSTOLAKIS: Somebody said what Ken
18 said was not right?
19 MS. DROUIN: Well, on the capability
20 categories, I think as you recognize when you do a PRA
21 you can do a very simplified PRA or you can do a very
22 detailed PRA. So what the capability category gets to
23 is that for each of the requirements where it, where
24 you can distinguish whether that requirement can be
25 written, there's three factors you consider. The

1 level of detail, how much you represent the plant, to
2 what extent, whether you keep it high level. Maybe
3 more functional to get into your systems modeling down
4 all the way to the component level of detail.
5 The next one is the degree to which you
6 represent the plant from the data, from using generic
7 data to using plant-specific data and then how much
8 you represent the realism in terms of the analysis.
9 So these are always three things, you know, when you
10 look at when you're trying to build your PRA model,
11 you can do that to three different levels of detail.
12 In some cases, you may not have that kind
13 of choice. For example, whether you're doing a very
14 simplified PRA model or a very detailed one, you still
15 would want to identify all your sources of
16 uncertainty. However, how you treat them may be
17 different if you're doing a simplified PRA versus a
18 very detailed PRA. So that's what the capability
19 categories allow you that flexibility when you're
20 building the PRA model.
21 MR. CANAVAN: And what that means, I sort
22 of jumped to the end. What that means is that if you
23 go to do an application, that application might have
24 requirements of certain capability categories of
25 portions of the PRA. So in other words, if you do

1 MSPI, there were 46 requirements that needed to be a
2 minimum of capability category for 42 or some level of
3 requirements.
4 But walking through the rest, and that's
5 the two minute view of the standard. The first QU-
6 A2b, which is the supporting level requirement, just
7 states that you should estimate the state-of-knowledge
8 correlation. QU-E3 wants you to estimate the
9 uncertainty interval and the overall CDF results. So
10 there's a part that says estimate the state-of-
11 knowledge correlation that says there's another part
12 requirement that asks you to estimate the uncertainty
13 level of the overall CDF results and estimate the
14 uncertainty intervals associated with the parameter of
15 uncertainties taken in account of the state-of-
16 knowledge. And that's for the level one, core damage,
17 part of the PRA and then there are two that apply to
18 the large early release frequency part and they're
19 essentially the same.
20 State-of-knowledge correlation
21 tendencies. So we did some looking at the state-of-
22 knowledge and we looked at the technical basis
23 documents, steps you through a bunch of sample cases
24 that we did, and there are several tendencies in the
25 state-of-knowledge correlation and one of these is

1 changed that I will note on the next slide. So if you
2 read the report, we did change one of these. The mean
3 value determined by the distribution, the distribution
4 supported on the PRA model and propagated through a
5 Boolean logic model doesn't preserve the mean when
6 there is a correlation effect. So what that says is
7 if you put a bunch of point estimates in, you run the
8 PRA model, you get a number. If you put a bunch of
9 parameters in, because of the state-of-knowledge
10 correlation, you get a different number for the mean.
11 So there are actually two means produced, one being
12 the point estimate and one being the propagated mean.
13 The propagated mean value, that's the one
14 produced using Monte Carlo simulation methods or some
15 other simulation method. Including a correlation
16 effect calculates usually a higher mean value and
17 that's because the correlation takes X squared to
18 something else, when two items in the accident
19 sequence are correlated, they aren't independent.
20 They're actually treated more like one item.
21 And the of state-of-knowledge correlation
22 can be significant. That was one of the things that
23 we noted. That used to be on this slide, because it
24 was an insight. The state-of-knowledge correlation
25 impact on the risk, the mean value, increases as the

1 error factors increase. So we just took a small model
2 and we took that we upped all the error factors, and
3 if you up all the error factors, state-of-knowledge
4 correlation gets bigger, becomes more important.
5 Also, the fraction of risk metrics
6 impacted increases. That's a bad sentence or phrase,
7 but what that's meant to be is as more of the model
8 becomes involved in the state-of-knowledge
9 correlation, the state-of-knowledge correlation impact
10 increases. And the number of coincident correlated
11 variables increases. So for example, if you have some
12 sequences where there are four motor-operated valves
13 and all of those motor-operated valves come from the
14 same pool of data, that's actually a very low cut set.
15 That's X times X times X times X.
16 But realistically, that isn't that. It is
17 correlated, and that correlation effect could be
18 pretty significant as you can see. But some of the
19 other insights that we have is the state-of-knowledge
20 correlation decreases as the use of plant-specific
21 data increases. Because when you start using more
22 plant-specific data, you start having more different
23 distributions. The more different the distributions,
24 that means they're coming from a different data set
25 and a correlation is lower.

1 Also with also error factors, the more
2 certain we are about our data, the less the
3 correlation effect will impact us. And the last is
4 modeling of CCF. Now I want to be real clear on this.
5 It's not so much that modeling CCF automatically
6 reduces uncertainty. That's not what we're trying to
7 imply here. We're trying to imply that if you didn't
8 model common cause between two like components and you
9 should have, if you analyze the model where you didn't
10 do that, the state-of-knowledge correlation is
11 important, but if you correlate the items through
12 modeling common-cause like you should have done
13 because it's a common-cause group, then the importance
14 of that lower tiered singletons is less. This isn't
15 a totally mathematical artifact. If you've done
16 common-cause modeling correctly, it shouldn't be an
17 issue.
18 MEMBER STETKAR: Let me stop you, Ken,
19 because this particular issue is one of the biggest
20 problems that I had with the technical basis document.
21 The problem is you're confusing numerical
22 convenience with completely different issues. The
23 state-of-knowledge correlation accounts for
24 uncertainty due to our understanding about the failure
25 rate and the uncertainty in that failure rate for

1 similar components.

2 Common-cause modeling accounts for the

3 physical effects of failure causes that are not

4 explicitly modeled in the PRA. They are two

5 completely different things. So simply by putting in

6 a fudge factor for those physical causes of failure

7 that we have not explicitly modeled does not provide

8 an excuse for not looking at the -- at the state-of-

9 knowledge correlation.

10 MR. CANAVAN: Agreed. That's not the --

11 MEMBER STETKAR: So in principle, if you

12 modeled -- if you explicitly put everything in your

13 PRA, modeled it explicitly, your beta factor would be

14 zero. Your beta factor would be zero and yet you

15 would still need to account for correlated

16 uncertainty.

17 MR. CANAVAN: And it would still be there.

18 You're missing the point. If I have a small example,

19 let's just say I have X and X in a model, and that's

20 it. That's the model.

21 MEMBER STETKAR: Right.

22 MR. CANAVAN: And so the cut set that that

23 produces is X and X. If I now model beta X and X and

24 X, one minus beta X times one minus beta X, if I now

25 do that model, the magnitude of the correlation effect

is lowered because I've modeled common-cause which isn't impacted by the correlation affecting --

MEMBER STETKAR: The magnitude of the correlation effect is unchanged. It's just a --

MR. CANAVAN: It's just a lower portion of the total. It's an insight of an artifact. It's not a --

MEMBER STETKAR: We're just looking at numbers.

MR. BLEY: This number is bigger than this number.

MR. CANAVAN: Correct.

MR. BLEY: But this number hasn't changed. That was John's point.

MR. CANAVAN: But as a matter of fact, the reason why it's lower is because you should have modeled common-cause in the first place and if you did, it wouldn't change.

CHAIR APOSTOLAKIS: But there is another issue here, Ken. Typically, well, let's say I have two separate systems. Each one is redundant, one out of two.

MR. CANAVAN: Yes.

CHAIR APOSTOLAKIS: And I want to model common-cause failures. And I use the multiple greek

1 letter model. Now the beta and gamma and whatever
2 else I need are more or less generic numbers, generic
3 distributions, right?
4 MR. CANAVAN: In some cases. INL is doing
5 a great job --
6 CHAIR APOSTOLAKIS: It's very hard to see
7 how you can have plant-specific information on the
8 LOCA failures. They usually have EPRI-NRC study, so
9 I should then consider the state-of-knowledge
10 correlation between the beta factor here and the beta
11 factor there when I do the analysis.
12 Now that may not be that important,
13 because I add them. The state-of-knowledge
14 correlation is really important when you multiple.
15 Right? But in principle, if I pick a beta value
16 here, that should be the same value as down there.
17 Now numerically, again that may not be --
18 MR. CANAVAN: It could be if it comes from
19 the same data set --
20 CHAIR APOSTOLAKIS: Why is it different?
21 MR. BLEY: It's not that it's different.
22 If you start trying to be very precise about this
23 fudge factor we've built, you could claim that since
24 it applies to motor-operated housing, a certain type,
25 it ought to apply everywhere in the plant. Well, if

1 you do that, you get numbers that clearly don't match
2 reality for common-cause failures. So it's a cobbled-
3 together model that we've been applying to trains of
4 the same kind of system and it seems to kind of work
5 there, but there's not a -- you can try and get real
6 precise beyond that, it's kind of -- you're exactly
7 right, but if you start --
8 CHAIR APOSTOLAKIS: It makes a difference
9 --
10 MEMBER STETKAR: My only point is that
11 substituting an observed -- substituting an observed
12 numerical effect, if I model common-cause failures or
13 pumps fail to start versus state-of-knowledge
14 correlation on the pump failure rate, the common-cause
15 contribution that cut set will always show up much
16 higher than the state-of-knowledge X squared type of
17 effect.
18 However, because we're talking about
19 uncertainty here, don't confuse uncertainty with
20 pragmatic numerical effects, because in most cases,
21 according to your observations and what we've seen,
22 it's absolutely true that the number of coincident,
23 correlated variables and the uncertainty in the
24 supporting distributions are very strong influences on
25 the numerical effect from a state-of-knowledge

correlation. Where do we see that? We don't see that in the pump-starts. We don't see that in the valve fails to open to close. We see it in the so-called passive failure mode, spurious opening and closure of motor-operated valves. Failures of batteries. Failures of piping if somebody puts piping in there.

Those things are never treated with common-cause failures in practice. So the place where you see the common-cause failures dominating the state-of-knowledge correlation, well, that's true. But that's exactly the place where we would never see the state-of-knowledge correlation being important anyway. The stated places where we see it being important is exactly the place where nobody models common-cause failure anyway.

So as a general guidance saying that don't worry about the state-of-knowledge because common-cause failures will take care of it.

MR. TRUE: That wasn't the --

MEMBER STETKAR: You did some of that message.

MR. TRUE: Everybody got that message.

MEMBER STETKAR: Everybody got the message. I got the message. Maybe the message should --

1 MR. TRUE: It was simply an observation.
2 When you model common-cause, the effect on overall
3 result is smaller. That's it. That's what he said.
4 Risk decreases as modeling is --
5 MR. CANAVAN: The text is -- point taken.
6 I took a big note. I will clarify the mathematical
7 artifact. And interestingly enough, one of the things
8 that comes out of it, if you go to the insights part
9 of that document, is it turns it all around and says
10 by the way, if you find yourself with a high state-of-
11 knowledge correlation, go check if your model common-
12 cause is right. Not that you should add it to reduce
13 uncertainty. It says go check that you did common-
14 cause modeling correctly, because chances are if you
15 have a really big state-of-knowledge, you forgot to
16 model common-cause in some important components.
17 CHAIR APOSTOLAKIS: If you have a big
18 state-of-knowledge, how can you forget whether common-
19 cause?
20 MR. CANAVAN: Well, what happens is --
21 it's certainly the other way.
22 MR. TRUE: The other thing that came
23 about, I mean, this work was all done back in 2003
24 basically. In the ASME standard at end of B was just
25 about coming out and the industry was really getting

1 into the ASME standard. If you turn this back around
2 and you realize what is happening to the PRAs out
3 there in the field is they were being driven to more
4 plant-specific data and more common-cause modeling by
5 the ASME standard. Because you have to treat it on
6 all the significant basic events, which are all those
7 that contribute more than half a percent or have a raw
8 greater than 2 have to be treated.
9 And so that tends to be a suppressing
10 factor on some state-of-knowledge, not the ISO LOCA
11 one, John. I know that.
12 MEMBER STETKAR: That was --
13 MR. TRUE: And we fixed it in the peer
14 reviews. But the broad impact on the base results of
15 a PRA, particularly CDF, we aren't going to see state-
16 of-knowledge coming up as much as we maybe did before.
17 The ISO LOCA issue came up in the peer reviews and I
18 believe that every plant has gone back and done an
19 offline calculation to do the state-of-knowledge
20 correlation right and then put it back in as a mean
21 value, as a frequency, to get that handle.
22 It's not to say there aren't going to be
23 other places that could come up.
24 MEMBER STETKAR: One of the reasons I
25 bring this up is something I mentioned this morning is

1 that these documents are being published in 2008.
2 They will be used by people doing risk assessments in
3 the next, you know, today and then the next few years
4 for new plant designs which increasingly rely on so-
5 called passive systems.
6 I don't know. I haven't looked at any of
7 those risk assessments yet, but my suspicion is that
8 they will be strongly influenced by multiple so-called
9 passive failure modes for which there is essentially
10 no available guidance or requirements to look at, for
11 example, common-cause failures. And therefore, you
12 know, maintaining kind of a sensitivity, if you will,
13 to --
14 MR. CANAVAN: Understood.
15 MEMBER STETKAR: -- to the state-of-
16 knowledge correlation could be substantially more
17 important even in, you know, the level one.
18 MR. CANAVAN: Understood.
19 MEMBER STETKAR: Typical. Forget the
20 interfacing system of LOCA, but you know --
21 CHAIR APOSTOLAKIS: Is it time to stop
22 calling it epistemic correlation? I mean, state-of-
23 knowledge distribution by epistemic distribution?
24 Something to think about. I don't want people to
25 think this is different from the epistemic

1 distribution or epistemic uncertainties we've been
2 talking about all over the place.
3 MR. CANAVAN: I have a seven o'clock
4 flight tonight.
5 (Laughter.)
6 MEMBER STETKAR: No, you don't. You
7 thought you have a seven o'clock flight tonight.
8 MR. CANAVAN: I'm going to move us along.
9 But a very interesting point. Point well taken. Use
10 of point estimates, our next part is when we get down
11 to brass tacks so to speak. Parametric uncertainty
12 guidelines. Now there used to be a bunch more of
13 these and we went through and there's been some
14 changes to these as well for the new document and a
15 couple of them that were particularly objectionable
16 were removed.
17 CHAIR APOSTOLAKIS: Well, point estimate
18 means mean values?
19 MEMBER STETKAR: That's correct.
20 CHAIR APOSTOLAKIS: Why didn't you use
21 mean values? The term mean values?
22 MEMBER STETKAR: Some folks --
23 MR. TRUE: It's computational. We refer
24 to the cut sets as we quantify as point estimate
25 calculations because we're not propagating

uncertainties.

CHAIR APOSTOLAKIS: Yes, but you have to make it clear that these are supposed to be mean values.

MR. CANAVAN: Point estimate mean is -- we can stick in the word mean, but the point is to drive a -- is to make a difference between --

CHAIR APOSTOLAKIS: I know what a point is --

MR. CANAVAN: Propagated --

CHAIR APOSTOLAKIS: The point may be lost.

MR. CANAVAN: Okay.

MR. TRUE: We can say unpropagated calculations maybe.

CHAIR APOSTOLAKIS: If you make it very clear up front that point estimate means the mean value of the input distribution, then it's clear.

MR. TRUE: We will check that. That's certainly the intention. We're aware of where the industry has gone.

MR. CANAVAN: So we put together a few guidelines and this again is back to the surrogate for when a point estimate mean value is an appropriate surrogate for a propagated mean value. And guideline one was simply if the risk metric is determined by cut

1 sets and this is in the case where there are small
2 groups of cut sets, so think of a very small risk
3 model or very small risk application and it's
4 determined by cut sets that it's a relatively small
5 group and the basic events are not correlated in any
6 way, then you can just simply use the point estimate
7 directly and a good example of this is sometimes Level
8 2 where the different values that are in the Level 2
9 are not correlated. They're related to phenomenon.
10 They are truly independent, if that's the case, and
11 then you have a small group of cut sets and you can
12 say everything in here is not correlated. So I can
13 use the point estimate value straight up.
14 The next one is -- the next guideline,
15 guideline number two is where the risk factor is
16 calculated on a large number of cut sets, but the cut
17 sets are all comprised of diverse contributors and
18 they're not from a narrow group of events. And you
19 can demonstrate that case.
20 I think, by the way, in all these cases
21 you need to demonstrate that point before you go off
22 and use the metric.
23 Number three is our preferred guideline.
24 I think it's where people end up most of the time,
25 especially if you're in a situation where you're doing

a large PRA and you're dealing with the whole PRA study, perform a detailed -- we say Monte Carlo calculation because most people use Monte Carlo, but there are other propagation techniques with greater than 10,000 samples to calculate the mean and show that that's within 20 percent of the point estimate.

MR. WALLIS: Why do you need 10,000?

MR. CANAVAN: You probably -- I got asked that question before, and you probably can use less samples as long as you can show that the result is reasonably reproducible. We have 25,000 which meant that you didn't ever have a problem --

MR. WALLIS: Very precise mean with that number.

MR. CANAVAN: Yes.

MEMBER STETKAR: The problem is you don't do enough samples, you don't capture the tails and the distributions that you need in a large population.

MR. CANAVAN: In a large population. We were just trying to err to the higher number.

CHAIR APOSTOLAKIS: Coming back to the calculation say of raw, you said earlier that the numerator which is the core damage frequency, the component down, typically is not done by propagating rigorous uncertainties. But it can be done though.

1 MEMBER STETKAR: It could be done.

2 CHAIR APOSTOLAKIS: So using guideline

3 three, I could do that.

4 MEMBER STETKAR: The only problem is I

5 think a lot of the software is not -- it's a practical

6 situation, a lot of the software does not do the

7 calculations that -- they do -- there's one set of

8 routines to do the uncertainty propagation and there's

9 another set of routines that do the importance measure

10 analyses.

11 It could be done, but it would require

12 reprogramming, I think -- anything that I'm aware of.

13 CHAIR APOSTOLAKIS: Why can't I go and say

14 event XYZ.

15 MR. TRUE: You could do it manually.

16 MEMBER STETKAR: You could do it manually,

17 but right now none of the software.

18 MR. TRUE: You would have to do sets-true,

19 sets-zero, for every basis event.

20 CHAIR APOSTOLAKIS: In order to do --

21 MR. TRUE: In order to do the modeling.

22 CHAIR APOSTOLAKIS: But I'm wondering --

23 MR. TRUE: And the problem is that you

24 can't necessarily go in by inspection and figure out

25 which ones you care about because it's not the ones

1 that are correlated that you care about, it's the
2 events that are in the cut sets that have the
3 correlated variables and additional failures in the
4 cut sets that have the correlated variables in them
5 that are the ones that are the most affected by the
6 state-of-knowledge correlation.
7 CHAIR APOSTOLAKIS: If you gave me a
8 guideline, select two or three, maybe using some of
9 these considerations, and run 10,000 samples to find
10 the raw, and show that that row is really not
11 numerically very close, the thing -- wouldn't that be
12 --
13 MR. TRUE: I think this could. My opinion
14 is that the -- a little bit of this is again too
15 worried about the numbers, a little bit of the razor
16 edge or bright line kind of thing. The raw of two and
17 Fussell-Vesely .05 are pretty darn low for
18 significance.
19 CHAIR APOSTOLAKIS: So it doesn't matter.
20 MR. TRUE: As long as you're getting
21 results that are about in the same region, if you're
22 off a little bit here or there, you pretty well
23 capture --
24 MR. CANAVAN: Hence, the 10 percent. I
25 mean you could argue that numbers as high as 20

1 percent difference in the --

2 CHAIR APOSTOLAKIS: Since we say anything

3 with raw greater than two is part of it.

4 MR. WALLIS: But it hasn't to do with any

5 particular percent. It is what it is.

6 MR. TRUE: What we're trying to do is to

7 say that if it is within that, then it is okay to use

8 the methods that we currently use basically.

9 MR. WALLIS: To use the point estimate.

10 MR. TRUE: To use the point estimate.

11 That's correct.

12 MR. WALLIS: So you've done something

13 which is better than a point estimate in order to

14 throw it away?

15 MR. TRUE: Because the methods that we use

16 in applications don't propagate all the time.

17 MEMBER STETKAR: Part of the problem is

18 that, for example, if you look at the first guideline

19 you're focusing on the things that you can see as big

20 picture contributors, whereas the state-of-knowledge

21 correlation is down in the noise and it could raise up

22 to be a contributor, but you don't know that. By

23 doing the uncertainty propagation, you force that to

24 the surface.

25 CHAIR APOSTOLAKIS: Made up in screen.

1 MEMBER STETKAR: That's exactly right. If
2 you look at the top 90 percent contributors to core
3 damage frequency and they satisfy guideline one, they
4 satisfy guideline two, that still does not necessarily
5 say that state-of-knowledge correlation is unimportant
6 because, you know, in principle the remaining 10
7 percent may be subject to factors of 30 from state-of-
8 knowledge correlations, you know, in a really
9 pathological case.
10 CHAIR APOSTOLAKIS: I'm wondering what
11 kind of guidance you can give to the practitioners so
12 there will be some assurance that this doesn't happen.
13 MR. TRUE: I think all cut sets, first of
14 all.
15 CHAIR APOSTOLAKIS: Say again?
16 MR. TRUE: I think all cut sets.
17 MR. CANAVAN: This is an application. I
18 think it supposed to --
19 MEMBER STETKAR: The guidelines, as I read
20 the document, focused on you look at the major
21 contributors to core damage that you can see. My
22 point is you ought to look at the things you can't see
23 also.
24 CHAIR APOSTOLAKIS: If you could select in
25 an intelligent way two or three of the sequences that

have been communicated on the basis of point values and suggest a calculation like guideline three, that might increase our -- I don't think they can do it for everything, right? But there maybe sequences that have three or four similar components.

MEMBER STETKAR: The problem is we're not going to solve the problem -- it's just to raise a sense --

CHAIR APOSTOLAKIS: We know what affects the result. It's the other factor, as you said, and the other components.

MEMBER STETKAR: Coincident components, yes.

CHAIR APOSTOLAKIS: So we could use some guidelines. Sorry?

MR. TRUE: And the fraction contributes to the total. See the other thing that you have to realize is that in the cut set base model and even in a risk management sequence based model, you're carrying tens of thousands of cut sets. You've gone down five orders of magnitude in a faulty cut set model to get yourself to a point convergence. The cut set file we're talking about using here is that file. So you've gone way deep.

CHAIR APOSTOLAKIS: It may have been

1 covered already.

2 MR. TRUE: If you go through and apply the

3 guidelines and you actually look at the cut sets, I

4 don't think --

5 MEMBER STETKAR: If you look at all --

6 MR. TRUE: I don't think the pathological

7 aspect will actually get us in trouble. If you stop,

8 sure, if you only look at the first couple pages of

9 cut sets and say I'm tired, I'm not going to do it.

10 CHAIR APOSTOLAKIS: What is a typical

11 truncation frequency? Ten to the minus what?

12 MR. TRUE: Easily about four or five

13 orders of magnitude.

14 MS. VANOVER: Yes, we look for

15 convergence, but for linear competes it's about five

16 minus 12 models. Six orders of magnitude?

17 CHAIR APOSTOLAKIS: Does that happen?

18 MR. TRUE: That's very typical.

19 MR. BLEY: No, you very seldom see this.

20 You don't expect it, but it could.

21 CHAIR APOSTOLAKIS: So it's --

22 MR. TRUE: A big error factors in lots of

23 -- MEMBER STETKAR: I'm worried, again, I'm

24 not so worried about existing PRAs of existing plants.

25 I'm also worried about new PRAs of new plants where

1 there could very well be large numbers of very low
2 frequency cut sets that are completely dominated by
3 relatively large numbers of passive failures.
4 MR. TRUE: No data as of today on how
5 those things are going to work.
6 MEMBER STETKAR: That's right, and this
7 guideline that is going to be applied by the industry.
8 MR. CANAVAN: There's another guideline
9 under development for them on capacity safety systems
10 credit and PRAs we're working on. It's actually
11 extremely interesting. But to --
12 CHAIR APOSTOLAKIS: Different systems you
13 correlate different things. You correlate, again,
14 heat transfer, maybe, coefficients. If you have two
15 different trains, you correlate these kind of things.
16 You rarely have to worry about random failures of
17 components. I mean, you have one valve here and one
18 valve there. The issue there is physical phenomenon.
19 MEMBER STETKAR: If one of eight valves
20 has to open and you have X to the 8th and it's --
21 CHAIR APOSTOLAKIS: No --
22 MEMBER STETKAR: -- check valve, for
23 example, I'm kind of worried.
24 MR. CANAVAN: More driving forces are
25 relied on. Okay, I'm going to move us on.

1 Essentially, this slide steps all the way
2 back and says okay, what are the ASME requirements
3 that I was trying to meet for the base model and how
4 are those met?
5 And this gives you a guideline on how to
6 meet the ASME requirement, and what this basically
7 says is perform a parametric uncertainty and report
8 the results. And the details are above on how to do
9 that.
10 MR. WALLIS: I think you have to specify
11 the confidence with which you predict these bounds?
12 I don't think you can just say service the bounds.
13 The more runs you do, the better confidence you get in
14 the bounds, if you get some sort of confidence value
15 for these bounds. Otherwise, it's an incomplete
16 requirement. Or you'll say with 95 percent confidence
17 or something like that, otherwise it's not a
18 meaningful statement.
19 MR. CANAVAN: I don't know exactly how to
20 answer you because the requirement says to specify the
21 uncertainty bounds --
22 MR. WALLIS: But you can never get them
23 exact. Even if you have a million Monte Carlo -- it's
24 never exactly -- you only know if it's some
25 confidence.

1 CHAIR APOSTOLAKIS: So what are you trying
2 to do here now with this guideline?
3 MR. CANAVAN: With this guideline, ASME
4 QUE3 requests that you provide the uncertainty bounds
5 of the answer. What we're just doing is saying to
6 perform an uncertainty propagation using a Monte Carlo
7 process or equivalent that through the Boolean model
8 that it counts for the state-of-knowledge correlation
9 reports the results of the fifth to the ninety-fifth.
10 Basically, perform the parametric evaluation and
11 report the result.
12 MR. TRUE: Go back to what QE3 actually
13 says. It says estimate. What we're basically saying
14 is calculate. The guideline is go propagate it and
15 calculate it.
16 MR. CANAVAN: And now what we're trying to
17 do is give them a little bit more detail, the
18 analysts, a little bit more detail on how we fulfill,
19 how he fulfills that requirement that says what.
20 And since it says estimate, while I do
21 agree that there needs to be maybe something that
22 talks about the number of samplings and how the
23 process is actually calculated, I mean we'll look into
24 confidence bounds and see what we can find, but I
25 think we're really responding to just ensuring that we

1 have some reasonable estimate of the bounds, whether
2 that be -- so I assume that corresponds to some
3 confidence. We'll take a look at that.
4 And then guideline two which is under
5 consideration. Some of this is work in process, I'm
6 not going to read it all. It says compare with
7 existing similar studies. So that's the bottom line.
8 It says that if you have, for example, Oyster Creek
9 and Nine Mile 1 or sister plants, they're virtually,
10 they're very identical in many respects. There are
11 some subtle differences between the two, but you might
12 argue that those are the sister plants in there and
13 they're very close. I wouldn't expect if one had
14 propagated uncertainty, the other model shouldn't be
15 that much different in terms of its fifths and ninety-
16 fifths.
17 We're moving away from this guide. It was
18 very popular -- IPE days, not everybody propagated
19 uncertainty. These days with the ASME standard really
20 looking for capability categories 2 and 3, looking at
21 much more rigorous treatments, we're finding that
22 nobody really does a whole lot of comparisons any
23 more.
24 CHAIR APOSTOLAKIS: I would be happy --
25 MR. CANAVAN: I'd be happier too.

1 MEMBER STETKAR: And Ken, especially if
2 this is focused towards applications, plant-specific
3 applications, it's pretty difficult for me as Plant X
4 to justify --
5 MR. CANAVAN: In 2002, when we were
6 writing this, there were an awful lot of people who we
7 felt that we would have been unfairly moving in a
8 direction that they might not want to go.
9 On the other hand, in 2007, it would seem
10 that that's a direction that they need to go. Having
11 said all that, my time is over.
12 CHAIR APOSTOLAKIS: You're hanging out
13 your flag?
14 MR. CANAVAN: I've got to hang out until
15 we're done.
16 MEMBER SIEBER: Have these documents been
17 published?
18 MR. CANAVAN: The first two that are
19 identified in the presentation are available on
20 epri.com to the public. And the draft will be
21 provided to you at the end of January. I don't know
22 if we'll make the final public, but we may make the
23 final available to you. We have ways to do that.
24 MR. BLEY: The things you've talked about,
25 are they going to remain for the most part stable into

1 the new document or are some of these the things that
2 are actually being changed?
3 MR. CANAVAN: I believe that aside from
4 the caveated one that I gave on the last example,
5 we're pretty fixed on most of the parametric, aside
6 from the note that I took from John Stetkar on making
7 sure that we're much clearer in the area of the CCF.
8 MEMBER SIEBER: Thanks.
9 MR. CANAVAN: With that, Don is going to
10 talk a little bit about the report that concerns
11 itself with the next three bullets on modeling
12 uncertainty.
13 MR. VANOVER: My name is Don Vanover with
14 ERIN Engineering and besides working on various EPRI
15 PRA scope and quality activities, my principal
16 responsibility within ERIN is as the PRA model owner
17 for Limerick and Peach Bottom. So I am involved in
18 day-to-day activities and use of the PRA model and
19 several applications, as well as working with other
20 utilities in providing support role for them and in
21 all phases of PRA applications, level one, level two,
22 and level three.
23 So that's just my background. As Ken
24 mentioned, I'm going to talk about the final three
25 objectives. The first objective to talk about is we

1 want to provide guidance to assist utilities in
2 identifying and characterizing sources of model
3 uncertainty. The second part of my report.
4 Again, why do we care about model
5 uncertainty beside the curiosity factor from a
6 licensee perspective from a utility perspective, what
7 we want to do foremost is be able to claim at the we
8 meet the ASME PRA standard and the Reg Guide 1200
9 Requirements when we get to applications. So what I
10 provided here, similar to what Ken did for the
11 parametric supporting requirements, is identify those
12 supporting requirements that specifically relate to
13 model uncertainty, issues.
14 They've been reframed in the last year or
15 so based on interactions by the Standards Committee
16 and the Federal Register notice that was published in
17 July of this year. The frame of the requirements now
18 focuses on it for the base model identifying and
19 characterizing sources of uncertainty and there's no
20 further requirement to evaluate all the sources of
21 uncertainty when we're looking at the base model.
22 It's only in the context of an application that we
23 worry about doing evaluations on these sources of
24 uncertainty.
25 MR. WALLIS: Can I go back to this

1 business of when point end solutions are not suitable?
2 The staff was very vague about how much uncertainty is
3 tolerable, how do you measure the uncertainty and so
4 on. I still am left uncertain -- unless there's some
5 kind of criteria for how much uncertainty is tolerable
6 or what you do with it, I think it's all up to just
7 arguing with the staff about what they will accept.
8 There doesn't seem to be any way of knowing when your
9 uncertainty is too much and when is it good enough and
10 so on. How do you know those things unless there's
11 some kind of measure for it.
12 MR. CANAVAN: You mean for the parametric
13 part?
14 MR. WALLIS: How do you know?
15 MR. CANAVAN: It's pretty clear. It says
16 ten percent.
17 MR. WALLIS: Is ten percent the criteria?
18 That's an awfully small number.
19 MR. CANAVAN: Yes, I think so too.
20 CHAIR APOSTOLAKIS: Are you talking about
21 the same thing?
22 MR. CANAVAN: If you are talking about the
23 parametric, if you're talking about the modeling
24 uncertainty, we're not quite there yet.
25 CHAIR APOSTOLAKIS: I think Graham is

1 referring to the ultimate decision.

2 MR. TRUE: He is saying that if you have

3 a mean value that's X and your uncertainty band is

4 plus or minus a hundred on either end, it's a

5 different decision then one that's plus or minus --

6 MR. WALLIS: Is that acceptable?

7 CHAIR APOSTOLAKIS: If the probability.

8 MR. WALLIS: The means were then ten

9 percent. That's quite different.

10 MR. CANAVAN: Well, for parametric then

11 it's a suitable surrogate. If you're speaking about

12 overall making a decision --

13 MR. WALLIS: Even if it's very uncertain.

14 I mean, the mean can still be exactly on the dot but

15 you can an enormous spread in --

16 MR. TRUE: And the way, I think, Gareth

17 explained this earlier that our acceptance guidelines

18 are generally set up based on mean value.

19 MR. WALLIS: Uncertainty in the mean is

20 the only thing that we're worried about? That's very

21 strange to me.

22 CHAIR APOSTOLAKIS: No, let's take a

23 situation where you have a line for delta CDF and in

24 one case the distribution of the delta CDF probability

25 is such that the mean is below the line, so it is

1 acceptable. But the probability of exceeding the line
2 is say .05. In another application it may be .15. In
3 both applications, the mean is below. The way I
4 understand your question is does this 0.05 or 0.15
5 make any difference?
6 MR. WALLIS: It might be 0.5. It could be
7 quite --
8 CHAIR APOSTOLAKIS: 0.5, I doubt it. The
9 mean would be above, if it's 0.5. So it would be a
10 small number and I think the answer is that this
11 footnote that I mentioned earlier that the staff says
12 very clearly that in these cases there will be
13 increased management attention. They don't tell you
14 what they're going to do. They're going to scrutinize
15 or try to convince themselves. So that's where they
16 leave it. There are no, that's why it is called
17 integrated decision making. I mean, they may be
18 convinced in some case that it is okay. In other
19 cases, they may not. That is why the line is not
20 bright. You may be below and be denied. That's where
21 things are now the way I understand it.
22 Gareth?
23 MR. PARRY: That's right.
24 CHAIR APOSTOLAKIS: They really insist
25 that it is a risk informed and they have to look at

1 the case.

2 MR. PARRY: Well, it's risk informed and

3 the process is set up such that the closer you are to

4 a boundary, the more scrutiny you're going to get.

5 MR. WALLIS: I would be much happier if

6 you had a firm boundary and you looked to the

7 probability of stepping over it instead of all this

8 scrutinizing

9 --

10 CHAIR APOSTOLAKIS: The probability of

11 stepping over would be small because the mean is

12 always on the tail. It will never go to 50 percent.

13 I'm willing to bet on it.

14 MR. WALLIS: Fifty percent. I mean, is 30

15 percent acceptable?

16 CHAIR APOSTOLAKIS: Even 30, I doubt it.

17 If it is 30 percent, the mean will be above.

18 MR. WALLIS: If your knowledge is very bad

19 --

20 MR. CANAVAN: The more uncertain you get,

21 the higher your mean moves too on a distribution. The

22 mean can cross the 90th percentile when you're very

23 uncertain. I mean, it's at the 70th now.

24 MR. WALLIS: You don't have more

25 uncertainty, you don't have a measure of uncertainty.

1 MR. CANAVAN: If you have a broader
2 distribution, if you were very uncertain about it.
3 MR. WALLIS: Was it broader? Was it lop-
4 sided or what? There are different ways to broaden
5 the distribution.
6 CHAIR APOSTOLAKIS: If you look, Graham,
7 if you look at the core damage frequency distributions
8 of PRAs that have done it, the mean value, as I recall
9 of the CDF is between the ADF and the 87th percentile
10 which means -- so if the mean is exactly at the line,
11 there is at most 15 percent probability that you are
12 above the line.
13 MR. WALLIS: I think that's nonsense.
14 CHAIR APOSTOLAKIS: Right.
15 MR. WALLIS: You could have a very
16 lopsided thing where in many cases there's nothing
17 that happens at all and in a few cases something very
18 seriously happens.
19 CHAIR APOSTOLAKIS: I'm telling you what
20 the real results are.
21 MR. WALLIS: What?
22 CHAIR APOSTOLAKIS: The mean value from
23 real PRAs is roughly at the ADF percentile of the
24 distribution, roughly. The distribution is not
25 symmetrical.

1 MR. WALLIS: That's just by experience, is
2 that it?
3 CHAIR APOSTOLAKIS: Yes, but a lot of
4 experience, not just -- but more detailed guidance
5 deliberately was avoided by the staff. They didn't
6 want to get into the business if the probability is
7 .06, do this if it's .07, do that. It was a very
8 deliberate decision on their part and I think it was
9 the right decision, at least with the --
10 MR. WALLIS: I think if I were worried
11 about the failure of a pressure vessel, I would not
12 look at it this way. I would look at here's my mean
13 estimate and here's something or other. I want to
14 know what's the probability that I burst the thing.
15 I wouldn't really care about all this other stuff. I
16 want to know what's the probability I get beyond
17 something acceptable. That's the only thing I'd be
18 interested in. That seems to be taboo in this
19 discussion.
20 CHAIR APOSTOLAKIS: It's not taboo. They
21 know what it is. They just don't tell you how they
22 are going to handle it each time. They know.
23 And the other thing is the big difference
24 between the pressure vessel and the case we're talking
25 about here, in the pressure vessel you have criteria

1 that are based on some physics. Here, it's a
2 regulatory guideline which took into account the fact
3 that you will be using mean values. There's a huge
4 difference, in my mind. They were deliberately
5 conservative and they said 10^{-4} or $^{-5}$ will be used with
6 mean value, so therefore it's not going to be 10 to
7 the minus whatever.
8 MR. WALLIS: Because the real value is 10^{-}
9 ^{6}, is that so conservative -- well, you can go on with
10 that.
11 CHAIR APOSTOLAKIS: It's not like you're
12 exceeding some failure criteria.
13 MR. WALLIS: But you may exceed something
14 which the public will accept which would be then a
15 failure criteria.
16 Why does it all have to be internal to the
17 NRC?
18 CHAIR APOSTOLAKIS: What is what? Graham,
19 I didn't hear you.
20 MR. WALLIS: Why does it al have to be
21 regulatory? I mean can't it be something that the
22 public can understand? Are you saying there's a
23 regulatory criteria. It's inherently conservative --
24 CHAIR APOSTOLAKIS: But you are bringing
25 up an example where you're comparing with the physical

1 failure of something. And I'm telling you that line
2 there does not represent the physical failure. When
3 they set up their acceptance guidelines, they said
4 okay now, what are we going to use? Mean values.
5 Okay, what does that mean? How low can I go? What is
6 the state-of-the-art? Am I being ridiculous? For
7 example, if I said the acceptance guideline is 10^{-8},
8 I am being ridiculous. If I make it 10^{-2}, then I am
9 not on the safe side.
10 So that's very different from saying that
11 the pressure vessel fails. There's no failure here.
12 It's a decision making process and it's an attempt to
13 formalize it as much as you can. I think it's very
14 different. And they make an argument that even if
15 you're close to the line you should approve it all the
16 time because the line is very conservative, right?
17 Some licensees have made that argument.
18 MR. WALLIS: Failure is core damage. It's
19 a physical event.
20 CHAIR APOSTOLAKIS: Right.
21 MR. WALLIS: You're looking at probability
22 of something which is a real physical event. You're
23 not looking at something that's regulatory.
24 CHAIR APOSTOLAKIS: That's true.
25 MR. WALLIS: So it's something like the

1 pressure vessel failing.

2 CHAIR APOSTOLAKIS: Not regulatory

3 guideline 174, the underlining, yes, you're right, the

4 underlining thing is --

5 MR. WALLIS: We can continue this

6 discussion some other time --

7 CHAIR APOSTOLAKIS: Whatever.

8 (Laughter.)

9 MR. VANOVER: Okay, I'll proceed on. So

10 the purpose of showing the supporting requirements

11 from the ASME PRA standard is to set up what the

12 objective of -- one part of the objective of the

13 report is, is to help utilities meet these supporting

14 requirements in the current context of their

15 definitions. And then they apply to both LERF as well

16 as CDF with the addition of the other two supporting

17 requirements.

18 We've worked with the NRC on developing

19 these definitions and these are consistent now.

20 They've changed a little bit now from the original

21 EPRI report, so these are the same as what appeared on

22 Mary's slides this morning with the definitions for

23 different assumptions that related to model

24 uncertainty versus those related to scope and level of

25 detail.

1 There also is a definition provided for
2 what constitutes a reasonable alternative hypothesis
3 for an alternate assumption.
4 When we released the original EPRI report
5 and more specifically the Applications Guide, it
6 became apparent that there was a lot of good work that
7 went into developing the long list of sources of
8 uncertainty in the original EPRI technical basis
9 document, but in the context of where we are now, it
10 became clear that a lot of those issues were related
11 to the scope or level of detail items rather than true
12 model uncertainty issues.
13 So the effort that we perused over the
14 last six months is to try to help differentiate both
15 the 200 plus sources of uncertainty that were
16 identified in the original EPRI report, what subset of
17 those are really model uncertainty issues with the
18 definition we now provided versus scope level of
19 detail issues that are not necessarily important in
20 the context of the base model because the analyst has
21 already decided are not important from the base model
22 perspective, but for specific applications they could
23 be important as we've talked about.
24 MEMBER SHACK: Consensus model seems to
25 have disappeared from your presentation.

1 MR. VANOVER: I did not include it, but we
2 would have the same definition.
3 CHAIR APOSTOLAKIS: So there is consensus
4 on that.
5 MEMBER SHACK: Same definition as 1855 or
6 same definition?
7 (Off the record comments.)
8 CHAIR APOSTOLAKIS: Can you tell us what
9 you're proposing the user to do? All day today we've
10 been hearing --
11 MR. VANOVER: I will get to that.
12 CHAIR APOSTOLAKIS: Let's go to do.
13 MR. VANOVER: Okay.
14 CHAIR APOSTOLAKIS: Okay, because it's
15 2:30.
16 MR. VANOVER: To help differentiate -- and
17 we'll get to what we want the users to do with this
18 guidance shortly. The definitions of how we help
19 differentiate scope level of detail issues versus the
20 model uncertainty issues were looking at phenomena
21 that's not or failure mode that's not completely
22 understood or significant interpretations to infer
23 behavior required to develop a model, where we got
24 some test results or some data and we need to apply
25 some assumptions regarding what would happen in the

1 real world in our logic model.

2 Or alternatively, there is general

3 agreement that the issue represents potential source

4 of model uncertainty and that category covers such

5 things as common-cause failures and human error

6 probability development. So we're capturing things

7 that we've got standard approaches for, but we're

8 still holding off those as potential generic sources

9 of model uncertainty to be identified as potential

10 candidates.

11 CHAIR APOSTOLAKIS: Is it conceivable that

12 at some point you and the NRC may agree that ATHEANA

13 is the consensus model for human error probability?

14 Would that solve that?

15 (Laughter.)

16 MR. CANAVAN: Probably not.

17 CHAIR APOSTOLAKIS: Or the EPRI

18 calculator. . I forgot about that.

19 MR. CANAVAN: The HRA calculator, yes.

20 That will eventually, ATHEANA will be an option in

21 there, I believe.

22 CHAIR APOSTOLAKIS: But could there be a

23 concept of consensus model there? No, probably not.

24 MR. CANAVAN: We're working on it.

25 CHAIR APOSTOLAKIS: Is it alternative

1 models that I am talking about?

2 MR. CANAVAN: We're working real hard on

3 that being a consensus approach. I would call that a

4 consensus approach. For example, one of the consensus

5 approaches that we have been talking about proposing

6 in the HRA using the calculator, but using the

7 calculator, for example, deciding when action should

8 be treated by ATHEANA, deciding when action should be

9 treated by HCR or some other method of deciding when

10 they can be screened. If you were to have this front

11 end that allowed you do that, you would have a

12 consensus approach, not necessarily a model. So there

13 are areas where ATHEANA is useful. There are areas

14 where other models --

15 CHAIR APOSTOLAKIS: And then you would

16 claim after that the uncertainty, or you would put an

17 uncertainty on top of the HCR.

18 MR. VANOVER: We would as part of

19 developing that consensus approach or model, we would

20 evaluate uncertainty in a broad arena. We would look

21 at well, what happens if we don't, what happens if we

22 apply a different model. What are all the

23 ramifications of the different parameters in there.

24 Then we sort of look at it and say --

25 CHAIR APOSTOLAKIS: I would say though

1 that that's an area when applying an alternate model
2 is really not practical. For example, if I use the
3 HCR, it's just inconceivable, oh yes, let me use
4 ATHEANA now. I mean, come on. It's a major
5 undertaking.
6 MR. VANOVER: I think in the context of
7 one of the lessons we did learn for the Limerick pilot
8 application was there are very few consensus models at
9 this point with the current definition, and what we
10 really have is a more accepted best practices. So
11 there is a higher pedigree to have a consensus model
12 versus an accepted best practice and at this point
13 until the accepted best practices become consensus
14 models, those still would be carried forward as
15 potential sources of uncertainty.
16 CHAIR APOSTOLAKIS: But there are also
17 situations where I think the human error probability
18 calculation is one, is where there are truly
19 legitimate alternate ways of approaching the problem.
20 MR. CANAVAN: That is the definition of
21 source of uncertainty.
22 CHAIR APOSTOLAKIS: I'm sorry?
23 MR. CANAVAN: That is the definition of
24 source of uncertainty. There are legitimate ways --
25 CHAIR APOSTOLAKIS: Somehow we have to

1 handle that.

2 MR. TRUE: Even if everybody used ATHEANA,

3 there would still be model uncertainty.

4 CHAIR APOSTOLAKIS: Yes, that's what I'm

5 saying. There's another approach because equal claim

6 to legitimacy perhaps.

7 MR. TRUE: And the analyst to analyst

8 variability that goes into it.

9 CHAIR APOSTOLAKIS: And it brings me back

10 to the NUREG-1150 approach.

11 MR. TRUE: Well, I'll even scare you worse

12 and I'll point out one other item and that is the

13 consensus model is wonderful. It doesn't really get

14 you out of anything though because when you do an

15 application you look at cause and effect. If there's

16 a cause and effect, this process that we've defined

17 and if there's a cause and effect, and it involves a

18 consensus model, you still evaluate the uncertainty

19 even though it's a consensus model because there's a

20 cause and effect.

21 So for example, if you're doing a diesel

22 generator or AOT and you use the Westinghouse seal

23 model, it's not like you don't evaluate what is the

24 sensitivity of the seal model to this application.

25 You have to do that.

1 CHAIR APOSTOLAKIS: Could you have a
2 consensus model with the distribution that is based on
3 what other models are saying? That could be an
4 approach?
5 MR. CANAVAN: Could be.
6 CHAIR APOSTOLAKIS: Okay.
7 MR. TRUE: Next slide.
8 MR. BLEY: If I may, are you revising the
9 consensus model description in the new report?
10 MR. TRUE: Yes.
11 MR. BLEY: Will it be consistent with the
12 one --
13 MR. TRUE: All the definitions now --
14 MR. BLEY: Are going to be the same
15 everywhere. Okay.
16 MR. TRUE: So just to refresh everyone's
17 memory of this, we started out the EPRI work in 2003.
18 We came and addressed you guys I think in April of
19 2004. And then working well ahead of the NRC.
20 In the meantime, the ASME standard was
21 evolving. In the meantime, the NRC began to engage
22 the subject, so we have time phasing issues between
23 the documents you have.
24 The goal for next year is to bring both of
25 these documents together and be totally consistent in

1 the way we approach and apply the methods and
2 definitions.
3 MR. BLEY: And the last one on this line,
4 I know right now from what you've said you aren't
5 updating the basis document. Do you eventually intend
6 to update it for at least consistency?
7 MR. CANAVAN: I really like the basis
8 document and I would like to keep it. We probably will
9 somewhere along the line for consistency purposes
10 either update it or take the important pieces of
11 technology that we'd like to move forward and publish
12 them separately.
13 CHAIR APOSTOLAKIS: Do you think this is
14 a time to take a 10-minute break?
15 MR. CANAVAN: Yes.
16 CHAIR APOSTOLAKIS: All right, we'll be
17 back, when?
18 MR. CANAVAN: Ten minutes.
19 (Laughter.)
20 MR. CANAVAN: I'm sorry, with the
21 uncertainty of that ten minute -- is this a consensus
22 model 10-minute break?
23 CHAIR APOSTOLAKIS: There's a probability
24 of maybe longer.
25 (Whereupon, the proceedings in the

1 foregoing matter went off the record at
2 2:37 p.m. and went back on the record at
3 2:52 p.m.)
4 CHAIR APOSTOLAKIS: Okay, we are back in
5 session. Some of us anyway.
6 So Dan, tell us what to do. You tell us
7 what to do.
8 (Laughter)
9 MR. VANOVER: Okay, this slide here shows,
10 the part that's not in green or blue or whatever that
11 color turns out, the process that was undertaken in
12 the original report where there was an extensive
13 literature search and a review of the insights from
14 other studies to identify potential sources of
15 uncertainty. And that work is documented in Appendix
16 H of the technical basis document. And that is the
17 piece we don't want to lose moving forward, because we
18 referenced that in looking at those sources of
19 uncertainty. And then for this report we've added the
20 context of screening those items related to
21 approximate method or scope level detail issues, and
22 by doing that, we end up with a smaller set, a more
23 manageable set, in the context of meeting the
24 requirements of the base model, that is, a generic
25 list of candidate sources of model uncertainties.

1 And what we are going to have in the EPRI
2 report is for each of those issues that we have been
3 working with the NRC to identify. Now this is where -
4 - what to do part. The utilities, to meet their
5 reporting requirements for each of those issues would
6 need to identify the part of the model affected, what
7 approach they took in addressing that source of
8 uncertainty; and what the impact on the model would be
9 given alternative approaches.
10 So we are going to try to set up a
11 template where we list, based on our experience, what
12 some of the possible approaches we are familiar with,
13 sort of going from more conservative to best estimate
14 in the hierarchy of how we would list them. And then
15 it would be up to each individual utility to take that
16 generic list and put the specifics in of the approach
17 they've taken and how it impacts their model.
18 And that would help each of the model
19 owner analysts users of the process to meet the
20 supporting requirements that have been difficult --
21 it's been difficult to establish what you really need
22 to do to meet those requirements up until now in the
23 TIA standard.
24 Here's one example, one of the topics
25 we've selected as a source of generic model

1 uncertainty is what's -- what happens with equipment
2 that normally requires DC to maintain operability when
3 the battery is depleted. And depending on the site,
4 the -- these type of sources of uncertainty would in
5 this case be important in station blackout events, and
6 station blackout events are big contributors on most
7 of the PRA models.
8 And then the question is specifically for
9 BWRs, what would happen to RCIC and/or HPIC, and for
10 the PWRs what would happen with turbine driven or
11 feedwater systems.
12 MR. WALLIS: You mean that if somebody
13 opens a valve and started a DC opening the valve; is
14 that what you mean?
15 MR. CANAVAN: Yes.
16 MR. WALLIS: Because I mean the guy isn't
17 going to turn the turbine.
18 (Laughter)
19 MR. VANOVER: It's manual operation of the
20 valve. So some of the possible approaches, a lot of
21 the sites have procedures, not very well trained or
22 well practiced, and not demonstrated, to utilize --
23 they are being trained more I guess. So an approach
24 that could be taken is, well, we are not going to take
25 any credit for continued operation. That's sort of

1 the conservative bias approach, even if I have a
2 procedure that exists. And I'm just going to say, DC
3 dies, I don't take any further credit.
4 I could look at taking credit for manual
5 operation of some of these systems following battery
6 depletion, based on an accepted human error
7 probability analysis. And then I could take a
8 somewhat more limited credit in specific areas,
9 depending on availability of other components, and say
10 -- make sure that performance shaking factors are
11 better satisfied, that action could be taken.
12 So there could be a subset of a list of
13 possible approaches. This is a generic source of
14 uncertainty. There have been different approaches
15 taken by a lot of utilities, and it can have a fairly
16 significant impact on results, and could especially
17 impact applications.
18 So this is the type of sources of
19 uncertainty we are looking at rather than scope level
20 detail issues. It actually makes a difference in your
21 sequence modeling, and it makes a difference, or it
22 makes a difference in the type of scenarios you could
23 have.
24 MR. TRUE: So there are 20-some odd topics
25 like this. For each topic there is a table like this

1 that says, this is what the issue is. This is
2 generally the parts of the model we expect to be
3 affected by this topic. And here is a spectrum of
4 approaches. Each licensee would be expected to
5 determine whether that topic applied to them at all,
6 and if it did, then assess how their results might be
7 impacted by other alternative approaches to that
8 topic.
9 MR. CANAVAN: Welcome to the edge of the
10 black hole.
11 MR. WALLIS: Now aren't there an awful lot
12 of these bits in the KRA that could be treated this
13 way with quite a few approaches to each?
14 MEMBER SIEBER: Yes.
15 MR. WALLIS: So this is an awful lot of
16 work for somebody.
17 MR. TRUE: We think we have narrowed it
18 down to 20-ish. Now it may show up in more than one
19 place in the model. But in terms of looking at it,
20 you go in --
21 CHAIR APOSTOLAKIS: But again, though, I
22 understand this approach. But if go with number one,
23 I'm becoming very conservative.
24 MR. CANAVAN: It is actually quite common,
25 number one.

1 CHAIR APOSTOLAKIS: Yes, and conservative.
2 And now I can study our problem.
3 MR. CANAVAN: Correct. And that's actually
4 quite common, which is why I made the statement before
5 that PRAs are actually quite conservative. Because
6 when you look at these 20 and you look at how they are
7 attacked, a lot of them are attacked with number.
8 CHAIR APOSTOLAKIS: You are giving it to me
9 as a possible approach. And I don't know, just to
10 avoid quantifying the uncertainty to be so
11 conservative, when I have problems both -- remember,
12 now where you have to be realistically conservative,
13 or conservatively realistic, and although the staff of
14 course doesn't care if you are conservative
15 conservative.
16 I don't know about John's concern about -
17 (Simultaneous voices)
18 MEMBER BLEY: You're masking?
19 CHAIR APOSTOLAKIS: Yes, you are masking
20 other things. It is not a solution. I mean I'm
21 wondering whether -- well, it's a possible approach.
22
23 MR. VANOVER: Right, and it could be a
24 solution for some applications, but that conservatism
25 could push you above the limit in other applications,

1 and you'd be more pressed to refine the model and try
2 to develop more credit.
3 MEMBER SIEBER: And you've got to refine
4 your procedures.
5 CHAIR APOSTOLAKIS: Got it?
6 MR. PARRY: Yes, I think you've got to look
7 at it in the context of making decisions again. If
8 this conservative modeling is sufficient to support
9 the case you are trying to make, then I think that is
10 a solution. In fact it's the best solution because
11 you will have real competence in the answer that you
12 use. It's straightforward.
13 It's when you have to do something more
14 refined I think that you start getting a little more
15 worried about the significance of that.
16 MEMBER ABDEL-KHALIK: But if the decision
17 involves more than just one model uncertainty then you
18 may run into this masking problem. And I was just
19 wondering if there was a requirement for a sort of
20 consistent approach toward conservatism?
21 MR. PARRY: No, I think there is a
22 requirement to look at combinations of sensitivity
23 studies and combinations of issues.
24 CHAIR APOSTOLAKIS: Logical combinations.
25 MR. PARRY: Logical combinations that can

1 affect the decision. And that's what you would be
2 looking at, and you would be looking to see if this
3 were able to mask something else.
4 I mean you have to look at all the
5 ramifications of it.
6 MEMBER BLEY: Is it a fair worry that if
7 you take this bounding approach for one decision,
8 maybe with a combination of things, and you accept the
9 position, and some months later you do it for another
10 and then for another, that you may have corrupted your
11 base case such that this is no longer a valid
12 approach?
13 MR. CANAVAN: Interestingly enough, you
14 probably started at the other end; you probably
15 started with many more conservatisms in the studies in
16 the '80s, and how you've come is, you've evolved, and
17 you've been removing them one at a time, and now you
18 have gotten down to this set where you have either
19 decided that you are not impacting the overall result
20 significantly or not; there wasn't a reason for you to
21 remove it; in other words you haven't done an
22 application where there is a cause and effect. There
23 has been no driving force for you to address the
24 conservatism.
25 If you pursue an application where there

is now a driving force for one or more, you might find yourself in a situation where you are looking at other approaches, either in the base model, or you are looking at at least assessing what are the impacts of options two and three?

MEMBER BLEY: But now you do it as one decision, as a bounding case. You are not rolling that back into your base model, or are you? If you are, then my concern disappears.

MR. CANAVAN: I think in most cases, since you're doing the work, you are rolling it into the base model.

MEMBER BLEY: then the concern disappears.

MR. TRUE: Either I'm not connecting or you guys aren't, because let's just take two examples. I'm a plant, and I use option two. I felt like possible approach number two, where I credited it with some HEP, I put a point one in there for my operator to be able to go out and do the Madrigal operation.

I come into this process, and I know that that is a pretty uncertain operator action. It's a nasty environment. It's dark. The room is hot. You're out of time in a pretty bad event to begin with.

So but I got HEP in there, and I think

1 it's relatively conservative. I would be expected
2 then to look at the case where, let's assume that
3 operator action didn't work, then how does that affect
4 my delta CBF? And if I'm still below the threshold,
5 and I can say, I'm still okay, but for my delta CBF,
6 delta LERF requirement, and that I'm done.
7 If I'm not, then it's going to be
8 incumbent on me to explain to the decision maker why
9 that case, assuming it fails all the time, doesn't
10 really apply to me. I've got portable fans that I use
11 that are gas powered. I have lights that I have in
12 the room or whatever, a store unit.
13 MR. CANAVAN: Or even add, maybe you put in
14 point one, and you find that if you stick in the one
15 you don't make it, but if you stick in point nine, you
16 do.
17 So hey, point nine, I definitely make it,
18 so I'm going to leave the model hte way it is. I
19 guess I was answering your question from the --
20 MR. TRUE: Okay, but my model is still
21 predicated on number two. I don't go back and change
22 my model to make it assume number one in every case.
23 It's still a sensitivity case.
24 Now let's take the other case where I come
25 in, I'm number one to start with. I've been

1 conservative; I'm done. I don't go look for the
2 goesdowns, as we were referring to this morning with
3 John. I'm at the goesup reporting --
4 MEMBER STETKAR: This is like goesups and
5 goesdowns.
6 (Laughter)
7 MEMBER STETKAR: Refer to your dictionary.
8 (Laughter)
9 MR. TRUE: I'm done. And so in a sense
10 certainly I'm conservative. I've limited the amount
11 of work I have to put into my conservative analysis.
12 If I can live with that decision, that's fine.
13 But those are the two kind of cases. If
14 you had case three, then you'd do successive cases, or
15 you might jump to the top and say, am I okay at,
16 assuming it always fail. And if not then you might do
17 the middle case, and say, well, I can use some more
18 bounding HEP and -- but you lead the model the way it
19 is.
20 MR. CANAVAN: We're in violent agreement
21 except in the cases where you are number one and you
22 don't make it. And then you go do number two, and
23 then you finish that, well, you put that in the model.
24 MEMBER STETKAR: I mean in principle there
25 should be one PRA, not 25 different PRA models for 25

1 different applications.

2 MR. CANAVAN: And I might even argue that

3 you might do number three, but be really

4 uncomfortable, like you really razored down the

5 credit, and you feel for this particular application

6 that you are doing, or in that particular circumstance

7 -- well, I was going to make a case that you might end

8 up back at two if you weren't comfortable with three.

9 But I think if you did three and you thought it

10 worked, then you'd stick with three too. If you did

11 the right job.

12 MR. TRUE: And then tying this back to the

13 overall risk-informed decision and performance

14 monitoring and all the other things, you might --

15 let's say you were doing this for diesel AOT. You

16 might take some compensatory measures, where I've done

17 some special things to train a certain set of

18 operators, or dedicate a person that if we have a

19 station blackout, it's your job to go get that diesel

20 powered fan and put it in there so I can justify a

21 different HEP in that case or even the HEP I use in my

22 basement, if I have felt I had to, as sort of a

23 compensatory measure to bolster the overall decision.

24 So that we are feeding back the insights

25 from these uncertain aspects of the model into the

1 decision making process in a productive manner, not
2 just a go-no go manner.
3 CHAIR APOSTOLAKIS: Let me understand what
4 all this means. Are you claiming that I can take care
5 of all the model uncertainty issues this way?
6 MR. VANOVER: Go to the next slide. What
7 we are trying to do as a first step is identify and
8 characterize what's in our model. And that's a useful
9 exercise for people as Gary said this morning, the
10 analysts have to understand what's in their model.
11 And going through this process that we've outlined
12 here, we'll make sure that everybody understands the
13 important sources of uncertainty, and how they are --
14 what assumptions are related to those sources of
15 uncertainty in their model, so that when they get to
16 applications, they know what they've done.
17 So -- what we- we're still looking at the
18 base model at this point, and what the guidance is
19 referring to. We haven't gotten to an application
20 yet. We are still at identifying, characterizing,
21 what we do with the subset of the sources of
22 uncertainty.
23 MR. WALLIS: I'm a little puzzled here,
24 because it seems to me that you have two plants, one
25 plant can makes all sorts of very, very conservative

1 approaches and come up with a certain value, and then
2 it comes in to ask for something. Another plant is
3 taking credit for everything it can possibly get.
4 It's fiddled around with all these assumptions to get
5 everything done his way. And he comes in with an
6 application to do something, does he get treated the
7 same way if he's got the same number?
8 MR. CANAVAN: If he makes it.
9 MR. WALLIS: It seems very strange.
10 MR. TRUE: Well, actually in this case he
11 wouldn't. Because he would be expected --
12 MR. WALLIS: He'd be expected to go back
13 and do these other things?
14 (Simultaneous voices)
15 MR. WALLIS: He's just looking for change,
16 and the change may be the same for both plants.
17 MEMBER CORRADINI: You would have to -- I
18 can't imagine -- I think what Graham just asked is, if
19 I had the same end result but I got there be a
20 different set of assumptions would that bother you?
21 It would have to -- you would have to try to analyze
22 that and then come to a conclusion that something is
23 up with one plant and different than another plant.
24 MR. WALLIS: These folks come to us, they
25 come to us for all kinds of things, power uprates and

1 stuff, and they give us a CDF value. We don't ask
2 them, are you right on the border of taking credit for
3 all these assumptions.
4 MR. VANOVER: Well, I think that's what
5 this process is trying to help the utilities as well
6 as the decision makers to provide a mechanism to
7 identify those types of assumptions and when they
8 become important in decisions.
9 So if I was the guy who was taking credit
10 for all those things --
11 MR. WALLIS: How do we know? If somebody
12 comes before ACRS?
13 MR. VANOVER: Well we'll get to what to do
14 in applications, but it would be incumbent upon the
15 licensee to identify and provide results of different
16 sensitivity cases with different alternative
17 assumptions. Then it's up to the decision maker to
18 weigh those results.
19 MEMBER SIEBER: It's probably fair to say
20 that the ACRS as opposed to the staff or the plant
21 management doesn't have the opportunity to look at all
22 these details. People who are the actual decision
23 makers have to take the time and put forward --
24 CHAIR APOSTOLAKIS: Incidentally, don't we
25 have to go to the plant to look at these things now?

1 Or is that something different? Don't we hvae to go
2 to the plant to look at the PRA now?
3 MEMBER SIEBER: Yes.
4 MEMBER MAYNARD: I would be bothered if two
5 identical plants came in, one had done an
6 ultraconservative, and the other had taken advantage
7 of everything it could, and you come out with the same
8 number, then I'd be wanting to know why. But if I
9 have two different designs, two different plants, I
10 think either one of them you've got to try to
11 understand --
12 MR. WALLIS: I just wonder how someone like
13 ACRS would know that that's the case, that one plant
14 was being very conservative, and the other was not.
15 MEMBER CORRADINI: The staff would tell us.
16 MR. WALLIS: They would tell us?
17 MEMBER CORRADINI: Sure they would.
18 MR. WALLIS: They would?
19 MEMBER SIEBER: No, they wouldn't. They're
20 shaking their heads no.
21 CHAIR APOSTOLAKIS: So uncertainties in
22 success criteria could be handled the same way?
23 MR. TRUE: We have some success criteria
24 that we believe are the main areas of uncertainty that
25 we have identified that we treat the same way.

1 MEMBER BLEY: Are your list of 20 topics
2 already laid out?
3 MR. TRUE: They are not in your handout.
4 (Simultaneous voices)
5 MR. CANAVAN: You get to descend into the
6 black hole on your own time.
7 MR. TRUE: When you get the report from us
8 at the end of January, they will certainly be in there
9 with this characterization around them.
10 And if there are -- I guess we do, in
11 visual form, have the list. At the end when we have
12 lots of time, we want to go just scan through that
13 list.
14 MEMBER BLEY: It'd be interesting, but
15 January is probably. But a matter of form, do you and
16 NRC expect that when you new report comes out, and
17 their new report revision comes out, that all of these
18 diagrams that show the process are going to be the
19 same pictures, or is that going to be quite different?
20 MR. CANAVAN: They will be --
21 MR. VANOVER: We believe that this diagram
22 here is consistent with what I believe is Figure 5.1
23 or 5.2 in the draft NUREG in terms of identification
24 categories and qualitative screening.
25 We haven't made them exact at this point.

1 MR. CANAVAN: They are not identical, but
2 the intents are the same. Whether they become
3 identical -
4 MEMBER BLEY: Are you going to try to make
5 them the same?
6 MR. CANAVAN: That's a good question. We
7 hadn't even discussed that.
8 MR. VANOVER: We talked about making sure
9 they were consistent.
10 We have -- we're looking at another
11 opportunity to get together, is that correct, Mary?
12 And at that time -- and there will be post-
13 publication. So there will be another opportunity for
14 us to share everything including diagrams.
15 We hope to make the documents' companions.
16 They are going to rely on each other; neither is stand
17 alone. They are going to reference each other in the
18 appropriate spots, our document being a little more
19 detailed and a little more pragmatic, and the NRC's
20 document being a little more overview, and a little
21 more regulatory based, which makes perfect sense.
22 MEMBER BONACA: I was asking just a
23 description on the three possible approaches you used
24 before. Are you providing those, some information on
25 the questions that the analyst has to go through?

1 For example if you take credit for
2 something, is there a procedure how credible the
3 action is? You must have a checklist.
4 MR. VANOVER: Right now the list is pretty
5 short, and we have to work on how much detail we want
6 to provide for each of the possible approaches.
7 MR. TRUE: I think in principle the answer
8 is going to be yes. The example you gave, though,
9 probably is something we would expect to be handled by
10 human liability methods. We expect to have a
11 procedure on those kind of things.
12 But in principle, other cases where there
13 are clearly things that would have to be investigated,
14 we would include that in additional types.
15 There will be a page or so on each of this
16 will explain in more detail the approaches -
17 CHAIR APOSTOLAKIS: And these will be in
18 the report?
19 MR. TRUE: And they will be in the report.
20 MR. WALLIS: I am getting very puzzled.
21 You have 20 of these different things, and there are
22 all kinds of approaches to each one. Which one of
23 these many things is used in the number which is
24 submitted to the NRC? Or is this a parametric
25 uncertainty type of thing where it looks at all of

1 these possibilities and calculates some means and all
2 of that?
3 My impression is, it's not --
4 CHAIR APOSTOLAKIS: I think in the context
5 of an application, they plan to -
6 (Simultaneous voices)
7 CHAIR APOSTOLAKIS: They would not even
8 show them to the NRC.
9 MR. TRUE: We should, just to clear this
10 up. So you have a base model. You have a model that
11 you have used, and it has some approach to each of
12 these 20 items.
13 MR. WALLIS: Like number two, let's say.
14 MR. TRUE: Like number two, okay. And
15 number two isn't the conservative approach. And so
16 you would report to NRC, here is my result, and -- but
17 in considering my own uncertainties I have identified
18 these other cases where I haven't either used a
19 consensus model or been conservative, and I've done a
20 sensitivity case on each of those to identify what the
21 result would be if I used that more conservative
22 approach.
23 So the NRC would get that result as well.
24 Then there is also a requirement to look at logical
25 combinations.

1 CHAIR APOSTOLAKIS: And then the NRC
2 somehow integrates all this knowledge without having
3 any way of doing it in terms of what's the probability
4 that one, two or three is right, which is George's
5 point? It seems to me you are putting an awful lot of
6 judgment on the requirements for judgment, and the
7 power of hte NRC.
8 MR. CANAVAN: No, it's actually submitted
9 to the NRC saying, here's my model. And in cases
10 where you weren't conservative, you then assess, well,
11 if I was conservative, what the answer would be. And
12 then you do logical combinations of the 20 items along
13 with any plant specific ones you've identified and you
14 say here's where that number would leave me.
15 And if you are below the criteria, since
16 this is regulatory --
17 MR. WALLIS: So I've got 10^-5 when I use
18 my base model. If I make everything as conservative
19 as possible I get 10^-4.
20 MR. CANAVAN: And if you are above the
21 criteria --
22 (Simultaneous voices)
23 MR. WALLIS: So what is the regulator going
24 to say?
25 MR. VANOVER: It might be helpful to think

1 about it this way, Graham. What has to happen is that
2 the licensee has to make a strong case that he has met
3 the criteria.
4 If he has demonstrated that the very
5 conservative case leads him to exceed the criteria,
6 then he has to put a lot more effort into justifying
7 why he should be using something less than that
8 conservative case.
9 But I think it's a matter of, in some
10 cases, like for example, crediting the Madrigal
11 action, he would have to demonstrate that this action
12 had been demonstrated to be feasible, that there were
13 procedures, that there was training, and that the
14 numbers had been calculated in accordance with an
15 acceptable HRA approach.
16 MEMBER SHACK: If you looked at this
17 diagram, if the guy picked number one, he would come
18 down to the supply conservative bias, and he would
19 say, I'm done. The guy that picked number two would
20 probably get kicked over into a candidate for a model
21 uncertainty assessment.
22 MR. KRESS: But why wouldn't they all
23 choose number one?
24 MR. VANOVER: It might not give him the
25 answer he wants.

1 MR. KRESS: But if he chooses first.

2 MEMBER SHACK: But still you ave covered.

3 When you go through this second process, you've gone

4 through these things, but you are still going to be

5 addressing conservatism, I mean uncertainty, somewhere

6 along the way. And if you pick number one you get to

7 do it with a simple yes-no. If you pick number two

8 you got more work ahead of you.

9 MR. CANAVAN: In some cases, number one,

10 number two, number three in this case are interesting

11 because, in this example, they are all treatable. We

12 can do number one, number two, number three.

13 Some of the other cases, number one,

14 number two, number three are logically or debatable

15 identical, or they are reasonable alternatives, or

16 there is not an answer, right.

17 I guess you could conservatively bound it,

18 but there might be other answers. In other words,

19 there might be two twos.

20 MEMBER SHACK: but you still have to

21 explode this last box.

22 MR. CANAVAN: Yes.

23 MR. TRUE: The applicable candidate --

24 MEMBER SHACK: Yes.

25 MR. TRUE: Yes. This is one -

1 (Simultaneous voices)

2 MR. VANOVER: This is the base model,

3 right. So this is the process you would follow to

4 meet the requirements in the context of the base

5 model. And then we would take that as a starting

6 point for how we look at uncertainties in the context

7 of applications.

8 MR. TRUE: So remember those ASME standard

9 requirements for QUE, this helps you meet that

10 requirement before your peer review comes in.

11 MEMBER ABDEL-KHALIK: How were the 20

12 issues identified or selected? Why not 30? Why not

13 40? Why not 100?

14 MR. CANAVAN: Excellent straight man.

15 Well, go back to that green slide.

16 MR. VANOVER: We didn't have a goal of

17 picking 20. The process we followed was on this slide

18 where we took the original list and screened out the

19 ones that were clearly approximate methods or scope

20 level detail issues. And then we were left with the

21 20-some we have. It's still a work in process, and

22 I'm sure we'll get feedback once we release the

23 report.

24 But the intent is to make it a subset of

25 issues that we know are important from practice, and

1 we know are likely candidates as sources of model
2 uncertainty.
3 But we didn't go in advance and say we
4 want to get 20. We said, here is the process we are
5 going to take. Let's screen -- let's make the list
6 smaller.
7 MEMBER ABDEL-KHALIK: But in the back of
8 your mind, did you have sort of some idea that this
9 has to be a reasonable number; otherwise the whole
10 process will become unwieldy.
11 MR. CANAVAN: It started with Appendix H,
12 Appendix H in the technical basis document, which I
13 think was 630 items.
14 MR. VANOVER: Not quite that many, about
15 200 plus.
16 MR. CANAVAN: I think we had more before.
17 (Simultaneous voices)
18 MR. TRUE: Let's back up to that.
19 Because what we did there was back in 2003 or '4.
20 What we did there was, we looked at these different
21 references. And the things we'd identified were model
22 issues and PRAs. And then we utilized the ASME
23 standard and its technical requirements for the BRA,
24 and we sourced our lining up the things we identified
25 with where they affected the PRA model. And we went

1 through a process of winding all those up.

2 And then we went back with five -- what

3 did we call them -- seven causes of uncertainty, and

4 we asked ourselves systematically, for every technical

5 requirement of the ASME standard were there

6 phenomenological issues that could affect requirement.

7 Were there human realiability issues. Were there

8 temporal variability? Were the discretization, which

9 is the level of detail issues there.

10 We had seven questions, and we identified

11 some more, and that ends up with this 200-odd thing.

12 Then we took that list, and as Don said,

13 we separated out all the ones that were basically

14 modelers' decisions about level of detail and scope.

15 And we said those are separate issues that will come

16 up as part of the specific application and how that

17 gets exercised.

18 And that left us with the ones that were

19 phenomenological, or human reliability --

20 MR. VANOVER: Interpretive behavior.

21 MR. TRUE: Interpretive behavior where you

22 had to make some inference about how the plant or

23 component would respond. And that popped out in 20

24 odd -- the reason why we're little evasive on an exact

25 number is, we're still debating what that exact list

1 is, and we've bee going back on forth with the staff
2 on that. And then we passed it around among various
3 people and have them look at it. And it seems to be
4 heading toward a reasonable estimate.
5 MS. DROUIN: Would you not add to that is
6 that that is a generic list, and it doesn't preclude -
7 - the applicant is still required to look on a plant-
8 specific basis to see if there are other uncertainties
9 that are unique, you know, to his plant and his
10 application.
11 So the list is not intended to be the
12 list.
13 MR. TRUE: And then there is also, and we
14 are getting way ahead of Don here, but there is also
15 a step where if there is some new state of knowledge
16 changed, not like the correlation thing, but a change
17 in our state of knowledge about a plan or system
18 behavior that has come up generically, that gets
19 brought in too. So like the sump issue. If we'd made
20 this list five years ago we wouldn't have had the sump
21 issue probably on our list.
22 But in some time period prior to all the sumps being
23 fixed, we would have that on our list.
24 Or the grid stability is now on our list
25 actually, and it wouldn't have been 10 years ago.

1 So we've brought in -- so when there were
2 new issues that come up for the industry, they get
3 added to the list too. It's not intended to be the
4 final word on every model uncertainty that could ever
5 occur.
6 MEMBER BLEY: Let me state something just
7 occurred from an earlier discussion. Somebody
8 mentioned the AEOD, and I don't know what they're
9 called now, those risk studies they were doing looking
10 at plant data against system and partial system
11 modeling. A number of those identified problems in
12 modeling that could lead to errors in -- essentially
13 errors in PRA results.
14 Have those been systematically factored
15 back into people's PRAs? Is anybody tracking that on
16 the industry side to see if any of those things are
17 worthy of being included?
18 MR. TRUE: I don't know anything about it.
19 MR. CANAVAN: I know what you're talking
20 about, actually. I've seen one of the reports.
21 MEMBER BLEY: One of the more interesting
22 ones had to do with the diesel generators and when
23 they broke it into pieces, some of the ways we were
24 modeling those was a little optimistic.
25 So those aren't really systematically

1 being tracked?

2 MR. CANAVAN: No, but the peer reviews are

3 primary vehicles to catching that, along with the

4 internal reviews of the utilities of their own

5 product. But the peer reviews are the other way of

6 catching errors in the model; also seeing how you line

7 up against the standard, and promoting consistency, I

8 think are a few of the things that come out of the

9 peer reviews.

10 CHAIR APOSTOLAKIS: So how would I do this

11 for human error?

12 MR. VANOVER: For Three Mile Island?

13 CHAIR APOSTOLAKIS: For human error.

14 MR. VANOVER: I'm sorry.

15 (Laughter)

16 CHAIR APOSTOLAKIS: I don't know what the

17 conservative approach is. I don't know which model to

18 use.

19 MR. VANOVER: But we can help you with

20 that. We have generated a general human reliability

21 analysis as a generic source of model uncertainty.

22 And for the base model, in the upper report what we

23 are recommending is some sensitivity cases, with all

24 human action set at the 95th percentile value. Just

25 to get some insights to how important it is.

1 CHAIR APOSTOLAKIS: You don't have the 95th
2 percentile. Because you are going to go with one
3 model to get it. My problem is that there are many
4 models.
5 If I use Athena, I get one thing. If I
6 use HCR I get something else. You know I have a
7 problem because I don't know which model to use.
8 I think you should try to put some
9 limitations to this list up front. It's a very useful
10 thing, but it does not resolve all the issues.
11 MR. VANOVER: But I think we identify that
12 in the context of human reliability analysis.
13 MR. TRUE: But we didn't want to spend too
14 much time trying to force people to do other methods,
15 but just to get an understanding -- it's an
16 unsolvable issue. I mean there is no practical
17 solution at a utility's disposal on how to handle
18 that.
19 CHAIR APOSTOLAKIS: It's very interesting.
20 It's very important. It's unsolvable. So what do we
21 do? We accept anything the licensee says. That's
22 what we do. Come on, the power uprates.
23 (Simultaneous voices)
24 CHAIR APOSTOLAKIS: This is a change and
25 everybody says, yes. Amen, more power to you. Nobody

is asking how did you get the initial -

(Simultaneous voices)

CHAIR APOSTOLAKIS: No, they have to finish by 4:00 o'clock.

(Simultaneous voices)

MR. CANAVAN: Actually we only have two more slides, but on the HRA part we are trying to find a few benchmarks.

MEMBER SIEBER: I have a quick question. You've got 20 things to get your attention, and I bet you a good number of them can be resolved by operator manual actions.

When do you start considering that the operator has got too many locks on his knapsack and can't do them all?

MR. TRUE: That actually should be accounted for if you are taking credit for it, it should be accounted for in the development of the hu man factor event and the quantification of the human error probability.

(Simultaneous voices)

MR. TRUE: And in the ASME stadnard is requires you to look at only human actions in context of the scenario, so if there are too many actions or highly dependent on each other you have to account for

1 that in the probabilities.

2 What you are finding is that there are

3 lots of actions that have to be taken in the same

4 event, and the probably of subsequent actio --

5 CHAIR APOSTOLAKIS: Can we move on to slide

6 #27? Let's do that then.

7 MR. VANOVER: Okay, so the next objective

8 was to provide guidance --

9 (Simultaneous voices)

10 MR. VANOVER: -- in logical combination.

11 So moving to slide #26 --

12 CHAIR APOSTOLAKIS: Seven.

13 MR. TRUE: He wanted to jump to 27.

14 CHAIR APOSTOLAKIS: I want to jump to 27.

15 This is a new topic, so I wanted to have

16 some discussion on it.

17 MR. VANOVER: Our feeling as far as

18 sensitivity studies is it should not be an exhaustive

19 set of sensitivity studies, and that's consistent with

20 the guidance that is currently in Reg. Guide 1174.

21 I think -- so what we are trying to

22 provide here is, from your base model assessment you

23 have identified that subset of the subset of issues

24 that are retained as applicable sources of

25 uncertainty.

1 I think we need to go back to the prior
2 slide a second. You also need to look at, when you
3 get in the context of an application, what your
4 application-specific key contributors are? Is there
5 a cause-effect relationship between assumptions and
6 the key contributors?
7 And that helps formulate your set of
8 sensitivity cases. I think we are a little bit
9 concerned that the guidance and the draft NUREG would
10 -- one interpretation would be that you need to be
11 exhaustive, and we don't think that's what you need to
12 do as far as the sensitivity cases that are included,
13 or look at every basic event and whether it's risk
14 achievement worth would put you above a factor of two
15 or exceed the acceptance guideline.
16 So what we are trying to provide is
17 guidance to say, look at your results. Look at what
18 cuts have changed that are contributing to your delta
19 CDF, if that is the application. Look for cause-
20 effect relationships between assumptions and your key
21 contributors, and then use those insights by looking
22 at your results, as well as the insights you've
23 already established by performing the process on your
24 base model, to identify a set of sensitivity cases,
25 and we are thinking in the range of five to 10

1 sensitivity cases.

2 CHAIR APOSTOLAKIS: Why do you think

3 looking at each cut certain, doing all this stuff, is

4 simpler or quicker than just calculating the raw? I

5 don't see that counting is quicker. We have all

6 identified the big ones. Then I go the table like

7 yours and see what the model uncertainties are; do a

8 matching there and -

9 MR. VANOVER: But I do an application. If

10 I'm doing a delta CDF application there is only a sub-

11 subset of all my cuts that are the change. So raw

12 could be unimportant in all the -- it could be a role

13 of 3.6, and by base model it's a role of 3.5 in my

14 application. But none of the concepts changed in the

15 context of what I changed.

16 (Simultaneous voicies)

17 MR. TRUE: -- that has nothing to do with

18 your EDGAOT.

19 CHAIR APOSTOLAKIS: You find the role of

20 delta CDF. So all that stuff is out.

21 MR. TRUE: We actually don't do the raw

22 thing.

23 CHAIR APOSTOLAKIS: What I'm saying is that

24 it is not obvious to me that looking at the cut sets

25 is simpler than finding the role of delta CDF, not of

1 the whole thing.

2 MR. VANOVER: I think if you do an

3 application is it is incumbent on you to look at what

4 cut set has changed, and what is driving your delta

5 CDF calculations.

6 (Simultaneous voices)

7 CHAIR APOSTOLAKIS: -- as your statement

8 we should go back and invalidate a lot of the stuff

9 we've done.

10 MEMBER STETKAR: Raw can be -- get away

11 from raw. Raw can be super misleading. Because

12 unless you appropriate the aggregate things and do a

13 raw of some group, which is what this whole

14 examination process goes for, raw is just a simple

15 basic event value. It doesn't really tell you much of

16 anything. It's not an issue; it's a component.

17 It's just a number. It can be useful if

18 you are looking at this pen, or a diesel generator.

19 But it really may not -- it often does not tell you

20 what hte real sources of uncertainty, or the real

21 sensitivities of a particular application.

22 MR. TRUE: I think John is right. It will

23 not answer questions for example to do with success

24 criteria, because they changed the logic on that.

25 CHAIR APOSTOLAKIS: Raw doesn't?

1 MEMBER STETKAR: Raw will not tell you for
2 example when, if you assume that I lose ventilation to
3 this room, and I have a bunch of solid state
4 electronics in here, your model when does that
5 electronics fail in terms of time, and what is the
6 failure mode, raw will tell you nothing about that.
7 It might tell you a particular fan is important, but
8 it won't.
9 CHAIR APOSTOLAKIS: And the cut sets will?
10 MEMBER STETKAR: The cut sets won't either.
11 But your knowledge of the model will.
12 CHAIR APOSTOLAKIS: Well, the question is,
13 what initial step will help you focus on something
14 that is important. Then you ask tehse questions about
15 timing and all that. You can do it for groups too,
16 but it's a little more work. It's not always
17 individual; you can do it for groups.
18 You changed the model. I understand all
19 that. But it is not obvious to me that by looking at
20 the cut sets you are doing a better job.
21 MR. TRUE: If somebody wants to use raw as
22 a guide, that's fine.
23 CHAIR APOSTOLAKIS: I mean that's an
24 initial step. It points you to something that is
25 important. You don't stop there.

1 MEMBER STETKAR: I have asked people for
2 example how important are seal LOCAs to your overall
3 risk results. And they can't tell me just by looking
4 at raw values.
5 I mean you can if you look at, oh okay,
6 there is this combination of pumps and these
7 conditions over here, and by implication it must be
8 going through a seal LOCA. But using raw values alone
9 you can't determine that.
10 MR. VANOVER: In fact, I did do that, at a
11 Limerick pilot application, I did look at raw in the
12 first context, and that wasn't necessarily pointing to
13 the right sources of model uncertainty.
14 MEMBER STETKAR: If loss of onsite power,
15 if station blackout is your dominant contributor, then
16 the diesels will show up important. But that's not
17 very useful.
18 MR. VANOVER: The key point is, you want to
19 do a reasonable set of sensitivity studies, and
20 choosing that set of sensitivity studies requires a
21 lot of judgment and an in depth understanding of the
22 model.
23 We think that hte performance of the
24 assessment on the base model will go a long way in
25 establishing a base line of what might be a good set

1 to look at, and then in the context application you
2 have to decide what other things that are really scope
3 level detail issues that could be key contributors to
4 the application.
5 In some cases it may be appropriate to
6 provide a bounding sensitivity case for their example
7 of no credit or some credit for operation of RCIC or
8 aux feedwater after loss of DC. We could easily set
9 that to 1.0 and see what the impact would be, and see
10 if we still meet the risk metric. If we are good to
11 go, we're good to go.
12 And then here we talked a little bit about
13 both increases and decreases in the risk metrics
14 should be investigated as appropriate, not just things
15 that go up, but there could be uncertainties that
16 would drive your answer even further away from the
17 acceptance guidelines.
18 The other issue that needs to be addressed
19 is to look at other logical combinations of things
20 that need to be considered. Perhaps in a specific
21 application as an example combinations of human
22 actions that weren't important in the base model
23 became more important in an application. And we were
24 relying on tech support center guidance for a bunch of
25 actions at once. And that would be a potential

1 logical combination.

2 If we hadn't discussed the pendency

3 appropriately before, it would be more important to

4 address that pendency in an application. That's an

5 example of a logical combination.

6 The other potential logical combination

7 would be if things that are driving the answer are

8 from the same data source, or some of the same

9 assumptions.

10 So we did have some guidance in the

11 original EPRI report on these issues, and we are

12 carrying that forward and trying to expand it to

13 provide even more guidance moving forward based on the

14 comments that that was an area that could be improved.

15 MR. TRUE: You don't want to end up 20

16 factorial logical combinations.

17 MR. VANOVER: I should say the guidance we

18 are providing in the context of application really

19 isn't changing much from what was in the original

20 technical basis document. What really changed was

21 addressing the base model, and then we're looking at

22 different criteria when we get into interpreting

23 results, which I think we'll get on the next slide.

24 Yes, go to the next one.

25 The last objective was to provide guidance

1 for interpreting results of sensitivity studies. And
2 this may address Graham's question, how far off can we
3 be when we look at different sources of uncertainty.
4 This slide is duplicative of one of Mary's
5 slides this morning. Again, the definition of key is
6 only -- key can only be used in the context of an
7 application related to an assumption or a source of
8 model uncertainty that could change the decision being
9 made or drive you into a different region for an
10 application.
11 Some important things to consider when
12 presenting the results to a decision maker for
13 interpreting results of sensitivity studies.
14 Obviously, we've already met the acceptance guidelines
15 in the base case analysis or we wouldn't be making the
16 submittal.
17 So what we need to document in the
18 sensitivity studies is a proper characterization of,
19 if we were to make different assumptions, why the risk
20 metric would still be acceptable; for example, still
21 below the limits. Or why we think the risk metric
22 variation is an artificial result, and therefore,
23 should not be a show stopper for the application
24 because one potential reason is it's unreasonable
25 variation in the parameter. We've guaranteed fail

1 something that is very unlikely to be guaranteed fail.
2 A lot of times in applications we identify
3 compensatory actions that for example we briefed the
4 crew of the need to do certain human actions which
5 should improve their likelihood of performing the
6 action, but we didn't make any adjustments to the
7 human erorr probability. So there could be
8 compensatory actions that would help to reduce the
9 risk associated with certain calculations.
10 Or there is just no real way to
11 effectively treat the uncertainty other than
12 performing a bounding assessment. So a bounding
13 assessment may be an unreasonable variation to an
14 input parameter.
15 And there could be other valid reasons,
16 again, incumbent upon the licensee and the model owner
17 and the PRA analyst to characterize why he thinks, or
18 he or she thinks, the base case is the best estimate,
19 and meeting the acceptance guidelines is the right
20 answer.
21 They've already been met, the acceptance
22 criteria have already been met, and we want to make
23 sure, and provide confidence to the decision maker as
24 well as everyone else involved, that the associated
25 uncertainty does not adversely impact the decision.

1 Now this is the concept. The original
2 version of this had a factor of two going all the way
3 out to the one minus 5N. We realized that we need to
4 potentially provide different criteria.
5 And the important thing to take away from
6 this is, the closer you get to a limit, either the one
7 minus six limit --
8 MR. WALLIS: Could you explain to me what
9 hte coordinates are in this blue-yellow thing?
10 MEMBER BLEY: Just walk us through the
11 whole thing. I can't read a thing.
12 MR. VANOVER: This is in the original
13 report. This is in the context of the Reg. Guide
14 1.174 application. The first axis is the delta CDS --
15
16 CHAIR APOSTOLAKIS: Why don't you use the
17 cursor? Because you need to be close to the
18 microphone. Use the cursor. All right.
19 MR. VANOVER: Okay, so this first axis is
20 the delta CDF per year, and it's minus six, minus
21 five, minus four. And then the second axis is delta
22 LERF with the decade difference on each of those.
23 CHAIR APOSTOLAKIS: And the vertical?
24 MR. VANOVER: And the vertical is the ratio
25 of the change, a factor if -- but delta CDF was a

1 certain amount. It's the ratio of the new delta CDF
2 compared to the base delta CDF as an example.
3 So the closer I get to the limits, the
4 more restrictive -- more certain they have to be,
5 correct.
6 And variations in results, you know, if
7 they keep you in the same range -- and that's we slid
8 the scale back a little bit to the five minus seven
9 and five minus six range for the factor of two,
10 because even in that range it would keep you in the
11 same region.
12 MEMBER ARMIJO: What is that ratio at that
13 point? What is the number?
14 MR. VANOVER: This axis, this is the 10 up
15 here, sorry. And then this is a two down here, and
16 then this goes to 1.1 at the end.
17 MR. TRUE: This is still a point of debate
18 between the staff and EPRI, and it's sort of trying to
19 get at the bright line, fuzzing the bright line. Then
20 if we are close but we are still within a factor of
21 two, sneak over a little bit; that's still should be
22 acceptable.
23 MR. CANAVAN: And remember, the mean met,
24 the uncertainty that is not meaning.
25 MR. VANOVER: Or the sensitivity study.

1 MR. CANAVAN: Or the sensitivity study that
2 is not meeting. So the mean, when you did the
3 application and you analyzed the mean, you were in
4 region --
5 MR. WALLIS: Well, there is no mean for
6 model uncertainty. You're just telling me you used
7 one, two and three. You don't do any mean
8 calculations?
9 MR. CANAVAN: No, you used the mean model,
10 which is the base model --
11 MR. WALLIS: Which is which one, 203?
12 MR. CANAVAN: It's whatever your base model
13 had in it.
14 MR. WALLIS: So it doesn't really mean
15 anything?
16 MR. VANOVER: Well, for example, let's go
17 back to that aux feedwater case. Let's say my delta
18 CDF was five minus seven when I had my base case
19 assumption which was case two, or I did take some
20 credit for --
21 MR. WALLIS: Taking a lot of credit, or
22 it's not the most conservative.
23 MR. VANOVER: Right. So now that is my
24 base case. Now for my sensitivity study I would fail
25 that action altogether, and I would have a new delta

1 CDF. I'd have to calculate both the new base CDF as
2 well as the delta CDF, and that would give me my -- so
3 whatever that delta CDF was for that sensitivity study
4 I would compare to the original base case and compare
5 to this act, to this figure and that would dictate how
6 many compensatory measures I would need to consider;
7 you know, then it's up to me to characterize the
8 degree of confidence in my base case assumption.
9 And in either case, the other changed from
10 what was in the original EPRI report, the results of
11 all the sensitivity studies would be documented and
12 summarized to the decision maker. We had previously
13 screened even reporting results of sensitivity results
14 before, but we thought it was important, and agree
15 with the NRC that they see the results, in any
16 context.
17 So the idea is to provide as much
18 information as possible, and only when you exceed the
19 limits by some amount would it be more incumbent upon
20 you to consider additional compensatory measures, or
21 provide more information that --
22 MR. WALLIS: So you tell us we should get
23 out of all this by always making the most conservative
24 assumptions.
25 MR. VANOVER: Not if that doesn't give you

1 a good answer.

2 MR. CANAVAN: If you make the conservative

3 assumptions --

4 MR. WALLIS: Then you don't have to do al

5 this.

6 MR. CANAVAN: Then you don't have to do all

7 this. Doing all this is a function of being more

8 realistic, the more realistic you get.

9 MR. WALLIS: You never seem to introduce

10 the idea of best estimate or realistic, we don't worry

11 about it.

12 (Simultaneous voices)

13 MR. CANAVAN: Well, because uncertainty

14 isn't always specifically becoming more realistic.

15 The example that we provided --

16 MR. WALLIS: Well, there must be something

17 which is more realistic. Presumably, amongst all

18 these choices, there is something that is more

19 realistic than others.

20 MR. CANAVAN: I tend to your model. Others

21 thing that for example if you take two theories of the

22 beginning of the universe, who is to say who's right.

23 MR. WALLIS: Well, you have evidence now

24 for these things.

25 (Simultaneous voices)

1 MR. CANAVAN: Pardon?

2 CHAIR APOSTOLAKIS: The compensatory

3 measures --

4 MR. CANAVAN: Well, they are typically

5 qualitative.

6 CHAIR APOSTOLAKIS: Work with probability

7 one. Is that correct?

8 MEMBER BLEY: They may not even be assessed

9 qualitatively. It would depend. If you were seeking

10 credit, yes, they would generally be quantitative.

11 Again, it's risk informed regulation, so

12 as you approach a line, and as you get closer and

13 closer, the onus is on the applicantee, the person

14 applying, to provide a solid case that they are

15 operating in a safe manner.

16 So I think what happens is, the burden of

17 proof goes up and up and up as you get closer to the -

18

19 MR. TRUE: It's hard sometimes to quantify

20 them, George. If you think about the example of the

21 pre-shift briefing, when you're in a condition where

22 you want to have this higher probability of the human

23 action succeeding.

24 Quantifying the benefit of the pre-job

25 brief is sort of outside our traditional HRA methods.

1 But it is certainly a good thing, and if you were on
2 the ragged edge for that action it gives you some
3 confidence.
4 CHAIR APOSTOLAKIS: I think what you are
5 doing here is very useful. I think though you ought
6 to think about cases where you can't apply this.
7 I'm not sure you have solved all the
8 issues related to model uncertainty by the approach
9 you have proposed. So there may be others that may
10 need some other treatment, especially Level 2. So I
11 think you are very good --
12 MR. TRUE: We deal with more issues, but
13 not all Level 2. Not all Level 2. There are some
14 complicated ones.
15 CHAIR APOSTOLAKIS: Are you done?
16 MR. VANOVER: I am done.
17 (Simultaneous voices)
18 MR. CANAVAN: Okay, I am going to summarize
19 in a minute or less.
20 We're working -- we're continuing to build
21 on the prior industry work and take advice from
22 learned folks like yourself, on proof of documents.
23 MEMBER CORRADINI: Nice try.
24 MR. CANAVAN: Well, I'm trying to save the
25 day. Did well working with the staff on 1855 and we

1 see a need to continue to address, potentially address
2 other events.
3 And now as I promised here's a surprise
4 for all the good members. Here is the list.
5 (Simultaneous voices)
6 MR. CANAVAN: It's not complete. It
7 represents I think I said 600 items before. We
8 started with some huge list. We worked it down to
9 some 200 items that were in the Appendix H, which is
10 one of the reasons why we don't want to give up the
11 old document. We like that list. A lot of those are
12 level of detail, but we still think it's important.
13 MR. WALLIS: Do you have any written
14 material on item #12?
15 MR. TRUE: Not that we can give you yet.
16 MR. WALLIS: I'd really appreciate some
17 written material on item #12.
18 MR. CANAVAN: We can take a look at what
19 we have.
20 MEMBER CORRADINI: Can we see the next
21 round?
22 MR. CANAVAN: Yes, you can. Actually this
23 is being left with you.
24 MR. TRUE: Does that mean it has to go into
25 the public record?

1 MR. WALLIS: Does it mean what?

2 MR. NOURBAKSH: If you present anything

3 it's under -- unless you request it you don't want it

4 to be public.

5 MEMBER CORRADINI: I don't think they want

6 it. I think that's what I just heard.

7 MR. CANAVAN: It is not fully baked. It is

8 only half baked.

9 MEMBER CORRADINI: Does that mean it could

10 grow or shrink?

11 MR. CANAVAN: It could grow or shrink.

12 MEMBER CORRADINI: So can we ask some

13 things now? It's starting to get interesting. I want

14 to look at #19. Explain --

15 MEMBER MAYNARD: I am sorry, but right now

16 if we continue it's going to be in the public record.

17 I think you guys need to decide whether this is

18 something that can be put in the public record or not.

19 Whether we need to go into a close session.

20 (Simultaneous voices)

21 MR. TRUE: It's your project. I am just

22 the contractor.

23 (Laughter)

24 CHAIR APOSTOLAKIS: I think we should stop

25 today, because you know, there may be a reason to go

1 off the record.

2 MEMBER SIEBER: On the advice of counsel.

3 CHAIR APOSTOLAKIS: We can wait for a

4 month.

5 MR. CANAVAN: At the end of January you

6 will have the list with the descriptions.

7 CHAIR APOSTOLAKIS: Very good.

8 MR. CANAVAN: Thank you for your patience.

9 CHAIR APOSTOLAKIS: We thank you very much

10 for coming here. Thank you guys very much.

11 I think the last thing that's remaining

12 for us to do is to go around the table and maybe give

13 some preliminary thoughts on what we have heard.

14 CHAIR APOSTOLAKIS: Is it Jack or Mario who

15 starts? Mario? Okay.

16 MEMBER BONACA: All in all I am encouraged

17 by what I saw today. One thing that I sensed in the

18 NUREG that would have been very helpful to have

19 examples.

20 So again the EPRI work is bringing about

21 and addressing that kind of issue there. Some of the

22 comments I gave before, there is some part of the

23 discussion on chapter three that seems to almost make

24 statements there is arbitrariness in the way that the

25 analysts can do this or not do that, et cetera. I

1 don't think that was the intent, and I don't believe
2 that it should be there.
3 And I think that there will be a
4 suggestion that as you review the final draft you look
5 at that and get the final impression.
6 I think the approach taken is good because
7 it addresses most of the applications that are being
8 made of limited scope PRAs right now.
9 So all in all I think it was -- I was
10 pleased with what I saw.
11 CHAIR APOSTOLAKIS: Tom.
12 MR. KRESS: I agree with Mario. I thought
13 it was a good doctrine of determining the types of
14 uncertainties that need to be looked, and approaches
15 that might be used to look at it.
16 Originally I was concerned about how one
17 chooses between these approaches and what to do with
18 them once you got them. I think the EPRI document
19 might help out there.
20 I guess within the scope that they took
21 on, that it does pretty well. I was expecting a
22 larger scope in some sense. Maybe that's for
23 something in the future.
24 For example I was expecting to hear things
25 like what is the basis for the acceptance guidelines

1 that we have, acceptance guidelines on things like
2 CDF. What is that a good basis? I mean why should
3 the mean be the right basis?
4 And I was expecting to see more in terms
5 of discussing the range of uncertainty on how they
6 relate to margins and to depths.
7 We got some discussion on that today, but
8 I was still left a little vulnerable in that area. I
9 get the impression that this should be touted as a
10 kind of uncertainty for BWR plants in terms of 1.174
11 which has as its basis maintaining very small changes
12 to licensing basis. I don't know how you would apply
13 that to something like future plants, or to something
14 like where the regulatory objective might be to meet
15 some acceptance criteria rather than maintaining small
16 changes to the licensing basis.
17 I'm still a little -- have some
18 reservations about how to apply uncertainties to
19 things like selection of SSCs using importance
20 measures.
21 All in all I think given the scope that
22 they undertook it was a pretty good document, and well
23 written. And I'm anxious to see the EPRI report.
24 CHAIR APOSTOLAKIS: Thank you.
25 MEMBER ARMIJO: I'll pass.

1 CHAIR APOSTOLAKIS: Pass. Bill.

2 MEMBER SHACK: When we originally sort of
3 proposed this to the NRC I was expecting something
4 more like a focus on parametric modeling or parametric
5 approach to modeling uncertainty, so I'd get 1150 kind
6 of results.

7 I think what hte staff did is really the
8 right approach. To focus it on the impact of
9 uncertainty on the decisions that they have to make.
10 That is really where it was at.

11 And I just thought it was very interesting
12 reading. And an interesting approach. So I'm looking
13 forward to future developments.

14 CHAIR APOSTOLAKIS: Said.

15 MEMBER ABDEL-KHALIK: Well, I don't have
16 any comments on the mechanics of this whole process.

17 My concern is sort of more philosophical,
18 as to how this entire process affects the decision
19 maker.

20 Are we trying to make the decision sort of
21 -- the decision maker superfluous? In a sense, what
22 is the value added by the decision maker at the end of
23 the day?

24 And I'm not sure how or where you can
25 address that.

1 CHAIR APOSTOLAKIS: Are you saying that
2 they seem to be in fact determining the decision?
3 MEMBER ABDEL-KHALIK: Right. Right. In a
4 sense you are moving the process to the point where it
5 becomes a fait accompli. The decision maker doesn't
6 have to do anything. He looks at the results and
7 says, okay, that's reasonable, stamp it. Got it on.
8 MR. PARRY: I'm only going to say that this
9 is not the decision. This is one input to the
10 decision. The decision maker still has to integrate
11 all these decisions. So we are not making the
12 decision maker superfluous. We are making his job
13 easier is what we are trying to do.
14 MR. VANOVER: I think the other intent is,
15 I think we would end up providing more information to
16 the decision maker than they are being provided right
17 now with this process; so that he would be more
18 informed in making the decision.
19 MEMBER SIEBER: As a former decision maker,
20 I find this process helpful to the system making the
21 decision, because you have a larger understanding of
22 the basis upon which it's made, and how -- what
23 happens when you go to the other side, either side.
24 I think that is a good thing.
25 I also think it's a good thing for

1 decision makers to understand what this process is,
2 not only the analysts and the staff but plant managers
3 and site officials.
4 MEMBER ABDEL-KHALIK: But there are a lot
5 of decisions in which this is going to be the primary
6 input, information. Whether or not to take a piece of
7 equipment out of service. Whether or not to repair
8 piece of equipment A before equipment B, whether or
9 not to spend more money on repairing equipment A
10 during this outage, or wait until next outage.
11 And this, I just don't really see that
12 what the role of the decision maker in those
13 situations will be.
14 MEMBER ARMIJO: That is risky.
15 MEMBER BONACA: He has to make a decision.
16 He can make it in the absence of any information. Or
17 he can do it in the presence of good information. I
18 think what is important is that the decision maker
19 should almost exhaust the number of questions around,
20 for example, an alternate configuration that you might
21 have.
22 MEMBER ABDEL-KHALIK: And that's where my
23 concern comes up. You know the decision maker has to
24 provide feedback to the process, and that I don't see
25 here.

1 MEMBER CORRADINI: In fact I'm guessing
2 what these guys are saying is, if these guys present
3 them, since I'm wearing all this anyway, if these
4 presented this, I would expect a decision maker who is
5 able in his or her job will go, I don't like that.
6 Tell me if you wiggle that, tune that knob, tell me
7 how the result changes. I would assume.
8 (Simultaneous voices)
9 MEMBER BONACA: Consider this additional
10 attribute. I mean clearly there is interaction that
11 has to be there between the guy who makes the
12 decision, and hopefully he is familiar enough with the
13 PRA process that he will ask the questions. And these
14 people from the PRA will be ready to provide the
15 answers to those questions.
16 CHAIR APOSTOLAKIS: One area may be, after
17 all these sensitivity studies, the decision maker may
18 have to decide how reasonable these things are, and
19 how much should the decision be based on some of these
20 studies, and maybe more on others.
21 As we said in the LOCA frequency case, the
22 decision maker would have to use the totality of the
23 sensitivity studies to form an opinion. That
24 formulation of an opinion is outside what they are
25 doing. So that is one part maybe where the decision

1 maker comes into the picture.

2 But what they are doing in the context of

3 the risk of decision making, they are also giving

4 advice where the risk information is not good enough,

5 and you have to move also to more defense in depth by

6 putting these compensatory measures.

7 But the decision maker will have to make

8 a decision as to whether to accept them. So they are

9 giving a lot of advice. But ultimately I think a

10 decision maker will have to take action.

11 In some cases maybe it will be obvious.

12 You know if you do the calculations, and in fact I

13 understand through the grapevine that they are giving

14 more and more weight now to the risk information as

15 opposed to, say, nine years ago. Is that correct?

16 MR. PARRY: I'm not in the decision making

17 process.

18 CHAIR APOSTOLAKIS: All right, so you don't

19 know what the decision makers do.

20 Dennis.

21 MEMBER BLEY: Yes, a few things. Said's

22 comments got my interest up a little bit. But I guess

23 I felt pretty strongly on the side of not seeing this

24 as taking away decision making responsibility at all.

25 And I think as more cases process through, the key

1 people who do have to make decisions will begin to
2 understand their PRAs more thoroughly, and what their
3 limits are.
4 I mean they're in a spot they have to
5 question this and have to make sure that they are
6 convinced the information coming to them, and maybe
7 put their own uncertainty limits on the outside of
8 that.
9 I see it as a plus. I was disappointed
10 when I first read all three documents, surprised that
11 I saw nothing in there except a word or two here or
12 there on expert elicitation. And I understand now
13 that that is intention. I'm not 100 percent convinced
14 that at least what seems to me to be having the
15 judgments more intrinsic rather than getting it out to
16 be examined and thought about is a good thing. But I
17 have to think more about that.
18 I think I'd like to compliment both the
19 industry and staff on the way this is coming together.
20 It's like nothing I've quite seen before. I think
21 it's really a good exercise.
22 If we could have three reports that really
23 link together from both sides and they help address
24 this issue across the board, I think that will be
25 great.

1 Personally, there is an awful lot here, an
2 awful lot that is very important to the future use of
3 PRA, and I got to study it a bit more; not a bit more;
4 a lot more to get really comfortable. I have
5 questions, but I can resolve some of those on my own.
6 CHAIR APOSTOLAKIS: Otto.
7 MEMBER MAYNARD: Overall, I think a lot of
8 good work has been done, and this provides a lot of
9 good information.
10 I do want to go back a little bit to
11 Said's comments just a little bit, because while I do
12 appreciate this type of information for a decision
13 maker is very valuable and very helpful.
14 We do need to remember, however, that PRA
15 is a tool, and it does not replace the decision maker,
16 and will not ever replace the decision maker.
17 And I think we have to be careful. You
18 are never going to be able to totally quantify
19 everything and be able to put them in boxes where it
20 removes others; sometimes the more you try to do that
21 the less effective the decision maker is. I think
22 sometimes a little bit of nervousness on the decision
23 maker's part is good at keeping it going. Not to have
24 too much confidence in maybe a number or something
25 like, and to be a little more questioning.

1 So I think we need to recognize that.

2 Also recognize that the acceptance

3 criteria for most of what we are dealing with here,

4 the acceptance criteria was established with the

5 consideration that the mean has some uncertainty. And

6 we need to be careful that we don't start trying to

7 double count uncertainties and add it on top of adding

8 and adding and adding. There are a number of things

9 already in PRAs. And we are quick to point out the

10 deficiencies that might be there, but there's also a

11 lot of strengths.

12 You know codes already have uncertainties

13 built into them. Instruments are usually taking into

14 account. We use go/no-go type of things where in

15 reality a little bit less may still work.

16 No real credit for fixing things that may

17 not work. If it breaks, we say it's broken forever,

18 unless it's something we have taken credit for an

19 operator action. And in reality things get fixed that

20 don't work the first time, a lot of times through a

21 scenario there.

22 As far as on 1855 itself, again, I think

23 it provides a real good question and a great overview.

24 I enjoyed reading it; relearned some things, and found

25 it very useful.

1 I was expecting it to have more guidance
2 in it as to exactly how you do it. I'm not sure what
3 the intent of the NUREG was. It does provide a lot of
4 useful information that is needed to establish that
5 guidance. And it can be done either by endorsing an
6 industry standard, the EPRI document, or a reg guide
7 or something coming out later. But at some point it
8 needs to turn into, what's the acceptance criteria?
9 We focused on this primarily decision
10 maker from the utilities side in a lot of what we've
11 been discussing lately, but the regulator has to have
12 a criteria that it uses to decide, is this acceptable
13 or not?
14 And I want to get back to a little bit of
15 my degree of specificity in the decision making. I
16 think it's important that there is flexibility left
17 there for the decision maker both from the industry
18 side, the utility's side, and also from the
19 regulator's side.
20 I think if we try to establish criteria
21 that is too tight we take that process away from it,
22 I don't think we end up with the best product out of
23 this. And I think the regulatory decision maker, the
24 industry decision maker, leave some room there. They
25 may have to have some negotiations; it might be a

1 little painful, but I think you come out with a better
2 answer that way than trying to establish a criteria,
3 a sharp black and white line.
4 That's all.
5 CHAIR APOSTOLAKIS: John.
6 MEMBER STETKAR: I think again I would like
7 to compliment both EPRI and the staff. I think you
8 are doing a really good job trying to pull everything
9 together.
10 One thing I would caution, and I was a bit
11 disappointed in the NUREG, but I understand now a
12 little bit more of the focus on reliance more on the
13 EPRI documents to provide a little bit more concrete
14 guidance and specific examples.
15 I think one thing I'd caution the whole
16 process, and I've mentioned it a couple of times, is
17 to be sensitive to the fact that these documents, this
18 process, will be used now and in the future for
19 addressing the issues of uncertainty, and that some of
20 the examples and specific screening criteria,
21 numerical things that you have, you may want to be
22 careful about the implications of those specific
23 examples and criteria for newer plant designs,
24 applications in areas that perhaps we haven't yet seen
25 but may be coming forward.

1 So I think that those examples and you
2 know we had a lot of struggle here today saying, show
3 us how it will be done. And I think you should be
4 sensitive to those issues when you show us how it will
5 be done.
6 CHAIR APOSTOLAKIS: How about your earlier
7 comment about being conservative is not always --
8 MEMBER STETKAR: I already made that. As
9 a summary that's true. I mean the approach as a wrap
10 up is indeed I believe too heavily focused at looking
11 at the -- I won't use the term, goesup, the increases
12 in core damage frequency or the risk metric without
13 being equally sensitive to sources of uncertainty that
14 would numerically decrease, or sources of uncertainty
15 that might mask the changes in the results from
16 particular applications.
17 CHAIR APOSTOLAKIS: Professor Corradini.
18 MEMBER CORRADINI: Okay, thank you. I
19 guess I am kind of new to all of this, so half the
20 reason I came today was to learn. And so I think this
21 was really beneficial for me. I think the staff's
22 document is -- was quite good in explaining background
23 information, and kind of giving you a perspective on
24 it.
25 I guess like others I was looking for

1 examples. I think now I understand how the two or the
2 two groups and the three documents will eventually
3 marry together to do that.
4 I guess I am kind of looking forward to a
5 month from now when we see the list that we heard
6 might occur, how they treat some of these. Because
7 some of them actually involve some physical variations
8 versus operator actions or how operators can take
9 action, or I can't remember what you call them, but
10 I'll call them state variables in terms of how the
11 system parameters are.
12 So I guess I am very interested in that,
13 because I tend to on a new topic, or I'm not sure
14 about the basis of it, I try to work from the examples
15 to try to understand. So that's what I was looking
16 for.
17 Other than that I guess the one thing I'd
18 suggest for the report writing, and I'm -- not to
19 repeat, because a lot of the things I pretty much
20 agree with all the other things that the other folks
21 have said is, that I think early in the chapters some
22 historical perspective for the reader, however much
23 that reader is the expert, as to what some of this,
24 what has been seen in the past relative to past
25 studies, such as NUREG 1150, and what you might expect

1 in the future in terms of what the decisions might be
2 would be good, only because I think it will last a
3 whole lot longer.
4 I think John's one comment about this will
5 probably, once out, will be used again and again is
6 important. So if you want to have a long life, you
7 actually want to give it some historical perspective,
8 and also some examples that transcend where you were,
9 but where you might go. And I think that's kind of
10 important.
11 But other than that I think I pretty much
12 agree with a lot of the other points that others have
13 made.
14 CHAIR APOSTOLAKIS: Very good.
15 Graham.
16 MR. WALLIS: Well, I've got to write a
17 report on the NUREG. I think we had a very useful
18 descriptions from the staff and EPRI on what's been
19 going on and the work they've done.
20 I was looking for more specific guidance
21 from the staff on what to do, and particularly on what
22 hte outcome should be from all these activities. The
23 list of activities described, chapter four, there were
24 descriptions of what could be done, but there wasn't
25 an indication of which one of these would be useful

1 for what purpose; which ones had certain advantages;
2 why you'd want to submit this rather than that. And
3 so on. And what kind of an output should this process
4 finish up with, and why.
5 I thought there would be a benefit to
6 stand back and have a fundamental look at what are we
7 trying to do about uncertainties in the kind of terms
8 that can be expressed in the most useful way for
9 certain kinds of decisions. And what kinds of things
10 can you have as an outcome of a study which really
11 help a decision maker in hte most useful way. And I
12 didn't see that.
13 The NRC has a lot of description of
14 activities and assessments to be performed. There
15 were lots of box diagrams. I wasn't really sure if
16 this was sort of an idea of how it might be done, or
17 whether it was realistic that this is what people
18 could do.
19 This is where EPRI helped me, because I
20 got the feeling that people actually did do some of
21 these things, and that it was realistic to require
22 them.
23 In that context it would have helped to
24 have had many examples. Examples, this is the kind of
25 thing I mean, by this sort of an assessment and this

1 kind of valuation.

2 At the end of the day I was left with a

3 feeling, I've said it several times, this is too

4 complex information for the decision maker. For the

5 decision maker to look over 20 different alternative

6 things with one, two, three, four options, and all

7 that, and somehow assess, did they do reasonable

8 things, I think a decision maker needs more specific

9 metrics of uncertainty that everybody understands;

10 something which is crisper; is focused down to

11 something that is meaningful. Not just a mean value.

12 Probably some way of characterizing the uncertainty

13 which we understand.

14 I was surprised not see things like best

15 estimate and upper and lower bounds and all that as we

16 asked for, the specifics. We are asking you to do

17 this, make your best estimate, give me an upper and

18 lower bound. Give me 95th percentile -- something

19 like that rather than leaving it all up to the analyst

20 to figure out what to submit and how to be prepared to

21 answer questions when the NRC has them.

22 But anyway, I will put a lot of this into

23 more mature form.

24 CHAIR APOSTOLAKIS: Just so people don't

25 panic.

1 Tom and Graham are here as consultants,
2 and they are expected to write a report to me. The
3 other members don't have to. So -
4 (Simultaneous voices)
5 CHAIR APOSTOLAKIS: Okay, he is expected to
6 write a report.
7 MS. DROUIN: Is there a page limitation?
8 CHAIR APOSTOLAKIS: Anything you want.
9 (Simultaneous voices)
10 MEMBER SIEBER: I have a number of
11 comments. First of all I thought the presentations by
12 the staff and by EPRI were good. They helped my
13 understanding of the various phases. When I prepared
14 for the meeting all I had available to me was NUREG
15 1855 and the companion documents that have come out
16 over the years, and with just that, I did not
17 comprehend what it is you are going to do with this
18 stuff in a practical way. And I think EPRI has filled
19 that box, and I will certainly visit their website
20 tonight, and call them in the morning. And to get the
21 documents, because even those presentations where you
22 were, there was not enough detail and meat today to
23 fully understand this.
24 CHAIR APOSTOLAKIS: I thought the documents
25 up on the website now are the ones we have.

1 MEMBER SIEBER: Yes, but I don't have them.

2 In the role of the decision maker,

3 decision maker, you know, TRA is only one tool for a

4 decision maker to make decisions. And there are a lot

5 of factors that a decision maker has to take into

6 account. And the decision maker in PRA world is not

7 going to go through all these uncertainty analyses and

8 calculations. It's going to be a briefing by the PRA

9 people where the PRA people bring out the pertinent

10 facts.

11 On the other hand the decision maker has

12 to know enough about the process, and enough about

13 uncertainties, to be able to ask the right questions.

14 And I think that's important.

15 When the original PRAs were asked for by

16 the NRC, we did one in our plant and found a few

17 things in the original design that had an impact on

18 the risk that was significant for our plant, and we

19 changed it.

20 Now we find out that a lot of plants,

21 after they did their IPEs or PRAs in the initial round

22 these little things that were having significant risk

23 impacts.

24 So decisions are being made in a practical

25 sense way back before there was a regulatory structure

1 to do it, and before there were all these techniques
2 to be able to do it and to define what the
3 uncertainties are, and how much you should believe
4 this and how much you should believe that.
5 So for me as an industry and as a
6 government agency there has been a lot of progress
7 made. And I think it's important to that process.
8 So I would consider today from my
9 viewpoint a success. I've learned a lot. I have a
10 better understanding of the issues, and how problems
11 are attacked. But I also think I still need to do
12 more homework.
13 MEMBER BONACA: Can I add one thing? I
14 totally agree with that. We have lived through, 20
15 years ago we were doing PRAs and making decisions.
16 The issue was that the decision was always to be made.
17 The question is, what information did you have? The
18 questions you are asking of the analyst are no
19 different from what you were asking before. Simply
20 you didn't have quantitative information, nor you had
21 a relational data to help in the decision.
22 That's when PRA came of age, anybody in
23 the plant who was an electrical engineer or a civil
24 engineer, they were marveling about the insights that
25 the PRA would bring to the table. Because they could

1 see them themself, and they had to deal with
2 analytical circuit, for example, and here you have a
3 guy coming in with an analytical tool that shows him
4 things he hasn't seen. And they say, oh, gee, I never
5 realized that. You are absolutely right.
6 So I think from that perspective, this is
7 very important, because it provides a means of
8 channeling information, and doing the right
9 questioning of the uncertainties.
10 CHAIR APOSTOLAKIS: That's why I think it's
11 a little bit of a strong statement to say that PRA is
12 just a tool. I mean it is a tool, but it's really a
13 very important input.
14 I agree with what I've heard, so I don't
15 have to repeat it. The only comment that I haven't
16 heard, and maybe I can make it for the benefit of the
17 staff, I think NUREG-1855 is too wordy, repetitive.
18 It really needs a good editing job. Somebody has to
19 sit down and read it from beginning to end, and
20 tighten it up. And that of course, I would like to
21 see more examples and concrete guidance maybe by
22 reference to the EPRI document, which is what hte
23 staff is planning to do.
24 But I think the editing would help a lot.
25 A lot of hte stuff is repetitious from the regulatory

1 guide 1174, and so on. And we don't need all that.
2 And then some stuff is repeated from chapter to
3 chapter. So I think that would be a good thing to do,
4 and make it shorter and more meaty.
5 Other than that, unless a member or a
6 consultant has a comment or the staff, I think we have
7 reached the end of the day.
8 Any comments from anybody?
9 MS. DROUIN: A lot of good insights y'all
10 gave us. I took a lot of notes. I think I have a
11 good idea of where we need to go and make the document
12 more useful.
13 I look forward to coming back. The reason
14 I'm hesitating here is because several people said
15 they want to see more in hte presentation; more in the
16 presentation. And I struggled with that to be honest.
17 I can't tell you how much time we spend on trying to
18 figure out what to put on the vugraphs, what not to
19 put on the vugraphs.
20 You know as you saw we had 44 vugraphs.
21 So you're telling me you want more meat, I'm not sure
22 how to answer that and developing vugraphs that are
23 useful to be frank without taking the 100 page
24 document and making every page a vugraph.
25 So I really need some assistance.

1 CHAIR APOSTOLAKIS: Okay, let me give you
2 some assistance. All this elaboration on what is
3 model uncertainty and this and that and diagrams, I
4 would say model uncertainty; here are the three ways
5 we are proposing for handling it. Way one, couple of
6 slides; two, three. And if anybody like somebody who
7 may not be here asks you, what do you mean by
8 assumption, then you give the definition. But don't
9 include those things in the presentation. Go straight
10 to what you are telling people to do. That's one way.
11 MR. PARRY: And that way you promise not to
12 ask what uncertainty is.
13 (Laughter)
14 CHAIR APOSTOLAKIS: As usual, I gather
15 somehow the staff, not just today, likes to present
16 history, management issues, you know, overall
17 approach, process. This committee tends to be focused
18 more on what you are actually recommending that people
19 do. It's a very performance --
20 MR. WALLIS: I would start off by saying,
21 this is what the -- it's the kind of decisions that
22 have to be made. This is the kind of information
23 decisoin makers need, and this is why he or she
24 worries about uncertainty.
25 And we're answering those by what we're

1 doing here.

2 MEMBER CORRADINI: I was going to say, what

3 Graham just said is kind of the age-old way in which

4 I've stumbled into over many years. Work the problem

5 backwards. What is the final result you expect, and

6 work backwards from is.

7 CHAIR APOSTOLAKIS: And then we can see how

8 you get there. But for example, the slide that PTRI

9 had with the batteries, this is telling me what to do.

10 That's a good one. Here is an example. That's the

11 kind of slide that I think will go a long way.

12 In fact, I would start with the decision

13 like Graham suggest, then give maybe three or four

14 different situations, because the decisions are not

15 always -- they are not all the same. And work

16 backwards.

17 MR. WALLIS: And that's the output that you

18 have from getting all this assessment and

19 understanding which helps the decision maker.

20 MS. DROUIN: I mean I have no problem with

21 doing that. But I'll be honest, we come to the

22 meeting with an assumption that since the document has

23 been out there for 30 days that y'all have read it and

24 have read the details, and that we don't have to

25 repeat the details and we want to get into those

1 discussions.

2 CHAIR APOSTOLAKIS: Well, the message from

3 the committee is, we should focus on the details and

4 forget about the general discussion of, there are

5 uncertainties due to incompleteness and models and

6 that kind of stuff.

7 If you have a new something that settles

8 it, you know, what is model uncertainty, by all means.

9 But if it's a traditional thing, we have parameter and

10 model, who needs that. We know that.

11 Anyway, I think we reached the end of hte

12 day. I thank the speakers, the staff, the industry

13 and everybody else.

14 And we'll see you after the New Year, when

15 we see you.

16 (Whereupon at 4:28 p.m. the proceeding in

17 the above-entitled matter was adjourned.)

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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: Advisory Committee on Reactor Safeguards

Docket Number: n/a

Location: Rockville, MD

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.

Charles Morrison
Official Reporter
Neal R. Gross & Co., Inc.

NUREG-1855: Treatment of PRA Uncertainties in Risk-Informed Decision Making

Advisory Committee on Reactor Safeguards
Subcommittee on PRA

Presented by
Mary Drouin, Gareth Parry, US Nuclear Regulatory Commission
John Lehner, Brookhaven National Laboratory
Jeff LaChance, Timothy Wheeler, Sandia National Laboratories

December 19, 2007

Objective of Meeting

- Share the staff's approach and work in Draft NUREG-1855
- Solicit and gather feedback from ACRS

Outline of Presentation

- Introduction
  - Background/History
  - Objectives/Scope
- Overview of Approach/Guidance
- Understanding the PRA Model
- Parameter Uncertainties
- Model Uncertainties
- Completeness Uncertainties
- Risk-Informed Decision-making: Dealing with Uncertainties
- EPRI Interface
- Status and Schedule
- Future work

Background/History

- RG 1.174
  - There needs to be a full understanding of the impacts of the uncertainties through either formal quantitative analysis or more simple bounding or sensitivity analyses
- PRA Standard (for internal and external events)
  - Sources of model uncertainty required to be identified
- RG 1.200
  - Full understanding of the uncertainties and their impact is needed (sources of uncertainty are to be identified and characterized)

Background/History -- ACRS

ACRS recommendations to staff –

- April 21, 2003 letter:
  - Guidance on how to perform sensitivity and uncertainty analyses
  - Rigorous analyses for parametric uncertainties, sensitivity studies to identify the important epistemic uncertainties and quantification of the latter
- May 16, 2003 letter
  - Address model uncertainties
  - Guidance for the quantitative evaluation of model uncertainties should be developed
  - Guidance include a clear discussion of the roles of sensitivity and uncertainty analyses, as well as practical procedures for performing these analyses.
  - Address how uncertainties impact decisionmaking with examples to show the pitfalls if uncertainties are inadequately addressed

NUREG-1855 -- Objectives

- Provide guidance on how to treat uncertainties associated with PRA in risk-informed decision making
- Objectives of this guidance include fostering an understanding of:
  - The uncertainties associated with PRA
  - The impact of the uncertainties on the results of the PRA
  - The uncertainties in the context of the decision making

NUREG-1855 – Scope/Application

- Focuses on the use of PRA insights and results and ways to address the associated uncertainties
- Guidance limited to addressing uncertainties associated with use of the risk model results
- Guidance to be consistent with NRC's PRA policy statement and Regulatory Guides 1.174 and 1.200
- Guidance intended to support national consensus PRA standards and industry related work

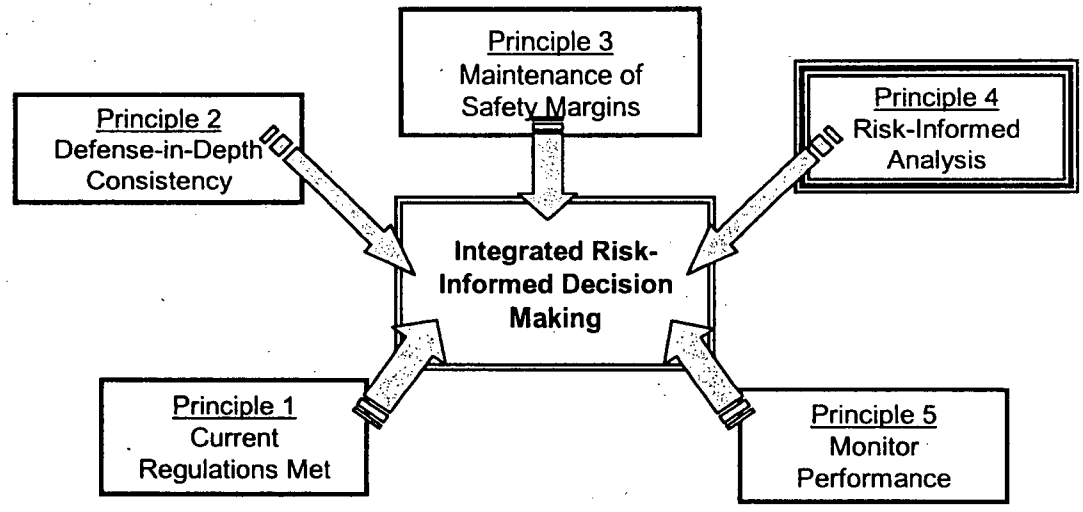
NUREG-1855

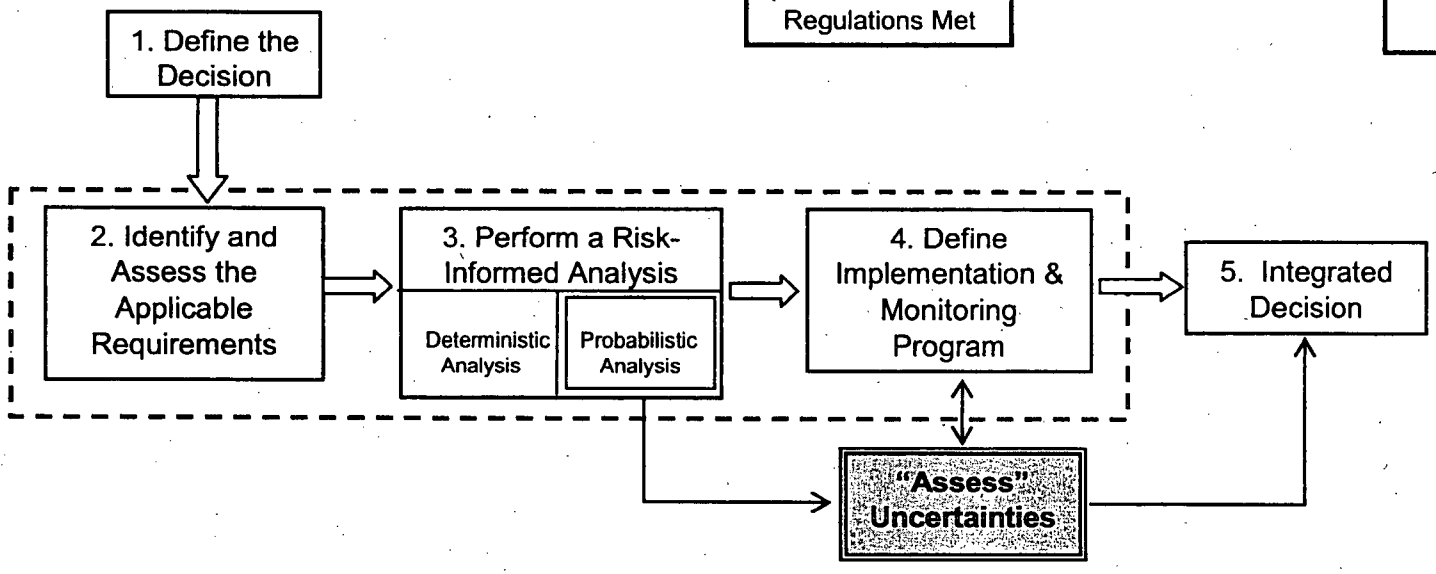
Chapter 1: Introduction
Chapter 2: Overall Approach
Chapter 3: Understanding the PRA Model
Chapter 4: Parameter Uncertainty
Chapter 5: Model Uncertainty
Chapter 6: Completeness Uncertainty
Chapter 7: Risk-Informed Decision-Making: Dealing with Uncertainty

Appendix A: Staff position on EPRI documents

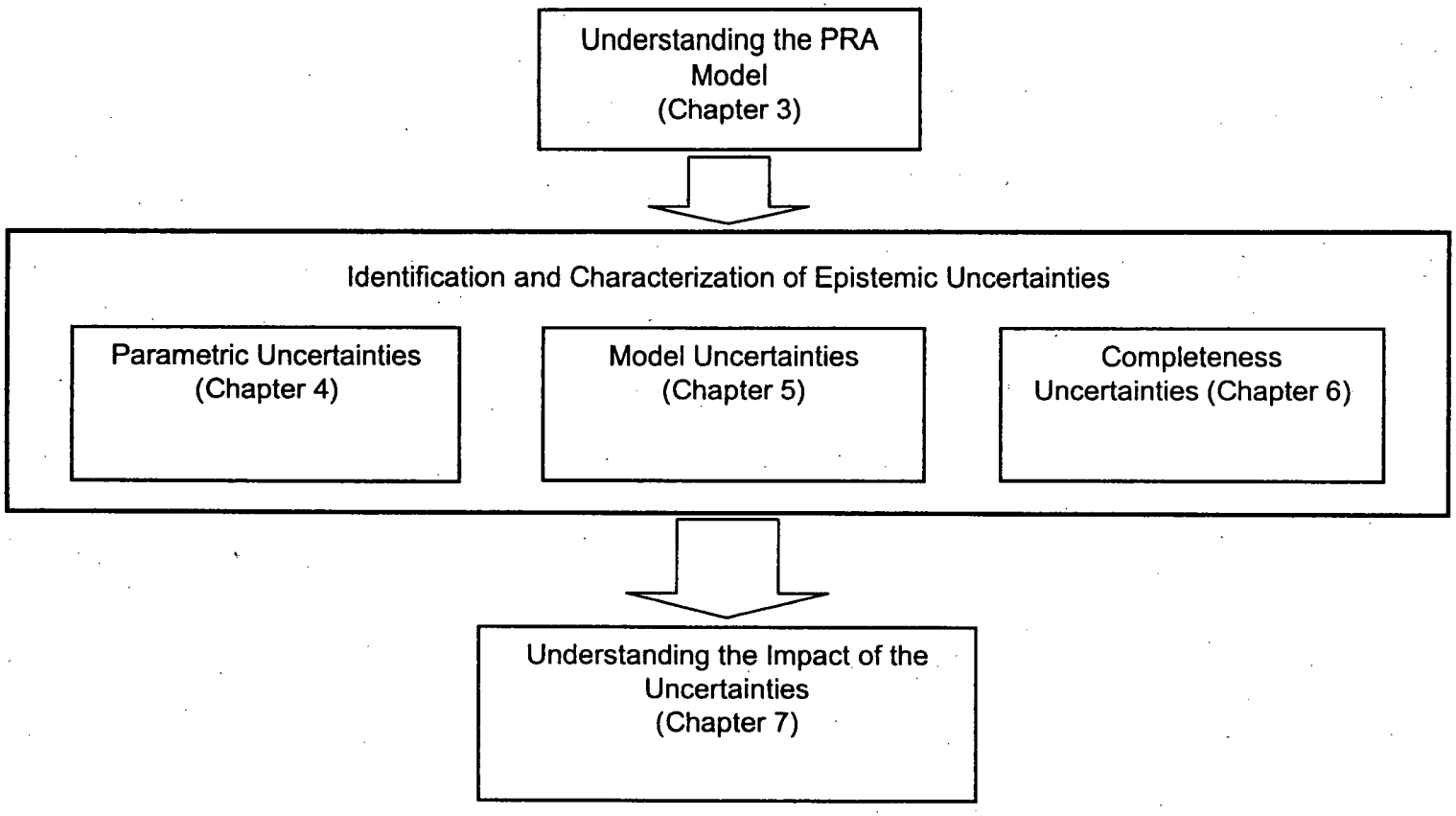
Chapter 2: Overall Approach

Provides an overview of the overall approach used (in the NUREG) to address uncertainties in risk-informed decision making





Chapter 2: Overall Approach



Chapter 3: Understanding the PRA Model

- Provides an overview of the characteristics of the PRA model and the different sources of uncertainty associated with a PRA model
  - Focuses on the nature of the model used to characterize risk (i.e., a PRA model)
  - Defines the types of uncertainty that result from the modeling process
  - Describes how these uncertainties are addressed

The Risk Model

- Introduction of the PRA as the Risk Model
  - All models are approximations
  - Need to "understand" the model to use it correctly
    - PRAs address rare events
      - No direct verification
      - Uncertainties on how to model phenomena or equipment behavior
    - Scope and level of detail at discretion of the analyst

Characteristics of a PRA Model

- Structure of the PRA Model
  - Accident sequences/scenarios as a simplified (discretized) representation of all possible outcomes
  - Probabilistic models for basic events
- Role of Assumptions
  - Assumptions related to scope or level of detail
  - Assumptions related to model uncertainty
- Scope
  - Risk metrics
  - Plant operating states
  - Initiating events

Characteristics of a PRA Model (cont'd)

- Level of Detail
  - A certain level of detail is inherent in the PRA standards (e.g., inter-system dependencies)
  - Some at the discretion of the analyst and driven by the projected use of the PRA
- Combination of Results
  - The models for the different scope items vary in level of detail and conservatism
    - Screening approaches
    - Approximations
  - Needs to be recognized when combining the results

PRA Models and Uncertainty

- Types of epistemic uncertainty
  - Parameter
  - Model
  - Completeness
    - Known omissions
    - Unknown omissions
- Assessing the impact of uncertainty
  - Chapter 4 - Parameter uncertainty
  - Chapter 5 - Model uncertainty
  - Chapter 6 – Completeness
    - Known omissions only - Unknown unknowns addressed through defense-in-depth, safety margins, and performance monitoring
  - Chapter 7 – Uncertainty and risk-informed decision making

Chapter 4: Parameter Uncertainty

- Provides guidance on how to address parameter uncertainty in the use of PRA results for decision making
  - Characterization of parameter uncertainty
  - Propagation of uncertainty
    - State of knowledge correlation
  - Comparison of results with acceptance criteria

Characterization of Parameter Uncertainty

- Parameter uncertainty is the uncertainty in the values of the parameters of a model, given that the mathematical form of the model has been agreed on
  - Usually characterized by using probability distributions on the parameter values
  - Bayesian estimation is commonly used for the characterization

Propagation of Parameter Uncertainty

- Uncertainties in parameters of basic events need to be combined to estimate uncertainty of risk metrics such as CDF, LERF, or intermediate results. Propagation carried out using:
  - Monte Carlo method
  - Latin Hypercube Sampling

- State of Knowledge Correlation must be considered to avoid underestimate of uncertainty

Comparison of Parameter Uncertainties with Acceptance Criteria

- SECY-97-221 identified three possible approaches for comparison with acceptance criteria:
  - Comparing mean values
  - Use of percentile measures
  - Use of one criteria for mean values and a second for a percentile measure

- Most acceptance criteria currently are expressed in terms of mean values, and using mean values for comparison is the current recommended approach

Chapter 5: Model Uncertainty

- Provides guidance for identifying and characterizing model uncertainties in PRAs and assessing what the impact of model uncertainties is on insights used for risk-informed applications
  - Provides definitions on the concepts of key model uncertainties and related key assumptions
  - Provides process used to identify and characterize key model uncertainties and related assumptions

Definitions – Source of Model Uncertainty

A ***source of model uncertainty*** is one that is related to an issue in which there is no consensus approach or model and where the choice of approach or model is known to have an effect on the PRA model (e.g., introduction of a new basic event, changes to basic event probabilities, change in success criterion, introduction of a new initiating event).

A source of model uncertainty is labeled ***key*** when it could impact the PRA results that are being used in a decision and, consequently, may influence the decision being made. Therefore, a key source of model uncertainty is identified in the context of an application. This impact would need to be significant enough that it changes the degree to which the risk acceptance criteria are met and, therefore, could potentially influence the decision. For example, for an application for a licensing basis change using the acceptance criteria in RG 1.174 [NRC, 2002a], a source of model uncertainty or related assumption could be considered "key" if it results in uncertainty regarding whether the result lies in Region II or Region I, or if it results in uncertainty regarding whether the result becomes close to the region boundary or not.

Definitions -- Assumption

- An ***assumption*** is a decision or judgment that is made in the development of the PRA model. An assumption is either related to a source of model uncertainty or is related to scope or level of detail.

- An ***assumption related to a model uncertainty*** is made with the knowledge that a different reasonable alternative assumption exists. A reasonable alternative assumption is one that has broad acceptance within the technical community and for which the technical basis for consideration is at least as sound as that of the assumption being made.

- An ***assumption related to scope or level of detail*** is one that is made for modeling convenience.

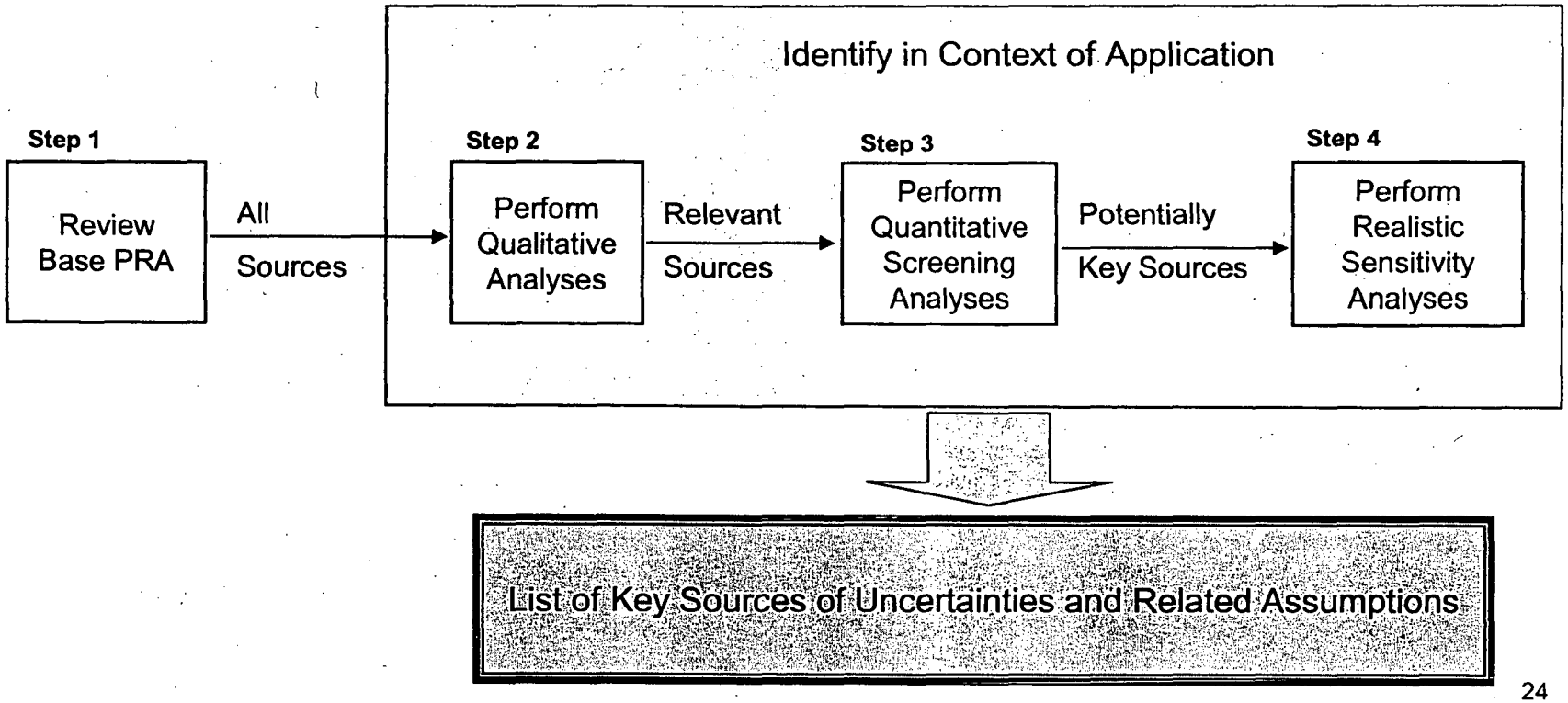
- An assumption is labeled ***key*** when it may influence (i.e., have the potential to change) the decision being made. Therefore, a key assumption is identified in the context of an application.

Definitions – Consensus Model

- ***Consensus model:*** in the most general sense, as a model that has a publicly available published basis and has been peer reviewed and widely adopted by an appropriate stakeholder group. In addition, widely accepted PRA practices may be regarded as consensus models. Examples of the latter include the use of the constant probability of failure on demand model for standby components and the Poisson model for initiating events. For risk-informed regulatory decisions, the consensus model approach is one that the NRC has utilized or accepted for the specific risk-informed application for which it is proposed.

Chapter 5: Overall Process to Identify Key Sources of Model Uncertainties

Four Step Process:



Step 1: Base PRA Sources

- Identify and characterize those sources of uncertainty and related assumptions in the base PRA model
- Three step approach
  - Identification
  - Characterization
  - Qualitative screening
- PRA model can be affected:
  - at the basic event level
  - in the logic structure
  - or both

EPRI Report
Guideline for the Treatment of Uncertainty in Risk-Informed Applications

Identify Sources of Model Uncertainty and Related Assumptions

- Identify sources against PRA structure
- Perform literature search

Characterize Sources of Model Uncertainty and Related Assumptions

- Identify part of PRA model affected
- Identify model or assumptions selected
- Identify impact on the PRA model

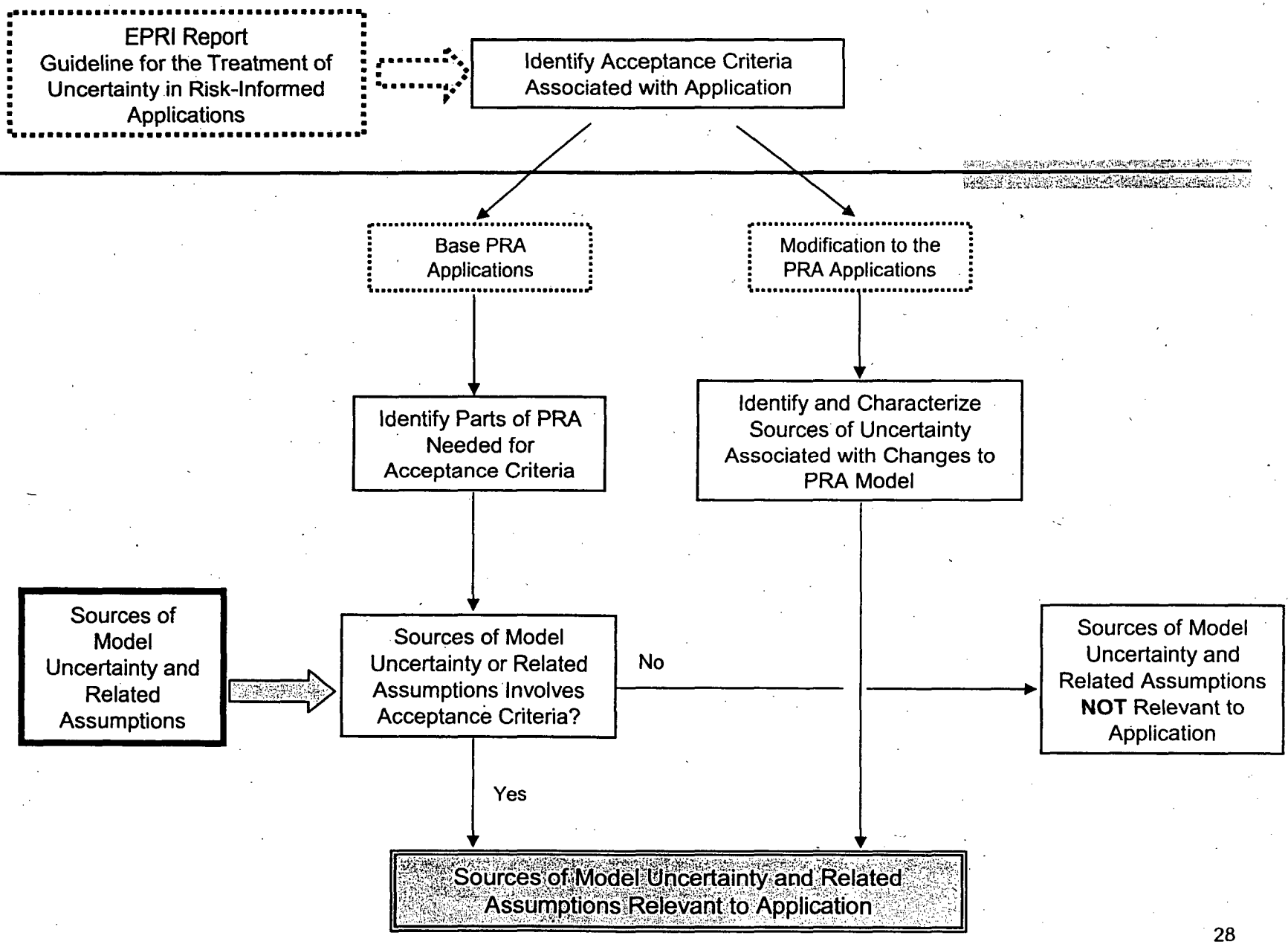
Qualitative Screening of Model Uncertainty and Related Assumptions

- Consensus model
- Bounding, conservative model

List and Characterization of Model Uncertainties and Related Assumptions

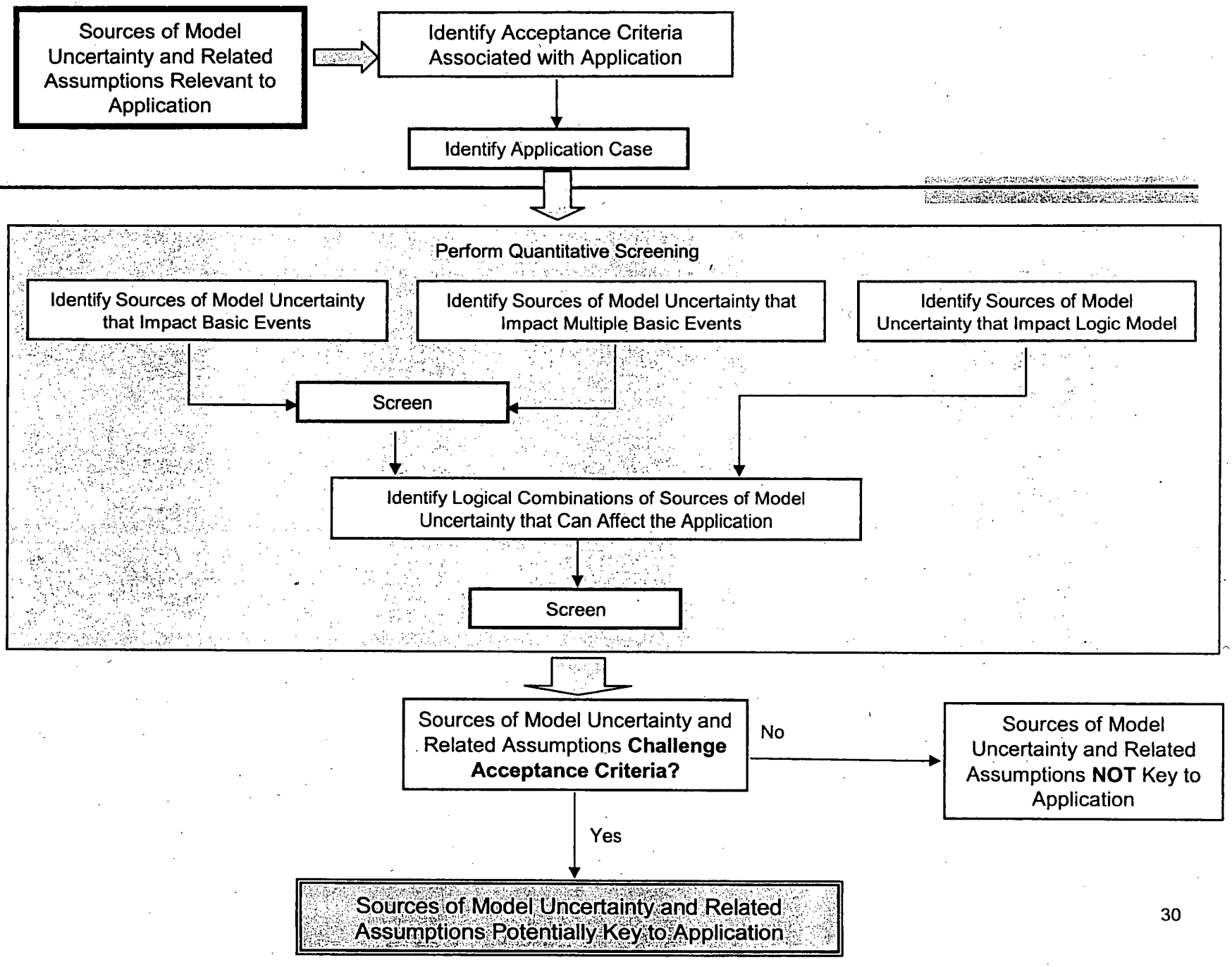
Step 2: Sources Relevant to Application

- Sources only relevant in context of an application
- Approach
  - Understanding application
  - Screening
- Acceptance criteria for the application will include cumulative objectives, incremental objectives, or both
- New sources may be introduced by the application


EPRI Report
Guideline for the Treatment of Uncertainty in Risk-Informed Applications
Identify Acceptance Criteria Associated with Application
Base PRA Applications
Modification to the PRA Applications
Identify Parts of PRA Needed for Acceptance Criteria
Identify and Characterize Sources of Uncertainty Associated with Changes to PRA Model
Sources of Model Uncertainty and Related Assumptions
Sources of Model Uncertainty or Related Assumptions Involves Acceptance Criteria?
No
Sources of Model Uncertainty and Related Assumptions **NOT** Relevant to Application
Yes
Sources of Model Uncertainty and Related Assumptions Relevant to Application

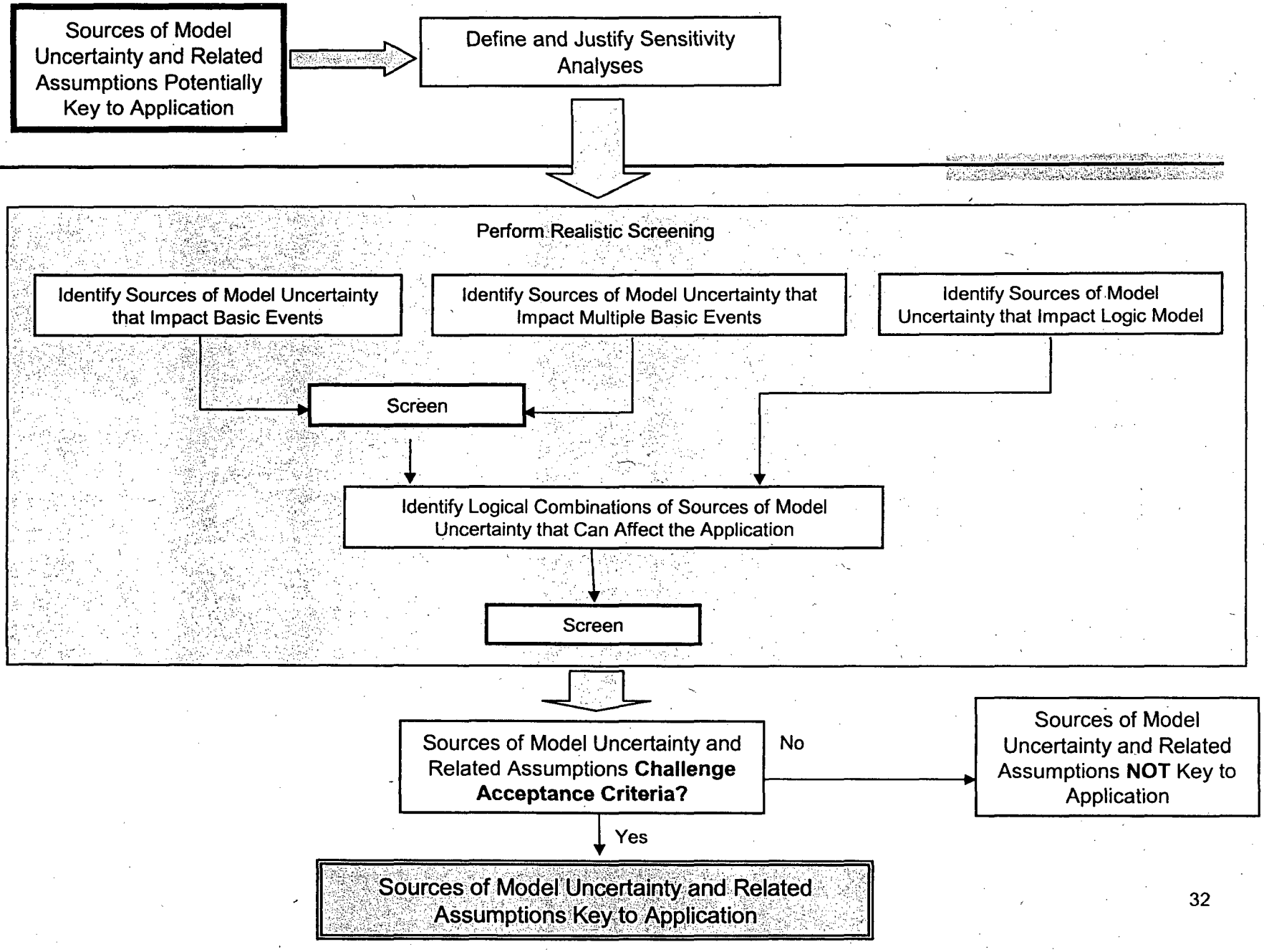
Step 3: Potential Key Sources

- Identify sources that can potentially impact the decision
- Evaluate the "importance" of the source
- Evaluate in terms of:
  1. Cumulative or incremental acceptance criteria
  2. Single basic event, multiple events, logic structure, or logical combinations


Sources of Model Uncertainty and Related Assumptions Relevant to Application
Identify Acceptance Criteria Associated with Application
Identify Application Case
Perform Quantitative Screening
Identify Sources of Model Uncertainty that Impact Basic Events
Identify Sources of Model Uncertainty that Impact Multiple Basic Events
Identify Sources of Model Uncertainty that Impact Logic Model
Screen
Identify Logical Combinations of Sources of Model Uncertainty that Can Affect the Application
Screen
Sources of Model Uncertainty and Related Assumptions **Challenge Acceptance Criteria?**
No
Sources of Model Uncertainty and Related Assumptions **NOT** Key to Application
Yes
Sources of Model Uncertainty and Related Assumptions Potentially Key to Application

Step 4: Key Sources

- Perform realistic sensitivity analyses
- Identify sources that actually influence the decision
- Define acceptable sensitivity analyses
- Evaluate in terms of:
  1. Cumulative or incremental acceptance criteria
  2. Single basic event, multiple events, logic structure, or logical combinations


Sources of Model Uncertainty and Related Assumptions Potentially Key to Application
Define and Justify Sensitivity Analyses
Perform Realistic Screening
Identify Sources of Model Uncertainty that Impact Basic Events
Identify Sources of Model Uncertainty that Impact Multiple Basic Events
Identify Sources of Model Uncertainty that Impact Logic Model
Screen
Identify Logical Combinations of Sources of Model Uncertainty that Can Affect the Application
Screen
Sources of Model Uncertainty and Related Assumptions **Challenge Acceptance Criteria?**
No
Sources of Model Uncertainty and Related Assumptions **NOT** Key to Application
Yes
Sources of Model Uncertainty and Related Assumptions Key to Application

Chapter 6: Completeness Uncertainty

- Provides guidance on addressing one aspect of completeness uncertainty in risk-informed applications – incomplete PRA scope or incomplete PRA level of detail
- Specifically, guidance is provided on
  - Determining the required scope of an application
  - Defining the types of bounding analyses
  - Selecting and using bounding approaches

Required PRA Scope for Application

- Scope of the required PRA defined by:
  - Risk metrics relevant to the application
  - Power operating states (POSs) affected by application
  - Initiating events affected by the application
- PRA level of detail
  - Minimum level determined by PRA standards
  - Applications can require higher or lower levels
- Base PRA scope or level of detail may require upgrading if important to application

Bounding Analyses

- Bounding analyses can be used to address missing PRA scope or level of detail
  - Demonstrate that the missing scope is not important to risk, or
  - Provide a bounding risk estimate
- Bounding analyses capture the worst credible outcome and frequency of that outcome
  - Screening can be performed based on frequency, outcome, or both
- Acceptable bounding analyses address:
  - Completeness of potential impacts and their effects
  - Frequency

Selection and Use of Bounding Approaches

- Bounding approach is specific to event being considered
- Screening of risk contributors – progressive process
  - Qualitative screening
  - Quantitative screening
- Bounding risk contributors
  - Simplified risk assessment with conservative quantification
  - Use of surrogate events

Chapter 7 -- Risk-Informed Decision Making: Dealing with Uncertainty

- Provides guidance on addressing the uncertainty in PRA results in the context of risk-informed decision making
  - The risk input is only one input to the decision
  - The decision-maker needs an understanding of the robustness of the risk input to the decision
- Specifically, guidance provided on
  - Presenting the results of PRA uncertainty analysis
  - taking uncertainty into account in addressing the comparison of PRA results with quantitative acceptance criteria
  - Addressing uncertainty in SSC categorization
  - Using qualitative approaches to address uncertainty in integrated decision making

Presenting the Results of PRA Uncertainty Analysis

- Approaches to presentation
  - Continuous probability distribution
  - Discrete probability distribution
  - Provide results for different assumptions/models
  - Bounds or ranges
- Tools for understanding what is driving the uncertainty
  - Importance analysis
  - Sensitivity analysis

Comparison of PRA Results with Acceptance Criteria

- Uncertainty arising from level of detail
  - The model must have sufficient level of detail to address the decision
  - Minor differences can occur
- Parameter uncertainty
  - Method of comparison is dictated by the formulation of the acceptance criteria
  - Results should be qualified recognizing any conservatisms associated with the level of detail
  - Issues with "bright line" criteria

Comparison of PRA Results with Acceptance Criteria (Cont'd)

- Model Uncertainty
  - Focus on supplying the decision maker(s) with an assessment of the credibility of alternate hypotheses that affect the decision
- Completeness
  - For those contributors not included in the PRA, either demonstrate the effect is insignificant, or modify the implementation of the decision
- Combining results
  - Essential to understand the contributors to the risk results, and their risk pedigree

Qualitative Approaches

- Used when contribution to risk are not or cannot be addressed quantitatively
  - Performance monitoring
    - Used to confirm an assumption (e.g. 50.69)
  - Limiting scope of plant modification
    - NEI 00-04 approach to dealing with less than full scope PRAs
  - Use of compensatory measures
    - Used to neutralize the expected impact of a change

EPRI Interface

- EPRI developing companion documents intended to support NRC NUREG, national consensus PRA standards, and industry PRA related efforts
- NRC working closely with EPRI
- Staff plans to "endorse" in appendix to NUREG-1855

Status and Schedule

- Issued as draft for public review and comment
  - Public review and comment period of 3 months
- Public meetings to be scheduled; tentative dates:
  - Initial public meeting February 1, 2008 to present the NUREG
  - Public meeting February 29, 2008 to discuss in detail the NUREG
  - Public meeting in April to go over public comments and staff position
- Meet with ACRS full committee, March 2008
- Issued for use, May/June 2008

Future Work

- Training
  - Due to the complexity and importance of this issue training is being developed to assist users
  - Structure/format of the training just now being discussed

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Treatment of Uncertainty for PRAs

ACRS Meeting
December 19, 2007

Ken Canavan (EPRI)
Doug True (ERIN)
Don Vanover (ERIN)

EPRI PRA Scope and Quality – Previous Uncertainty Deliverables

- Guideline for the Treatment of Uncertainty in Risk-Informed Applications: Technical Basis Document (1009652, December 2004)
- Guideline for the Treatment of Uncertainty in Risk-Informed Applications: Applications Guide (1013491, October 2006)

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EPRI Treatment of Uncertainty

- New Report to be Issued
- "Treatment of Parameter and Model Uncertainty for Probabilistic Risk Assessments"
- Streamlined version compared to Original Technical Basis Document and Applications Guide
- Technical Basis Document to be Maintained for Reference Information

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EPRI Report Objectives

- Identify when point estimate solutions are not suitable in light of parametric uncertainties
- Assist utilities in identifying and characterizing sources of model uncertainty
- Provide guidance for identifying appropriate sensitivity cases and logical combinations of sensitivity cases
- Provide guidance for interpreting results of sensitivity cases in the context of applications
- **Complement to NUREG-1855**

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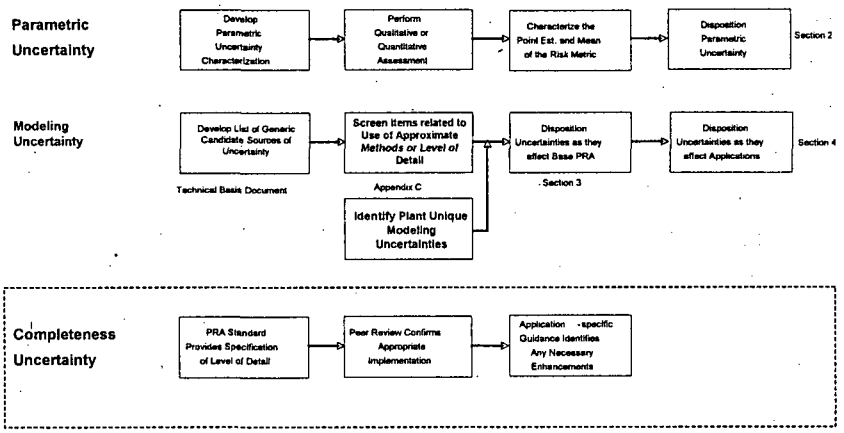
EPRI High Level Process

- Two types of uncertainty considered in EPRI report



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Parameter Uncertainty – Supporting Requirements

- ASME PRA Standard, Addendum B and Federal Register Notice (FRN)
  - QU-A2b: ESTIMATE the mean CDF from internal events, accounting for the "state-of-knowledge" correlation between event probabilities when significant.
  - QU-E3: ESTIMATE the uncertainty interval of the overall CDF results. ESTIMATE the uncertainty intervals associated with parameter uncertainties (DA-D3, HR-D6, HR-G9, IE-C13) taking into account the "state-of-knowledge" correlation.

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Parameter Uncertainty – Supporting Requirements

- ASME PRA Standard, Addendum B and FRN
  - LE-E4: QUANTIFY LERF consistent with the applicable requirements of Tables 4.5.8-2(a), 4.5.8-2(b), and 4.5.8-2(c)
  - LE-F3: IDENTIFY and CHARACTERIZE the LERF sources of model uncertainty and related assumptions, consistent with the requirements of Tables 4.5.8-2(d) and 4.5.8-2(e).

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State-of-Knowledge Correlation Tendencies

- The mean value determined by the distributions propagated through a Boolean logic model does not preserve the mean when there is a correlation effect.
- The propagated mean value (e.g., Monte Carlo simulation) including the correlation effect calculates a higher mean value.
- State of Knowledge Correlation (SOKC) can be significant

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Parametric Uncertainty Insights

- SOKC impact on risk increases as:
  - Error Factor increases
  - Fraction of risk metric impacted increases
  - Number of "coincident" correlated variables increases
- SOKC impact on risk decreases as:
  - Plant specific data is used versus generic
  - With lower error factors
  - Modeling of CCF increases
- Need a basis for determining when SOKC is "significant"

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Parametric Uncertainty Guidelines - Use of Point Estimate (1 of 2)

- Use of point estimate calculations for mean value comparisons to address QU-A2b SR
  - Guideline 1:
    If the risk metric is determined by cutsets or sequences that do not include basic events with SOKC, then use the point estimate directly.

    or
  - Guideline 2:
    If the risk metric is calculated to depend on a large number of cutsets or sequences with diverse types of contributors, that is, not from a narrow group of SOKC events, then use the point estimate directly.

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Parametric Uncertainty Guidelines - Use of Point Estimate (2 of 2)

or

- Guideline 3:
  Perform a detailed Monte Carlo calculation with >10,000 samples to calculate the mean and show that it is within 10% of the point estimate.

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Parametric Uncertainty Guidelines - Uncertainty Interval Characterization

- For CDF and LERF risk metrics to address QU-E3 SR
  - Guideline 1:
    Perform a parametric uncertainty propagation using a Monte Carlo process or equivalent through the Boolean logic model accounting for the state-of-knowledge correlation and report the results to establish the uncertainty bounds of 5% and 95% on the risk metric.

    or

Perform parametric evaluation and report results

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Parametric Uncertainty Guidelines - Uncertainty Interval Characterization

- For CDF and LERF risk metrics to address QU-E3 SR
  - Guideline 2:
    Perform a comparison of the plant features and model with a PRA that has previously evaluated the parametric uncertainty; and if the plant differences and model differences are relatively minor or are judged to be effectively compensated, then report the published result as adequately describing the parametric uncertainty about the risk metric.
  - In either case, if there are model uncertainties that are shown by sensitivities to increase these bounds, clearly identify these results to the decision maker.

Compare with existing similar study

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Model Uncertainty Supporting Requirements

- As clarified by NRC via a Federal Register Notice (FRN)
  - QU-E1: IDENTIFY sources of model uncertainty.
  - QU-E2: IDENTIFY assumptions made in response to model uncertainties.
  - QU-E4: For each source of model uncertainty and related assumption identified in QU-E1 and QU-E2, respectively, IDENTIFY how the PRA model is affected (e.g., introduction of a new basic event, changes to basic event probabilities, change in success criterion, introduction of a new initiating event)

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Model Uncertainty Supporting Requirements

- As clarified by NRC via a Federal Register Notice (FRN)
  - QU-F4: DOCUMENT the characterization of the sources of model uncertainty and related assumptions (as identified in QU-E4).
  - LE-F3: IDENTIFY and CHARACTERIZE the LERF sources of model uncertainty and related assumptions, consistent with the requirements of Tables 4.5.8-2(d) and 4.5.8-2(e).
  - IE-D3, AS-C3, SC-C3, SY-C3, HR-I3, DA-E3, IF-F4, and LE-G4: DOCUMENT the sources of model uncertainty and related assumptions (as identified in QU-E1 and QU-E2) associated with ...[each element].

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Assumption Definitions

- An ***assumption*** is a decision or judgment that is made in the development of the PRA model. An assumption is either related to a source of model uncertainty or is related to scope or level of detail.
- ***An assumption related to a model uncertainty*** is made with the knowledge that a different reasonable alternative assumption exists.
- ***A reasonable alternative assumption*** is one that has broad acceptance within the technical community and for which the technical basis for consideration is at least as sound as that of the assumption being made.
- ***An assumption related to scope or level of detail*** is one that is made for modeling convenience.

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Model Uncertainty Definitions

- Many "sources of uncertainty" items in original list are related to scope or level of detail rather than "model" uncertainty
  - Model uncertainty important for base model and applications
  - Scope/Level of Detail issues only potentially important in applications

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Model Uncertainty Definitions

- Candidate Source of Model Uncertainty
  - The phenomena or nature of the event or failure mode is not completely understood,
  - Significant interpretations to infer behavior are required to develop a model (this is the case where some information is available, but is not sufficient to derive a definitive model or value), or
  - There is a general agreement that the issue represents a potential source of modeling uncertainty.

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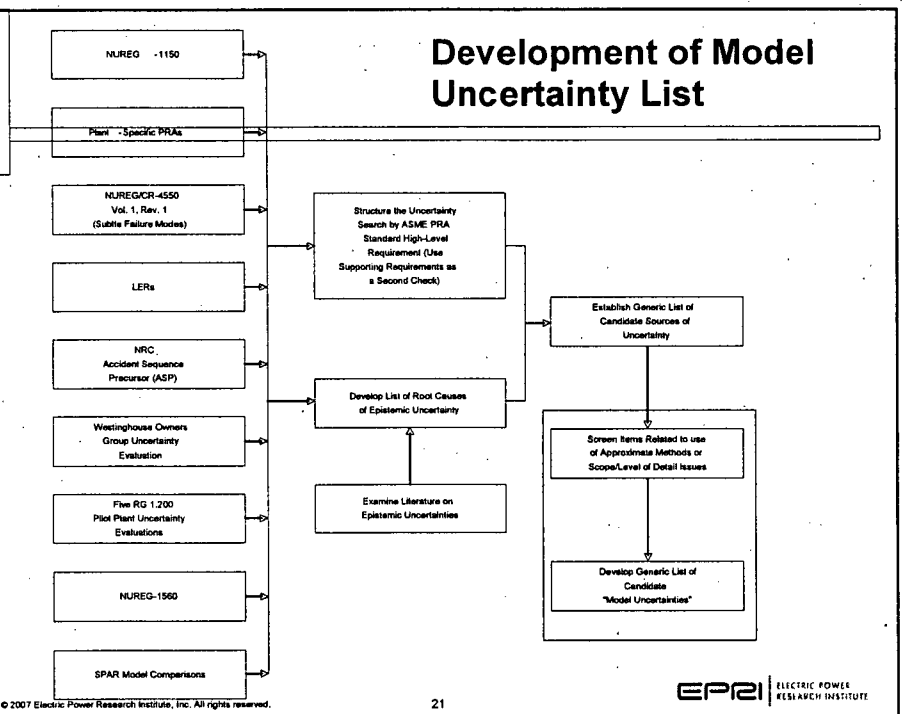
Development of Model Uncertainty List



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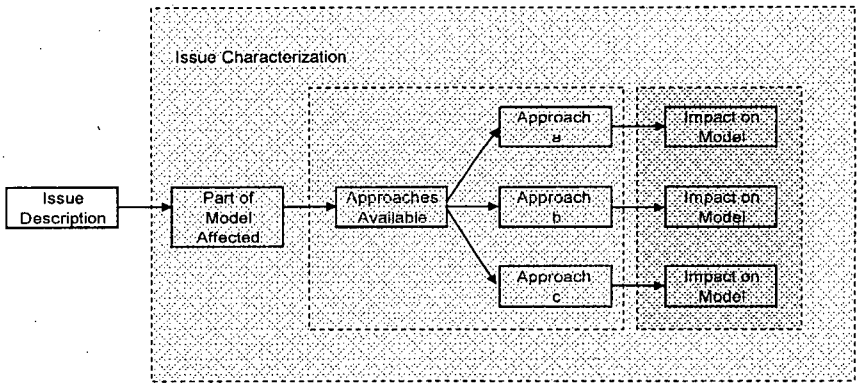
Base PRA Model Assessment

- Template for Model Uncertainty Issue Characterization



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Sample Model Uncertainty Issue Characterization

Topic	Discussion of Issues	Part of Model Affected	Possible Approaches
Operation of equipment after battery depletion (IN)	Station Blackout events are important contributors to baseline CDF at nearly every US NPP. In many cases, battery depletion may be assumed to lead to loss of all system capability. Some PRAs have credited manual operation of systems that normally require DC for successful operation (e.g. turbine driven systems such as RCIC and AFW).	Credit for continued operation of these systems in sequences with batteries depleted (e.g. long term SBO sequences)	1. Assume failure of DC powered SSCs upon battery depletion.
			2. Credit manual operation of selected systems using appropriate HEP following battery depletion.
			3. Limited credit for manual operation based on specific scenarios where HRA PSFs can be satisfied.

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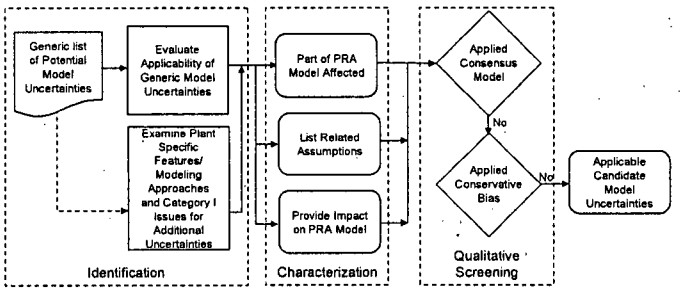
Base PRA Model Disposition

- Model Uncertainty Identification, Characterization, and Screening



- From FRN
  - *A source of model uncertainty* is one that is related to an issue in which there is no consensus approach or model and where the choice of approach or model is known to have an effect on the PRA model (e.g. introduction of a new basic event, changes to basic event probabilities, changes in success criterion, introduction of a new initiating event).

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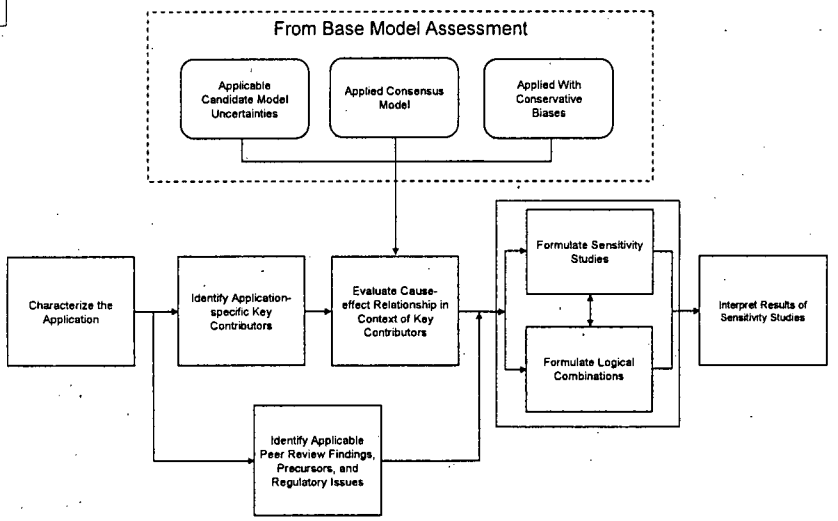
Framework for the Assessment of Key Sources of Uncertainty for Applications



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Sensitivity Study Guidelines

- Once the source of uncertainty is identified then there is a need to establish a reasonable range for the sensitivity evaluation. RG 1.174 provides this guidance:

  "a choice of reasonable alternative hypotheses, adjustment factors, or modeling approximations or methods...In this context, "reasonable" is interpreted as implying some precedent for the alternative, such as use by other analysts, and also that there is a physically reasonable basis for the alternative. It is not the intent that the search for alternatives should be exhaustive and arbitrary"

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Sensitivity Study Guidelines

- The variation in PRA input parameters that are to be used in the sensitivity studies require judgment and an in-depth understanding of the model.
- It may be appropriate in certain cases to provide a "bounding" sensitivity case to demonstrate the worst possible risk metric associated with a modeling uncertainty.
- Both increases and decreases in the risk metrics should be investigated, as appropriate.

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Logical Combination Guidelines

- Logically connected modeling uncertainties may create synergistic effects that have profound effects on risk metrics.
- Synergies have the greatest potential to impact decision-makers. Therefore, there may be situations where a specific set of key model uncertainties represent logical combinations to be investigated.

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Logical Combination Guidelines

- These logical combinations are to be determined using the following guidelines:
  - Multiple model uncertainties are derived from the same assumption or data source

    or
  - A specific issue related to environment, access, or specific procedural implementation affects multiple sources of uncertainty

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Definition of "Key" from the FRN

- An assumption is labeled "key" when it may influence (i.e. have the potential to change) the decision being made. Therefore, a key assumption is made in the context of an application.
- A source of model uncertainty is labeled "key" when it could impact the PRA results that are being used in a decision, and consequently, may influence the decision being made. Therefore, a key source of modeling uncertainty is identified in the context of an application. This impact would need to be significant enough that it changes the degree to which the risk acceptance criteria are met, and therefore, could potentially influence the decision. For example, for an application for a licensing base change using the acceptance criteria of RG 1.174, a source of model uncertainty or related assumption could be considered "key" if it results in uncertainty regarding whether the results lie in Region II or Region I, or if it results in uncertainty regarding whether the result becomes close to the region boundary or not.

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Interpreting Results of Sensitivity Studies

- The sensitivity cases need to be documented in a manner that characterizes the results of each study and the impact on the risk metrics.
- This characterization should explain:
  - Why the risk metric changes are acceptable, if deemed possible.
  - Why the risk metric variation is an artificial result because of:
    - Unreasonable variation in parameters,
    - Failure to account for other compensatory measures,
    - Inadequacy of the model to effectively treat uncertainty, or
    - Other valid reasons...

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Interpreting Results of Sensitivity Studies

- It is important to recognize that in the case of a risk-informed application, acceptance criteria have already been met.
- The purpose of the characterization of the uncertainty, as reflected in the sensitivity case(s), is to ensure that the associated uncertainty does not adversely impact the decision.

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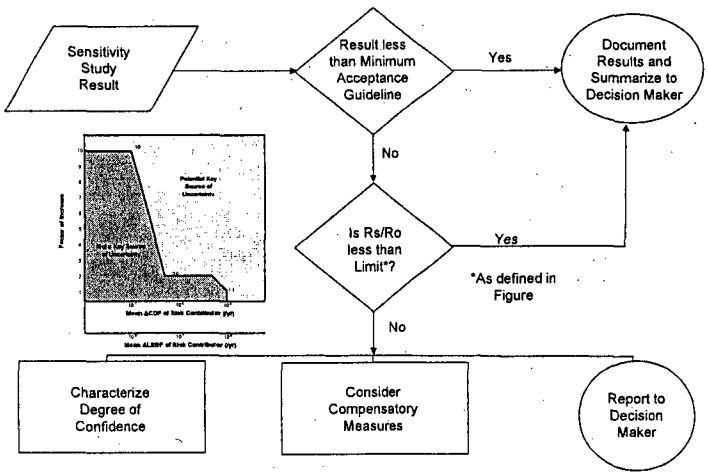
Application Sensitivity Study – Impacts on Decision



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Summary

- EPRI Treatment of Uncertainty
  - Continuing to build on prior industry work
  - Working with NRC on complement to NUREG-1855
  - Need to continue to address external events

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