Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: ACRS Subcommittee on Reliability and Probabilisitic Risk Assessment Meeting

Docket Number: (Not applicable)

Location: Rockville, Maryland

Date: Wednesday, December 19, 2007

Work Order No.: NRC-1917 Pages 1-335

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

+ + + + +

SUBCOMMITTEE ON RELIABILITY

AND PROBABILISTIC RISK ASSESSMENT

+ + + + +

MEETING

+ + + + +

WEDNESDAY,

DECEMBER 19, 2007

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The meeting was convened in Room T-2B3 at the Nuclear Regulatory Commission, Two White Flint North, 11545 Rockville Pike, at 8:30 a.m., George E. Apostolakis, Chairman, presiding.

MEMBERS PRESENT:

GEORGE E. APOSTOLAKIS Chairman
SAID ABDEL-KHALIK Member
J. SAM ARMIJO Member
DENNIS C. BLEY Member

MEMBERS PRESENT: (cont'd)

MARIO V. BONACA Member

MICHAEL CORRADINI Member

OTTO L. MAYNARD Member

WILLIAM J. SHACK Member

JOHN D. SIEBER Member

JOHN W. STETKAR Member

CONSULTANTS TO THE ACRS PRESENT:

THOMAS S. KRESS

GRAHAM B. WALLIS

NRC STAFF PRESENT:

MARY DROUIN

GARETH PARRY

JOHN MONNINGER

ALSO PRESENT:

JOHN LEHNER

DOUG TRUE

TIMOTHY WHEELER

KEN CANAVAN

DON VANOVER

TABLE OF CONTENTS

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

(8:31 a.m.)

CHAIRMAN APOSTOLAKIS: The meeting will now come to order.

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

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

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

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

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in The Federal Register on November 30, 2007. A transcript of the meeting is being kept, and will be made available as stated in the Federal Register notice.

It is requested that speakers first identify themselves, use one of the microphones, and speak with sufficient clarity and volume, so that they can be readily heard.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting.

We will now proceed with the meeting, and I call upon Ms. Mary Drouin to begin.

MS. DROUIN: Thank you, George. Before we get started, I'd like to turn it over to our manager, John Monninger.

MR. MONNINGER: Good morning, Professor Apostolakis and fellow ACRS members. I'm John Monninger. I'm the Deputy Director for the Division of Risk Analysis within the NRC's Office of Nuclear Regulatory Research.

I want to thank you very much for this opportunity today to brief you and inform you on our work relating to the development of NUREG-1855. This is a very important project for the NRC, for both the Office of Research and the program offices such as NRR and NRO.

In looking through this report, or past staff interactions with the ACRS, you will note that this is a followup or this is a result of one of the ACRS's recommendations back in 2003. The notion of the treatment of uncertainty, or the importance of the treatment of uncertainty, is recognized in both deterministic analysis and is also recognized that it is needed for risk analysis also.

As I mentioned, this is a joint project with the Office of Research and the Office of Nuclear Reactor Regulation. Supporting us is both Sandia National Labs and Brookhaven National Labs, so we have tried to pull together all of the available expertise in developing this guidance document.

With that, we look forward to your comments and recommendations from today's meeting. And with that, I will turn it back over to Mary.

MS. DROUIN: Thank you, John. At the table with me are three of the other primary authors. To my left is Tim Wheeler from Sandia National Labs. To my right is Gareth Parry with the Office of NRR, and John Lehner from Brookhaven. Another primary author to the document is Jeff LaChance, but unfortunately he couldn't be here today. But I did at least want him recognized.

This document has gone out for public review and comment, then to the ACRS, but it was very early on in the beginning of the work. And so this is I think your all's first opportunity to really see what we've done. I look tremendously forward to your all's input to this document.

CHAIRMAN APOSTOLAKIS: When is the public comment period ending?

MS. DROUIN: March 28th.

CHAIRMAN APOSTOLAKIS: So --

MS. DROUIN: We went out --

CHAIRMAN APOSTOLAKIS: Yes, go ahead.

MS. DROUIN: We went out for a substantial period for public review and comment than we normally do. You know, normally we go for 30, maybe 60 days. We went for more on this, because we think this is an important piece of work. We think there is a lot in here to understand, so we really wanted to give the public substantial time to really get into the document.

You're going to hear this afternoon, and you'll hear through today, because this has also been a collaborative effort with EPRI. And there is pieces of our document where we are relying on the EPRI work and vice versa.

CHAIRMAN APOSTOLAKIS: So when do you think will be a good time for you to come before the full Committee? After you respond to the public comments?

MS. DROUIN: I am going to get into that towards the end of the slides.

CHAIRMAN APOSTOLAKIS: All right.

MS. DROUIN: We do want to come back. And so when is the appropriate time in terms of the public meetings and everything we're going to have?

CHAIRMAN APOSTOLAKIS: Right.

MS. DROUIN: Etcetera.

MR. KRESS: When you speak of collaborative effort with EPRI, does that mean you'll just read their report, or do you meet with them and discuss things, or how does that work?

MS. DROUIN: Oh, we've had very extensive meetings, one on one, several.

MR. KRESS: With the prime authors of the EPRI report.

MS. DROUIN: Yes. We shared each other's work.

MEMBER BLEY: Mary, one last thing before you get into the presentation. I'd really appreciate it if all of your speakers -- and I'll ask the others as well -- if you can give us a sense as you go through as to what's different with your document form the two EPRI documents, and how they are complementary, and how you see them all fitting together.

MS. DROUIN: We're going to try and do that.

MEMBER BLEY: Okay, thanks.

MS. DROUIN: It was already our intent. So hopefully we will succeed in doing that for you.

Okay. You know, we are here to share the approach. What our intent is to do is to walk you through the document, chapter by chapter, and explain what's in it. So I know I don't have to tell you, stop any time and ask questions. But we're here to get your input on this. I mean, this is the first time. It is a draft. And even though it's not a huge document in terms of number of pages, the information, though, I think in it is somewhat complex and subtle and can be difficult to communicate.

What you see here -- they don't have the chapter numbers, but we're going to go through, as I said, the chapters. And when you look at this, you know, I mean, we're going to give a little bit of an introduction. What we've tried to do is in this --

Chapter 2, which is the overview, to try and give an overall picture of it, and then get into the details.

We thought it was very important for the reader to kind of understand the context before we get into the depths of the technical guidance in this document. So let's just try and get started.

MR. WALLIS: Could you explain to a naive member of the public what you mean by "uncertainty"? I mean, if you had to explain it to somebody who didn't have a technical background, how would you explain what you mean by "uncertainty"?

MS. DROUIN: We have a whole chapter on that.

MR. WALLIS: Yes, I know. But, I mean, just how would you explain to somebody?

MS. DROUIN: Can we not wait until we get to that part of the presentation?

MR. WALLIS: I guess we could. I was just wondering if -- okay.

MS. DROUIN: Because I think it's a very valid question.

MR. WALLIS: Because I think that what you mean by it, it affects the way in which you answer the question in the report. Do you want a measure of it or something? Or what -- well, go on. We'll get into it I guess later on. It would just help me to see -- this is the problem we have with uncertainty, this is how we're going to deal with it. But anyway, go ahead. Go ahead.

MS. DROUIN: Okay. Thank you. The treatment of uncertainties has always been an issue, something that the Commission has been addressing, maybe not well but has always wanted to deal with. And we've dealt with it in different ways. You go all the way back to just the PRA policy statement, and in there it talks about the treatment of uncertainty is an important issue for regulatory decisionmaking.

You can go back to 1999 I think when the Commission came out with their White Paper and talked about the risk-informed approach, you know, needs to explicitly identify and quantify the sources of uncertainty. So as we started moving into PRA, and looking at the risk associated from your -- I'm sorry, the uncertainties associated with the risk analysis, you know, the uncertainties became much more prevalent in determining how to deal with them in our risk-informed decisionmaking.

Prior to that, you know, we have the safety margins and stuff like that that dealt with the uncertainties or the unknowns. Now, as we move into the uncertainties associated with risk, it demanded more attention than just dealing with safety margins.

MR. WALLIS: Now you are talking -- I'm sorry. You're talking about understanding. I think some scientist once said that until you can put numbers on something you don't have an understanding. Is that your approach in this document?

CHAIRMAN APOSTOLAKIS: Which, in fact, it was a consultant.

MS. DROUIN: I don't think you have to have numbers to necessarily --

MR. WALLIS: Well, describing is not understanding, is it? I mean --

MS. DROUIN: I don't think you have to have quantitative numbers to understand --

MR. WALLIS: You don't?

MS. DROUIN: -- the uncertainty.

MR. PARRY: Basically, I think in terms of understanding, what we mean is understanding where the uncertainty originates and what its impact is on the result. Some of that could be qualitative, some of it could be quantitative.

MR. WALLIS: Presumably, it's desirable where possible to make it quantitative?

MR. PARRY: Particularly where you need to understand its significance, yes.

CHAIRMAN APOSTOLAKIS: Now, the first paragraph on your slide, though, says that it should be quantitative, right? Even the bounding analysis is some quantitative analysis, so you are agreeing that it's really quantitative. I mean, 1.174 says that.

MS. DROUIN: I mean, ultimately, when you're making a risk-informed decision, and you're using quantitative results, you certainly want to know how the uncertainty is impacting those quantitative results.

CHAIRMAN APOSTOLAKIS: So in that sense it's quantitative.

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

Okay. And what's important about this slide is that, you know, this document is here to support -- we view the NUREG-1855 as a support document. Now, this isn't just all of them, but, you know, here were three we thought significant documents when you talked about risk-informed decisionmaking, that this NUREG is intended to support, you know, Reg. Guide 1.174, the PRA standards.

This is a critical document that it's supporting, because when you look at the PRA standard, the PRA standard, if you remember it, just tells you what to do. It doesn't tell you how to do it. And so the PRA standard is telling you, you know, you have to identify your sources of uncertainty, and you need to characterize them. And that's as far as the standard goes.

So our work, and I think particularly the EPRI work, is picking up at that point to give the user that guidance in a sense of how to meet the PRA standard.

MEMBER CORRADINI: So just to get back to the questions of -- so that's really the key focus of 1855 is just to repeat what you said, which is to -- with the standard's words give a user guidance within the context of the PRA?

MR. PARRY: Within the context of using the PRA results to make decisions.

MEMBER CORRADINI: Okay. Excuse me. I'm sorry.

MR. WALLIS: Well, how about the output from the PRA? Output from PRA is usually a number, like 10^{-6} or something. What is the output in terms of uncertainty?

MS. DROUIN: Well, when you look at your PRA and you have your output of $1E^{-6}$, you know, associated with that, you will have your parameter uncertainties associated with that.

MR. WALLIS: Is this a plus or minus? Is it a percent, or is it -- what is the output measure of uncertainty?

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

MR. WALLIS: Are you going to tell us that?

MR. PARRY: Yes. And also, I'd like to suggest that it's not just a number that we focus on. It's also what constitutes that number, and that -- where that number comes from. So I think we're going to cover all of that in the subsequent discussions.

MR. WALLIS: As long as you get to my bottom line at the end.

MR. PARRY: We probably will.

MR. WALLIS: This thing I described it, how do you -- what's your output that you tell somebody --

MR. PARRY: Yes.

MR. WALLIS: -- this is the uncertainty, and, you know --

MR. PARRY: We will get to that.

MS. DROUIN: Right. As I said, we are going to -- we have -- before we even get into the decisionmaking part, we have three chapters where each of them go through the different types of uncertainty and how to deal with them. So you just bear with us.

I think John already spoke to this. You know, this was another impetus of why we started the program. The ACRS was very interested in this, and, you know, wrote two letters to us. We did respond that we were going to come back and deal with coming up with a guidance document on the treatment of uncertainty. So let's just kind of get to the beginning.

Okay. Risk-informed decisionmaking, you know, is an integrated process that -- usually risk insights, and so since you're using risk insights you have to be aware of the uncertainties associated with those, both your epistemic and your aleatory. But this document is primarily dealing with, of course, the epistemic and then getting into your parameter, your model, and your completeness, which we're going to discuss in more detail.

But we're trying to provide guidance on how to treat those various uncertainties in your decisionmaking. And in order to do that, and to achieve that objective, we think what we have to focus on in this document is to provide guidance on the understanding of the uncertainties associated with the PRA -- you know, what the impact of these uncertainties are on the results of the PRA, and then understanding the uncertainties in the context of the decisionmaking.

These we think are three critical issues that have to be dealt with. And if we don't deal with these issues, then trying to address the overall objective of guidance of how to treat the uncertainties in your decisionmaking, you won't be able to get there.

So these three --

CHAIRMAN APOSTOLAKIS: Understanding, though, is not good enough. Understanding and what to do, right? I mean, you want people to understand, but also you give them guidance what to do.

MS. DROUIN: Yes, right.

CHAIRMAN APOSTOLAKIS: Because, you know, anybody can say, "I understand it."

MS. DROUIN: But all we're saying is that in order to know what to do --

CHAIRMAN APOSTOLAKIS: Oh, you have to understand.

MS. DROUIN: -- you have to understand these things up front and --

CHAIRMAN APOSTOLAKIS: This is very interesting. I mean, isn't that sort of self-evident? But anyway, I know what -- I know where you're coming from.

MS. DROUIN: You know what, George? You would think it was. It would be interesting, when you start talking with people that they don't have that.

CHAIRMAN APOSTOLAKIS: Oh, I'm with you.

MR. PARRY: And I think the focus we are really making is that uncertainties are really only important when you actually try to use the results. So it's really in the context of the decisionmaking that --

CHAIRMAN APOSTOLAKIS: I believe the ACRS over the years has emphasized that point, right, that you should --

MR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: -- focus on the impact of uncertainties --

MR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: -- on decisionmaking. Otherwise, it's just an exercise.

MR. PARRY: Right.

MS. DROUIN: Exactly.

MR. PARRY: Exactly.

MR. WALLIS: I'm a little puzzled because many engineers use tools without understanding them.

CHAIRMAN APOSTOLAKIS: But here they have to understand.

MR. WALLIS: The important thing, first of all, is to figure out what you're trying to do with the tool. But anyway, go ahead.

MR. KRESS: Your second sub-bullet, the red ones, I quite often have viewed uncertainties as a result of the PRA. It's one of the results.

CHAIRMAN APOSTOLAKIS: Yes.

MR. KRESS: I was a little confused about the way it's worded, the impact on the results. I thought it was a result, properly done PRA, but maybe I'm confused there.

MR. PARRY: I think that's semantics.

MR. KRESS: Yes, it's semantics I guess.

MS. DROUIN: I do think that is semantics, because within your PRA you have uncertainties, and what kind of impact those uncertainties have, because by the fact that it's an uncertainty doesn't mean that is the answer. Another answer could give you -- could change the ultimate results of the PRA. So, yes, those --

CHAIRMAN APOSTOLAKIS: But the results --

MS. DROUIN: -- in and of themselves are, if you want to call those results coming out of the PRA, yes.

M E M B E R B O N A C A : So it's the conclusion you can draw --

MR. PARRY: Yes.

MEMBER BONACA: -- from the PRA, very specific engineering study you're performing.

MR. PARRY: Yes, that's really the third bullet. It's the impact on the decisionmaking, that impact, right.

CHAIRMAN APOSTOLAKIS: I think the second sub-bullet could be the impact. The first and the third aren't good enough.

MR. PARRY: Well, I think the second sub-bullet needs some -- it's really trying to understand -- what we're trying to get at -- and you'll see that in the way we discussed it -- we're trying to look at the origin of the uncertainty, how is that manifested in the structure of the PRA model.

CHAIRMAN APOSTOLAKIS: Why don't you say that? Because this is not --

MR. PARRY: This is a viewgraph, so, I mean, I think we say it differently in the report.

MS. DROUIN: Well, let me put it this way.

We use those same words in the report, but there are several paragraphs that go into the discussion of that. But, again, you know, we would welcome any comments to --

CHAIRMAN APOSTOLAKIS: I think the comment from Tom really is that you should not give the impression that the uncertainties are different from the results of the PRA. And if you read it literally, that's what it means. And I know you don't mean that, but just rewording it. Okay.

MS. DROUIN: But before we move on, let me -- I just want to talk to that for a second, not that particular sentence but the point of what you're trying to make. And I will say it is something that we have struggled with. As the authors of the report, we are so close to it that I do feel that this document may suffer somewhat from the language in it.

That doesn't necessarily always convey the exact meaning, so we do welcome those kinds of insights as you read the report, to give those to us.

CHAIRMAN APOSTOLAKIS: I think Dr. Wallis' comments come from that perspective, from the perspective of an informed member of the public, right? Mary just said that we are also --

MR. WALLIS: From IT at one time.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Let's continue.

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

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

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

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: You don't want to -- this document is not intended to advance the state of the art, right?

MR. PARRY: Right.

MS. DROUIN: Right. Okay. So how was this report organized? Now, I just quickly -- very quickly walked you through, you know, Chapter 1 and the introduction. You know, that gets into the objectives and the scope and application.

Chapter 2, which we're going to get into next, is supposed to be a high-level summary of the overall approach, so that before you're getting into the details you have the complete picture of what this document is to be about. And then, we start submerging you, when you get to Chapter 3, into the actual details.

MR. WALLIS: Okay. Chapter 2, you talk about Reg. Guide 1.174, and you have various principles, two of which are defense-in-depth and safety margins, which are mentioned at various times in the report. There was no connection ever made in this report with these principles.

There's no indication that the PRA uncertainties helped you evaluate in any way the safety margin or defense-in-depth. I think you ought to try to do that.

MR. PARRY: I'm not --

MR. WALLIS: Because you have safety margins because of uncertainties. You have defense-in-depth because of uncertainties. There must be a connection of some sort. So they're all just lost in the report.

MR. PARRY: It's somewhat tenuous, though, the connection. The PRA cannot really -- the way we've treated it in here is to say that defense-in-depth and safety margins are essential because of the things that we really don't know about. And if we don't know about them, they are not going to be in the PRA model. So they are treated as -- and that's the reason why we still have them in our principles of risk-informed decisionmaking. The PRA is just one aspect of that decision.

So we're focusing in this document on the stuff that we know that we've put in the model, the stuff that we know that we haven't put in the model --

MR. WALLIS: Can I tell you something about safety margins? When you do a full analysis of mechanics, like failure of -- a mechanical failure of something, by doing a statistical analysis of uncertainty you can tell how to impose safety factors or whatever. I mean, safety margin is often derived from a study of uncertainties, and you can --

MR. PARRY: But we don't do that --

MR. WALLIS: -- do something with a PRA in that regard, I'm sure.

MR. PARRY: We typically do not, but --

MR. WALLIS: You're not doing it.

MR. PARRY: No.

MR. WALLIS: You dismiss that as a possibility, right?

MR. PARRY: Well, the -- we work on the basis of the design basis of the component.

MEMBER SIEBER: Actually, if you look at the history, defense-in-depth and safety margins came long before PRA became a useful tool. And they were put in there because they didn't -- just because of the uncertainty principles that are expressed in this paper now.

And in a deterministic sense, you didn't know whether you did the problem right or not. They put margin in. You didn't know whether you characterized the problem or even addressed the problem at all, so you put defense-in-depth in. I think that's where it comes from.

MR. WALLIS: Well, let me give you an example. I'm sorry to interrupt. When you come up with a number, you're going to say later on you use the mean value, right? Mean value of 10^{-6}. That's what you tell the Commission, tell the public, that the risk associated with a reactor is 10^{-6} CDF per year.

If the uncertainty in that goes to -- and it could range because of your uncertainties from 10^{-5} to 10^{-7}, and if the 95th percentile gives you 10^{-5} or something you might say, "Because of defense-in-depth and safety margins, we are going to require that the 95th percentile meet some criteria." That is a measure of safety margin to me.

MR. PARRY: Well, we could do that.

MR. WALLIS: Very clear.

MR. PARRY: That's not the way our decision criteria are set up.

MEMBER BLEY: Can I -- something is bothering me about the conversation. It seems to me maybe you are putting too fine an edge on what is in the PRA and what's not in the PRA. In the PRA, you have success criteria. Many of those were set originally by various sensitivity studies and uncertainty examinations of -- to let you set success criteria so that you know they will cover the whole range under which you are applying them.

So I think there is some of the kinds of thinking that could go into margins in what we do in PRA, and the idea that you could use some of that to help in setting margins is something that maybe has a place in this report. Putting it out because it's not done in PRA seems a fine line that is going to come back to bite you later on somewhere.

MS. DROUIN: I don't think it's -- whether or not, you know, you all want to -- us to expand the scope of what we intended to do, you know, we can take that under advisement and under consideration. That was not part of the scope of what we were trying to do.

Now, it's certainly something we can look at, and we can consider, and it may well be that we should expand the scope to that. But right now that was not part of the scope of our piece of work. We weren't trying to deal -- you know, we had a very narrow scope, and just that narrow scope, in and of itself, you know, was complex.

MEMBER BLEY: I understand. But let me make one statement on that, and then we can go on, as far as I'm concerned. George may have something else.

The way the scope is limited to the reader in this area is that it's applied to what is in the PRA, and that's a definition of the scope that I think means different things to you folks than it does to me as a reader. And I think it isn't sufficiently clear in the report exactly what that scope is.

CHAIRMAN APOSTOLAKIS: And I agree with that, but also I think you can make a connection by referring to what Jack Sieber said. I mean, the original defense-in-depth and the safety margin concepts were developed to handle uncertainty.

Now, the PRA comes. The question is: is it replacing those? No. Why not? Well, first of all, PRA does not include the margins, right? And we have tried to urge the staff to quantify those, and I guess NRR objects. So what does PRA quantify? It quantifies only a redundancy. If you have a one out of two or one out of three system, yes, the PRA will show a difference.

So I think these insights will be important to put -- and then, you have the extra problem, of course, of the unknowns, so you want to have defense-in-depth, to maintain some defense-in-depth because of that.

A nice discussion on these things I think would place the whole thing in context, and it would be useful I think.

MEMBER SIEBER: I think it goes further than that, though, George because if you have margins set in a deterministic way, you know, I really don't know what the effect is. My success criteria -- you know, something may be successful and not be operable, believe it or not. And what the PRA does is give you some idea as to how valid the margin really is.

And I think that fine tunes the regulations or fine tunes the opportunity to regulate without piling on, so to speak.

CHAIRMAN APOSTOLAKIS: Now, the issue of margins is kind of a sensitive thing, because as I said PRA really does not get into it. I mean, we are given the success criteria and the PRA analyst works against those. But the redundancy is done very well.

MR. PARRY: And remember, the other thing, too, about PRA models is we don't deal with partial failures. I mean, our components fail or they don't fail.

CHAIRMAN APOSTOLAKIS: Sure.

MR. PARRY: It's a very disparatized approach to looking at things, and we do it within certain boundary conditions. So I think what I'm hearing is a suggestion maybe we should be pushing the state of the art a little bit in this area.

CHAIRMAN APOSTOLAKIS: No, no.

MR. PARRY: And I don't think we should be doing that.

CHAIRMAN APOSTOLAKIS: I think what Graham Wallis said fits very well within your earlier statement that you want to look at the whole thing within the decisionmaking process. If the decisionmaking process has two boxes that say defense-in-depth and safety margin, then maybe you can bring those into the discussion, too, rather than focusing only on the PRA element.

We are not asking you -- no, we're not asking you to advance the state of the art, but statements like the discussion of the last three or four minutes would help I think.

MR. KRESS: Well, the quantification of the uncertainty in distribution is a way to arrive at the mean. And I was looking somewhere in there in your discussion on acceptance guidelines. Just why the Commission, for example, thought the mean was the appropriate choice. Maybe it is. Apparently, they thought so. But I didn't see any discussion on that at all.

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

MR. KRESS: Is it in there?

MR. PARRY: Yes.

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

CHAIRMAN APOSTOLAKIS: We'll come to that.

MR. KRESS: I thought I read it was the appropriate choice because the Commission said so.

MR. PARRY: No, no. There is also a discussion of the various options that we looked at, and it's in Chapter 7 I think maybe.

MR. KRESS: Yes. You noted the various options, but you never said why the mean was the right option to choose.

CHAIRMAN APOSTOLAKIS: Well, we'll come to that, won't we?

MR. WALLIS: I'm sorry. I think this is really -- this really is important, though, because when decisions are made in the public arena people don't -- you know, there's a question about PRA results. And so when someone says, "Oh, 2 times 10^{-5} is less safe than 1 times 10^{-5} in the PRA," people will say, "We don't really believe that, because there are so many uncertainties in the PRA."

If you really want to assure me that something is safer than something else, I want a factor of 10. That really reflects the uncertainties in the PRA, and it reflects a safety margin. It's inherent in the way people think about PRA, because it is questionable what the results -- you know, how they should be interpreted. People look for big safety margins, and how far the PRA prediction is from what's acceptable.

MR. PARRY: What we're trying to do in this document is in fact to put the PRA results in context given the uncertainties that we have and the way that we construct the model. And it's part of the information that goes to making a decision, and it's only part of the information. It's not the -- we're not risk-based.

MEMBER CORRADINI: So if I may --

MS. DROUIN: Can we go to this figure that's up on the screen?

MEMBER CORRADINI: Before we go to the figure, Mary, I guess I'm listening -- since I'm not a practitioner in this, and I've listened to all you guys who are practitioners, and you didn't have a reaction to Dennis' comment and I'm kind of curious what your reaction is, because I thought -- what I thought he said was he'll accept your assumption that you're going to do uncertainty or investigation of quantifying or qualitatively understanding uncertainty within the context of the PRA. But how you view it and how he reads it are different.

So I'm kind of curious, if there is a disconnect there, even if we allow you that this is the way you guys are going to do it, it sounds to me like people could misunderstood that.

So I'm -- I think I understand where Graham is going, and you can agree or not agree to go there, because that's not within your context, I'm kind of curious what your reaction is to Dennis' point, because I -- I'm trying to learn through all of this.

MS. DROUIN: Can you repeat what your point was, Dennis, please?

MEMBER BLEY: That's probably difficult.

(Laughter.)

MS. DROUIN: I thought we answered that.

MEMBER BLEY: No, it was -- it wasn't a question. It was -- the way the conversation has gone so far this morning has a lot to do with how you've defined your scope. And a lot of the definition of scope has to do with exactly what's meant -- how we're looking at uncertainties within the PRA model.

I've taken that -- as I read it, I took

that a little more broadly than you did, and that raised some questions. So my statement was I don't think you've defined the scope up front in a way that makes it unambiguous to the reader. Just saying we've limited it to what's in the PRA, you have to go a little further than that.

MS. DROUIN: Okay. But what is that you're looking for that you -- why you think it's ambiguous?

MEMBER BLEY: Well, I --

MS. DROUIN: Because I don't -- I don't know what --

MEMBER BLEY: -- I began with the point of you're saying you don't -- I drew an analogy -- at least it was an analogy for me -- between the way one sets success criteria in the PRA and these issues of margin, in that when you do them, if some -- George said somebody gives them to you. I don't know who the heck gives them to you, unless you're just copying them from a previous PRA.

But in the initial looking, you had to do a fair number of sensitivity studies and some uncertainty analysis to decide where to break your success criteria, how to apply them, and how to make sure the way you set them covered the full range of events that were within that definition.

So that was a bit of this kind of sensitivity looking and looking at the range of things. From that, I could infer that you could do some of the things that Jack talked about earlier. You're saying, no, that's clearly out of the scope, because we're only looking at what's in the PRA. So I --

MS. DROUIN: Well, your success criteria --

MEMBER BLEY: -- I see it a little differently.

MS. DROUIN: But your success criteria, Dennis, is part of the PRA, and that is one source of uncertainty that will show up. So since it's in the PRA, it will be part of this document in the sense that's a source of uncertainty.

MR. WALLIS: It won't push off? Westinghouse tells me that two pumps will cool the core rather than three, and you just accept that. Then, it may well be there's a lot of uncertainty in that success criteria depending upon the other situations.

CHAIRMAN APOSTOLAKIS: It is a common practice to question the success criteria, though.

Let's be honest here.

MR. PARRY: For some of -- yes, for feed-and-bleed it certainly is.

CHAIRMAN APOSTOLAKIS: So in selective cases --

MEMBER BLEY: And early on for LOCA success it was. I mean, there were lots of --

MR. PARRY: Even now for LOCA success.

MS. DROUIN: If I translate your question, your question really will be that when we get to that part of the document that gives the guidance of how you determine what are your sources of uncertainty, I mean, that's what your real question is is whether or not the document does that to the extent that it should, such that you will be able to identify that as a source of uncertainty.

MEMBER BLEY: And I guess since you've been able to do those kind of things -- and I'll look forward to seeing the discussion of those -- if I were the decisionmaker making decisions about this plant, and you had a PRA that had been done and I wanted to wonder if the margins we've set for this plant are reasonable in one area or another, and asked you, "Gee, is there anything from the analysis in the PRA that could help me understand that better?" why wouldn't you be able to do some of that? Why is that outside of scope?

MR. PARRY: What margins are you talking about, Dennis? Can you define an example of one? Because I'm really not seeing it right now.

MEMBER BLEY: Well, he could do the Appendix K, but that's -- you could ask that one, but probably they haven't looked at that one hard enough, I'm pretty sure. But that would be one example.

If it -- is it limited to Level 1 PRA? I forget what you said in the document.

MR. PARRY: Level 1 and LERF.

MEMBER BLEY: And LERF.

MR. PARRY: Yes.

MEMBER CORRADINI: Oh, so it is Level 2.

MS. DROUIN: Just as it pertains to LERF.

CHAIRMAN APOSTOLAKIS: Can we come back to these questions when the staff talks about specific --

MS. DROUIN: Yes, because I really think that your question is more into --

CHAIRMAN APOSTOLAKIS: -- aspects, because I think at this point we have exhausted --

MS. DROUIN: -- do we have the guidance sufficient to get into some of those things, and should it?

CHAIRMAN APOSTOLAKIS: Yes, we'll come to that.

MS. DROUIN: Now, you may not be completely happy with what you see here, and I'm not trying to punt, but this is where the NRC in the EPRI work are merging/melding, and it's in the identification of the sources of the model uncertainty.

MEMBER BLEY: I'll think more about the margin issue, but when it -- the margin question was cut off, that that's clearly outside our scope. I wasn't sure why, and I have to think more about particular margins, so go ahead.

MS. DROUIN: Well, when we talk about that, we're talking about -- when you come back here to, you know, your principles for risk-informed decisionmaking, you know, and this is the figure that shows up, you know, of course in Reg. Guide 1.174. What we're trying to point out here is that when you look at the different principles, you know, with principle 1 saying, you know, you have to meet your current regulations, you know, keep defense-in-depth, maintain safety margins, your risk-informed analysis, monitor performance.

Now, we've sanitized these to be more

broad and not specific to an application of 1.174. But what we're trying to point out, which I can't do -- right there.

(Laughter.)

MEMBER BLEY: It's upside down and backwards or something. It's kind of hard to --

MS. DROUIN: But anyway, the box there that's, you know, bolded a little bit more, which is the risk-informed analysis, that's the context of this work. You know, we aren't dealing with the other principles. We're dealing with the uncertainties coming out of that risk-informed analysis as an input to your risk-informed decisionmaking.

CHAIRMAN APOSTOLAKIS: But you can't ignore the other two boxes. In fact, in some place I recall your saying, "Under these circumstances, compensatory measures would be required."

MS. DROUIN: Right. And --

CHAIRMAN APOSTOLAKIS: You are invoking defense-in-depth there.

MS. DROUIN: Yes. When you get into Chapter 7, Chapter 7 deals with principles.

CHAIRMAN APOSTOLAKIS: We'll do it when we come to Chapter 7. I think this is too high level.

MR. PARRY: But just to put the context of this report, though, we really are dealing with uncertainties in the PRA model as an aid to helping the licensees and ourselves understand how to meet the ASME standard when we're doing a PRA in the context of --

CHAIRMAN APOSTOLAKIS: So now you are changing it. I thought you said it was in the context of decisionmaking.

MR. PARRY: How we treat uncertainty in the context of decisionmaking using the ASME standard to support the claim that the PRA you're using is technically adequate. That's a long statement.

CHAIRMAN APOSTOLAKIS: Yes, but it's --

MR. WALLIS: In the model, you have these branches where you go this way or that way depending on various success criteria. Success criteria are probably part of the model.

MS. DROUIN: They are part of the model.

MR. WALLIS: So uncertainties in the success criteria are part of the uncertainty.

MS. DROUIN: We just agreed to that.

MR. WALLIS: Well, I didn't see it.

MEMBER SHACK: But you do have this thing about consensus models where you sort of throw away uncertainties once you've decided on the consensus model.

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

CHAIRMAN APOSTOLAKIS: Are we going to come to all of these questions?

MS. DROUIN: Yes.

MR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: Okay. Right now, let's go on. What is this top diagram doing there, with the sacred top diagram?

MS. DROUIN: I'm sorry?

(Laughter.)

CHAIRMAN APOSTOLAKIS: The top diagram is something we all know.

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: It has been reviewed --

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: -- to death. And then, you are adding on the same slide a bunch of boxes. What is that? The bottom part, what is it?

MS. DROUIN: That should be a familiar figure, again, also. And what we were trying to say is that in the decisionmaking process, you know, we are dealing with -- when you see it come out of the -- perform a risk-informed analysis, which is one of the principles of your risk-informed decisionmaking, is that you've got your deterministic part and you have your probabilistic part, and we're assessing the uncertainties coming out of the probabilistic analysis as input into your integrated decisionmaking. It wasn't supposed to be any more complicated than that.

CHAIRMAN APOSTOLAKIS: Yes. Again, that sends the wrong message, that after you do the probabilistic analysis you assess the uncertainties. And some members object to that.

MEMBER STETKAR: And that's wrong.

CHAIRMAN APOSTOLAKIS: The uncertainties are part of the probabilistic analysis.

MEMBER BLEY: And your text says that.

MS. DROUIN: Right.

MEMBER BLEY: But the picture doesn't.

CHAIRMAN APOSTOLAKIS: The picture doesn't.

MEMBER BLEY: So it's a comment on the artwork on the figure and --

MS. DROUIN: Do you want that arrow going certain ways?

MEMBER BLEY: The uncertainty is an overview on all of those three pieces. It doesn't flow as something that gets tacked on after the PRA, please. And your text says that, but --

MS. DROUIN: Yes.

MEMBER BLEY: -- I hate to see that figure, because the figures will float around.

MR. WALLIS: Well, Mary, the arrows all go in one direction here. If this were designed for -- I would say it ends up at five, so I want you to define in Chapter 1 what kinds of things the decisionmaker needs to know in terms of uncertainties. Define it at the beginning, and then it should be clear that the document leads to giving him what he needs. And I'm not quite sure that you do that. You talk all these are forward -- about understanding things and so on. But what is it the guy at the end really needs to know?

MR. PARRY: I think what he needs to know -- and I think we say that here -- is that he needs to know that the results that we're using for the PRA to assist in making the decision, that he can have confidence in the decision -- in meeting that decision that says that the risk-informed analysis says that the risk impact is --

MR. WALLIS: He's going to ask you, how confident do I need to be? And how do I measure my confidence? He's going to ask you questions like that.

MR. PARRY: All right.

MR. WALLIS: And you're going to have to say, "These are the kinds of questions he's asking me. Now I've got to supply an answer to his question."

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

MR. WALLIS: Okay. Could you maybe -- just advice about how I would write the report. But think about it a bit.

MS. DROUIN: Let's go ahead and go to slide number 11. This is getting to the document at this point, because it seems like you guys want to get into the details.

CHAIRMAN APOSTOLAKIS: Yes, we do.

MS. DROUIN: You don't want any -- so let's just --

MEMBER BLEY: One short comment on Chapter 2. You jump into the kind of uncertainty we can deal with is epistemic, and here's the things we're looking at, kind of out of the blue when I come to it, without defining the aleatory part and that you're not doing it. Just a comment on how the presentation goes. It just -- all of a sudden there's epistemic and no aleatory, and it leaves me wondering why. I figure out that that's not part of your charter, but it -- it didn't flow.

MEMBER SIEBER: You are required to use the words, though.

MR. PARRY: Okay. Let me talk about Chapter 3, right?

MS. DROUIN: Yes. I mean, I'm a little bit hesitant, but -- because I don't feel like we've really kind of explained how this whole thing is put together. But let's just start jumping into it. So go ahead.

CHAIRMAN APOSTOLAKIS: Are you going to tell us how it was put together? I mean, it's your presentation.

(Laughter.)

PARTICIPANT: That's not evident.

(Laughter.)

MS. DROUIN: Thank you very much for that statement. I didn't have --

CHAIRMAN APOSTOLAKIS: Standing Committees on slide 10. That is how you put everything together.

MS. DROUIN: Oh. I think at this point let's move to Chapter 3.

MR. PARRY: Okay. What we've tried to do in Chapter 3 is to really set the scene for what it is we're dealing with in terms of uncertainty. So the first thing we try and do is to define what we mean by a PRA model, which is the subject of this report, and, in particular, to try and characterize what -- try and explain the essential characteristics of the PRA model. Not to go in great detail, but to go sufficiently to support the remainder of the report.

As a result of that, then we want to focus on what are the types of uncertainties that result out of trying to create a PRA model, so that we can set the scene for the remaining chapters, which tell you how to deal with those types of uncertainties.

Go on to the next.

So what we do in the first part of Chapter 3 is -- just to put the thing in context is to just remind people that PRA is a model, and that all models are approximations. And this is important because there are different understandings of what we mean by "uncertainty."

Some of them -- and we're trying to make the distinction between things that arise because of the approximations that we're making, and things that arise because we -- a function of our state of knowledge. So the statement we're making is that if you're going to use a PRA model to help you make decisions, then you need to understand exactly what that model does.

That means you've got to understand the scope and the level of detail that's inherent in the model you've constructed, and you've got to understand, too, that this is a model that has -- we're looking at rare events.

It's not a model that you can validate or verify. It's -- and we know that there are uncertainties on how to model the phenomena and the equipment behavior that we have to model in the PRA.

The last -- well, the last of the second order of bullets on this slide says the scope and level of detail are at the discretion of the analyst. To some extent, that's true. But to a large extent, if an analyst tries to build a PRA model and meet the ASME standard, for example, then he is going to have a certain defined level of detail. It's going to be detailed enough that the dependencies are modeled correctly, for example.

But it doesn't tell you how many systems you need to model to address a specific function. So if you're in a boiling water reactor, for example, you have all sorts of low pressure systems. This standard does not tell you that you have to include all those systems. It's really up to the analyst to decide how many he decides to --

CHAIRMAN APOSTOLAKIS: But, Gareth, this sub-bullet gives the impression that there is a lot of arbitrariness there. Isn't it better to say that the scope and level of detail are dictated by the needs of the decisionmaker?

MR. PARRY: Yes, actually. And that --

CHAIRMAN APOSTOLAKIS: That really is the accurate statement. The decisionmaker --

MR. PARRY: And that is exactly what we state in the --

CHAIRMAN APOSTOLAKIS: I'm sorry?

MR. PARRY: That is what we state in the report. This is --

CHAIRMAN APOSTOLAKIS: Why are you trying to mislead us with the slides? This is the second time you are saying the slide --

MR. PARRY: Actually, I'm not really done listening to --

CHAIRMAN APOSTOLAKIS: You want to see if we are paying attention?

(Laughter.)

MEMBER BONACA: The text has some of the same message, and you get a message that there is a level of arbitrariness, that, you know, you get a sense that -- and it probably is true, that, you know, in most --

CHAIRMAN APOSTOLAKIS: No, it's not true.

MEMBER BONACA: -- the model built by another individual could have -- what bothered me was that it could have significantly different results, and that's really what bothered me.

MR. PARRY: Okay. But that's -- but what we do say in there is that we don't expect those differences to lead to major differences in the results, because the fact is that if you are going to build it according to the standard then you do have a certain amount of --

MEMBER BONACA: In fact, at some point you get to that point there.

MR. PARRY: Right.

MEMBER BONACA: As I was reading, however, I really had a sense that -- I said, well, there is no -- so I think that maybe if --

CHAIRMAN APOSTOLAKIS: If it is decisionmaker -- decisionmaking focused, the whole thing, I think you should say that here, too.

MR. PARRY: I think in the text we do say, in fact, that the level of detail is determined --

that you need is determined by the decision you are trying to make using the PRA.

CHAIRMAN APOSTOLAKIS: Why not say it in the slide, too? It's not at your discretion.

Now, the direct verification issue, I know where you're coming from, but I think you should elaborate a little more and say, you know, we are looking at the past experience of 30, 35 years. The accidents or the incidents that we have seen are in the PRA one way or another. Maybe not the details, but they are included.

The AEOD, or the former AEOD, is doing all of this analysis over the years with Idaho, and unavailabilities of safety systems or the unavailabilities in the PRA. You know, there is -- I mean, it's not as bad as it may sound.

MR. PARRY: This is a lesson that I should have learned from my past appearances here.

(Laughter.)

I shouldn't write anything on viewgraphs, because you focus on the words that are there rather than the message that we're trying to do in the report. Let's move on to the next slide.

MR. KRESS: Well, let me ask you a question.

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

MR. KRESS: Go ahead.

MS. DROUIN: I mean, if you look at the report, the report does say the analyst constructing the PRA model determines its scope and level of detail. And you have to understand, it's an iterative process. When the analyst is first developing the PRA model, he doesn't know all of the different applications. And he is going to make a decision on the scope and level of detail.

Then, the decisionmaker comes in and the PRA scope and level of detail may not be sufficient to support, and then you have a decision to make. You know, now do you expand the PRA so that it does cover that? Can it go to the scope and level of detail? The decisionmaker needs to make -- I mean, it --

CHAIRMAN APOSTOLAKIS: But what's the PRA I will be talking about? The PRA that is actually used in a decision.

MS. DROUIN: That's right.

CHAIRMAN APOSTOLAKIS: Because I have seen over the years, you know, especially people who want to be critical, they pick a number from some exercise how bad it did, and say, "Well, there is no basis for this. The whole thing is garbage."

The real question is: has any responsible decisionmaker, like the Nuclear Regulatory Commission, has it ever made any decisions using those garbage numbers? And the answer is no.

So it really has to be repeated all the time that it's decisionmaking that drives the needs of the model. Anybody can do something according to a PRA. That's not a PRA in the sense that we are talking about here. It's a PRA that will actually be used to make a decision.

MS. DROUIN: But all I'm trying to say is that the initial decision when you've got that blank piece of paper, and you're going to create your PRA model, you don't know the decisions that are going to be used with that model.

CHAIRMAN APOSTOLAKIS: But the ASME model -- standard tells me that there will be a Category 1, Category 2, so you have some idea.

MS. DROUIN: No, no. The category --

MR. PARRY: Not the level -- well, not to the level of detail in terms of how many systems you take credit for, for example. Well, no, it -- we address that.

CHAIRMAN APOSTOLAKIS: Jack?

MEMBER SIEBER: I think one of the

weaknesses is in the model uncertainty. For example -- I can give you a couple of examples. One of them is a pump that is supposed to perform to deliver water to a certain vessel under certain pressures and temperatures and flows. That pump may be degraded, and from an operability standpoint it's considered inoperable.

And at the other end of that, we don't know for certain what the conditions truly are that the pump is pumping into. So that represents -- if you just say, "If it's operable, then it's a success. If it has a failure probability, that means it's not operable and it fails." Those things are too simple in order to make a discrete decision about, for example, can you supply water to the core under accident conditions.

And I think that this document, even though it's designed as a -- to me it's an overview kind of a document, it touches on these things. But if a plant manager assigns somebody to do the PRA, and then he turns around and says, "I want to make decisions based on that," it very well could be that neither the plant manager or the PRA person knows the intricacies of how to model certain events in the plant.

CHAIRMAN APOSTOLAKIS: Well, yes, that's true.

MEMBER SIEBER: On the other hand -- and so there may come under 1.174 decisions about whether it's okay to modify the plan. And to me that's -- you know, I think the state of the art has to have standards that are more concise and more complete than what this document, and also what the PRA standards are.

CHAIRMAN APOSTOLAKIS: But my point is that when the plant manager, in fact, wants to make a decision using that model, that's when these questions come up. That's when some of the analyses that the staff is proposing under model uncertainty could be done, some sensitivity work, if this or that, and to me that is that PRA.

It's the tool that is used by somebody to make a decision, because before that, you know, it's just an analysis that is sitting there waiting to be used by somebody.

MR. PARRY: Actually, when we get to slide 14, you'll see the statement that --

CHAIRMAN APOSTOLAKIS: Okay. So this is now 13?

MR. PARRY: We'll go to 13, and then we'll get to that point again.

MS. DROUIN: Okay.

MR. KRESS: Let me ask you a question before you get there, Gareth. It's a simple question.

CHAIRMAN APOSTOLAKIS: Unlike the other --

MR. KRESS: Yes. They're complicated.

MS. DROUIN: Tom, you have a simple question?

MR. KRESS: Okay.

MS. DROUIN: We'll raise the flag.

MR. KRESS: Be wary when a Tennessean says this is --

(Laughter.)

I'm a decisionmaker, and I want to make a decision involving the mean of a CDF. I've got a PRA of limited scope. It doesn't have seismic, it doesn't have fire, and it doesn't have low-power shutdown, and I've got a CDF out of it.

Now, what my -- my decision is involving the mean value of a CDF. Now, how do I take these missing elements, translate them into some sort of an uncertainty, and move my -- how do I know how to move my mean to a different value? Is this not discussed in the report.

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

you can't say anything about it.

MR. KRESS: Well, you --

MR. PARRY: We discuss a little bit what you do if you don't have those analyses, and you can -- it wouldn't be a good example for your case. You'd have to restrict your decision to the information that you know.

MR. KRESS: What I do know is people have made estimates of the effect of fire and estimates of low power and shutdown. And these are -- these are some sort of estimate on the effect on the means for specific plants. I have information, and is there a way to --

MS. DROUIN: I don't think that you can do an estimate of how those things may affect that mean. You just can't. But what you can do, and what we get into in that chapter on completeness, is you can use information in terms of what effect that may have on your risk in terms of bounding it. But in terms of the impact on that number for your Level 1 CDF, I don't see where --

MR. KRESS: That may be the question. If I can use these and say that -- I can change my mean to a value that I know bounds it, then that's --

MR. PARRY: Yes, we do discuss that.

CHAIRMAN APOSTOLAKIS: There is a discussion on completeness.

MR. PARRY: Okay.

MS. DROUIN: But I'd like to come back and say something about the standard in all of this. The standard tells you, you know, what to do, and it goes to a certain level of detail. But the standard recognizes that the scope and level of detail, as dictated through their requirements, may not be sufficient for every application that's out there, and that's the whole purpose of Chapter 3.

And it's not until -- so that's what I'm saying. A priori, when you are doing your PRA and establishing that level of detail, you may not have established a level of detail adequate enough for a particular decision you're making. And Chapter 3 walks you through how you come and make that determination.

CHAIRMAN APOSTOLAKIS: Chapter 3 of this report?

MS. DROUIN: Of the standard.

MR. PARRY: Of the standard.

CHAIRMAN APOSTOLAKIS: ASME standard.

MR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: Yes.

MS. DROUIN: So, I mean, ultimately the decisionmaker, you know, is going to have a need he's going to have to have fulfilled. But 99 percent of the time that comes after, you know, he already has the PRA model.

CHAIRMAN APOSTOLAKIS: So I think it would be helpful in the introductory part of the report to state which PRA you are talking about. You are talking about a general model that may have a number of applications, right? Rather than the PRA that will be used for a specific application.

MR. PARRY: No, I don't think so. I think we are talking about a PRA model that is being used for the -- what we're really talking about is the use of PRA results in decisionmaking. If that means that you have to go back and refine the model, then that's what you'd have to do. We are really talking -- what we are really addressing here is how you use the results in decisionmaking, and how the uncertainties in the results affect that decisionmaking.

MS. DROUIN: Well, we do get into -- and you'll see in the words -- you know, we talk about the base PRA. And maybe we need to expand more. But when we talk about the base PRA, that's the PRA you're starting with.

CHAIRMAN APOSTOLAKIS: That's what I mean.

MS. DROUIN: You may refine --

CHAIRMAN APOSTOLAKIS: For individual decisions. So this is more --

MS. DROUIN: That's right.

CHAIRMAN APOSTOLAKIS: -- like when -- in the -- about 20 years or so ago, you know, like various companies would do the PRA for Seabrook, the PRA for Indian Point. I don't think they had a specific decision in mind. They did the PRA --

MS. DROUIN: Exactly.

CHAIRMAN APOSTOLAKIS: -- and that's what you're talking about.

MS. DROUIN: That's what I'm talking about.

CHAIRMAN APOSTOLAKIS: And a specific decision you may go back and question some success criteria or do something more on human error, and so on.

MEMBER BLEY: But once you do that, if you follow that process, you've got a new base.

MS. DROUIN: Then you have a new base.

CHAIRMAN APOSTOLAKIS: For that decision.

MS. DROUIN: For that decision.

MEMBER BLEY: Well, if you've extended the scope of the PRA, you've now got a new PRA. If you've actually had to -- if you didn't just do a bounding analysis, but you went back and expanded your PRA to cover the issue.

MS. DROUIN: That's true. You have created a new base PRA model, yes.

MEMBER BLEY: But you'd probably keep --

MEMBER SIEBER: There is nothing that makes you do that except your own sense of professionalism.

MEMBER BLEY: And your desire to apply it to a particular --

CHAIRMAN APOSTOLAKIS: Well, and the state-of-the-art changes, you know. That's why people, you know, you see PRA Rev 3, you know, over the years. It's updated.

MEMBER SIEBER: My impression may be wrong, but when PRAs first came out, if you tracked individual plants, the risk has declined and I think it has declined because the PRAs have become more sophisticated and the modeling has become better.

CHAIRMAN APOSTOLAKIS: That's a significant contributor, but also there have been other changes in the plants themselves.

MEMBER SIEBER: Yes, there at the plant

and --

MR. PARRY: And as you add the different scope items like fires, the PRA -- the CDF goes up again. So it's --

MEMBER SIEBER: Yes, right.

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

MEMBER SIEBER: Yes, but that's explainable.

MEMBER CORRADINI: I have a different question. So when I read Chapter 3, is it -- is the audience for this somebody who is doing PRAs and needs to understand the context you want the PRA to be done in? Or is it -- the audience somebody that is learning to -- beginning to learn the PRA process?

CHAIRMAN APOSTOLAKIS: This is not a tutorial, is it?

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

MEMBER CORRADINI: So it's basically for those that are using it.

MR. PARRY: Yes.

MS. DROUIN: Yes.

MEMBER CORRADINI: For experts.

MR. PARRY: Right.

MEMBER CORRADINI: Okay.

CHAIRMAN APOSTOLAKIS: Okay. Let's go on.

MR. WALLIS: Wait a minute, wait a minute, wait a minute. You've put something up here. An accident sequence is simplified discretized representation.

MR. PARRY: Yes.

MR. WALLIS: How much uncertainty is introduced by discretization? I mean, the idea that one pump or two works or doesn't work? It's a big simplification, right?

MR. PARRY: Yes.

MR. WALLIS: There must be some uncertainty introduced by the very fact that you're discretized.

MR. PARRY: That's why --

MR. WALLIS: Do you know how to handle that type of uncertainty?

CHAIRMAN APOSTOLAKIS: Let the man speak for just a minute.

MR. WALLIS: Do you know how to handle that type of uncertainty?

MR. PARRY: That's the whole point of --

MR. WALLIS: Is there a technology when -- you can't treat one and a half pumps, apparently. Or can you go back to the PRA and say, "We redesigned the model, so we can treat one and a half pumps working, not just one or two"?

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

MR. WALLIS: So how do you estimate what you lose in terms of precision by discretization?

MR. PARRY: I think what we do is we learn to live with the lack of precision. And the whole point of, really, this slide and the first bullet is that, in fact, it's a recognition that the PRA model is not the complete model of all of the --

MR. WALLIS: Well, I'm not asking that. I'm asking, how do you estimate or measure the uncertainty associated with this?

MR. PARRY: And that's why I'm going to try and tell you that we really do not --

MR. WALLIS: Do not, okay.

MR. PARRY: In the sense that discretization tends to be somewhat conservative, right, we lump things together in terms of like if -- for example, if we had a -- group initiating events, we don't treat each initiating event separately; we group them.

And the rules for grouping them are that you group them so that things that are subsumed within the group have the dominant -- the dominant contribution of that group comes from the things that bound the consequences of the initiating events that are absorbed within that group.

MEMBER CORRADINI: Can you say that again, please?

MR. PARRY: I'll try to.

(Laughter.)

MEMBER CORRADINI: It looks like you tried to formulate -- so I want to make sure I understand.

MR. PARRY: The way we do grouping is to make sure that something that's grouped into that group does not have a worse --

MR. WALLIS: You are being conservative. So being conservative isn't the same thing as understanding uncertainty. To be conservative is sort of philosophy.

MEMBER SIEBER: Well, you're blowing by. Uncertainty --

MR. PARRY: Okay.

MR. WALLIS: All right.

MEMBER SIEBER: -- comes through an answer.

MR. PARRY: Would you hold off and let me try and talk through this? Because it is a significant point, and it relates to -- it has ramifications throughout a lot of the stuff that we've been discussing outside of this context, in particular in combining the results from different scope items. Okay?

So all we're saying here is: what is the PRA model? Well, first of all, it's the second discrete accident sequences, right? With success criteria that are stated quite -- it's either one pump or it's two pumps. It's things like that.

Another thing that we have to recognize, because it's relevant later on, is that this model has -- it's a nested set of models, if you'd like. Right? You build accident sequences, and the way you quantify the probability of the function lost for those functions that appear on the event tree is through models like fault trees. Those at the bottom have basic events in them.

So we have lots of models for these different basic events. So it's a nested set of models that's essentially probabilistic.

Okay. When you construct a model, right, you make certain assumptions. And we've been very careful to try to make the distinction between assumptions that are related to the scope of the PRA model or the level of detail. Now, and those that relate to model uncertainty, okay?

The ones that relate to the level of detail are the types of things that you are talking about. Okay? And a lot of those things are conservative assumptions that we've built into the model. So we have to recognize that some of the results we are producing are conservative.

So that's the distinction we're trying to make there. We're trying to talk about things that are really -- they're done to make the model tractable. There are other things that we -- assumptions we make because, well, maybe we're not -- we don't have a detailed understanding of some of the phenomena, so we have to make assumptions of how we are going to model those. Those are different, and those are the types of things that probably we're going to go after in this document.

There are other things in this -- when you're characterizing the PRA model, which we wanted to talk about which was scope. And by "scope," in this context we mean what risk metrics is it dealing with? And in our case it's typically dealing with CDF and LERF, but it could be dealing with a complete Level 2, we could be doing a Level 3.

But, really, in this document we're

focusing on CDF and LERF. And I believe that's the focus of the EPRI work, too.

The other elements of scope are things like the plant operating space. Currently, we are really focusing on full-power operations, and that is, again, the focus of the EPRI work. Eventually we will get to doing things like low power and shutdown, but that's a little way off.

The other aspect of this is: what initiating events are -- I think a term we have actually been crafting these days is hazard groups, which relates to, for example, are we dealing with internal events? Are we dealing with external events, such as earthquakes, high winds? Are we dealing with internal hazards, like fires or floods? Okay. So the scope is determined by these three assets, if you'd like.

Now, if we can flip to the next --

MEMBER CORRADINI: So can I just ask a clarification?

MR. PARRY: Yes.

MEMBER CORRADINI: Yes, that's very helpful. So to go back to the one that you're not doing, which is the one on the level of detail, which is inherently conservative --

MR. PARRY: No, not the level of detail. Well --

MEMBER CORRADINI: I'm sorry.

MR. PARRY: -- the discretization.

MEMBER CORRADINI: Discretization, excuse me.

MR. PARRY: Well, it's related to level of detail I guess.

MEMBER CORRADINI: Okay. But just for my understanding, then, you know it's conservative because you've done some sort of calculations so that you know -- you think two pumps are going to perform like this, but there is uncertainty in how they perform, so you're going to cut the line here and start a failure above -- above the thing.

So in some sense you've already built in a calculation, or you've done a sensitivity to know where you draw the lines.

MR. PARRY: No, that -- okay, that --

MEMBER CORRADINI: I mean, isn't that what you mean?

MR. PARRY: No, that's not quite what I mean.

MEMBER CORRADINI: Well, that's part of what you mean. I mean, what you're saying is I could have half a pump, which means instead of pumping a 300 gpm I'm going to pump 150 under these weird conditions, but I'm going to call that a failure. So I have the pump curve, and the pump curve behaves like this. And if it doesn't put out with this delta P and at this flow rate, I'd call it a failure.

So I've done some sort of calculation and manipulation and decided that conservative -- you use the word "conservative," which I think is what I understood it to mean, which is above this point it's a binary. It's go/no-go. And I need two of those to make it work, and I have only one of them. It doesn't work.

MR. PARRY: Right.

MEMBER CORRADINI: So is that -- I'm going back to where he started.

MR. WALLIS: Well, this goes on forever. I think this is good, but the bottom line is, when you tell me the CDF is 10^{-6}, because you've got conservatives in there, you're really telling me it's less than 10^{-6}.

MR. PARRY: Right.

MR. WALLIS: Is that what the conclusion should be?

MR. PARRY: Let me --

MR. WALLIS: Is that it? Because of these conservatisms, it should be less than --

MR. PARRY: We're going to get into a discussion at some point, if we get there --

(Laughter.)

-- that will -- one of the things that you, as an analyst, have to provide to the decisionmaker is a characterization of the results that you have. If you believe it's conservative because of the way that you constructed the model, then you need to be able to say that. If it's conservative and still allows the decision to be made, then I think we've done enough.

If it's conservative and it creates a question as to whether the decision should be made, then one solution is to refine the model. And that's one of the options that you have.

CHAIRMAN APOSTOLAKIS: If the discretization is judged to be too gross -- for example, LOCA -- then people question it and the PRA is changed. That's why there is a small LOCA, there is a medium LOCA, there is a large LOCA. In some PRAs, there is an excessive LOCA.

So there is a lot of thinking that goes into this discretization. But now to say, you know, this particular pump, what exactly does "failure" mean, and does it supply the actual number of gallons per minute, I would say that's a detail that really doesn't affect the conclusions much.

MR. PARRY: I think you're right, and I think yours is a better example of how --

CHAIRMAN APOSTOLAKIS: Yes. The initiative events -- the LOCAs, for example, I think is a good example --

MR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: -- where the discretization was revisited because of the physical and chemical, whatever, reaction of the plant to various LOCAs. So now, let's not forget that you also have the failure data, because at some point you will use a failure rate for that one.

So, you know, when they tell you that, yes, over the last 152 tests it failed two times, you usually don't have a way of finding out what they actually mean. I mean, they probably mean that they didn't supply the gpm that you needed. But exactly what the number was and this -- I mean, this is lost in the detail, and I don't think that that's an important topic.

MEMBER BLEY: But you kind of hit on the

key I think, and I think it's covered in here, if I look around. But it isn't -- doesn't hit me right off the bat. And an easy one to stay with is the discretization for me.

When you look at your results, if you're getting major contributions from those place where you set up the discretization and it's clearly the source of the problem, the source of -- if it's a high number, whatever, larger contributor, it's almost incumbent on you to address that, or at least, as Gareth said, to present it to the decisionmaker.

As I read Chapter 3, it kind of left me with that as a gap. As I read later things, I see ways to fix that gap. And I'm just wondering if, you know, the report needs something up front to say you can address these. These are addressed in --

CHAIRMAN APOSTOLAKIS: One other --

MEMBER BLEY: But I think that's a key thing.

CHAIRMAN APOSTOLAKIS: All right. One other thing that is I think outside the scope of your work, but it's something that has bothered me over the years. Every time we talk about the limitations or the approximations that a PRA does, we seem to lose sight of the fact that if you didn't do this, you would do something much worse.

When he puts up there, you know, the accident sequences, and so on, it's a PRA that introduced the accident sequences. In the traditional system, we have those stylized design basis events, and we don't really even both to look at these things. See what I'm saying? That we -- sometimes we tend to focus on the details, and we're missing the big picture that this is a tremendous advance. the fact that you are developing these sequences, in fact thousands of them, is really a great benefit of doing a PRA.

Now, whether, you know, I have modeled a pump failure exactly, as Mike says, is the line here or somewhere else, in my view that's a detail that really doesn't matter. When it matters is, in the LOCA example we are actually taking action.

MEMBER SIEBER: But that is consistent with the old -- the deterministic way of doing business. If the pump didn't achieve a certain pressure and a certain flow, the pump was inoperable, and that didn't take into account the fact that it might have fulfilled its mission. You had to take it out of service, overhaul it, do whatever you have to do.

CHAIRMAN APOSTOLAKIS: Good.

MEMBER SIEBER: And so if anything, PRA can give you a little bit more latitude.

CHAIRMAN APOSTOLAKIS: Exactly.

MEMBER SIEBER: But I'm convinced that the only thing worse than PRA, as far as decisionmaking is concerned, is deterministic methodology.

CHAIRMAN APOSTOLAKIS: Good. Let's move on. Let's move on. This is a good point.

MR. WALLIS: This has been a very good discussion, but I'm not sure that it is conservative because you've got things down the road. I mean, you're saying the pump works or it doesn't work. That's fine, to be conservative about that. But then, the operator has to make decisions down the road based on what he sees. And if the PRA tells him the pump is working or not working, what the plant is doing is giving him symptoms which may indicate the pump is partially working.

Now, his decision based on what he sees may be worse than it would be if he really knew it was not working. Do you see what I mean? I mean, if the PRA says it's not working, then the operator knows what to do. If there are mixed symptoms, because it's sort of partially working, or intermittently working or something, this may lead to bad decisions by the operators. It's not clear that you are being conservative when you assume it's yes or no.

MS. DROUIN: But the operator wasn't saying that you -- that it was ultimately conservative to the overall result. That decision, in and of itself, is a conservative decision, but it doesn't mean that as -- it translates through, because you've got many other decisions that you're going to be making in developing that PRA model that could offset that conservative aspect in the model.

MR. WALLIS: Yes, that's right. It could offset it, right. So you don't really know they're conservative.

MS. DROUIN: That's right.

MR. WALLIS: Thank you.

MEMBER BONACA: Yes. I think Graham is right. I mean, in deterministic analysis when you do a LOCA, you don't do it to see what really a transient looks like. You do it to determine whether or not your ECCS is sufficient, if it's adequate, all that kind of stuff.

So you have a very different goal. In this particular case, you are trying to predict events, etcetera, so you may have some ambiguous scenarios out there. But I don't think that, then, they will be significant to the results, because you do have a spectrum of evaluations that covers the bound.

CHAIRMAN APOSTOLAKIS: Okay. Why don't we move on to --

MR. PARRY: Let me add just a little bit to that, though, what Graham was talking about. Again, another aspect I think of what we call discretization or simplification is that we tend to make assumptions in the PRAs like that when a system is demanded -- we don't model the real time at which things occur in the sense that, you know, pump A might fail 10 hours into the incident.

We tend not to do that. We tend to say, "Okay. I'm going to assume the pump failed, and it failed at time T equals zero," which sort of tends to put a premium on the time for response for the operator, for example. But you're right in the sense that partial information and misleading information could lead the operators to make errors of commission, and that is an omission in current PRAs that we recognize.

So there is that aspect, and that's one of the issues of completeness that we in fact recognize.

MEMBER SIEBER: But that's not as significant as it may appear to us, because the operating procedures are totally deterministic. And they take the worst-case event, and they add margin to the extent that they can.

MS. DROUIN: Right.

MEMBER SIEBER: So you can mess up your PRA, and the operators are still going to do the same things they did before. The only thing that is different is that he makes an error in following his procedures, or her procedures.

CHAIRMAN APOSTOLAKIS: Okay. Slide 14.

MR. PARRY: Okay. Wait a minute. No, no, go back. 14.

CHAIRMAN APOSTOLAKIS: Let's go back to slide 5.

MR. PARRY: No.

(Laughter.)

MR. PARRY: There's one thing we didn't discuss, and there's an important thing that --

CHAIRMAN APOSTOLAKIS: What is it we did not discuss?

MR. PARRY: Okay. All right. So we mentioned level of detail. We don't go -- we won't belabor that point, but I will put the second -- point you to that second bullet is that -- on the second part of that and it's "and driven by the projected use of the PRA." Okay? That's the level of detail that is -- which is --

CHAIRMAN APOSTOLAKIS: Which is what I said earlier.

MR. PARRY: It's what we discussed.

Okay. But this is relevant for the next topic, which is combination of results. And this is -- this is a subject formerly known as aggregation. This is when you take the results from, say, an internal events PRA and a fire PRA and a seismic PRA, and try and meld them into one single result.

It's very important to recognize that the models for these different scope items are going to vary in levels of detail and conservatism, vary in lots of different ways. I'm talking about fire analysis, for example. They use different screening approaches for determining which of the fire -- physical analysis units are going to be addressed in detail. And there are different levels of approximation.

Okay. And the message we want to get across in this is that it's not simply -- you can't just simply add the results from different PRAs and be happy with it. You have to understand the pedigree of all of those different parts. And this is I think particularly important if you think -- this is a little off topic, but getting into the -- moving into the area where we're going to be doing NFPA 805.

A lot of the licensees are going to be transferring to NFPA 805. They are going to be building fire PRA models to do that. Those fire PRA models, they will be perfectly adequate for NFPA 805. But if they, then, try and use them in something like Tech Spec Initiative 4B, they may find that, in fact, they don't have enough level of detail, and that the conservatism that has been put in the model to deal with 805 is going to come back and bite them.

So it's an -- the message we're trying to get across here is that, really, that you have to be very careful. And actually, it's probably even worse in fires, because you might be -- for different physical analysis units you might have different levels of detail in one versus another, even though they perhaps contribute the same to core damage frequency.

But we'll come back to that a little later on, because that's important for --

MEMBER BONACA: I have a question. You

know, here again, you have a bullet where you talk about the discretion of the analyst. So when I was reading that in the text, I got an impression that you may have significant differences based on the choice of the analyst that he may make or not make, and I don't believe that.

But one thing that was occurring to my mind was that you in PRA have looked at SPAR models of a lot of plants for which there are already PRAs, and they have compared those PRAs. You have adapted them. You have come up with certain results.

MR. PARRY: Right.

MEMBER BONACA: It would be interesting at some point, if not part of this document, but maybe as part of this document, too, to have an appendix that brings up some of the lessons learned. Have you seen an enormous variability of results, for example, or conclusions from an approach where you have different analysts using different models doing the same analysis to come up with a model and reach certain conclusions? Because you have also conclusions drawn from these comparisons.

I think there is a mention somewhere in the report, in fact, that what -- I think it would be valuable for us to understand it.

MR. PARRY: Okay. I think -- but that -- it's true that I think we have to recognize the two -- there are two different aspects of that. One is, if they're using different models -- like, for example, if they're using different models for success criteria --

MEMBER BONACA: Yes.

MR. PARRY: -- that's a model uncertainty issue in the way we characterize it here. Level of detail would be more, for example, as I mentioned, does a person modeling a boiler water reactor, does he take credit for enhanced CRD flow versus somebody who doesn't? Because typically the core damage frequency for boiling water reactors is pretty low.

Adding in the CRD flow from many sequences is not going to make a big difference. And I think the point that we're trying to make in this is that we don't expect those level of detail type of issues to create significant details, differences between the different models. Certainly, not when compared with differences in the determination of success criteria, for example, which can make big differences.

MEMBER BONACA: Yes, my question was whether, in a sense, that at some point maybe outside of this effort here, it would be interesting to know the lessons learned from the problem where you have -- you have 70 models out there that you are comparing.

MR. PARRY: Doug wants to make a comment.

CHAIRMAN APOSTOLAKIS: State who you are, please.

MR. TRUE: Yes. Doug True, Engineering, one of the EPRI contractors working on the industry side of things. There has been some good work done in comparing the SPAR models with industry models, and there were a set of insights developed and documented by research on that topic. And that was actually part of the input to the work we've been doing to help try and identify areas of model uncertainty that we should be aware of in application.

So we've brought it into our document and incorporated those in our work.

MEMBER BONACA: What document are you referring to?

MR. TRUE: I think actually Pat may need to answer that, but there was -- I was part of the MSPI benchmarking work that you guys did. Is that when you did it, Pat? Yes. And then, there was a RIC presentation that Pat gave in 2005, '06.

CHAIRMAN APOSTOLAKIS: This year.

MR. TRUE: This year, '07, 2007.

MEMBER BONACA: Could we get a copy of that?

MR. TRUE: The RIC presentation?

MEMBER BONACA: Yes.

CHAIRMAN APOSTOLAKIS: RIC is -- yes, we can get it. I'm a little -- I'm sorry.

MEMBER BONACA: I want to elaborate on that just --

CHAIRMAN APOSTOLAKIS: I'm a little concerned we are spending too much time on generalities, and I really want to focus on specific guidance that --

MR. WALLIS: I wanted to ask about -- you brought up aggregation, which I think is an important issue here. If I have these internal events for seismic, if I knew something about the bias and uncertainty associated with each one of them, I might know something about how to put them together. Are you going to end up with some measure of bias as well as uncertainty in your uncertainty discussion here?

MR. PARRY: No, not -- not --

MR. WALLIS: Because I think we have the sort of feeling that the five PRAs were all -- they are too pessimistic by a factor of 10 or something. But is there some way to estimate that better than just in a gut feeling?

MR. PARRY: No, and I don't -- I don't think that that is our intent.

MR. WALLIS: Isn't that a big part of the uncertainty is in the bias of these --

MR. PARRY: If the result that you're getting from the PRA doesn't help you make a decision, then you're going to have to do something about that bias.

MR. WALLIS: But you don't have any measure of it, or any --

MR. PARRY: No, you can't -- until you redo -- until you refine the model, you will not have an estimate.

CHAIRMAN APOSTOLAKIS: So as I say, we are spending too much time on high-level questions. If we could -- I really want to get into the specific guidance --

MR. PARRY: Okay.

CHAIRMAN APOSTOLAKIS: -- parameters, models, and risk-informed decisionmaking. So if -- please, if you have questions, maybe you can try to ask them when the actual guidance is discussed, because, you know, we can talk forever about the high-level stuff.

MR. WALLIS: But they never mention bias in there.

CHAIRMAN APOSTOLAKIS: But we can raise it when it comes to models, for example. But in that context, I think it will be more meaningful.

MR. PARRY: Okay. The next slide, I'll go through it very quickly.

MEMBER SIEBER: Well, let me just say a couple of words about screening. Screening is slide 14.

MS. DROUIN: We are already on 15.

(Laughter.)

MEMBER SIEBER: Whatever.

CHAIRMAN APOSTOLAKIS: What's the question?

MS. DROUIN: I'm sorry.

MEMBER SIEBER: No, I asked you to say --

MR. PARRY: Oh.

MEMBER SIEBER: Because you can screen -- if you have a lot of moderate things, you can reach a threshold where you can screen them out in combination, and you can --

MR. PARRY: Well, I think what it was referring to here, really, was not so much screening things out as using screening approaches to determine how much detailed analysis you would do. It's really -- it's really a screening to determine a level of detail is what I was referring to here.

So you'd keep the result in, but you'd know it would be a conservative result, even though it might be quite low.

MEMBER STETKAR: Gareth, let me ask you about that, because unfortunately, George, I have to apologize, but there isn't much detail in the rest of the slides. So since you brought up screening, what I wanted to ask is, since you're writing a document in let's say the year 2008, is the purpose of this document to provide guidance for the state of the art, let's call it, in risk assessment technology, let's say early 1990s as applied to existing PRAs for existing nuclear powerplants in the United States? Or is it a document that is supposed to be used by PRA practitioners, for example, in the year 2009? Let me ask you that first.

MR. PARRY: I don't see why not.

MEMBER STETKAR: Okay. Screening, then, and your approach to screening is all wrong, because you -- you emphasize very strict, absolute numerical quantities throughout the document. I see $1E^{-6}$, I see $1E^{-7}$, which have developed a methodology in the United

States.

MR. PARRY: But wait a minute.

MEMBER STETKAR: Wait, let me finish. Those screening criteria are completely invalid when I see results for newer designs that publish total -- total core damage frequencies on the order of $1E^{-7}$ from all contributors.

MEMBER SIEBER: They did a better job of screening.

MEMBER STETKAR: Okay. It's just a point that when you're writing this document, you should be extremely sensitive when you discuss screening, and especially sensitive when you emphasize the use of absolute numerical values, because people are going to use that. People are going to refer to this document in the year 2010 and say, "NUREG-1855 says I don't need to worry about this, because I can show it's less than, you know, $9E_{-7}$ or something."

MR. PARRY: I don't think they're reading that correctly, John.

MEMBER STETKAR: Okay.

MR. PARRY: And maybe you're not reading it correctly either, because I think that -- we don't talk criteria in here. We don't put screening criteria as criteria. We put them as examples of things that have been used.

When we're talking about the acceptance guidelines -- and the examples we use in here are from Reg. Guide 1.174 -- they are there for examples, but those guidelines are for operating reactors for making license amendments. There is a discussion going on as to whether that should apply to new reactors.

MEMBER STETKAR: Okay.

MR. PARRY: That's a different issue. We're not proposing this as the criteria that you use. We're trying to demonstrate how you make a decision given that those are the criteria that you have been given.

MEMBER STETKAR: Granted. And I recognize that. But to be somewhat provocative, the problem is that when -- the problem is that when people look at examples that are cited, they tend to take on a life of their own. And I didn't see enough cautions.

I recognize what you're trying to do, and what you're trying to do, when I read the words, is fine. The problem is all of the examples -- there are not enough cautions in there to say that when you apply these types of screening decisions you need to do it within the context of whatever models, analyses, and things that you have in hand.

In other words, it's a relative decision, and your examples are drawn from, you know, let's say early '90s thought processes with those kinds of numbers.

CHAIRMAN APOSTOLAKIS: Okay.

MR. PARRY: Just recognize that. That's only the point I'm trying to make.

CHAIRMAN APOSTOLAKIS: Can you go to slide 16?

MS. DROUIN: It's Chapter 6.

CHAIRMAN APOSTOLAKIS: Slide 16, please.

MS. DROUIN: Let me --

CHAIRMAN APOSTOLAKIS: We don't need to know what parameter uncertainty is. Can we go to like slide 16? I really want the discussions to be later on when you talk about various specific things, because this can take forever.

MS. DROUIN: Right. No, we'll jump to Chapter 4. My question is, George, when were you planning on a break? Do you want to do a break before we get into Chapter 4, or go to Chapter 4 --

CHAIRMAN APOSTOLAKIS: We can do it now.

MS. DROUIN: I'm asking --

CHAIRMAN APOSTOLAKIS: This sounds like a good time, so we'll break until, what, 10:25.

(Whereupon, the proceedings in the foregoing matter went off the record at 10:07 a.m. and went back on the record at 10:25 a.m.)

CHAIR APOSTOLAKIS: Okay. We are back in session. There is a request to move to Chapter 5 now because one of the presenters is catching a plane, and then we'll go back to Chapter 4. I hope it's not Mary. Mary always stays to the bitter end. Okay. So you guys tell us about model uncertainty.

MS. DROUIN: Okay. Tim Wheeler is now going to take over from Sandia. Tim is the one that has to leave at noon time, and since it looks like there's a good probability that we won't finish by noon, we want to make sure that Tim can get through his presentation.

CHAIR APOSTOLAKIS: Okay.

MR. KRESS: What's the uncertainty on that?

CHAIR APOSTOLAKIS: Guys, let's go. Please.

MR. WHEELER: Thank you very much, and I think according to the instructions of the Chairman this morning at the beginning of the meeting, I should introduce myself. I'm Timothy Wheeler from Sandia

National Laboratories.

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

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

The reason for this is that this was a problem that came out of the standard, and people understanding what is meant by a source of uncertainty, and by a key source of uncertainty. And if you look at the PRA standard right now, the standard in terms of Rev 1 tells you to identify, and then you have to do some analysis, sensitivity studies on your key sources of uncertainty.

Well, that's almost an impossible task to accomplish, because then you're trying to find what you mean by "key", and it's just almost impossible to bound what you mean by that. And you really need to do that in the context of the application. It's what is key in terms of what could influence your decision. Therefore, what could influence the acceptance criteria that you're using, so key really becomes important in terms of an application.

In terms of the standard and what you can do there on your base PRA, now we're going back to the base PRA, not the PRA that you may use for your decision, there's just no way, and it becomes, as I said, very difficult to identify what your key sources are. And you really don't need to do that for your base PRA.

What you really need to do for your base PRA is know what the sources of uncertainty are, and what are their potential impacts. And I don't mean from a quantitative perspective. Understanding it, is this source of uncertainty going to change your accident sequence? Is it going to change your success criteria? Is it going to change what your initiating events are? So understanding where your sources of uncertainty are, and how they could influence the model, not the degree to which, or the extent, but just where they would influence is what you really need to know from the base PRA.

So we have been having a lot of discussions on this. We had a public meeting, and in the public meeting among the NRC staff, and with the stakeholders we came up with these definitions that you see on this slide and the next slide, trying to get to the point where key is in the context of the application. In terms of the base PRA, you're concerned about what are the sources, and what could they potentially influence. So these are very different definitions than what you will see in the current standard.

The other important definition was what is meant by a consensus model.

MR. WALLIS: Are you going to talk about what you mean by "source of model uncertainty", or are you just going to flash up this slide?

MS. DROUIN: No, we're just giving you the definition. When we get into the steps, we --

MR. WALLIS: This is an interesting definition, because it's a workable definition, but the consensus may itself have uncertainties in --

MS. DROUIN: Absolutely.

MR. WALLIS: So what do you about that? The model that people have consensus about cannot be a very good representation of reality.

MR. PARRY: That would typically be reflected, though, in the parameters of the model. They migrate.

MR. WALLIS: We have this in thermal hydraulics all the time, and none of the models is particularly good. So there's uncertainty no matter what you agree to.

MS. DROUIN: Of course there's uncertainty. We're not saying there isn't.

CHAIR APOSTOLAKIS: In the old days when we were using the COMPBRN code for fire analysis, we all knew it had uncertainties, so what we did is an uncertainty factor, do it on the model itself. And then you also propagate the parameter --

MR. WALLIS: But they don't do that. They don't seem to --

CHAIR APOSTOLAKIS: Well, we'll come to the guidance, but the important thing at this point is to recognize that even if there is a consensus model, there may be uncertainty.

MR. WALLIS: Then we're going to ask later what you --

CHAIR APOSTOLAKIS: The only reason it's consensus is because the only one, nobody else has developed an alternative.

MS. DROUIN: Not necessarily. No, that's not true.

CHAIR APOSTOLAKIS: Not always, but in this case, that was the case. That's what I'm saying. It's not the consensus in the sense that there are five models and everybody says number three is the one we go with. There may be situations where you have only one model, and you have uncertainty.

MS. DROUIN: There could be situations -- yes, where you only have one model.

CHAIR APOSTOLAKIS: That's what I'm saying.

MS. DROUIN: But there are -- we're just saying there's also cases where there's more than one.

CHAIR APOSTOLAKIS: Absolutely.

MS. DROUIN: But this is the one everybody has chosen to use.

CHAIR APOSTOLAKIS: So, yes, there is model uncertainty. So we'll come to the guidance at some point.

MS. DROUIN: Right. And we aren't saying because it's a consensus model, you don't have uncertainty. But the point is, is that when you have a consensus model, you can screen something out because it's a consensus model.

CHAIR APOSTOLAKIS: Another example, a recent example is heat transfer coefficient equations. You're going to different medium, and it's not clear that the old ones apply, and you run a few experiments. You see the uncertainties. And, ultimately, it's a matter of judgment, what you do about it. So, yes, there is one model, but there may be uncertainty about it. And that's not covered by the parameters, parameter uncertainty in the model.

MS. DROUIN: That's correct.

CHAIR APOSTOLAKIS: The model itself may be biased or whatever.

MR. PARRY: But if we all agree that we could live with that bias, then we don't use -- the point we're making, I think, is that if we all agree to that model, whether it's biased or not, and that is the model we will use in our decision making, then we don't have to do alternative --

CHAIR APOSTOLAKIS: But you --

MR. PARRY: That's all we're saying.

CHAIR APOSTOLAKIS: Then you have to put uncertainty of the predictions of that model.

MR. PARRY: If there uncertainties on the predictions of that model, we would include them. Right.

CHAIR APOSTOLAKIS: Yes.

MR. PARRY: Yes.

MR. WALLIS: And then there's this thing about it's known to have an effect. I'm not sure how you know. There's only one model, the choice has an effect. So, again, there could be sources of uncertainty with one model. You don't really say what you mean by an effect. I guess you're going to get into all this, are you?

MS. DROUIN: Yes.

CHAIR APOSTOLAKIS: Yes. There is several slides on this issue, so let's --

MS. DROUIN: We just wanted to up front, to let you know that there were key things that were causing some problems because of the definitions, and we have tried to correct those definitions. We're just trying to give you a little bit of the history of why it was important that these definitions -- that we come to a consensus on the definitions.

CHAIR APOSTOLAKIS: Right.

MR. PARRY: We do define what we mean by "effect" by that parenthetic example.

MS. DROUIN: Yes. Okay. Given that, now we're going to go back and walk you through. And you'll see how these terms play out through the process.

MR. WHEELER: So at a high level, the process for identifying which sources of uncertainty are key to the decision being made in the application, basically, again, high level, four steps. You have to identify your sources of uncertainty. You want to -- step two says perform qualitative analysis, and it is that, but it is also more than that, as we'll get into in details. It's identify then the context of your application so that you are appropriately evaluating the sources of uncertainty within the proper context of the decision to be made.

Perform qualitative analysis. Let's pick the low hanging fruit while we can, and then move to a quantitative screening analysis, which is fundamentally based on potentially conservative quantitative evaluations of those parts of the PRA that are relevant to the uncertainty issues. And if you can screen issues out based on a potentially conservative quantification, and that's an easy step to further reduce the set of uncertainty issues that are potentially key. But then, ultimately, issues that have not been able to be screened out easily, either qualitatively or quantitatively, must be evaluated through a realistic sensitivity analysis to ultimately determine if they do, indeed, constitute key sources of uncertainty.

So in step one, as we said, it's very critical to identify your sources of uncertainty, basically three steps. You must identify the source of uncertainty, and then also characterize them so that we understand exactly how they influence the PRA, and what parts of the PRA they influence. And then execute a qualitative screening on this set. And towards the issue of characterization, PRA model can affect basic events, it can affect logic structure of the PRA, or it can affect both.

So, as this diagram shows, what's important here is what we want to show, too. As you see the horizontal flow of a process, this document is more of a process-related document. And a lot of the specificity is going to be developed in conjunction with working with EPRI, where a lot of the specificity of specific types of sources of uncertainty, things like that. We're working with EPRI to coordinate with them that there'll be more specificity in their documents.

But in identifying potential issues of model uncertainty and related assumptions, one source is the PRA itself, because the ASME standard directs that sources of uncertainty be identified in the PRA. So if the PRA has been performed according to the standard, there should be a good jump-start right there in identifying sources of uncertainty. But in addition to that, the NUREG recommends doing literature research, or as we've said, we're working with EPRI to ensure that --

CHAIR APOSTOLAKIS: Who is doing all this analysis? When you say on the left, for example, identify sources of model, who is doing the identification, the analyst, the peer reviewers, both?

MR. PARRY: Both, but the owner of the PRA should have the primary responsibility.

CHAIR APOSTOLAKIS: So this is at the very end after you go through the process of --

MR. PARRY: Really should be doing it all along, but I guess --

CHAIR APOSTOLAKIS: Well, no. But what I'm going to see is the very end, the final result. And then the owner of the PRA will say --

MS. DROUIN: The owner of the PRA --

CHAIR APOSTOLAKIS: -- this is what I have done.

MS. DROUIN: Because it's part of the standard that -- it's part of your documentation when you look at the standard, is to document all your sources of uncertainty, so that should be an outcome, or a product from your PRA based on the standard.

CHAIR APOSTOLAKIS: There will be some help, I hope. I mean, I think I have seen tables with model uncertainties that are fairly common.

MS. DROUIN: Right. This is where we're interfacing --

CHAIR APOSTOLAKIS: We'll talk about it? Good.

MS. DROUIN: With EPRI. And, as Tim said, what we're doing in this chapter is we're laying out the process with the result coming out of Chapter 5, is here are the key sources of uncertainty related to your application. Now but starting out over here, you're starting with trying to identify up front in step one all your sources of uncertainty. So we laid out the process, and where we're interfacing and showing on this figure here is EPRI has laid out a generic list of the sources of uncertainty with a PRA.

CHAIR APOSTOLAKIS: Who's going to tell me, and when, what to do with this model uncertainty? You've gone through the process. I have identified -

MS. DROUIN: That's going to come in Chapter 7.

CHAIR APOSTOLAKIS: So we're going to discuss it today?

MS. DROUIN: Yes.

CHAIR APOSTOLAKIS: Okay. Let's go on.

MR. WALLIS: Can I ask you something now? Are you describing here something which is well-established, developed, state-of-the-art? Do people do all this stuff now?

CHAIR APOSTOLAKIS: No.

MR. WALLIS: We do not? Do we know how well it works, is my question. I mean, this is laid out. Do we know how well it gets done?

MS. DROUIN: I think that where I would say it's not well done is the documentation. I would say yes, it's -- in order to -- I mean, we know where the sources of uncertainty -- we know how to identify the sources of uncertainty. We know how to do that. What people don't do a good job, is documenting them.

MEMBER BLEY: Can I put it a little different way? This is in the PRA standard, and the

PRAs are being reviewed against the standard by industry, have you seen if those reviews have identified that these sources of model uncertainty are actually identified?

MR. PARRY: Maybe we ought to let Ken answer that.

MR. CANAVAN: Well, the first question -- this is Ken Canavan from the Electric Power Research Institute. The first question was, has it been tried? There's been two pilots of the process that was originally identified, and the process has changed a bit as a result of some of those lessons learned through some of those pilots. So I think, has it been tried? Well, yes. And we've learned a lot --

MR. WALLIS: This is in the process of development.

MEMBER SIEBER: It's part of the standard, though. Right?

MR. CANAVAN: The two pilots were completed on the first process, and the process is being refined, and we'll probably need to pilot it again.

CHAIR APOSTOLAKIS: But individual studies ----- I mean, NUREG 1150 actually did handle in the Level II Analysis, model uncertainty through expert opinion. Right? And taking the linear combination. But individual studies have done some of this. In fact, John and Dennis have a paper out, something you did with Dave Johnson.

MEMBER BLEY: A long time ago, yes.

CHAIR APOSTOLAKIS: Yes, a long time ago.

MEMBER BLEY: Yes.

CHAIR APOSTOLAKIS: And there are other papers, too, but on a grand scale, I don't think you can pick up a PRA and see all this stuff in there. Now the pilots may be that, but they are pilots.

MR. CANAVAN: Yes.

CHAIR APOSTOLAKIS: They are not part of it.

MS. DROUIN: I agree, but I don't think it's because it's a lack of not knowing how to do it. It's just a lack of documentation. People haven't systematically --

CHAIR APOSTOLAKIS: I think it's more than that, Mary.

MEMBER STETKAR: I think it's more than that.

CHAIR APOSTOLAKIS: It's more than that.

MEMBER STETKAR: It's a lack of sensitivity to the --

CHAIR APOSTOLAKIS: Exactly.

MEMBER STETKAR: The analysts don't --

CHAIR APOSTOLAKIS: Yes.

MEMBER STETKAR: -- when they develop the models.

MS. DROUIN: That's right, but it doesn't mean that they don't know how.

MEMBER BLEY: That's a fine point, because if they don't document it, once they've moved on, it's kind of lost, and it has to be --

MS. DROUIN: I don't disagree. I don't disagree. But it's not that we need to go out and develop methods, and develop tools because we don't know how to do it. It's just that we don't systematically, as we're doing the PRA, as we're developing our model, say okay, here's a source of uncertainty. It's a lack of -- I like John's word, it's a lack of sensitivity. I mean, to me, that's sensitivity and then documentation. It's not a lack of ability.

CHAIR APOSTOLAKIS: Nobody said it was stupid, if that's what you mean.

MR. PARRY: It really is a lack of awareness that -- I think people make assumptions without really recognizing --

MEMBER STETKAR: No one has ever told an analyst when he sits down, he or she sits down to do a systems analysis that you should put into writing, I, today made this decision because, but I could have made a different decision because. I mean, nobody ever -- they may think that, but nobody ever --

(Simultaneous speech.)

CHAIR APOSTOLAKIS: Say of academic interest, so I really want to get down to the guidance, guys. I really do want to do that. Are you telling me on individual issues what to do? I can appreciate the understanding part, I appreciate process, but at the very end, somebody has to tell me what to do. I really believe that's important. So, Tim, please go on.

MR. WHEELER: Okay. Anyway, as we said in this process, when you have identified your uncertainty, it's also very important, and this is, I think, be propagated through the whole chapter, is you want to understand how it affects the PRA, what were the assumptions made in the development of this part of the model? Was data used, what were the data issues, was expert judgment used, how does it impact the PRA, does this simply affect certain specific basic events, or could it affect the selection of initiating events, or the entire structure of the PRA by introducing new accident sequences, or restructuring the event trees?

And then, as we said before, qualitative screening on the basis of things, such as consensus models, and if you were to look back at our definition of consensus models in this document, it says it's a model which basically the NRC has accepted. So, therefore, as Gareth said, there is no need for the applicant, or for the licensee who is applying to the NRC, to further justify their use of that consensus model.

CHAIR APOSTOLAKIS: Is there a better word for consensus? There ought to be a better word.

MEMBER SIEBER: Proved.

CHAIR APOSTOLAKIS: Proved is stronger. Is it stronger, there's other --

MEMBER SHACK: Well, they need to agree on the definition of consensus model, which they haven't done yet.

CHAIR APOSTOLAKIS: They have.

MEMBER SHACK: Well, no. The EPRI one is significantly different.

CHAIR APOSTOLAKIS: Oh, but Mary presented the definition.

MEMBER SIEBER: If you're applying for a risk-based application of a regulation, I don't think the staff would accept the fact that I've got all my friends in Missouri and Kansas to agree with my model, so it's a consensus model. I think the staff's approval is what's key.

MR. WHEELER: And it's my understanding that the definition of consensus model in this document speaks to that.

MEMBER SIEBER: Okay.

MR. WHEELER: Gareth, did you want to respond to that?

MS. DROUIN: Oh, sorry. We were talking.

MR. WHEELER: Oh. Do you want to rephrase the question, or restate the question?

MEMBER SIEBER: It wasn't a question.

MR. WHEELER: Okay. I think that the consensus model as we identified it here implies the NRC accepts it as a consensus model.

MEMBER SIEBER: That's right. That's what makes the consensus.

MS. DROUIN: Yes.

MR. PARRY: For that application.

CHAIR APOSTOLAKIS: But as long as you say that there is uncertainty about it, I'm not too unhappy.

MS. DROUIN: Just because it's consensus, does not mean --

CHAIR APOSTOLAKIS: If you say consensus means this is it, and we believe the results, that's a different story. But if you say yes, this is the model we're going to use, but we know it has uncertainty, and maybe there is -- then I think it's okay.

(Simultaneous speech.)

MR. PARRY: It has to be characterized.

CHAIR APOSTOLAKIS: Okay. Okay. I think this is high level, too. Let's go to the next slide.

MR. WALLIS: Can you put it in perspective for me? Does model uncertainty change the CDF by a factor of 10 or something? How significant is it?

CHAIR APOSTOLAKIS: No, they're going to tell us that when they talk about Chapter 7, she said. Right?

MR. WALLIS: How significant is model uncertainty? When I think about a number --

MS. DROUIN: Chapter 7 brings all the pieces together, and how you use the pieces.

MR. WALLIS: But it doesn't tell you how important it is. Is this a factor of 10, or 100 on the PRA? What is it?

MR. PARRY: The importance is judged by whether it changes the decision you're trying to make.

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

CHAIR APOSTOLAKIS: It could be five, it could be two, it could be 100. I mean, Gareth is right. It really depends on whether it affects the decision. Slide 20, whatever.

MR. WHEELER: Step --

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

MR. WHEELER: All right. After the first step of identifying the issues and doing the consensus model qualitative screening, the next step is, it's important -- you need to understand the context of the application for which you're using this, because that's very important, because many of the uncertainty issues may have absolutely nothing to do with the application at hand. So the point here is you can further filter or screen out many of the uncertainty issues that are identified in the PRA, simply because they're not relevant to the application at hand.

An example may be if there's an application to increase the allowed outage time for a diesel generator, then you need only focus on those parts of the PRA that involve loss of off-site power, because that's the part of the PRA that's being dealt with here.

But another important point is that the application itself may be creating a modification, if you will, to the PRA, which in and of itself is introducing new uncertainty issues, so you have to consider both. You have to --

CHAIR APOSTOLAKIS: Do you have an example of that?

MR. WHEELER: Introducing something new in the --

CHAIR APOSTOLAKIS: Yes, that the application produces something new?

MR. WHEELER: I'm not sure off the top of my head I can think of something. But, I mean, the point is that if you're suggesting to actually change some operational feature of the plant that requires the applicant to actually modify or add something to the PRA, you, essentially, have now, you have a base PRA, and you have a modified PRA.

MEMBER CORRADINI: Is hydrogen igniters an example? Well, I guess here's where I'm going with this. When I was reading it, I was looking for an example to bring forth the point. And I have to admit, my major comment about all this is, it's an awful lot of words with very few examples. So I go back to my original question about who's the audience? And you're saying it's experts. So, okay, experts don't need examples.

CHAIR APOSTOLAKIS: No, no, no. Even experts need examples.

MEMBER CORRADINI: But, personally, I like examples, and there aren't a lot of them in there. And this is --

MR. PARRY: One example you could think of in this case would be 50.69, example. Right?

CHAIR APOSTOLAKIS: Right.

MR. PARRY: Because the impact of 50.69, the reduction of special --

CHAIR APOSTOLAKIS: 50.69 for the new members is?

MR. PARRY: Okay. It's the relaxation of the special treatment requirement on --

(Simultaneous speech.)

MR. PARRY: Yes, based on their safety significance. One of the things that we don't really know how to deal with is, what is the impact of the safety significance on the component reliability -- sorry -- what is the impact of the special treatment on the component reliability? It's an unknown, so that's a source of uncertainty that we would have to address in the decision making, so that's one example. And maybe Doug has some others, too.

CHAIR APOSTOLAKIS: That's a good point, yes.

MR. TRUE: This is Doug True, again. I was just going to sort of build off of Tim's example on diesel generators, and allowed outage time changes. That's an easy one.

In doing that, you might modify your PRA model to refine the way you treat recovery of off-site power. In the base model, you may have had a treatment that was adequate, met the peer review, and was fine, but when you went to go do your AOT analysis, you found that it was too simplified, and so you might introduce a convolution model that does a more sophisticated calculation of off-site power recovery, coupled with the failures.

That's a change in your PRA model that would fall down that right-hand side of the flow chart. And there are uncertainties and assumptions you have to make in doing that analysis that you've introduced because you've made that change for this particular application.

MEMBER STETKAR: That's a good example.

CHAIR APOSTOLAKIS: Thank you. Okay. Slide 29.

MR. WHEELER: Okay. So once you've essentially put your initial set of -- in any potential new course of uncertainty through two qualitative filters, you now move on to a quantitative screening process. And one feature that's important here is the process outlined in this chapter addresses both what we call cumulative or incremental acceptance criteria. An example of incremental acceptance criteria is 1.174, or an example of cumulative is where you might be evaluating an application against a maximally acceptable core damage frequency, or something such as that.

And then, also, the method in Chapter 5 addresses within the context of both cumulative and incremental acceptance criteria applications. The fact that we have uncertainty measures, I'm sorry, sources of uncertainty that could, as we spoke to earlier, impact the PRA model in different ways, we could have simply impacting a single basic event, or an uncertainty issue which ultimately impacts the model by impacting the quantification of multiple basic events. It could impact the logic structure of the model itself, or we could have logical combinations of uncertainty issues, where, in essence, there is a synergistic relationship. Whereas, the combination of uncertainty measures need to be considered and combined.

MEMBER STETKAR: Tim, let me just ask you, because you skipped over the second bullet.

MR. WHEELER: Okay.

MEMBER STETKAR: And George keeps saying tell me what to do. And the second bullet in the NUREG tells me what to do. And it says I use a risk achievement worth-type process, either on a single basic event, or cumulative things. A question came to mind, and, basically, determine the importance whether the risk achievement worth is greater than a factor of two, meaning I can potentially have a factor of two increase in the core damage frequency as kind of a rough quantitative screen.

The documentation, the report, the method doesn't -- let me characterize that by saying that may capture the effects of uncertainty on risk increase. The methods, as I read them, do not capture any effects of uncertainty on risk decrease. So, for example, suppose I've applied a very, very conservative assumption in my PRA, and developed a model that's very, very conservative because of that. And I'm willing to live with that, but it is a source of conservatism.

If I just look at risk achievement worth, it may show a relatively small risk achievement worth, if it's a relatively large contributor. It may show a very, very large risk reduction worth. Now the fact that my risk assessment has this overriding source of conservatism in it can, in fact, skew the results for particular applications. I don't see any guidance in this document to tell me how to be sensitive, or how to evaluate potential key sources of uncertainty for down-size, downward risk. Because risk achievement worth just tells me could it be higher? And you say well, I should certainly examine things that could increase stuff. And I totally agree with that, especially if I'm looking for something that says do I meet certain acceptance criteria?

However, if I'm more interested in terms of uncertainty as far as it affects my decisions about a specific application, I'm equally concerned about things that may be excessively conservative and masking other points. And I don't see any guidance in here to tell me how to identify those potentially important sources of uncertainty, which would be analogous to like a risk reduction worth screen.

CHAIR APOSTOLAKIS: So you're saying use the second, possibly a second importance measure that deals with --

MEMBER STETKAR: Right. I mean, risk reduction worth screen --

CHAIR APOSTOLAKIS: Right.

MEMBER STETKAR: If you're interested in plus or minus a factor of two on core damage frequency, as a screen, you ought to be as sensitive to the downside as you are to the upside.

MEMBER SIEBER: I think Reg Guide 1.174 in that chart that's in there, the block chart that says you can't make changes if your nominal risk at the plant is high, even though the changes may be small. That means, to me, that it would not be appropriate to screen out model uncertainties because they would appear both in the base, and in the --

CHAIR APOSTOLAKIS: It would be in both, yes.

MEMBER SIEBER: -- one with the change, because it does have an impact on the decision. And I didn't see that discussed here.

CHAIR APOSTOLAKIS: Let me understand this. Are you saying that I may screen out a model uncertainty because of its insignificance with respect to the total CDF, but it may turn out to be significant to delta CDF?

MEMBER SIEBER: I think it's the other way around.

CHAIR APOSTOLAKIS: The other way around?

MEMBER SIEBER: Yes. One may be presumed to be risky because of assumptions made in the overall model, but when you apply a modification and model that modification with these other baseline assumptions still in there, the modification may result in a small delta risk, but the baseline PRA might put you in a place on that chart where you can't do that. You can't change it, which means --

CHAIR APOSTOLAKIS: See, this is the kind of discussion that I'd like to have in terms of specific ways of handling things. I do appreciate what you have here about process, but when it comes down to what to do, I think the document is not as comprehensive as it is when it comes to process. And I wonder how we can address that? I really want to start by saying another meeting, and in the case of model uncertainty, here is what you're going to do, and this is why.

MEMBER BLEY: But there's a related issue.

This document in the early part says they'll refer you to the EPRI documents, where appropriate. There aren't many cross-references yet. You need to get some of those in. It might be some of the things we're looking for, we'll see this afternoon.

CHAIR APOSTOLAKIS: If we do, that would be great. Now let me ask --

MEMBER BLEY: And you might refer to them. I don't know if that's an intention or not.

MS. DROUIN: There are -- the places where there are cross-references are where there is going to be a cross-reference. If there's not one in here because there's not -- I mean, we carefully went through and identified in the document where our two documents come together, and where you need to go to the EPRI document.

CHAIR APOSTOLAKIS: You have an appendices to be determined. Right?

MS. DROUIN: Right.

CHAIR APOSTOLAKIS: Let me ask, is there an update to the EPRI report, or are you still sticking to the 2004?

MR. TRUE: We're working on an update that fits better with the NUREG.

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 could use a good editing by somebody.

MR. WALLIS: Actually, this chapter is full of a lot of musts, you must do this, you must do that. The word "must" is used about 20 or 30 times in this chapter. That's something you really have to do, it must be done.

CHAIR APOSTOLAKIS: Yes, but I think it's fair to say that the current version of the NUREG is very strong with understanding, and process for identifying things. There is very little on what you actually do. As an example, in the case of model uncertainty, the NUREG 1150 approach, the linear weighted combination of various assumptions. If you want to dismiss it, at least tell us that you are dismissing it. You know, that kind of thing. People have done things, and it would be nice to see that. Maybe we'll see them in the EPRI update. That would be great, too. And you guys will approve or disapprove. I mean, I think that the practitioner needs to know what to do.

MS. DROUIN: Okay. Well, I think we need to talk about that a little bit more, because I'm not sure now. I thought I was understanding you, and now I'm not so sure.

CHAIR APOSTOLAKIS: Okay. Tell me what --

MS. DROUIN: That what you're looking for, whether we had ever intended on doing that. In terms of what we were intending was, if you go to this chapter, for example, is giving the reader guidance on how to identify his sources, his key sources of model uncertainty in the context of an application. Then when you go to Chapter 7, Chapter 7 is going to tell you what to do with that information. We were not intending to provide guidance on how to model your uncertainties.

CHAIR APOSTOLAKIS: Why not?

MS. DROUIN: And it sounds to me like you're looking for that, which was never a part of the scope of this work.

MEMBER CORRADINI: So the scope of the work is not to provide guidance.

CHAIR APOSTOLAKIS: Wait a minute. It says treatment. What is treatment?

MS. DROUIN: How to treat it in your decision making.

CHAIR APOSTOLAKIS: But in my decision making, I may want to -- I look at three alternate models, and I may decide to do a NUREG-1150 approach, gather a bunch of experts that give me the weight.

MS. DROUIN: I'm not saying --

CHAIR APOSTOLAKIS: Aren't you going to tell me -- that's up to me?

MS. DROUIN: No, no, no. I'm just saying that that was not part of the scope here. Now we may have to revisit that, but it was never part of the scope of this, is all I'm saying.

CHAIR APOSTOLAKIS: I understand what you're saying, but I think then -- it's my personal view. I mean, the Committee has to decide, then the scope should change. That's my view. But let's hear the gentleman --

MEMBER MAYNARD: I was wondering if this is part of this project, or something that NRR will be doing later in some type of a guidance document, because I didn't see a lot of guidance in this. I saw a lot of these are ways of doing things, and this is what could be done, or this is how you may address it. At some point, it does need to come together as to more guidance. This is really what we expect.

CHAIR APOSTOLAKIS: Maybe EPRI will do it.

MEMBER BONACA: And there has to be tangible example, the point that Michael brought up. It's very important, because, otherwise, you're left with generalities.

MEMBER MAYNARD: But it could be done as part of the Reg Guide, or it -- I mean, as part of the NUREG -- or it could be a Reg Guide later. At some point, though, this has to come together, I think.

CHAIR APOSTOLAKIS: Go ahead.

MR. TRUE: Yes. I mean, there's like ten subjects on the table, so let me kick off --

CHAIR APOSTOLAKIS: Pick one.

MR. TRUE: I think on the example, one of my comments to the staff when we first saw the draft NUREG was hey, we can give you examples to help eliminate these things, real examples that we've actually done in past applications, that will help. And we've committed to do that in the comment period. So I think we can do that, and it will help move things along.

Staff may not appreciate this, but I want to go to two points that are a little bit inter-related. One is John's point about you're only look at the goes ups, and not at the goes downs. And the other is George's point about whether you use NUREG-1150 weighted probability for different assumptions, or something else.

I think that what's inherent in the process is that we're really not doing the NUREG-1150 approach. We're handling this through sensitivity studies. And the sensitivity studies are looked at, and compared to the acceptance guidelines that apply to the decision that's being made. And, so, if we look at, for example, the diesel generator AOT, or 1174 application of some other type, you're looking at the delta CDF, and saying does this model uncertainty have the potential to kick me above, or significantly above my acceptance guideline? And, so, that's why we're focused on the goes ups, is that we want to know are we in an area where we could end up going over through some reasonable alternative hypothesis?

It's true, and it was argued in the EPRI work, the original EPRI work talked about going both ways, but we sort of relented in the fact that really it comes down to a regulatory decision, and what the regulator wants to know is, is there a real potential I'm going to be exceeding this acceptance guideline?

CHAIR APOSTOLAKIS: I mean, you're really not avoiding what 1150 did. Because, as we all know, sensitivity studies have a sense of arbitrariness, so you are using a particular assumption. Then you have to make a judgment then if that sensitivity study makes sense. How likely is it? Which brings you back to some sort of evaluation of the probability that this is a valid --

MR. PARRY: We don't want to use probabilities. I don't think that's -- that's not the approach we're taking.

CHAIR APOSTOLAKIS: I really want a detailed discussion on these things at some point. Maybe today is not appropriate, I don't know.

MR. TRUE: The piece of what John brought up that is important, in the context I described, the 1.174, 1.177 application, you're always going up to a delta CDF and looking at how large is the increase, and comparing to some absolute threshold. The masking problem comes in ranking applications where we're using importance measures, and those types of things. And we've attempted to deal with that in 5069 through a series of sensitivity studies where you change input assumptions, and look at key areas in the model to see if you are masking. And that's the only regulatory application that I'm aware of that used importance measures in that way. And we tried to be aware of the masking problem in setting that up. So I think that the way the guidance is structured is it's primarily oriented towards the 1.174-type applications, where you're looking at the -- always looking at the goes ups, and how much higher can that go up, and not --

the ranking applications are a different animal, in which we have different problems. And I think we understand that, and Chapter 7 does a little talking about that. That may need to be --

MEMBER STETKAR: A little bit, but it's still focused on the goes ups.

CHAIR APOSTOLAKIS: What I want to understand is, is there going to be a time when we'll have detailed discussion of these approaches? There has to be. Maybe not today.

MS. DROUIN: You know what I was thinking, George, maybe a way to deal with this is -- and, as I said, we're out for a three-month public review and comment period -- and it seems to me that maybe the best way to get the Committee's input is, we're going to have to come back. But instead of us, to be honest, giving you a presentation, is us just coming in and listening, and you all go through the document, and give us your input.

CHAIR APOSTOLAKIS: Well, the document we have now, it's a little short on guidance.

MEMBER STETKAR: The other thing is, there's a good --

MS. DROUIN: Between now and the end of the public review and comment period, this is the document that's out there for review.

CHAIR APOSTOLAKIS: I understand that.

MS. DROUIN: Now that doesn't mean that we have to wait until the end of the public comment period to start making changes, but I've taken a lot of notes, and I've gotten some feedback, and I know some things to do. But it would help me a lot more if I sat down with the Committee, instead of doing a presentation. You all walk us through and say well, I didn't see this, or I didn't like that.

CHAIR APOSTOLAKIS: But you said it's outside you scope now. And the other thing is, we haven't seen the EPRI --

MS. DROUIN: This particular issue, I'm just talking overall.

MEMBER STETKAR: We need one cut through both of them, and decide where to go from there.

CHAIR APOSTOLAKIS: But it appears that the update that EPRI is working on is crucial here.

MEMBER BLEY: Well, they've also got the application guide.

MR. CANAVAN: Ken Canavan, EPRI. We're not going to take you on a guided tour of the black hole today. We're going to sort of show you the methodological approach, show you an example, and then give you the EPRI report in the short term. That may be a month or so away, but that will -- when we give you the EPRI report, it allows you to look at all the issues, and is a full discussion, and has all the detail.

The intent of the EPRI report is very pragmatic. It's very guidance-oriented. It is what to do, so I think what you're looking for probably isn't it 1855, by design, if we're companion documents, details in one that's missing from the other.

CHAIR APOSTOLAKIS: Okay.

MEMBER BLEY: Ken, are you updating both your documents?

MR. CANAVAN: We're getting into this afternoon's presentation, but no.

MEMBER BLEY: Okay.

MR. CANAVAN: We're updating the applications guide part.

MEMBER BLEY: The application guide is what is being updated.

MR. CANAVAN: Right.

MEMBER BLEY: Okay.

MEMBER SHACK: Neither one of these, I mean -- you know, a lot of us are looking for 1150 kind of uncertainty analysis, and I don't think we're going to get that out of the EPRI documents, or this document. In Tom's terms, you're going to go left to right on this guidance where you need to know the overall cumulative thing, some sort of bounding arguments, and they're not really going to try to give you an 1150 analysis. The real emphasis here is a 1174 kind of application, where you're kind of worried about the delta CDF, and making sure you don't exceed those guidelines.

I mean, to me, you guys are so focused on cutting the problem down to a manageable size, and bounding these increments in a semi-qualitative/quantitative sense for 1174 applications, but if somebody is expecting you to give guidance so that you end up with 1150 results, I don't think they're going to find it out of this document.

MS. DROUIN: No.

MEMBER SHACK: Or that document.

MS. DROUIN: And that was never the intent.

MR. PARRY: That was never the intent. Right.

MS. DROUIN: The intent is that given what you have --

MEMBER SHACK: Well, I'm not sure that we all -- you know, when we say uncertainty analysis, when Tom says uncertainty analysis is a product of the PRA, he means 1150.

MS. DROUIN: Right, which is not what we mean.

MEMBER SHACK: Which is not what you meant.

MS. DROUIN: No. All we mean is that when you --

MEMBER SHACK: But we must at least understand what you meant so we don't keep asking you to produce what you're not meaning to mean.

MS. DROUIN: When you've got a decision under-hand, you have some kind of acceptance criteria you're using, and how are the uncertainties affecting that acceptance criteria that could influence your decision. And that's the boundary that we were trying to do.

MR. WALLIS: But you're too much focused on the NRC. I mean, PRAs have a problem with the public. The public doesn't believe them. You've got to tell them something about how confident you are in the results. It's not just an internal problem. Intelligent people out there are trying to figure out how they should take these values that come out of the PRA.

MR. PARRY: And how those values are used in the context of making decisions.

MR. WALLIS: Yes.

MR. PARRY: Because that's what they should be worried about.

MR. WALLIS: Not just 1174, all kinds of things.

MR. PARRY: All kinds of decisions. And we've tried to broaden it from that point of view.

MS. DROUIN: We have not focused this on 1174.

MR. PARRY: The reason why I think that we consciously chose not to go the 1150 route --

CHAIR APOSTOLAKIS: I'm not -- 1150 was an example, guys.

MR. PARRY: I understand that, but it seems that some people are expecting that we're going to go that way. So from a personal point of view, I don't think that's very useful for making decisions, because what you're going to do is, you're going to weight different model results and come up with some mean value.

Really what we're trying to do with this approach is to demonstrate that for certain decisions, it doesn't matter what assumption you've made. It's still an acceptable decision. It's to try and give people confidence --

CHAIR APOSTOLAKIS: I understand that. If it works, you're right. But the problem is that sensitivity analysis, at some point you will have to tell us how likely this sensitivity assumption is.

MR. PARRY: No, we don't necessarily go --

CHAIR APOSTOLAKIS: Well, I'll tell you, in 5069, South Texas came here and said look, even if increase all the failure rates by a factor of ten, we're still below the thing, so we are great.

Now if you are a bad guy, you might say well, why not 100? Say no, no, no. That goes above the -- it's no good. What tells me that a factor of 100 is no good?

MR. PARRY: Okay.

CHAIR APOSTOLAKIS: There must be an assessment that this is an extremely unlikely assumption.

MR. PARRY: Right. That's one way of doing it.

CHAIR APOSTOLAKIS: And that brings you

back to the 1150 approach.

MR. PARRY: But another -- no, it doesn't, necessarily. Remember, the approach that's taken in 5069 is a little different. Right? There's a sensitivity study that's done that says I'm going to assume that if the factor is five, say, and I can demonstrate that the delta CDF is low enough, then that's okay. But you don't necessarily justify that factor five directly. What you do is you set up a performance measuring criterion to make sure that that factor five is never realized. So you would use a different part of the risk-informed decision making to validate that statement.

CHAIR APOSTOLAKIS: I don't think that's the way it was done. I mean --

MR. PARRY: I think that is the way. I think that is the way it was done.

CHAIR APOSTOLAKIS: South Texas said the factor of ten, everybody said yes, that's unreasonable.

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

CHAIR APOSTOLAKIS: It was a judgment on the part of people that that's an unreasonable thing to do.

MR. PARRY: But there's still that safety net of the performance monitoring. And that is how Reg Guide --

CHAIR APOSTOLAKIS: That's why we need specifics, because this is, again, very high level discussion. And, again, I'm not talking about 1150 that you have to do -- well, it seems it would make sense to at least mention it as a way of handling model uncertainty. I mean, it has been done by a major study of this Agency. It was completely silent. And, also, when you have a consensus model you have uncertainty, don't you need some guidance how to figure out what that uncertainty is? I mean, this is the kind of what to do advice that I'm looking for.

MR. PARRY: And what we're trying to do in this document is to make sure that when people use these results, they present the decision maker with the information that he needs to judge whether he can have confidence in the results.

CHAIR APOSTOLAKIS: And that's part of that information, in my view, unless you argue that the decision maker --

MS. DROUIN: George, I already made a note that at least --

CHAIR APOSTOLAKIS: Okay. I think we have exhausted --

MS. DROUIN: -- we should go in and discuss different approaches, like 1150.

CHAIR APOSTOLAKIS: Right.

MS. DROUIN: And why we have chosen the approach we have chosen.

CHAIR APOSTOLAKIS: And how does it fit in your overall scheme.

MS. DROUIN: Right. I agree with you.

CHAIR APOSTOLAKIS: That's a reasonable --

MS. DROUIN: I think that's a fair comment, and I think we should do that.

MEMBER BONACA: I think the EPRI guidance provided, however, is on target with that certification, because that's really 99 percent of the applications taking place today are in the direction. I mean, they're applying versus 1.174, and so I think this kind of additional information, I think this serves a purpose.

CHAIR APOSTOLAKIS: But look at Slide 30.

MS. DROUIN: Slide 30?

CHAIR APOSTOLAKIS: Yes. I would call this guidance for achieving a particular goal, like identifying the sources of model uncertainty. I would like to see something as specific as this telling me now what to do with it. That's what I'm saying. And I think Mary has taken a note, let's go on. Let's go on. Which one is the next one?

MS. DROUIN: You're talking about when you get to the end box, which is -- the product coming out of this is ultimately here are your key sources of uncertainty.

CHAIR APOSTOLAKIS: Right. But under -- you have two boxes that I see here that say screen.

MS. DROUIN: Yes.

CHAIR APOSTOLAKIS: Is that a judgmental screening? What is it based on? How is it done? You know, that's part of what I'm looking for.

MS. DROUIN: I think this is an important discussion right now, because the -- what I'm hearing is that when you read the document, you did not think there was enough guidance explaining that box.

CHAIR APOSTOLAKIS: For instance, in general, there is not enough guidance as to what to do, certain things quantitatively.

MS. DROUIN: How to perform that step.

CHAIR APOSTOLAKIS: Quantitatively, right. For example, there is a mention of taking the raw for delta CDF or CDF, and so on, but is that what you're recommending? That's the kind of -- you become quantitative in certain parts, but other parts are not quantitative.

MR. PARRY: That's what Section 5.4 does, I think. Address that screen.

MS. DROUIN: No, I understand that. But what George is telling us is that, if I understand correctly, the guidance we have here, you're saying is not detailed enough.

CHAIR APOSTOLAKIS: Right.

MR. WALLIS: You're talking about --

CHAIR APOSTOLAKIS: And I think some of my colleagues have the same view.

MS. DROUIN: I'm not surprised -- I'll be quite frank -- I'm not surprised by those statements.

CHAIR APOSTOLAKIS: Also, next time we meet, I would suggest that your slides focus more on this part rather than general. I mean we have seen now the general approach, and so on, so zero in on the real thing.

MS. DROUIN: You're never going to be happy with our presentations.

CHAIR APOSTOLAKIS: Oh, no, no. I've been happy many times in the past, Mary. This is a very unfair statement.

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 trying to come up with what is an appropriate alternative hypothesis, and potentially disagree eternally as to what is an acceptable way to address the real sensitivity.

But anything that does not get screened out quantitatively, ultimately, one has to do a realistic sensitivity analysis to determine if there is an alternative, a realistic alternative hypothesis that could create -- end up in a PRA result which does present an unacceptable result to the regulator.

This flow chart is the same shape, so it's still the same process flow, except that now the screening really -- they're not really screens any more, they are realistic sensitivity assessments of the uncertainty issue. And I think given the type of discussions we've had so far on Chapter 5, I think that's all we need to say here on this point.

CHAIR APOSTOLAKIS: Okay.

MS. DROUIN: The only question I would have is because I felt John brought up a major point in terms of we looked at our initial importance screening that we did focus on raw, and we didn't look at risk reduction. And I'd like to get, maybe not here today, but more of your insights and input into that to make sure that I've understood it correctly so we can appropriately address your concern, because I thought you brought up a really good point.

MR. PARRY: But bear in mind, also, that what Doug said is true, that we're really looking at things, or we're butting against criteria. And I think when you recognize that you have conservatism in your analysis, and you're butting against the criteria, then I think it's the applicant's responsibility to determine whether he needs to do something about that.

CHAIR APOSTOLAKIS: Well, the point is, I think we had a very long letter a few years ago on importance measures, and one of the problems we identified was that because they are global measures, you know, they take the whole PRA into consideration when you calculate raw, they may be distorted by the fact that certain parts of the PRA are done conservatively. For example, seismic or fire.

Now one way that I remember the industry went around it was to do separate -- to develop separate importance measures for the internal events PRA, for the fire, for seismic, and then present also the global importance measures, and then draw certain conclusions. And that's, for example, one way of handling that.

MR. PARRY: That's what Doug was referring to in his --

CHAIR APOSTOLAKIS: Yes. But this is specific guidance. Now there may be more that we can do now, because that was a few years ago. I don't know.

MS. DROUIN: But I think we need to let the reader know why and where, why not and where, in terms of the risk reduction. We don't even speak to it here.

MEMBER STETKAR: The real concern is that -- I'll draw this picture here -- is that if your total risk is characterized by the sum of a large number of contributors, and if some of the more important, bad use of terminology, perhaps, but some of the top -- some of the big picture contributors --

MS. DROUIN: You've got to use the right words.

MEMBER STETKAR: -- are driven by excessive conservatism, modeling conservatism, assumptions and things like that. Now if you go in with a specific application and you want to show that the risk increase from that application is small, and small enough to be acceptable, in truth, if the total risk -- a large delta on a small contributor is a small change on the total, but if that total is driven by uncertainties that are dominated by conservatisms, that large delta on a small contributor may be a much larger delta on the real total. Follow what I'm talking about?

MS. DROUIN: Yes.

MEMBER STETKAR: So identifying the fact that, in fact, there may be a large source of uncertainty in what you call your base PRA, which is the same model that you use for a particular application, that that may be masking changes down in the small areas where you're looking at a particular application. That's my concern, that is an equal concern is terms of applications in the Reg Guide 1.174-type application, in addition to the overall understanding of the base PRA model. And I only bring this up because I've seen it.

MS. DROUIN: Yes.

CHAIR APOSTOLAKIS: Mary said she wants to talk to you privately. That's fine.

MEMBER STETKAR: Yes.

CHAIR APOSTOLAKIS: Okay. And, also, regarding advice, you realize, as a Committee, we cannot give you advice today, because you can read the transcript if you want, but the Committee really speaks only through the letter.

MS. DROUIN: Right.

CHAIR APOSTOLAKIS: And there is no letter today. So shall we move on to Chapter 6, perhaps, or back to Chapter 5? What do you want to do?

MEMBER STETKAR: Four.

CHAIR APOSTOLAKIS: Four? Yes.

MEMBER STETKAR: Four is easy.

MS. DROUIN: No, we need to move on to 6. He disappears in 35 minutes.

(Simultaneous speech.)

CHAIR APOSTOLAKIS: So we're going to do Chapter 6, give us quantitative guidance how to do completeness.

MR. WHEELER: Before we start discussing Chapter 6, let me ask the Committee a question. Do you have similar thoughts and potential concerns about 6, as you did with 5, that when you read it, was it too general, and there was not --

CHAIR APOSTOLAKIS: Yes.

MR. WHEELER: Okay. Then the presentation is not going to help. So I think a lot of your -- probably your recommendations that you've asked for in number 5, will --

CHAIR APOSTOLAKIS: Well, let me propose

then, you, lady and gentlemen, that maybe the rest of the time should be on Chapter 7.

MS. DROUIN: Okay.

CHAIR APOSTOLAKIS: Because 7 seems to be where things come together.

MS. DROUIN: That's right.

CHAIR APOSTOLAKIS: Why don't we do 7? If we have time, we'll go back to -- who is doing 7?

MEMBER STETKAR: George, I think it might be worthwhile to spend 10 minutes, no more, on Chapter 4, only because Chapter 4 is the only place that the NUREG talks about state of knowledge uncertainty.

CHAIR APOSTOLAKIS: Right.

MEMBER STETKAR: And that is a very significant difference between the EPRI document, and this document.

CHAIR APOSTOLAKIS: So let me ask then --

MEMBER STETKAR: It's probably worthwhile --

MR. PARRY: It's not a difference. We're punting to the EPRI document to actually provide the details.

MEMBER STETKAR: I sure hope you're not, but let's --

(Simultaneous speech.)

CHAIR APOSTOLAKIS: This is general, guys. Mary, would you like to discuss Chapter 7 first, and then go back to 4, or do 4 first, and then to 7?

MS. DROUIN: Before I answer, can I ask you a question?

CHAIR APOSTOLAKIS: Yes.

MS. DROUIN: Do you want us to finish by noon?

CHAIR APOSTOLAKIS: Yes.

MS. DROUIN: Okay. Then let's go to 7.

CHAIR APOSTOLAKIS: Okay. But then we'll reserve some time at the end to at least address the issue of state of knowledge correlation.

MS. DROUIN: Okay. Let me just say one -- 30 seconds on the state of knowledge. We are punting to EPRI. However, if you're reading an old EPRI document, we have had some concerns, and we're working with EPRI to work out those technical concerns.

CHAIR APOSTOLAKIS: So you are not dismissing the issue, then.

MS. DROUIN: No, no, no, no.

MR. PARRY: No, no, no, no.

MR. CANAVAN: Ken Canavan for EPRI. We'll talk about that this afternoon, and you guys can chime in any time you like.

CHAIR APOSTOLAKIS: Good. Very good. Because in your earlier version, you sort of dismissed it. For the record, they disagree with my statement.

(Laughter.)

CHAIR APOSTOLAKIS: Okay. Let's go to Chapter 7.

MR. PARRY: Okay. What we're trying to do in Chapter 7 is, this says to provide guidance on addressing the uncertainty in the PRA results in the context of a risk-informed decision. Okay. With a recognition that the risk input is only one input to the decision, so what we're trying to achieve with this is to give the decision maker, who is going to have to take this information and use it, an understanding of the robustness of the risk input to the decision. Okay. So that's the focus of what we're trying to do.

MR. WALLIS: Do you have any measures of this robustness?

MR. PARRY: Robustness is determined by whether taking all the uncertainties into account, you can still make the same decision. It's driven by the acceptance --

MR. WALLIS: How does he take them into account, he just looks at a whole lot of discussion?

MR. PARRY: That's what this chapter is about. That's what I'm going to try and tell you.

MR. WALLIS: Okay.

MR. PARRY: Okay? Specifically, what we're going to talk about is -- we start out by saying how can you present the results of PRA uncertainty analysis? We have a discussion on the way you can do that. And then we use Reg Guide 1.174 --

MR. WALLIS: What does the decision maker look for?

(Simultaneous speech.)

CHAIR APOSTOLAKIS: Let's give at least 60 seconds.

MR. WALLIS: Okay.

CHAIR APOSTOLAKIS: And then we'll ask.

MR. PARRY: What we do in the chapter is we used Reg Guide 1.174 as an example of a set of acceptance criteria, we want to say what these things look like. And then we're going to use that as a discussion tool for saying how we deal with parameter uncertainty, how we deal with model uncertainty, how we deal with completeness uncertainty, and to some extent, also, how we aggregate results.

There is a section in this chapter on addressing uncertainty and categorization. It's pretty light. I think we need to do more work on that section, but it's a recognition that there has been some work done in this area. And EPRI has done quite a lot of work in this area.

I think we were more concerned in this case with how do you deal with the uncertainties in, say, like an internal events PRA model in this context, rather than the broader context of how do you deal with when you're bringing in other scope items. But I think that might be an issue that we should address here. And then, finally, we add some discussion on using qualitative approaches to address uncertainty, as an alternate to just using the quantitative measures.

Okay. We talk a little bit about how you can present the results of PRA uncertainty analyses, which is obviously dear to some people's heart here. We could do it in terms of continuous probability distributions on the numerical results.

MR. WALLIS: You've got a continuous probability distribution from --

MR. PARRY: We don't, and that's one thing we discussed, that you only do that when you have a continuous distribution on the probabilities that you can propagate. So we recognize that that's something that we can do for parameter uncertainties. Okay?

CHAIR APOSTOLAKIS: And this propagation can be done routinely now with the existing software.

MR. PARRY: With existing software. So that's a recognition that we can do that.

CHAIR APOSTOLAKIS: Okay.

MR. PARRY: We can define that. But other approaches are things like discrete probability distributions, which has been used to address certain types of model uncertainty. For example, I remember back in 1984 when I did the Limerick Severe Accident Risk Assessment, we used that type of distribution to parameterize the seismic hazard, and the seismic contribution to CDF.

Okay. That does require, if you're going to use that, though, you have to assign probabilities to the different models, or degrees of belief to the different models. This is 1150.

CHAIR APOSTOLAKIS: 1150.

MR. PARRY: Okay. Personally, I think that adds another dimension, another cause for argument as to whether the results you're getting are reasonable. We can probably beef up that in a future version of the document. Okay?

Another approach is just to provide

results for different assumptions and different models, as discrete representations without associating a degree of belief for that particular representation. And that's really the direction in which we've been leaning. Otherwise, you can just provide simple bounds or ranges in the results.

Okay. Now that's just talking about how you present the results, but perhaps the most important thing that we're trying to stress in this document is that that is only one part of presenting the results. The other important part is understanding where that comes from, understanding where the uncertainty comes from, so that you can do something about it, and so that you can assess whether it's significant to your application. And we just recognize that the various tools that you use for understanding the contributions to the uncertainty, and the contribution to the risk are importance analyses, and sensitivity analyses. We don't say much more than that.

Okay. Now we do talk a lot about comparing PRA results with acceptance criteria. Okay. So we talk first -- we address, first of all, the uncertainty arising from the level of detail. Okay? Because this is something that -- Mario, has referred to it as a degree of arbitrariness, and to some extent it is arbitrary to what level of detail you put in the model, but if you're going to use the model to support the decision, then it's got to have sufficient level of detail that you can address the issue that you're trying to model. So, in a sense, this level of detail thing is, to some extent, self-correcting. I mean, if you don't have a hook in the model to attach your cause/effect relationship to, you don't have a way of addressing the issue.

But we do recognize that there are minor differences that can occur due to the fact that, as I said before, the example I gave was maybe somebody didn't take credit for a CRD enhanced flow, another person did. This is an issue, and we recognize it in here that, in fact, this is something that we need to spend a little bit more time on. I'm getting ahead of myself here. I'm going to talk about that in the context of parameter uncertainties.

The statement we make about parameter uncertainties, and this relates to some of the discussion we've had today, is that really the method of comparison of the PRA results with the acceptance criteria is very much a function of the way that those criteria have been set up.

Our acceptance criteria or guidelines that we have for the NRC, for most of our regulatory applications, are declared to be you will use the mean value of the propagated uncertainty distribution to compare with those guidelines.

MR. WALLIS: This is an arithmetic mean you always mean, do you?

MR. PARRY: I mean arithmetic mean, yes. I do not mean geometric mean. Right.

MR. WALLIS: You don't mean sort of an assessment that the probability be in the 50th percentile, it's something completely different.

CHAIR APOSTOLAKIS: No, this is not expert opinion.

MR. WALLIS: No, but the means -- if you have an already skewed distribution, I'm not quite sure what the mean --

MR. PARRY: Well, of our distributions are kind of skewed, and the means are actually quite high up there on the percentile list.

MEMBER BLEY: They tend not to be so skewed that you can't define the mean.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: Is it not the 80th or 85th percentile, usually?

(Simultaneous speech.)

MR. PARRY: In that range.

CHAIR APOSTOLAKIS: It could be way up there, but, I mean, most of the time.

MR. PARRY: Typically, it's not. So that's the approach for dealing with parameter uncertainty, is typically we're going to use the mean value --

MR. WALLIS: If you use the mean value, there's no measure of uncertainty in that case at all. You're not even addressing uncertainty.

MR. PARRY: No. Actually, that's not entirely true, and I think that's where this state of knowledge correlation thing actually comes into play significantly.

MR. WALLIS: You're uncertain amount the mean, is what that tells you.

MR. PARRY: No, no, no, no. What it tells you is that the mean of X squared is considerably larger than the mean of X all squared.

CHAIR APOSTOLAKIS: That's not what he means.

MR. WALLIS: It seems to me the question that the Commission is always asking is how good is the number you're giving me? And if you're only giving me the mean, you're not telling me anything about how good it is.

MR. PARRY: The Commission has stated in its criteria that it is the mean value that we will compare with --

MR. WALLIS: How good is that?

CHAIR APOSTOLAKIS: You are presenting the whole distribution. Let's not forget that. But in terms of the criteria part of the guidelines, you are expected to use the mean value.

MR. PARRY: Use the mean value, right.

CHAIR APOSTOLAKIS: Another thing that very often we forget is that these guidelines didn't come down from any mountain. When people defined the guidelines, they had in mind the mean.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: So the whole thing comes together.

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: Okay? It's not as if something objective external to us, and we decided to use the mean.

MR. WALLIS: So the probability of stepping over the acceptability criterion is not addressed at all.

CHAIR APOSTOLAKIS: It's consider -- if the mean is below the line --

MR. WALLIS: If it's a very broad distribution --

CHAIR APOSTOLAKIS: If it's very broad, the staff will go back to the integrated decision making process and start talking about it. There is a very key paragraph in 1.174 that says as you approach the line, there will be increased management attention.

MR. WALLIS: But you don't have to approach the line with the mean in order to have a pretty good chance of stepping over that boundary.

CHAIR APOSTOLAKIS: No. If you have a pretty good chance, the mean will be close.

MR. WALLIS: Doesn't have to be.

MEMBER BLEY: Well, as the distribution gets very broad, the mean moves up into a higher --

MR. PARRY: Yes.

MEMBER BLEY: The broader, the further up it moves.

CHAIR APOSTOLAKIS: That's right.

MR. PARRY: I think George is right, that decisions that are close to the guidelines are going to be much more scrutinized than --

CHAIR APOSTOLAKIS: This paragraph should not have been a footnote. It should have been in bold face letters, because it's a key paragraph. It says if you're close to the line, you should expect scrutiny until we both fall down from exhaustion.

(Laughter.)

CHAIR APOSTOLAKIS: And that's what's happening, actually.

MEMBER SHACK: Sort of like an ACRS meeting.

(Laughter.)

MR. PARRY: One of the things that we address in this section is, in fact, maybe sort of relates to -- well, it's not really your point. It's more related to the fact that there are going to be differences that are caused by the level of detail that people put into the model. And that this raises issues, if we try and treat the criteria as guidelines. Okay? And this is what's happening all the time in the significance determination process. And people are worried that they want to sharpen the pencil to either get above or below the line, depending on whether they're the SRA or the licensee. And there's a problem with that, I think, in the sense that we have to address that fact, that minor differences really do not -- they don't really represent a significant impact on the risk.

MR. WALLIS: So it's been close to the line on either side.

MR. PARRY: Oh, yes.

CHAIR APOSTOLAKIS: Absolutely.

MR. WALLIS: Oh.

MR. PARRY: Let's move on.

MEMBER SIEBER: It should be fuzzy lines.

MR. WALLIS: Now we've found out what you are, we're just trying to figure out how bad you are in that regard. You're happy for folks to step over the line, just arguing about how far you can go. Right?

CHAIR APOSTOLAKIS: It's very clearly stated that you can be above the line and still get approval.

MR. PARRY: Yes.

MR. WALLIS: So what's the criterion for how far you can go over --

CHAIR APOSTOLAKIS: There's no criterion. This is thermal hydraulics term. In our case, there are no criteria, there are guidelines.

MR. PARRY: Okay. Let's move on, I guess. In terms of the other types of uncertainty, in terms of model uncertainty, that's the stuff that was discussed in Chapter 5. And what Tim described is the process that we're going to use to identify the key sources of uncertainty for the decision maker. And what our focus is here, is that what we want is that the decision maker should be supplied with an assessment of which of these hypotheses and our assumptions, and which model uncertainties can have an impact on whether the decision is correct.

The way we've chosen to do it is through sensitivity studies. So what this would do is you present the decision maker with a set of decision -- with a set of results relating to the different models, or the different assumptions, and an assessment really of the credibility of those hypotheses. We're not going to put numbers on them, because we don't think that that's necessarily something that we can do in any realistic way.

CHAIR APOSTOLAKIS: But that credibility guide, how do you do that?

MR. PARRY: Well, I --

CHAIR APOSTOLAKIS: Make assessment of the credibility, that's a number. Now somebody has to give me numbers, expert judgment, something.

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

think what you would try and do is to assess whether Expert A had -- whether there was reasonable --

(Simultaneous speech.)

CHAIR APOSTOLAKIS: I remember in one of the rules we risk-informed, that originally in the sensitivity analysis, maybe it was EPRI, I don't remember, it said increase the failure rates by a factor of five. Then a revision comes and says increase them by a factor of two. And the question was, why did the five become two? And coming back to South Texas, they increase it by a factor of ten, and it worked. What if it hadn't worked? They would have gone down to seven? You see, you have a problem there of somehow what is reasonable to do is subject to discussion.

MR. PARRY: I agree, and you have to recognize whether you can make a reasonable technical argument for the basis for that sensitivity study. That's what, I think, we're focusing on. But if you can't rule out a hypothesis, or an assumption that is going to push you over the limit, then I think as a regulator, we almost have to take that as a credible hypothesis, and say this is no longer an acceptable criteria.

CHAIR APOSTOLAKIS: Even if it is very

unlikely.

MEMBER STETKAR: Even if there's only a fraction of a percent probability that that kind --

MR. PARRY: I don't know. What does that mean? What does that mean, that fraction of a probability. It's not something you can measure. It's your opinion. Right?

CHAIR APOSTOLAKIS: Yes, but we make decisions based on opinion all of the time. In fact, we have formalized it in this Agency, the expert opinion. But let me bring another point.

You're addressing the issue of having alternate hypotheses, and you're doing the sensitivity analysis.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: What, again, if you have a consensus model which has uncertainty? Then it's difficult to tell what an alternative assumption would be. You have a computer model, RELAP 5.

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: And you are trying to use it now somewhere where it's not a routine application, and you may have uncertainties in three places. And somebody says well, I believe the uncertainty because of this, is that distribution, that distribution, and propagates all the distributions. You can't do sensitivity analysis until you do very many of them, and you start changing all sorts of things. You don't have alternative hypotheses --

MR. PARRY: I don't think that's what we're talking about.

CHAIR APOSTOLAKIS: I know, but I'm saying that that's another situation where model uncertainty -- the COMPBRN Code, we always had a distribution on the code itself, the results of the code. How would you do a sensitivity analysis on that?

MR. PARRY: And how did you determine that distribution?

CHAIR APOSTOLAKIS: By comparing with the very few experimental data we had.

MR. PARRY: Okay. Then you have --

CHAIR APOSTOLAKIS: But it's better than not doing it. It's better than just saying here is a code, use it, when I know that the results may be off by a factor of two, or factor --

MEMBER SHACK: Presumably, you would argue that the code result really is the adjusted result. I mean, you sort of build -- if you know it, you build it into it.

CHAIR APOSTOLAKIS: So you don't do this then.

MR. PARRY: An example of a consensus model would be the Westinghouse RCCP LOCA model.

MEMBER CORRADINI: The what? I'm sorry.

MR. PARRY: The Westinghouse Reactor Coolant Pump Sealed LOCA model.

CHAIR APOSTOLAKIS: In some cases, that's not the case. I agree.

MR. PARRY: That's the type of thing we're talking about when we're talking about --

CHAIR APOSTOLAKIS: I understand. I'm telling you that there may be other kinds of things that you may want to include. I don't dispute what you're saying.

MEMBER CORRADINI: I don't think he wants to, though. What I keep on hearing with the two of you is that you want to do this, and I don't think he feels it's in his scope.

CHAIR APOSTOLAKIS: No, no, no, no, no. The difference is, I'm not doubting what they did. I'm saying there are additional things that need to be considered. There may be other situations where people have tried to address model uncertainty in a different way, that doesn't fit this approach.

MEMBER CORRADINI: So my question is, is it within the scope of what they're after, because --

CHAIR APOSTOLAKIS: Well, the scope has to change.

MEMBER CORRADINI: Okay. That's fine with me. I just --

MEMBER SHACK: It depends on the decision they're trying to make, George.

MEMBER SIEBER: In the case of the cooling pump, what caused them to really want to refine the model is the fact that the result from the simplified analysis isn't quite what they wanted to get. And that could -- you don't write that into this document. On the other hand, I think there's a lot of decisions that are made like that. I don't get the result that I want, I'll work on the analysis to eliminate or reduce uncertainties.

MEMBER MAYNARD: Yes, but I think that happens all the time, and I think that's consistent with this document. It's not unusual to do kind of a broader scope, take a look at something, as long as everything fits within that, that's fine. But when it doesn't, you refine it, and I think that's a legitimate approach. And that's one of the options here, is to reduce uncertainty by redoing the model, refining the model to some degree to remove some of the model uncertainty.

MS. DROUIN: Right, but what I thought where the disagreement is, is that what we have said is that once we call something a consensus model, we don't have to go and investigate an alternative hypothesis. We haven't dismissed the fact that there's uncertainty associated, but we aren't going to investigate the alternative hypothesis.

MR. PARRY: That's right.

MS. DROUIN: But I thought you were saying you didn't like that.

CHAIR APOSTOLAKIS: No.

MR. PARRY: Because the consensus model, if it has uncertainty, will have a prescribed approach for dealing with that uncertainty.

CHAIR APOSTOLAKIS: Well, let's hope so. The pilots that the industry mentioned going to try to implement all this? Because we really need practical applications of these ideas to refine them. So Doug mentioned two pilot projects. Right?

MR. TRUE: That was on the --

CHAIR APOSTOLAKIS: Oh, that was different.

MR. TRUE: That was on the EPRI.

MS. DROUIN: I think this is -- I just want to make sure I understood that are you agreeing -- it's not clear to me that you're agreeing or not agreeing with that approach. It sounds to me like you still want us to pursue, even though we call it a consensus, even if it's been deemed a consensus model, you still want it to be -- alternative hypothesis to be pursued. That's what I thought I heard you saying.

CHAIR APOSTOLAKIS: No, no, no. The alternative hypothesis, my problem is this credibility thing, that I really think -- the credibility. At some point, you have to say something about how likely this particular hypothesis is to be true. And Gareth says that can be done judgmentally. Well, of course, it will be judgment, but by avoiding numbers, I'm not sure how far you can go avoiding numbers. That's what I'm saying, that if we had a practical application it would shed a lot of light on this.

MR. PARRY: I really would object to the term of "likely" associated with a hypothesis.

CHAIR APOSTOLAKIS: Why not? Why?

MR. PARRY: Well, because that seems to suggest that there's -- I mean, we all know that any of these hypotheses is probably not the right answer. What you're really looking for is an answer that is not even well-likely. It's -- I don't think it's the right --

(Simultaneous speech.)

MEMBER BLEY: Is it conservative in all cases of interest? Is that what you're --

MR. PARRY: Well, it's -- in a sense they're all equally likely, if they're based on some sort --

CHAIR APOSTOLAKIS: I have had problems with sensitivity analysis from day one. There were some members of this Committee 30 years ago that enjoyed taking some study the staff did or the industry, and said look, if I change the number by a factor of ten, everything changes. And I'm sitting there, why are you changing it by a factor of ten? You know, there is so much arbitrariness in all this.

MR. WALLIS: It must be a bit of uncertainty, I guess. I think it could be ten times as big.

CHAIR APOSTOLAKIS: But they never felt that they had to tell us how likely that factor of ten was. You have to put some rules there to the game. You can't just change things and say my goodness, if I change this by a factor of 1,000, the whole system collapses. Well, yes, thank you.

MR. PARRY: We recognize that, George. And I think we do mention in here that if you are going to propose alternate cases for sensitivity, then they have to be defendable. In some cases, though, it's not necessarily defendable, and I will take 50.69 as an example, because in that case, you can choose to say I want to make sure that things don't get any worse than X, and set up a monitoring program to make sure that things don't get worse than X. And if they do, then you change it. That's a risk-informed decision making approach.

CHAIR APOSTOLAKIS: I understand.

MR. PARRY: Which recognizes uncertainty.

CHAIR APOSTOLAKIS: And, in fact, we did that last time with seismic, the LOCA frequencies. The approach that the staff took was how large would the flaw have to be for something bad to happen, and they concluded it had to be so large that it was really very unlikely that you would ever see that kind of flaw.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: And we all accepted that argument, without really saying how unlikely it is.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: So in some cases it works, in some cases it doesn't work.

MR. PARRY: Right. And what we're trying to do is come up with a pragmatic approach that can be used.

CHAIR APOSTOLAKIS: Okay. Let's go on.

MR. PARRY: Okay.

CHAIR APOSTOLAKIS: Completeness, how do you handle completeness, multiply by five?

MR. WALLIS: Are you finished with --

MS. DROUIN: Before we go on, you may want to go back, and you can give us comments later on, or we can come back to it later on today. I mean, we did have a small section, and maybe -- I say small, because you obviously missed it. But there is guidance in here that you have to justify your sensitivity analyses, the ones you choose to do.

CHAIR APOSTOLAKIS: I read it. I didn't miss it. I read it.

MR. PARRY: At least you agree with that.

(Simultaneous speech.)

MR. PARRY: Okay. In terms of completeness, okay. The aspect of completeness that we're talking about here is the completeness associated with the stuff that we know that we don't have in the model. Okay? Not the stuff that we don't know we have in the model, because that's dealt with elsewhere.

MEMBER BONACA: I have a question on that, however. How do you deal with the CDF? I mean, CDF, typically -- I mean, you're talking about -- that bullet there talks about the delta CDF. Okay? The delta CDF that you have.

MR. PARRY: Okay.

MEMBER BONACA: And the question I have is how do you deal with the completeness in the CDF?

MR. PARRY: The only way you can deal with it, as we say, is either you have to demonstrate that the contribution that you don't have in is insignificant. If the thing that you're concerned about is the CDF.

MEMBER BONACA: Total CDF.

MR. PARRY: If you're worried about the total CDF, you have to demonstrate that what you've left out of the model is insignificant. If that's the --

MEMBER SHACK: It doesn't change your decision. You can be moving along this axis in your 1.174.

MR. PARRY: Okay. That's -- yes, 1.174

allows you -- I think that's --

MEMBER SHACK: I think that's really what Mario was -- he needs to know where he is on that axis before he can do it.

MR. PARRY: Okay.

MEMBER BONACA: Because, really, this confusion has been there for -- we know what --

MR. PARRY: If your delta CDF is less than 10 to the minus 6, you don't have to worry about whether -- I mean, that's the way the criteria are set up.

CHAIR APOSTOLAKIS: Yes, it really doesn't matter where you are on the axis, unless you really go to 10 to the minus 2.

MR. PARRY: Yes.

(Simultaneous speech.)

MR. PARRY: 1.174. Right.

CHAIR APOSTOLAKIS: Another argument that was used in the past is okay, they haven't done a fire or a seismic, or their shutdown. They haven't done their shutdown, but look, other people have. They say it's comparable to the internal events, so let's multiply the internal event frequency by two. Does it make any difference? No.

MR. PARRY: But maybe just to say what

we're going to do about completeness. We don't have any magic bullets for saying multiply things by factors of two and three to allow for the fact that you haven't modeled something. You have to make -- if it's significant to your decision, you either have to model it, or you have to show that it's not significant.

MEMBER BONACA: There is a broken line there at 10 to the minus 3.

CHAIR APOSTOLAKIS: What did you say, Mario?

MEMBER BONACA: There is a broken line here, an endpoint, 10 to the minus 3.

CHAIR APOSTOLAKIS: No, it's not specified where.

MR. PARRY: It's not specified.

CHAIR APOSTOLAKIS: But, I'll tell you, in terms of real life, if you look at how the NRC and the industry have responded in the past, Quad Cities, especially, if you go above, I would say, two or three ten to the minus three for CDF, all hell breaks loose. But they don't want to specify where, but I think from the behavioral point of view, that's where you get into adequate protection. I remember Quad Cities, the guy came up with nine ten to the minus 3 the first test. Boy!

MR. PARRY: Okay. Just in the interest of speeding up, I'm not going to -- there is a section there about combining results. I'm not going to go into that here. Okay? Except to say that whenever you're using the results, you have to understand the pedigree of the results, because that plays a role in how you use them.

And, again, I will not talk about, in the interest of time, I will not talk about the qualitative approaches. You can read that. There's not very much written in there, but it is a recognition that there are some things that we can't necessarily quantify all the sources of uncertainty. But what we can do is, we can compensate for them in different ways.

I think with that, I will hopefully stop, and hand back to Mary.

CHAIR APOSTOLAKIS: Let me ask, John, are you going to be here this afternoon?

MR. LEHNER: Yes.

CHAIR APOSTOLAKIS: So we can have the discussion of the state of knowledge correlation when EPRI sits up there, and maybe you can participate in that discussion. You can participate in everything, but in particular there, since we skipped that part.

MEMBER BLEY: I'm going to try something. One thing, you don't have to answer this now, but I want to understand better this idea of the consensus model, and what it takes for us not to have to look at alternative hypotheses. I've gone back and re-read what's in there several times now, and it raises some questions for me that I'd really like to get on the table later on with you.

CHAIR APOSTOLAKIS: Okay. Good.

MR. WALLIS: I have a comment.

CHAIR APOSTOLAKIS: Yes. Go ahead.

MR. WALLIS: I have a comment on Chapter 7. I'm not sure if I can express it very well, but you seem to be going to -- when you get to this decision maker, you say, well, the CDF is 10 to the minus 6, but then you're going to supply this decision maker with what it seems to be a huge pile of paperwork qualitatively discussing all of the assumptions I made, and so on, and so on. I think that takes away from the credibility of the answer. If you don't have a measure of how good the answer is, you have to have acres of paperwork to explain all the reasons you did this, that, and the next thing, and so on. That takes away from the credibility of the answer. You really need a qualitative measure of how good the answer is in terms of a deviation of some sort, or a number that says --

MR. PARRY: The deviation is already included, because this is the -- that is the results of the sensitivity study.

MR. WALLIS: But there are so many of these.

MR. PARRY: There aren't that many, it turns out. For specific decisions, there are probably not going to be that many. It's not as big as you think.

MR. WALLIS: Well, think about it, because you seem to be asking for assessments of so many things in terms of words and discussion.

CHAIR APOSTOLAKIS: We have faced that problem in the past, as well, where the analysts tried to shift some of the responsibility to the decision makers, and this Committee was not too favorable to that approach, because the decision maker usually is not qualified to go back and work with the PRA.

MR. WALLIS: That's right. He wants the answer.

CHAIR APOSTOLAKIS: And, in fact, the LOCA frequencies, I was screaming all the time give us what is your best result. And they said no, no, no, we're not going to do that. We'll give you 15 sensitivity studies. So yes, we should be careful not to ask too much of the decision maker, because the decision maker is --

MR. PARRY: Well, I think the decision maker has to have the right assessment of the analysis.

CHAIR APOSTOLAKIS: That's right.

MR. PARRY: And I think it's the analyst's responsibility to say that given all the evidence that I have, I think that --

CHAIR APOSTOLAKIS: This is it.

MR. PARRY: -- this is the right decision. Right. But this -- and this is why I think it is. Right? And in many cases, if the various sensitivity studies still allow you to accept the decision, then you're obviously pretty happy about it. It's only when you get where there are clear differences, and there are not many cases where they are going to be like that, I don't think.

MEMBER BONACA: It's between the decision maker and the analyst, there is also questioning going back and forth. Have you considered if this happens, and the answer no, we haven't considered because there is no need, and the reason is, is bound by this condition. And there is a lot of questioning that has to take place. And oftentimes, it brings out surprises.

CHAIR APOSTOLAKIS: Okay.

MS. DROUIN: I also think in looking at 7, we could add in here, we don't have a discussion of the form of the documentation, of what you're supplying to the decision maker. And I think we can add to that in this chapter.

MR. PARRY: Yes. Just to add to that, actually, we developed an office instruction, like 504, which is associated with presenting the decision maker with discussion of options. And part of this is presentation of the uncertainties and the various decisions.

CHAIR APOSTOLAKIS: I believe that at least I would be able to make more reasonable substantive comment on what you should do after I hear what EPRI has to present. And maybe we can break for lunch.

MS. DROUIN: I mean, I could wrap this up now in a couple of minutes, I think.

CHAIR APOSTOLAKIS: What?

MS. DROUIN: I said I think I can finish

our presentation real quick.

CHAIR APOSTOLAKIS: I thought you finished.

MS. DROUIN: No.

(Simultaneous speech.)

CHAIR APOSTOLAKIS: Next?

MS. DROUIN: I don't have to spend any time on that slide.

CHAIR APOSTOLAKIS: All right.

MS. DROUIN: But I did want to talk just about a minute in terms of where we're going, the meetings and stuff we have planned.

CHAIR APOSTOLAKIS: Oh, okay. That's interesting. Meeting in March, I thought it was February. That's good if it's in March. That's good. So you want a letter in March.

MS. DROUIN: Probably we'll be asking for a letter. Like I said, we went out for three months. Now here are some tentative dates. We picked these dates because in talking particularly with EPRI and other stakeholders, people's calendars were already full, and there were key stakeholders that we want to make sure that are going to be at these public meetings, so we were trying to work around that, so we've already penciled in dates. And there were two, February 1^{st} --

CHAIR APOSTOLAKIS: February 29^{th}?

MS. DROUIN: I'm sorry?

(Simultaneous speech.)

CHAIR APOSTOLAKIS: Sorry, Mary. Go ahead.

MS. DROUIN: That's okay. To have a public meeting on February 1^{st}, and that would really be more of us presenting the -- even though the document has been out there, it hasn't been out there too long, and so we would want to walk through the document to the public to help them in reading it. Then have a second meeting, public meeting on the 29^{th}, a month later, where we're now in a listening mode, and the public is coming in and sharing their initial views of it. So we'd like to go through those two meetings before we come back to the Full Committee, which would then be the 1^{st} of March. Now if you want to have another Subcommittee, maybe we could work it in here.

CHAIR APOSTOLAKIS: I want to ask you about that. Ken Canavan told us that maybe in a month there will be an EPRI document. Doug?

MR. CANAVAN: End of January.

CHAIR APOSTOLAKIS: End of January. Okay.

So if we -- I think that's an important document for us. I would hate to have to write a letter without it.

MS. DROUIN: Us too.

CHAIR APOSTOLAKIS: Okay. So if we get that -- let's say we get that document by the end of January, we have a -- I think it's kind of tight, Mary. If we have a Subcommittee meeting in February, then you want the Full Committee in March?

MS. DROUIN: We weren't planning a Subcommittee in February.

CHAIR APOSTOLAKIS: Well, how -- an intelligent Subcommittee meeting means we have --

MS. DROUIN: Based on this meeting, we may want to have one.

CHAIR APOSTOLAKIS: But we need -- I mean, if we get the EPRI document the end of January, I don't see how we can have a Subcommittee meeting --

PARTICIPANT: And we need Appendix A, too.

CHAIR APOSTOLAKIS: Sorry?

PARTICIPANT: And we need Appendix A, too.

CHAIR APOSTOLAKIS: We need your Appendix A, as well.

MS. DROUIN: We hope our Appendix A will be one sentence. We endorse the EPRI document.

(Simultaneous speech).

MS. DROUIN: We hope, so we have been meeting with EPRI on a very regular basis looking at their working, giving them our feedback, and so they're very much aware of what our concerns are. And so far, I think we're merging to an agreement on a lot of these issues.

CHAIR APOSTOLAKIS: If we have --

MS. DROUIN: Our goal being that at the end of the day we have no issues, and we can just completely endorse their work.

CHAIR APOSTOLAKIS: If we have a Subcommittee meeting say the middle of February, and we have some comments on the report, and you agree to change the report, you don't have time to do it. So we'll come back --

MS. DROUIN: Before the Full Committee?

CHAIR APOSTOLAKIS: Yes. And we'll come back in March, and say --

MS. DROUIN: Why would we have --

PARTICIPANT: The public comment is until the end of February.

MS. DROUIN: Why would we have to change the report before, prior to the Full Committee, if we're in agreement with your comments, and we've agreed to change it, you need to see that? You need to physically see those changes?

CHAIR APOSTOLAKIS: Yes. We need to see --

MS. DROUIN: So you all have no trust --

CHAIR APOSTOLAKIS: No, don't say that.

(Simultaneous speech.)

MS. DROUIN: So if March is too early.

CHAIR APOSTOLAKIS: Mary, would it be --

MS. DROUIN: I, personally, don't have a problem --

CHAIR APOSTOLAKIS: -- upsetting to your schedule to have the Full Committee meeting in April? Does that destroy anything, or damage it?

MS. DROUIN: It doesn't destroy anything for me. I just need to have the support of my management that we're going to --

CHAIR APOSTOLAKIS: Would that be a major -- I mean, realistically I don't see -- I would hate to have to write a letter in March that says do not publish. I don't want to do that.

MR. MONNINGER: I guess my thought is, we prepared this schedule based on our understanding of the approach and the scope into this meeting. I think one of the things we have to go back and think about is a lot of the comments from the Committee. And are we on the same scope, or are we mission creep, exactly where we are on this, before really commenting on this.

CHAIR APOSTOLAKIS: It's not an important thing, but we will not have the public comments and the resolution. We will not have the EPRI report. I think it would be much more realistic to schedule it for April.

MR. MONNINGER: Yes. I think we would definitely want to have the most productive meeting.

MS. DROUIN: Yes.

MR. MONNINGER: And if the most productive meeting means that the public comment period is over, and you guys digest the EPRI document, yada, yada, yada, it's much better to have a productive meeting. And if that means --

CHAIR APOSTOLAKIS: Okay. So we'll have to discuss that in the future.

MS. DROUIN: So we're thinking about a Subcommittee then in March.

CHAIR APOSTOLAKIS: Something like that, yes. Early March, maybe.

MS. DROUIN: And that's why on the bottom one, I initially had May there. And I thought no, as well as I know I'm going to come here, we're going to get delayed, so let's put June down there, also.

MEMBER BLEY: You're going to have a public meeting the last day of February. You won't have written public comments, or not many then. Do you expect you'll have some sort of a response document to what you hear in that meeting that we'd have before?

MS. DROUIN: Right, because you see -- you know, I had three bullets there, a third public meeting where we would then in April, and it would be towards the end of April, to go back to the public and say okay, we hear all the comments we've gotten. Here's our response to it, and here's how we resolved them. And it would give the public one last chance, if there were comments that we just really disagreed with the public, to let them know that prior to seeing the final publication of the document.

MEMBER BLEY: If our meeting is Full Committee early April, when do you anticipate you'd have a response document in place? It would be nice to see that before the Subcommittee meeting. Not likely, but certainly before the Full Committee meeting.

MS. DROUIN: With the public comment

ending the end of March --

MEMBER BLEY: It's the end of March.

MS. DROUIN: Well, I can change the -- it hasn't been published yet. I can only give the public two months. Right now we were giving them three months, the end of March. And I'll tell you, with speaking with all the people involved in this, everybody's calendars are so loaded down --

CHAIR APOSTOLAKIS: Including our's.

MS. DROUIN: -- that to shorten the public comment period is not going to serve anybody well.

CHAIR APOSTOLAKIS: Yes.

MS. DROUIN: And there's one slide, because I think it's important. One piece we haven't talked about, that is on our table to do. We have not started this piece, but because of the complexity of this document, we are anticipating developing some kind of training so that when -- soon after the document is issued, plan to have some training courses.

CHAIR APOSTOLAKIS: For the NRC staff?

PARTICIPANT: For industry?

CHAIR APOSTOLAKIS: Industry, too.

MS. DROUIN: I mean, my view is that it would be public, because this document is just not for

NRC. Everybody needs to understand how to use this document and everything, and we've also talked to EPRI. Our intent, and so I think Ken is going to talk a little bit about this. But, hopefully, we -- we worked together on the training thing, too.

MEMBER BLEY: It would be joint training then.

MS. DROUIN: All of that has to be seen.

MEMBER BLEY: Okay.

MS. DROUIN: But I just wanted to let you know there is a training aspect to this.

CHAIR APOSTOLAKIS: Very good. Are you done?

MS. DROUIN: Yes. Thank you.

CHAIR APOSTOLAKIS: Thank you very much. We'll reconvene at 1:15.

(Whereupon, the proceedings went off the record at 12:14 p.m., and went back on the record at 1:17 p.m.)

CHAIR APOSTOLAKIS: Back in session. Now we're going to hear from the industry and who will start? Ken?

MR. CANAVAN: I will start us off.

CHAIR APOSTOLAKIS: Introduce your colleagues, please.

MR. CANAVAN: Sure. My name is Ken Canavan. I'm with EPRI and with me the big guy, Doug True. We brought him in case you have any real hard questions and --

MEMBER SHACK: He'll whip us into shape.

MR. CANAVAN: And Don Vanover also of ERIN Engineering who will be presenting the second half. We're going to tag team this for you.

After the questions this morning, I'm disappointed I only brought three people with me. Three total.

CHAIR APOSTOLAKIS: Two.

MR. CANAVAN: Three total.

(Laughter.)

CHAIR APOSTOLAKIS: You have to bring yourself. So you brought two people.

MR. CANAVAN: I wanted to take a moment --

CHAIR APOSTOLAKIS: The Committee cares about precision.

(Laughter.)

MEMBER MAYNARD: There's a number of uncertainty in the number, George.

MR. CANAVAN: Actually, I wanted to talk a little bit about that today.

(Laughter.)

CHAIR APOSTOLAKIS: Have we lost somebody there? Okay.

Okay, Ken, sorry.

MR. CANAVAN: That's okay. I wanted to thank the Subcommittee for their time. I always enjoy hearing the issues get discussed all the way from the very theoretical all the way to the very pragmatic and practical.

And I did want to talk a little bit about uncertainty, just overall, the definition to take us back a little bit. Uncertainty is sort of a -- is the lack of uncertainty. It's a state of having a limited knowledge of where it is not possible to exactly describe where you are. For example, if I ask you how long a day is, you probably would say it's 24 hours. You're not correct. Actually, it's 23 hours and 56 minutes and I don't know the number of seconds. That's why we have Leap Year. And that occurred to me sitting in the back of this room that a day isn't 24 hours. It's 24 hours plus or minus something.

CHAIR APOSTOLAKIS: But from the regulatory perspective, that's irrelevant.

(Laughter.)

MR. CANAVAN: This is true. But even a year is 365 days, commonly accepted, but has an uncertainty, obviously, because next year is Leap Year, 366 days next year.

And I'm probably not in a unique position, but at EPRI my title includes risk and it includes safety. So I get to see both sides of the equation and when I look at that equation I see something that when we talk about safety analysis and deterministic analysis, we talk about something where the uncertainty is treated a certain way. That's what it means to me. It means when you do deterministic analysis the way you treat uncertainty is you bound there. If there's an uncertainty that you're not sure of, you just choose a bounding value, whatever that bound may be, however high it has to be, you make it, so that your convinced that you've covered the situation. That's how you do safety analysis.

On the other hand, you see real true, hard core risk analysis which is the other direction, which is everything is probabilistic, even to the point to where you might weight alternative theories. You might propagate uncertainties of the parameters. You might have everything expressed as a distribution. That would be something that you could theoretically use for risk-based regulation.

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 for the case of risk. So when you give our your probabilistic number and you think you're conservative, if you are using that value, then it's simply that that's a bounding value of the true mean without expressing what the bound is.

The two documents that were produced was the guideline for the treatment of uncertainty and risk from the applications, the technical basis. That was produced in December of 2004 and in December of -- that was produced in December of 2004. That's what I'd like to refer to as everything you ever wanted to know about uncertainty and more. That document starts with the phrase, "in all engineering endeavors, there is uncertainty." And so it starts at the beginning and takes you through all the different types of uncertainty and how we, in the nuclear industry, and we in probabilistic risk assessments, use and treat that uncertainty or at this particular point, don't treat uncertainty.

It lays out all the things that we were going to tackle and the things that we weren't going to tackle as we moved forward in our work. The next document was the guideline for the treatment of uncertainty and risk-informed applications of The Applications Guide. This was intended to be short handbook that said what to do. As a matter of fact, if you read it, it really does say what to do. After its publication in October of 1996 we entered a long series of discussions with the NRC staff and public stakeholders. We made the document public, by the way.

CHAIR APOSTOLAKIS: 2006, for the record.

MR. CANAVAN: 2006, yes.

CHAIR APOSTOLAKIS: You said 1996.

MR. CANAVAN: Wow, no, 2006.

CHAIR APOSTOLAKIS: A decade is nothing.

MR. CANAVAN: Plus or minus ten. That Applications Guide was intended to be very pragmatic. One of the -- how that document started off was representing the pragmatic portions of treating uncertainty in risk-informed applications. And that's a key. We're looking at the range of applications that are applied, and we're looking at how we should treat uncertainty in those applications. And it was very pragmatic in nature. So I think when we come up with an application, the thought was there was a process to apply and treat uncertainty of similar -- to the processes that we use in other engineering areas.

CHAIR APOSTOLAKIS: So the document, you

gentlemen referred to earlier is an update of one of these documents or is it a new document? It's a new slide?

MR. CANAVAN: A new document to be issued. Thank you, George. I love a straight man.

After October of 2006, we started discussions with stakeholders and the staff and this Committee as well, I think, at least one time, maybe not after the Applications Guide was formally published, but we did meet with this Committee once. The point of all these interactions was to gather information. We also performed two pilots of the first document. As a result of all these gathered lessons learned and all discussions with the staff, we felt it important to revisit some of the issues that in that document. We're hoping that many of your concerns that you might have, having read those documents are treated in the newer version and the presentations that follow are some of our early ideas of what would be in the new document.

MEMBER SHACK: Did you give us a date?

MR. CANAVAN: We did, a draft of the report will be provided broadly by the end of January, not just to this Committee, but I think it will be a broader distribution than that. I think it will be a very wide distribution as a matter of fact to solicit as much opinion as we can --

CHAIR APOSTOLAKIS: That would be a draft document?

MR. CANAVAN: It will be a draft document. We will be looking for additional feedback.

MR. BLEY: Will that be publicly available or only --

MR. CANAVAN: Yes.

MR. BLEY: Publicly available.

MR. CANAVAN: It will be publicly -- the draft will be made -- public is a -- in this particular case it won't be on the website. Other documents are currently on the website, publicly available for no fee. This future document, the draft that we've provided very broadly and we will not put any restrictions on its distribution because it's for comment. When we finalize it, there may be a different situation. We may provide it to this Committee and the industry, but that will be --

CHAIR APOSTOLAKIS: But our next subcommittee meeting on the 19th I think we should spend some time, if you guys agree, telling me about your new document.

MR. CANAVAN: We would welcome that.

CHAIR APOSTOLAKIS: Which means you have to be here. We have to decide that and we have to coordinate it among you, the staff, and us. But there will be, I thought we said some time in February?

MR. BLEY: March.

CHAIR APOSTOLAKIS: March. What happens in February? No, in March, okay.

And then the Full Committee is in April, yes. Because we will be waiting until the staff receives the public comments, right? That's why we pushed everything, because we can only comment in an environment like this.

MR. CANAVAN: The title of the new document is "The Treatment of Parameter and Model Uncertainties, Probabilistic Risk Assessments." We're getting a little bit more specific about what we're speaking about. It's a streamlined version compared to the --

CHAIR APOSTOLAKIS: Wait, let's talk about your title. You're leaving "incompleteness" out which I think is --

MR. CANAVAN: Correct.

CHAIR APOSTOLAKIS: But do you want to maybe modify it a little bit to make sure that you are addressing risk-informed decision making? I mean it's up to you, but it's one thing to talk about how perfect the PRA can become and quite another to talk about how the decision is changed.

You don't have to --

MR. TRUE: No, I think it's a worthwhile comment. We have two masters we're trying to serve here and Don will get into this. One is support of risk-informed decision making, but the other is support of the utilities meeting the ASME standard. It has requirements in it that they need to be able to say they met and we're helping to provide that process for meeting the QUE requirements which QU is the modification and E is the uncertainty element qualification.

We can broaden that to include risk-informed decision making, but it needs to not only be --

CHAIR APOSTOLAKIS: Treatment of parameter and model uncertainty for PRA quality and decision making. Covers both.

MR. CANAVAN: There has been some discussion of whether or not, you know, whether or not there is such a thing as an unapplied PRA model. In other words, as soon as you finish a PRA, if you quoted CDF to somebody, you've essentially applied it, right? You've told somebody what the CDF was.

CHAIR APOSTOLAKIS: But it's not the same thing as making a decision.

MR. CANAVAN: You haven't made a decision, but you've communicated something. So like I said, it's a very interesting discussion that we've had on unapplied model.

MR. TRUE: On a utilities basis, it's not very long after you've done that then you're using it in your A4 program or maybe through other things.

MR. CANAVAN: You haven't found a case where somebody actually did a PRA, at least in the nuclear power industry where someone has done a PRA and then suddenly said well, that's it. Here's the CDF. I'm all done now.

Generally, shortly after that it gets involved in all the programs and becomes an applied model, even if you don't make any changes to it. And therefore the base model does have some application, if you will.

Okay, well, this is going to be a streamlined version compared to the original technical basis document and the applications guide, so it's going to be a little bit smaller than both of those documents. The intent is again to instruct PRA analysts and practitioners in how to derive information to appropriately handle uncertainty. The interesting thing that I've noted from this morning that I think is very important for us to continue is that the Committee has pointed out that there's an awful lot of -- all these reports could benefit from a little, just a little bit of introductory material and having heard the comments and thinking back on the reports, I think this report would be served as well by having a little bit of introductory material, at least an overview, to present for example, how we're trying to get -- what our goals are and how we're trying to get there.

MR. BLEY: Ken, will the new report replace the Applications Guide or will it refer to it?

MR. CANAVAN: Excellent, thank you. the report will replace the Applications Guide, but not the technical basis document. We'll go into that a little bit later. There's pieces of the technical basis document that we wish to keep and refer to later. And that was my last bullet. That was going to be -- the technical basis portion of the document will be maintained as a reference material.

There's some important reasons for that. One is we will probably reference it in this report.

The other is it has material that is not going to be referenced in this document. So it's important that that material remain available.

The rest of this presentation is all framed around this slide. So you're going to see this slide an awful lot. We have some report objectives and they're listed here. They never really changed much from the inception of this entire endeavor which is --

CHAIR APOSTOLAKIS: Let me now say this.

MR. CANAVAN: Get it off your chest.

CHAIR APOSTOLAKIS: Why bother about the first bullet, Ken? The codes do it routinely? Why even raise the issue? You push a button and something comes out. It's not extra work. And it helps you update your distributions with experience from your plant as you move on. You see how your risk changes with experience, and plus, you satisfy people who worry about uncertainty. I mean this is something that maybe was real in the '80s. It's not any more in my view. SAPHIRE does it. RISKMAN does it. There are -- RiskSpectrum does it. CAFTA probably does it. Birds do it, everybody.

(Laughter.)

MR. TRUE: What you are saying, George, is absolutely true when you're talking about a base model. The problem is that that base model gets applied in ways that it may not be pragmatic and practical to do that. For example, all of our importance measures are done with point estimate solutions.

CHAIR APOSTOLAKIS: You should be using the mean values for the importance measures.

MR. TRUE: The importance measures don't come out of the uncertainty analysis. They're calculated from the cut sets.

CHAIR APOSTOLAKIS: Using the mean values, I hope.

MR. TRUE: Right.

CHAIR APOSTOLAKIS: Right.

MR. TRUE: The biggest correlation is not reflected --

CHAIR APOSTOLAKIS: I don't want to go into that. I'm just saying if you don't have state-of-knowledge correlation, why bother? I mean it's such a trivial thing to do now. Just do it, because the moment you raise the issue, people are starting to say oh, I can do a point estimate. Well, yeah, all right. The other problem I have is that if you are dong the point estimate calculation, you're not going to bother to develop distributions for the main input, with the basic inputs. So you're going to say this is my point estimate for an input. I don't know what that means. People claim it's a mean value. I don't know if it's a mean value. You see --

MR. TRUE: We may have a semantic problem which I think we've had before.

CHAIR APOSTOLAKIS: Think about this. You may not even want to raise the issue.

MR. TRUE: It's important. We have to. I'll try and again explain it. I think we agree that you must have mean values in the solution, right? But there's also the problem of propagating the distribution, addressing the state-of-knowledge correlation to get a true meaning of the overall result. That's one thing, and I think we generally agree --

CHAIR APOSTOLAKIS: And the codes do it routinely.

MR. TRUE: The codes do that, but what happens when that answer is significantly different than your mean-based point estimate solution that you use for calculating importance measures and doing on-line maintenance and all the other calculations where we don't propagate distributions every single time when we manipulate them all.

CHAIR APOSTOLAKIS: But my point is maybe we should start doing that. And so I will be using mean values for calculating the importance measures for the --

MR. TRUE: I may be wrong on this, but no tools I know of that give you importance measures based on the state-of-knowledge correlation --

CHAIR APOSTOLAKIS: No, no, no. State-of-knowledge correlation is important when you propagate the uncertainties. Once -- then you have -- I mean you're saying I will take the mean CDF with this component always down, and that mean CDF when it is down will be calculated rigorous propagating uncertainties. No?

MR. BLEY: I don't think there are any codes that actually do that.

MEMBER STETKAR: There's no code running today that does that, period.

CHAIR APOSTOLAKIS: So what do they do?

MEMBER STETKAR: They just calculate the point estimate total and set a basic event to true and calculate a new point estimate total and divide.

CHAIR APOSTOLAKIS: But if you have done --

MEMBER STETKAR: That's the way all the software works.

CHAIR APOSTOLAKIS: If you have done the rigorous propagation, the denominated if fixed.

MEMBER STETKAR: But you have to do it by hand is the problem.

CHAIR APOSTOLAKIS: No, no. It's the mean value of the CDF. The problem is the numerator when you put one component down. If you did the point calculation there using the mean values of the distributions, maybe that would be good enough.

MEMBER STETKAR: It may be good enough for certain applications and it may be very wrong for other applications.

MR. CANAVAN: Yes, it would depend on -- because what will happen the state-of-knowledge affects certain cut sets and not others.

MEMBER STETKAR: I'll give you a great example and that's the interfacing system LOCA contribution, the large early release frequency. You can derive tremendously different insights, whether or not you use the state-of-knowledge correlation for the mean --

CHAIR APOSTOLAKIS: But the solution is to use the mean values and then maybe two years down the line will have the ability to calculate the rigorous mean. My problem with point estimates is you stop with point estimates and I don't know what these inputs are and I don't know what the output is.

If they have already done the rigorous calculation and then they do it on the side, the point calculation where the points now are the means of the inputs, I probably don't have much of a problem with that. I think it's not -- there may be some basis where it's --

MR. TRUE: The ASME standard pushes you to do exactly what you said which is to use mean values for those point estimates. What we were trying to do is address the fact that the state-of-knowledge correlation can skew the mean value in trying to decide when do you get out of bounds where now you can't rely on those mean-based point estimate calculations.

CHAIR APOSTOLAKIS: I agree, that's a very important thing to do.

MR. TRUE: That's all we tried to do.

CHAIR APOSTOLAKIS: Okay.

MR. TRUE: That's all we tried to do.

MR. CANAVAN: That's all we tried to do. That was it.

CHAIR APOSTOLAKIS: But you do agree that in many quarters, doing a point estimate calculation means just put mean point values and get something out. That's not what you're saying.

MR. TRUE: I believe the pre-ASME standard that was --

CHAIR APOSTOLAKIS: That was the case.

MR. TRUE: The way it was done. I don't believe that is what happens today.

MR. CANAVAN: Now you need to put in the distribution.

MR. TRUE: I look to the staff to see if they --

MR. PARRY: That's correct.

MR. TRUE: I think we fixed that problem through another means, so we only took on the narrow objective saying when do we have to start bringing back the state-of-knowledge into it.

CHAIR APOSTOLAKIS: For the narrow objective, I fully agree with you.

MR. CANAVAN: That's the narrow objective. And the narrow objective is actually well stated to identify one point estimate solutions are not suitable in light of parametric uncertainties.

CHAIR APOSTOLAKIS: I guess people are

hiding this from us. Every application I see here is point. You guys say everybody is doing it, but I tried to remember an application where people actually -- anyway, I understand now what you're saying.

MR. CANAVAN: Assist utilities in identifying and characterizing the sources of model uncertainty. So these are the goals that Don will speak to and he'll talk a little bit about providing guidance for identifying the appropriate sensitivity cases and what are some logical combinations of those cases. And then lastly, providing some guidance for interpreting the results of sensitivity cases in the context of when you're doing an application. So what do you do with that? What do you do with those answers?

And one of our last bullets which is a new bullet which is why it's highlighted on the screen was to complement NUREG-1855 and basically have connections to that document where it was appropriate and make sure that we were filling in the appropriate level of detail where they were referencing the EPRI document.

This is another figure. You probably remember this if you've read the other reports and 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.

CHAIR APOSTOLAKIS: Do all of the members know what that means, by the way? It just occurred to me.

MR. CANAVAN: No.

CHAIR APOSTOLAKIS: Who is the best person? Ken?

MR. CANAVAN: I can talk a little bit about it.

CHAIR APOSTOLAKIS: Go ahead.

MR. CANAVAN: I have the staff who was also --

CHAIR APOSTOLAKIS: Or maybe you can, it's up to you, guys. We need a two-minute tutorial.

MR. CANAVAN: Two-minute tutorial. There is an ASME PRA standard. It is written a little different than most other standards, but level one probabilistic risk assessment applications. The standard has a series of high level and supporting level requirements divided by element.

In the area of the high level requirements are very high level and describe some overview item, and then the details of supporting level requirement provide what you should model. So there is a description of what. It's not necessarily how, it's more what. An example of a supporting level requirements in front of you, QU, that's the element number. It stands for quantification. There are nine high level requirements. QU is one of them. And then a supporting level requirement A2b, basically states to estimate the mean CDF from internal events accounting for the state-of-knowledge correlation between a event probabilities when significant.

Now there's different capability categories. This is sort of the middle one. Then there is a higher one and there is a lower one. Those capability categories are related to what that requirement needs to be when it is applied to certain applications.

CHAIR APOSTOLAKIS: Mike, we have a distribution.

MS. DROUIN: That's not correct.

CHAIR APOSTOLAKIS: We have a distribution for the failure rate of certain kind of pumps.

MR. CANAVAN: Yes, I described it in --

CHAIR APOSTOLAKIS: This describes our current state of knowledge as to where the rate is or maybe it will be revealed many years later. I have two of these pumps in my system and I do a Monte Carlo simulation. When I pick one value for lambda, the failure rate for one pump, the state-of-knowledge correlation means that you should use the same value for the other pump. You shouldn't sample again.

MEMBER CORRADINI: They are directly dependent.

MR. CANAVAN: Yes, we'll talk a little bit more --

CHAIR APOSTOLAKIS: That's the meaning of state-of-knowledge correlation.

MEMBER STETKAR: We shouldn't reduce our uncertainty about our understanding of the failure rate of that equipment simply because we artificially sample them as if they were --

CHAIR APOSTOLAKIS: If you correlate, you have a broader distribution.

MEMBER STETKAR: If I actually preserve the --

MEMBER CORRADINI: So you sample once.

CHAIR APOSTOLAKIS: Theoretically, this is a consistent way of doing it because the state-of-knowledge distribution says that there is one failure rate for all these pumps, I just don't know which one it is.

MEMBER STETKAR: If the failure rate is --

CHAIR APOSTOLAKIS: For all of it.

MR. CANAVAN: Essentially, if you have a

cut set or accident sequence that has two identical, two pieces of equipment where the data comes from an identical source, you wouldn't want to say that they are independent by indicating that it is this times this, X squared for example, X times X. It is really something where they are actually correlated since they're coming from the same data which is why it is called correlation effect. There is some correlation between the two. It is not 100 percent, but it is not zero either. It's something in between.

CHAIR APOSTOLAKIS: Okay, so that's a state-of-knowledge correlation.

MR. CANAVAN: That's state-of-knowledge. I was going to discuss that on the next slide. I was trying to give you a little primer about the ASME standard and I misspoke about capability category.

CHAIR APOSTOLAKIS: Somebody said what Ken said was not right?

MS. DROUIN: Well, on the capability categories, I think as you recognize when you do a PRA you can do a very simplified PRA or you can do a very detailed PRA. So what the capability category gets to is that for each of the requirements where it, where you can distinguish whether that requirement can be written, there's three factors you consider. The level of detail, how much you represent the plant, to what extent, whether you keep it high level. Maybe more functional to get into your systems modeling down all the way to the component level of detail.

The next one is the degree to which you represent the plant from the data, from using generic data to using plant-specific data and then how much you represent the realism in terms of the analysis. So these are always three things, you know, when you look at when you're trying to build your PRA model, you can do that to three different levels of detail.

In some cases, you may not have that kind of choice. For example, whether you're doing a very simplified PRA model or a very detailed one, you still would want to identify all your sources of uncertainty. However, how you treat them may be different if you're doing a simplified PRA versus a very detailed PRA. So that's what the capability categories allow you that flexibility when you're building the PRA model.

MR. CANAVAN: And what that means, I sort of jumped to the end. What that means is that if you go to do an application, that application might have requirements of certain capability categories of portions of the PRA. So in other words, if you do

MSPI, there were 46 requirements that needed to be a minimum of capability category for 42 or some level of requirements.

But walking through the rest, and that's the two minute view of the standard. The first QU-A2b, which is the supporting level requirement, just states that you should estimate the state-of-knowledge correlation. QU-E3 wants you to estimate the uncertainty interval and the overall CDF results. So there's a part that says estimate the state-of-knowledge correlation that says there's another part requirement that asks you to estimate the uncertainty level of the overall CDF results and estimate the uncertainty intervals associated with the parameter of uncertainties taken in account of the state-of-knowledge. And that's for the level one, core damage, part of the PRA and then there are two that apply to the large early release frequency part and they're essentially the same.

State-of-knowledge correlation tendencies. So we did some looking at the state-of-knowledge and we looked at the technical basis documents, steps you through a bunch of sample cases that we did, and there are several tendencies in the state-of-knowledge correlation and one of these is changed that I will note on the next slide. So if you read the report, we did change one of these. The mean value determined by the distribution, the distribution supported on the PRA model and propagated through a Boolean logic model doesn't preserve the mean when there is a correlation effect. So what that says is if you put a bunch of point estimates in, you run the PRA model, you get a number. If you put a bunch of parameters in, because of the state-of-knowledge correlation, you get a different number for the mean. So there are actually two means produced, one being the point estimate and one being the propagated mean.

The propagated mean value, that's the one produced using Monte Carlo simulation methods or some other simulation method. Including a correlation effect calculates usually a higher mean value and that's because the correlation takes X squared to something else, when two items in the accident sequence are correlated, they aren't independent. They're actually treated more like one item.

And the of state-of-knowledge correlation can be significant. That was one of the things that we noted. That used to be on this slide, because it was an insight. The state-of-knowledge correlation impact on the risk, the mean value, increases as the error factors increase. So we just took a small model and we took that we upped all the error factors, and if you up all the error factors, state-of-knowledge correlation gets bigger, becomes more important.

Also, the fraction of risk metrics impacted increases. That's a bad sentence or phrase, but what that's meant to be is as more of the model becomes involved in the state-of-knowledge correlation, the state-of-knowledge correlation impact increases. And the number of coincident correlated variables increases. So for example, if you have some sequences where there are four motor-operated valves and all of those motor-operated valves come from the same pool of data, that's actually a very low cut set. That's X times X times X times X.

But realistically, that isn't that. It is correlated, and that correlation effect could be pretty significant as you can see. But some of the other insights that we have is the state-of-knowledge correlation decreases as the use of plant-specific data increases. Because when you start using more plant-specific data, you start having more different distributions. The more different the distributions, that means they're coming from a different data set and a correlation is lower.

Also with also error factors, the more certain we are about our data, the less the correlation effect will impact us. And the last is modeling of CCF. Now I want to be real clear on this. It's not so much that modeling CCF automatically reduces uncertainty. That's not what we're trying to imply here. We're trying to imply that if you didn't model common cause between two like components and you should have, if you analyze the model where you didn't do that, the state-of-knowledge correlation is important, but if you correlate the items through modeling common-cause like you should have done because it's a common-cause group, then the importance of that lower tiered singletons is less. This isn't a totally mathematical artifact. If you've done common-cause modeling correctly, it shouldn't be an issue.

MEMBER STETKAR: Let me stop you, Ken, because this particular issue is one of the biggest problems that I had with the technical basis document.

The problem is you're confusing numerical convenience with completely different issues. The state-of-knowledge correlation accounts for uncertainty due to our understanding about the failure rate and the uncertainty in that failure rate for similar components.

Common-cause modeling accounts for the physical effects of failure causes that are not explicitly modeled in the PRA. They are two completely different things. So simply by putting in a fudge factor for those physical causes of failure that we have not explicitly modeled does not provide an excuse for not looking at the -- at the state-of-knowledge correlation.

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

MEMBER STETKAR: So in principle, if you modeled -- if you explicitly put everything in your PRA, modeled it explicitly, your beta factor would be zero. Your beta factor would be zero and yet you would still need to account for correlated uncertainty.

MR. CANAVAN: And it would still be there. You're missing the point. If I have a small example, let's just say I have X and X in a model, and that's it. That's the model.

MEMBER STETKAR: Right.

MR. CANAVAN: And so the cut set that that produces is X and X. If I now model beta X and X and X, one minus beta X times one minus beta X, if I now 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 letter model. Now the beta and gamma and whatever else I need are more or less generic numbers, generic distributions, right?

MR. CANAVAN: In some cases. INL is doing a great job --

CHAIR APOSTOLAKIS: It's very hard to see how you can have plant-specific information on the LOCA failures. They usually have EPRI-NRC study, so I should then consider the state-of-knowledge correlation between the beta factor here and the beta factor there when I do the analysis.

Now that may not be that important, because I add them. The state-of-knowledge correlation is really important when you multiple. Right? But in principle, if I pick a beta value here, that should be the same value as down there.

Now numerically, again that may not be --

MR. CANAVAN: It could be if it comes from the same data set --

CHAIR APOSTOLAKIS: Why is it different?

MR. BLEY: It's not that it's different. If you start trying to be very precise about this fudge factor we've built, you could claim that since it applies to motor-operated housing, a certain type, it ought to apply everywhere in the plant. Well, if you do that, you get numbers that clearly don't match reality for common-cause failures. So it's a cobbled-together model that we've been applying to trains of the same kind of system and it seems to kind of work there, but there's not a -- you can try and get real precise beyond that, it's kind of -- you're exactly right, but if you start --

CHAIR APOSTOLAKIS: It makes a difference --

MEMBER STETKAR: My only point is that substituting an observed -- substituting an observed numerical effect, if I model common-cause failures or pumps fail to start versus state-of-knowledge correlation on the pump failure rate, the common-cause contribution that cut set will always show up much higher than the state-of-knowledge X squared type of effect.

However, because we're talking about uncertainty here, don't confuse uncertainty with pragmatic numerical effects, because in most cases, according to your observations and what we've seen, it's absolutely true that the number of coincident, correlated variables and the uncertainty in the supporting distributions are very strong influences on 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 --

MR. TRUE: It was simply an observation. When you model common-cause, the effect on overall result is smaller. That's it. That's what he said. Risk decreases as modeling is --

MR. CANAVAN: The text is -- point taken. I took a big note. I will clarify the mathematical artifact. And interestingly enough, one of the things that comes out of it, if you go to the insights part of that document, is it turns it all around and says by the way, if you find yourself with a high state-of-knowledge correlation, go check if your model common-cause is right. Not that you should add it to reduce uncertainty. It says go check that you did common-cause modeling correctly, because chances are if you have a really big state-of-knowledge, you forgot to model common-cause in some important components.

CHAIR APOSTOLAKIS: If you have a big state-of-knowledge, how can you forget whether common-cause?

MR. CANAVAN: Well, what happens is -- it's certainly the other way.

MR. TRUE: The other thing that came about, I mean, this work was all done back in 2003 basically. In the ASME standard at end of B was just about coming out and the industry was really getting into the ASME standard. If you turn this back around and you realize what is happening to the PRAs out there in the field is they were being driven to more plant-specific data and more common-cause modeling by the ASME standard. Because you have to treat it on all the significant basic events, which are all those that contribute more than half a percent or have a raw greater than 2 have to be treated.

And so that tends to be a suppressing factor on some state-of-knowledge, not the ISO LOCA one, John. I know that.

MEMBER STETKAR: That was --

MR. TRUE: And we fixed it in the peer reviews. But the broad impact on the base results of a PRA, particularly CDF, we aren't going to see state-of-knowledge coming up as much as we maybe did before. The ISO LOCA issue came up in the peer reviews and I believe that every plant has gone back and done an offline calculation to do the state-of-knowledge correlation right and then put it back in as a mean value, as a frequency, to get that handle.

It's not to say there aren't going to be other places that could come up.

MEMBER STETKAR: One of the reasons I bring this up is something I mentioned this morning is that these documents are being published in 2008. They will be used by people doing risk assessments in the next, you know, today and then the next few years for new plant designs which increasingly rely on so-called passive systems.

I don't know. I haven't looked at any of those risk assessments yet, but my suspicion is that they will be strongly influenced by multiple so-called passive failure modes for which there is essentially no available guidance or requirements to look at, for example, common-cause failures. And therefore, you know, maintaining kind of a sensitivity, if you will, to --

MR. CANAVAN: Understood.

MEMBER STETKAR: -- to the state-of-knowledge correlation could be substantially more important even in, you know, the level one.

MR. CANAVAN: Understood.

MEMBER STETKAR: Typical. Forget the interfacing system of LOCA, but you know --

CHAIR APOSTOLAKIS: Is it time to stop calling it epistemic correlation? I mean, state-of-knowledge distribution by epistemic distribution? Something to think about. I don't want people to think this is different from the epistemic distribution or epistemic uncertainties we've been talking about all over the place.

MR. CANAVAN: I have a seven o'clock flight tonight.

(Laughter.)

MEMBER STETKAR: No, you don't. You thought you have a seven o'clock flight tonight.

MR. CANAVAN: I'm going to move us along. But a very interesting point. Point well taken. Use of point estimates, our next part is when we get down to brass tacks so to speak. Parametric uncertainty guidelines. Now there used to be a bunch more of these and we went through and there's been some changes to these as well for the new document and a couple of them that were particularly objectionable were removed.

CHAIR APOSTOLAKIS: Well, point estimate means mean values?

MEMBER STETKAR: That's correct.

CHAIR APOSTOLAKIS: Why didn't you use mean values? The term mean values?

MEMBER STETKAR: Some folks --

MR. TRUE: It's computational. We refer to the cut sets as we quantify as point estimate 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 sets and this is in the case where there are small groups of cut sets, so think of a very small risk model or very small risk application and it's determined by cut sets that it's a relatively small group and the basic events are not correlated in any way, then you can just simply use the point estimate directly and a good example of this is sometimes Level 2 where the different values that are in the Level 2 are not correlated. They're related to phenomenon. They are truly independent, if that's the case, and then you have a small group of cut sets and you can say everything in here is not correlated. So I can use the point estimate value straight up.

The next one is -- the next guideline, guideline number two is where the risk factor is calculated on a large number of cut sets, but the cut sets are all comprised of diverse contributors and they're not from a narrow group of events. And you can demonstrate that case.

I think, by the way, in all these cases you need to demonstrate that point before you go off and use the metric.

Number three is our preferred guideline. I think it's where people end up most of the time, 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.

MEMBER STETKAR: It could be done.

CHAIR APOSTOLAKIS: So using guideline three, I could do that.

MEMBER STETKAR: The only problem is I think a lot of the software is not -- it's a practical situation, a lot of the software does not do the calculations that -- they do -- there's one set of routines to do the uncertainty propagation and there's another set of routines that do the importance measure analyses.

It could be done, but it would require reprogramming, I think -- anything that I'm aware of.

CHAIR APOSTOLAKIS: Why can't I go and say event XYZ.

MR. TRUE: You could do it manually.

MEMBER STETKAR: You could do it manually, but right now none of the software.

MR. TRUE: You would have to do sets-true, sets-zero, for every basis event.

CHAIR APOSTOLAKIS: In order to do --

MR. TRUE: In order to do the modeling.

CHAIR APOSTOLAKIS: But I'm wondering --

MR. TRUE: And the problem is that you can't necessarily go in by inspection and figure out which ones you care about because it's not the ones that are correlated that you care about, it's the events that are in the cut sets that have the correlated variables and additional failures in the cut sets that have the correlated variables in them that are the ones that are the most affected by the state-of-knowledge correlation.

CHAIR APOSTOLAKIS: If you gave me a guideline, select two or three, maybe using some of these considerations, and run 10,000 samples to find the raw, and show that that row is really not numerically very close, the thing -- wouldn't that be --

MR. TRUE: I think this could. My opinion is that the -- a little bit of this is again too worried about the numbers, a little bit of the razor edge or bright line kind of thing. The raw of two and Fussell-Vesely .05 are pretty darn low for significance.

CHAIR APOSTOLAKIS: So it doesn't matter.

MR. TRUE: As long as you're getting results that are about in the same region, if you're off a little bit here or there, you pretty well capture --

MR. CANAVAN: Hence, the 10 percent. I mean you could argue that numbers as high as 20 percent difference in the --

CHAIR APOSTOLAKIS: Since we say anything with raw greater than two is part of it.

MR. WALLIS: But it hasn't to do with any particular percent. It is what it is.

MR. TRUE: What we're trying to do is to say that if it is within that, then it is okay to use the methods that we currently use basically.

MR. WALLIS: To use the point estimate.

MR. TRUE: To use the point estimate. That's correct.

MR. WALLIS: So you've done something which is better than a point estimate in order to throw it away?

MR. TRUE: Because the methods that we use in applications don't propagate all the time.

MEMBER STETKAR: Part of the problem is that, for example, if you look at the first guideline you're focusing on the things that you can see as big picture contributors, whereas the state-of-knowledge correlation is down in the noise and it could raise up to be a contributor, but you don't know that. By doing the uncertainty propagation, you force that to the surface.

CHAIR APOSTOLAKIS: Made up in screen.

MEMBER STETKAR: That's exactly right. If you look at the top 90 percent contributors to core damage frequency and they satisfy guideline one, they satisfy guideline two, that still does not necessarily say that state-of-knowledge correlation is unimportant because, you know, in principle the remaining 10 percent may be subject to factors of 30 from state-of-knowledge correlations, you know, in a really pathological case.

CHAIR APOSTOLAKIS: I'm wondering what kind of guidance you can give to the practitioners so there will be some assurance that this doesn't happen.

MR. TRUE: I think all cut sets, first of all.

CHAIR APOSTOLAKIS: Say again?

MR. TRUE: I think all cut sets.

MR. CANAVAN: This is an application. I think it supposed to --

MEMBER STETKAR: The guidelines, as I read the document, focused on you look at the major contributors to core damage that you can see. My point is you ought to look at the things you can't see also.

CHAIR APOSTOLAKIS: If you could select in 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

covered already.

MR. TRUE: If you go through and apply the guidelines and you actually look at the cut sets, I don't think --

MEMBER STETKAR: If you look at all --

MR. TRUE: I don't think the pathological aspect will actually get us in trouble. If you stop, sure, if you only look at the first couple pages of cut sets and say I'm tired, I'm not going to do it.

CHAIR APOSTOLAKIS: What is a typical truncation frequency? Ten to the minus what?

MR. TRUE: Easily about four or five orders of magnitude.

MS. VANOVER: Yes, we look for convergence, but for linear competes it's about five minus 12 models. Six orders of magnitude?

CHAIR APOSTOLAKIS: Does that happen?

MR. TRUE: That's very typical.

MR. BLEY: No, you very seldom see this. You don't expect it, but it could.

CHAIR APOSTOLAKIS: So it's --

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

MEMBER STETKAR: I'm worried, again, I'm not so worried about existing PRAs of existing plants. I'm also worried about new PRAs of new plants where there could very well be large numbers of very low frequency cut sets that are completely dominated by relatively large numbers of passive failures.

MR. TRUE: No data as of today on how those things are going to work.

MEMBER STETKAR: That's right, and this guideline that is going to be applied by the industry.

MR. CANAVAN: There's another guideline under development for them on capacity safety systems credit and PRAs we're working on. It's actually extremely interesting. But to --

CHAIR APOSTOLAKIS: Different systems you correlate different things. You correlate, again, heat transfer, maybe, coefficients. If you have two different trains, you correlate these kind of things. You rarely have to worry about random failures of components. I mean, you have one valve here and one valve there. The issue there is physical phenomenon.

MEMBER STETKAR: If one of eight valves has to open and you have X to the 8th and it's --

CHAIR APOSTOLAKIS: No --

MEMBER STETKAR: -- check valve, for example, I'm kind of worried.

MR. CANAVAN: More driving forces are relied on. Okay, I'm going to move us on.

Essentially, this slide steps all the way back and says okay, what are the ASME requirements that I was trying to meet for the base model and how are those met?

And this gives you a guideline on how to meet the ASME requirement, and what this basically says is perform a parametric uncertainty and report the results. And the details are above on how to do that.

MR. WALLIS: I think you have to specify the confidence with which you predict these bounds? I don't think you can just say service the bounds. The more runs you do, the better confidence you get in the bounds, if you get some sort of confidence value for these bounds. Otherwise, it's an incomplete requirement. Or you'll say with 95 percent confidence or something like that, otherwise it's not a meaningful statement.

MR. CANAVAN: I don't know exactly how to answer you because the requirement says to specify the uncertainty bounds --

MR. WALLIS: But you can never get them exact. Even if you have a million Monte Carlo -- it's never exactly -- you only know if it's some confidence.

CHAIR APOSTOLAKIS: So what are you trying to do here now with this guideline?

MR. CANAVAN: With this guideline, ASME QUE3 requests that you provide the uncertainty bounds of the answer. What we're just doing is saying to perform an uncertainty propagation using a Monte Carlo process or equivalent that through the Boolean model that it counts for the state-of-knowledge correlation reports the results of the fifth to the ninety-fifth. Basically, perform the parametric evaluation and report the result.

MR. TRUE: Go back to what QE3 actually says. It says estimate. What we're basically saying is calculate. The guideline is go propagate it and calculate it.

MR. CANAVAN: And now what we're trying to do is give them a little bit more detail, the analysts, a little bit more detail on how we fulfill, how he fulfills that requirement that says what.

And since it says estimate, while I do agree that there needs to be maybe something that talks about the number of samplings and how the process is actually calculated, I mean we'll look into confidence bounds and see what we can find, but I think we're really responding to just ensuring that we have some reasonable estimate of the bounds, whether that be -- so I assume that corresponds to some confidence. We'll take a look at that.

And then guideline two which is under consideration. Some of this is work in process, I'm not going to read it all. It says compare with existing similar studies. So that's the bottom line. It says that if you have, for example, Oyster Creek and Nine Mile 1 or sister plants, they're virtually, they're very identical in many respects. There are some subtle differences between the two, but you might argue that those are the sister plants in there and they're very close. I wouldn't expect if one had propagated uncertainty, the other model shouldn't be that much different in terms of its fifths and ninety-fifths.

We're moving away from this guide. It was very popular -- IPE days, not everybody propagated uncertainty. These days with the ASME standard really looking for capability categories 2 and 3, looking at much more rigorous treatments, we're finding that nobody really does a whole lot of comparisons any more.

CHAIR APOSTOLAKIS: I would be happy --

MR. CANAVAN: I'd be happier too.

MEMBER STETKAR: And Ken, especially if this is focused towards applications, plant-specific applications, it's pretty difficult for me as Plant X to justify --

MR. CANAVAN: In 2002, when we were writing this, there were an awful lot of people who we felt that we would have been unfairly moving in a direction that they might not want to go.

On the other hand, in 2007, it would seem that that's a direction that they need to go. Having said all that, my time is over.

CHAIR APOSTOLAKIS: You're hanging out your flag?

MR. CANAVAN: I've got to hang out until we're done.

MEMBER SIEBER: Have these documents been published?

MR. CANAVAN: The first two that are identified in the presentation are available on epri.com to the public. And the draft will be provided to you at the end of January. I don't know if we'll make the final public, but we may make the final available to you. We have ways to do that.

MR. BLEY: The things you've talked about, are they going to remain for the most part stable into the new document or are some of these the things that are actually being changed?

MR. CANAVAN: I believe that aside from the caveated one that I gave on the last example, we're pretty fixed on most of the parametric, aside from the note that I took from John Stetkar on making sure that we're much clearer in the area of the CCF.

MEMBER SIEBER: Thanks.

MR. CANAVAN: With that, Don is going to talk a little bit about the report that concerns itself with the next three bullets on modeling uncertainty.

MR. VANOVER: My name is Don Vanover with ERIN Engineering and besides working on various EPRI PRA scope and quality activities, my principal responsibility within ERIN is as the PRA model owner for Limerick and Peach Bottom. So I am involved in day-to-day activities and use of the PRA model and several applications, as well as working with other utilities in providing support role for them and in all phases of PRA applications, level one, level two, and level three.

So that's just my background. As Ken mentioned, I'm going to talk about the final three objectives. The first objective to talk about is we want to provide guidance to assist utilities in identifying and characterizing sources of model uncertainty. The second part of my report.

Again, why do we care about model uncertainty beside the curiosity factor from a licensee perspective from a utility perspective, what we want to do foremost is be able to claim at the we meet the ASME PRA standard and the Reg Guide 1200 Requirements when we get to applications. So what I provided here, similar to what Ken did for the parametric supporting requirements, is identify those supporting requirements that specifically relate to model uncertainty issues.

They've been reframed in the last year or so based on interactions by the Standards Committee and the Federal Register notice that was published in July of this year. The frame of the requirements now focuses on it for the base model identifying and characterizing sources of uncertainty and there's no further requirement to evaluate all the sources of uncertainty when we're looking at the base model. It's only in the context of an application that we worry about doing evaluations on these sources of uncertainty.

MR. WALLIS: Can I go back to this

business of when point end solutions are not suitable? The staff was very vague about how much uncertainty is tolerable, how do you measure the uncertainty and so on. I still am left uncertain -- unless there's some kind of criteria for how much uncertainty is tolerable or what you do with it, I think it's all up to just arguing with the staff about what they will accept. There doesn't seem to be any way of knowing when your uncertainty is too much and when is it good enough and so on. How do you know those things unless there's some kind of measure for it.

MR. CANAVAN: You mean for the parametric part?

MR. WALLIS: How do you know?

MR. CANAVAN: It's pretty clear. It says ten percent.

MR. WALLIS: Is ten percent the criteria? That's an awfully small number.

MR. CANAVAN: Yes, I think so too.

CHAIR APOSTOLAKIS: Are you talking about the same thing?

MR. CANAVAN: If you are talking about the parametric, if you're talking about the modeling uncertainty, we're not quite there yet.

CHAIR APOSTOLAKIS: I think Graham is

referring to the ultimate decision.

MR. TRUE: He is saying that if you have a mean value that's X and your uncertainty band is plus or minus a hundred on either end, it's a different decision then one that's plus or minus --

MR. WALLIS: Is that acceptable?

CHAIR APOSTOLAKIS: If the probability.

MR. WALLIS: The means were then ten percent. That's quite different.

MR. CANAVAN: Well, for parametric then it's a suitable surrogate. If you're speaking about overall making a decision --

MR. WALLIS: Even if it's very uncertain. I mean, the mean can still be exactly on the dot but you can an enormous spread in --

MR. TRUE: And the way, I think, Gareth explained this earlier that our acceptance guidelines are generally set up based on mean value.

MR. WALLIS: Uncertainty in the mean is the only thing that we're worried about? That's very strange to me.

CHAIR APOSTOLAKIS: No, let's take a situation where you have a line for delta CDF and in one case the distribution of the delta CDF probability is such that the mean is below the line, so it is acceptable. But the probability of exceeding the line is say .05. In another application it may be .15. In both applications, the mean is below. The way I understand your question is does this 0.05 or 0.15 make any difference?

MR. WALLIS: It might be 0.5. It could be quite --

CHAIR APOSTOLAKIS: 0.5, I doubt it. The mean would be above, if it's 0.5. So it would be a small number and I think the answer is that this footnote that I mentioned earlier that the staff says very clearly that in these cases there will be increased management attention. They don't tell you what they're going to do. They're going to scrutinize or try to convince themselves. So that's where they leave it. There are no, that's why it is called integrated decision making. I mean, they may be convinced in some case that it is okay. In other cases, they may not. That is why the line is not bright. You may be below and be denied. That's where things are now the way I understand it.

Gareth?

MR. PARRY: That's right.

CHAIR APOSTOLAKIS: They really insist that it is a risk informed and they have to look at the case.

MR. PARRY: Well, it's risk informed and the process is set up such that the closer you are to a boundary, the more scrutiny you're going to get.

MR. WALLIS: I would be much happier if you had a firm boundary and you looked to the probability of stepping over it instead of all this scrutinizing --

CHAIR APOSTOLAKIS: The probability of stepping over would be small because the mean is always on the tail. It will never go to 50 percent. I'm willing to bet on it.

MR. WALLIS: Fifty percent. I mean, is 30 percent acceptable?

CHAIR APOSTOLAKIS: Even 30, I doubt it. If it is 30 percent, the mean will be above.

MR. WALLIS: If your knowledge is very bad --

MR. CANAVAN: The more uncertain you get, the higher your mean moves too on a distribution. The mean can cross the 90th percentile when you're very uncertain. I mean, it's at the 70th now.

MR. WALLIS: You don't have more uncertainty, you don't have a measure of uncertainty.

MR. CANAVAN: If you have a broader distribution, if you were very uncertain about it.

MR. WALLIS: Was it broader? Was it lop-sided or what? There are different ways to broaden the distribution.

CHAIR APOSTOLAKIS: If you look, Graham, if you look at the core damage frequency distributions of PRAs that have done it, the mean value, as I recall of the CDF is between the ADF and the 87th percentile which means -- so if the mean is exactly at the line, there is at most 15 percent probability that you are above the line.

MR. WALLIS: I think that's nonsense.

CHAIR APOSTOLAKIS: Right.

MR. WALLIS: You could have a very lopsided thing where in many cases there's nothing that happens at all and in a few cases something very seriously happens.

CHAIR APOSTOLAKIS: I'm telling you what the real results are.

MR. WALLIS: What?

CHAIR APOSTOLAKIS: The mean value from real PRAs is roughly at the ADF percentile of the distribution, roughly. The distribution is not symmetrical.

MR. WALLIS: That's just by experience, is that it?

CHAIR APOSTOLAKIS: Yes, but a lot of experience, not just -- but more detailed guidance deliberately was avoided by the staff. They didn't want to get into the business if the probability is .06, do this if it's .07, do that. It was a very deliberate decision on their part and I think it was the right decision, at least with the --

MR. WALLIS: I think if I were worried about the failure of a pressure vessel, I would not look at it this way. I would look at here's my mean estimate and here's something or other. I want to know what's the probability that I burst the thing. I wouldn't really care about all this other stuff. I want to know what's the probability I get beyond something acceptable. That's the only thing I'd be interested in. That seems to be taboo in this discussion.

CHAIR APOSTOLAKIS: It's not taboo. They know what it is. They just don't tell you how they are going to handle it each time. They know.

And the other thing is the big difference between the pressure vessel and the case we're talking about here, in the pressure vessel you have criteria that are based on some physics. Here, it's a regulatory guideline which took into account the fact that you will be using mean values. There's a huge difference, in my mind. They were deliberately conservative and they said 10^{-4} or $^{-5}$ will be used with mean value, so therefore it's not going to be 10 to the minus whatever.

MR. WALLIS: Because the real value is 10^{-6}, is that so conservative -- well, you can go on with that.

CHAIR APOSTOLAKIS: It's not like you're exceeding some failure criteria.

MR. WALLIS: But you may exceed something which the public will accept which would be then a failure criteria.

Why does it all have to be internal to the NRC?

CHAIR APOSTOLAKIS: What is what? Graham, I didn't hear you.

MR. WALLIS: Why does it al have to be regulatory? I mean can't it be something that the public can understand? Are you saying there's a regulatory criteria. It's inherently conservative --

CHAIR APOSTOLAKIS: But you are bringing up an example where you're comparing with the physical failure of something. And I'm telling you that line there does not represent the physical failure. When they set up their acceptance guidelines, they said okay now, what are we going to use? Mean values. Okay, what does that mean? How low can I go? What is the state-of-the-art? Am I being ridiculous? For example, if I said the acceptance guideline is 10^{-8}, I am being ridiculous. If I make it 10^{-2}, then I am not on the safe side.

So that's very different from saying that the pressure vessel fails. There's no failure here. It's a decision making process and it's an attempt to formalize it as much as you can. I think it's very different. And they make an argument that even if you're close to the line you should approve it all the time because the line is very conservative, right? Some licensees have made that argument.

MR. WALLIS: Failure is core damage. It's a physical event.

CHAIR APOSTOLAKIS: Right.

MR. WALLIS: You're looking at probability of something which is a real physical event. You're not looking at something that's regulatory.

CHAIR APOSTOLAKIS: That's true.

MR. WALLIS: So it's something like the

pressure vessel failing.

CHAIR APOSTOLAKIS: Not regulatory guideline 174, the underlining, yes, you're right, the underlining thing is --

MR. WALLIS: We can continue this discussion some other time --

CHAIR APOSTOLAKIS: Whatever.

(Laughter.)

MR. VANOVER: Okay, I'll proceed on. So the purpose of showing the supporting requirements from the ASME PRA standard is to set up what the objective of -- one part of the objective of the report is, is to help utilities meet these supporting requirements in the current context of their definitions. And then they apply to both LERF as well as CDF with the addition of the other two supporting requirements.

We've worked with the NRC on developing these definitions and these are consistent now. They've changed a little bit now from the original EPRI report, so these are the same as what appeared on Mary's slides this morning with the definitions for different assumptions that related to model uncertainty versus those related to scope and level of detail.

There also is a definition provided for what constitutes a reasonable alternative hypothesis for an alternate assumption.

When we released the original EPRI report and more specifically the Applications Guide, it became apparent that there was a lot of good work that went into developing the long list of sources of uncertainty in the original EPRI technical basis document, but in the context of where we are now, it became clear that a lot of those issues were related to the scope or level of detail items rather than true model uncertainty issues.

So the effort that we perused over the last six months is to try to help differentiate both the 200 plus sources of uncertainty that were identified in the original EPRI report, what subset of those are really model uncertainty issues with the definition we now provided versus scope level of detail issues that are not necessarily important in the context of the base model because the analyst has already decided are not important from the base model perspective, but for specific applications they could be important as we've talked about.

MEMBER SHACK: Consensus model seems to have disappeared from your presentation.

MR. VANOVER: I did not include it, but we would have the same definition.

CHAIR APOSTOLAKIS: So there is consensus on that.

MEMBER SHACK: Same definition as 1855 or same definition?

(Off the record comments.)

CHAIR APOSTOLAKIS: Can you tell us what you're proposing the user to do? All day today we've been hearing --

MR. VANOVER: I will get to that.

CHAIR APOSTOLAKIS: Let's go to do.

MR. VANOVER: Okay.

CHAIR APOSTOLAKIS: Okay, because it's 2:30.

MR. VANOVER: To help differentiate -- and we'll get to what we want the users to do with this guidance shortly. The definitions of how we help differentiate scope level of detail issues versus the model uncertainty issues were looking at phenomena that's not or failure mode that's not completely understood or significant interpretations to infer behavior required to develop a model, where we got some test results or some data and we need to apply some assumptions regarding what would happen in the real world in our logic model.

Or alternatively, there is general agreement that the issue represents potential source of model uncertainty and that category covers such things as common-cause failures and human error probability development. So we're capturing things that we've got standard approaches for, but we're still holding off those as potential generic sources of model uncertainty to be identified as potential candidates.

CHAIR APOSTOLAKIS: Is it conceivable that at some point you and the NRC may agree that ATHEANA is the consensus model for human error probability? Would that solve that?

(Laughter.)

MR. CANAVAN: Probably not.

CHAIR APOSTOLAKIS: Or the EPRI calculator. . I forgot about that.

MR. CANAVAN: The HRA calculator, yes. That will eventually, ATHEANA will be an option in there, I believe.

CHAIR APOSTOLAKIS: But could there be a concept of consensus model there? No, probably not.

MR. CANAVAN: We're working on it.

CHAIR APOSTOLAKIS: Is it alternative

models that I am talking about?

MR. CANAVAN: We're working real hard on that being a consensus approach. I would call that a consensus approach. For example, one of the consensus approaches that we have been talking about proposing in the HRA using the calculator, but using the calculator, for example, deciding when action should be treated by ATHEANA, deciding when action should be treated by HCR or some other method of deciding when they can be screened. If you were to have this front end that allowed you do that, you would have a consensus approach, not necessarily a model. So there are areas where ATHEANA is useful. There are areas where other models --

CHAIR APOSTOLAKIS: And then you would claim after that the uncertainty, or you would put an uncertainty on top of the HCR.

MR. VANOVER: We would as part of developing that consensus approach or model, we would evaluate uncertainty in a broad arena. We would look at well, what happens if we don't, what happens if we apply a different model. What are all the ramifications of the different parameters in there. Then we sort of look at it and say --

CHAIR APOSTOLAKIS: I would say though

that that's an area when applying an alternate model is really not practical. For example, if I use the HCR, it's just inconceivable, oh yes, let me use ATHEANA now. I mean, come on. It's a major undertaking.

MR. VANOVER: I think in the context of one of the lessons we did learn for the Limerick pilot application was there are very few consensus models at this point with the current definition, and what we really have is a more accepted best practices. So there is a higher pedigree to have a consensus model versus an accepted best practice and at this point until the accepted best practices become consensus models, those still would be carried forward as potential sources of uncertainty.

CHAIR APOSTOLAKIS: But there are also situations where I think the human error probability calculation is one, is where there are truly legitimate alternate ways of approaching the problem.

MR. CANAVAN: That is the definition of source of uncertainty.

CHAIR APOSTOLAKIS: I'm sorry?

MR. CANAVAN: That is the definition of source of uncertainty. There are legitimate ways --

CHAIR APOSTOLAKIS: Somehow we have to

handle that.

MR. TRUE: Even if everybody used ATHEANA, there would still be model uncertainty.

CHAIR APOSTOLAKIS: Yes, that's what I'm saying. There's another approach because equal claim to legitimacy perhaps.

MR. TRUE: And the analyst to analyst variability that goes into it.

CHAIR APOSTOLAKIS: And it brings me back to the NUREG-1150 approach.

MR. TRUE: Well, I'll even scare you worse and I'll point out one other item and that is the consensus model is wonderful. It doesn't really get you out of anything though because when you do an application you look at cause and effect. If there's a cause and effect, this process that we've defined and if there's a cause and effect, and it involves a consensus model, you still evaluate the uncertainty even though it's a consensus model because there's a cause and effect.

So for example, if you're doing a diesel generator or AOT and you use the Westinghouse seal model, it's not like you don't evaluate what is the sensitivity of the seal model to this application. You have to do that.

CHAIR APOSTOLAKIS: Could you have a consensus model with the distribution that is based on what other models are saying? That could be an approach?

MR. CANAVAN: Could be.

CHAIR APOSTOLAKIS: Okay.

MR. TRUE: Next slide.

MR. BLEY: If I may, are you revising the consensus model description in the new report?

MR. TRUE: Yes.

MR. BLEY: Will it be consistent with the one --

MR. TRUE: All the definitions now --

MR. BLEY: Are going to be the same everywhere. Okay.

MR. TRUE: So just to refresh everyone's memory of this, we started out the EPRI work in 2003. We came and addressed you guys I think in April of 2004. And then working well ahead of the NRC.

In the meantime, the ASME standard was evolving. In the meantime, the NRC began to engage the subject, so we have time phasing issues between the documents you have.

The goal for next year is to bring both of these documents together and be totally consistent in the way we approach and apply the methods and definitions.

MR. BLEY: And the last one on this line, I know right now from what you've said you aren't updating the basis document. Do you eventually intend to update it for at least consistency?

MR. CANAVAN: I really like the basis document and I would like to keep it. We probably will somewhere along the line for consistency purposes either update it or take the important pieces of technology that we'd like to move forward and publish them separately.

CHAIR APOSTOLAKIS: Do you think this is a time to take a 10-minute break?

MR. CANAVAN: Yes.

CHAIR APOSTOLAKIS: All right, we'll be back, when?

MR. CANAVAN: Ten minutes.

(Laughter.)

MR. CANAVAN: I'm sorry, with the uncertainty of that ten minute -- is this a consensus model 10-minute break?

CHAIR APOSTOLAKIS: There's a probability of maybe longer.

(Whereupon, the proceedings in the

foregoing matter went off the record at 2:37 p.m. and went back on the record at 2:52 p.m.)

CHAIR APOSTOLAKIS: Okay, we are back in session. Some of us anyway.

So Dan, tell us what to do. You tell us what to do.

(Laughter)

MR. VANOVER: Okay, this slide here shows, the part that's not in green or blue or whatever that color turns out, the process that was undertaken in the original report where there was an extensive literature search and a review of the insights from other studies to identify potential sources of uncertainty. And that work is documented in Appendix H of the technical basis document. And that is the piece we don't want to lose moving forward, because we referenced that in looking at those sources of uncertainty. And then for this report we've added the context of screening those items related to approximate method or scope level detail issues, and by doing that, we end up with a smaller set, a more manageable set, in the context of meeting the requirements of the base model, that is, a generic list of candidate sources of model uncertainties.

And what we are going to have in the EPRI report is for each of those issues that we have been working with the NRC to identify. Now this is where -- what to do part. The utilities, to meet their reporting requirements for each of those issues would need to identify the part of the model affected, what approach they took in addressing that source of uncertainty; and what the impact on the model would be given alternative approaches.

So we are going to try to set up a template where we list, based on our experience, what some of the possible approaches we are familiar with, sort of going from more conservative to best estimate in the hierarchy of how we would list them. And then it would be up to each individual utility to take that generic list and put the specifics in of the approach they've taken and how it impacts their model.

And that would help each of the model owner analysts users of the process to meet the supporting requirements that have been difficult -- it's been difficult to establish what you really need to do to meet those requirements up until now in the TIA standard.

Here's one example, one of the topics we've selected as a source of generic model uncertainty is what's -- what happens with equipment that normally requires DC to maintain operability when the battery is depleted. And depending on the site, the -- these type of sources of uncertainty would in this case be important in station blackout events, and station blackout events are big contributors on most of the PRA models.

And then the question is specifically for BWRs, what would happen to RCIC and/or HPIC, and for the PWRs what would happen with turbine driven or feedwater systems.

MR. WALLIS: You mean that if somebody opens a valve and started a DC opening the valve; is that what you mean?

MR. CANAVAN: Yes.

MR. WALLIS: Because I mean the guy isn't going to turn the turbine.

(Laughter)

MR. VANOVER: It's manual operation of the valve. So some of the possible approaches, a lot of the sites have procedures, not very well trained or well practiced, and not demonstrated, to utilize -- they are being trained more I guess. So an approach that could be taken is, well, we are not going to take any credit for continued operation. That's sort of the conservative bias approach, even if I have a procedure that exists. And I'm just going to say, DC dies, I don't take any further credit.

I could look at taking credit for manual operation of some of these systems following battery depletion, based on an accepted human error probability analysis. And then I could take a somewhat more limited credit in specific areas, depending on availability of other components, and say -- make sure that performance shaking factors are better satisfied, that action could be taken.

So there could be a subset of a list of possible approaches. This is a generic source of uncertainty. There have been different approaches taken by a lot of utilities, and it can have a fairly significant impact on results, and could especially impact applications.

So this is the type of sources of uncertainty we are looking at rather than scope level detail issues. It actually makes a difference in your sequence modeling, and it makes a difference, or it makes a difference in the type of scenarios you could have.

MR. TRUE: So there are 20-some odd topics like this. For each topic there is a table like this that says, this is what the issue is. This is generally the parts of the model we expect to be affected by this topic. And here is a spectrum of approaches. Each licensee would be expected to determine whether that topic applied to them at all, and if it did, then assess how their results might be impacted by other alternative approaches to that topic.

MR. CANAVAN: Welcome to the edge of the black hole.

MR. WALLIS: Now aren't there an awful lot of these bits in the KRA that could be treated this way with quite a few approaches to each?

MEMBER SIEBER: Yes.

MR. WALLIS: So this is an awful lot of work for somebody.

MR. TRUE: We think we have narrowed it down to 20-ish. Now it may show up in more than one place in the model. But in terms of looking at it, you go in --

CHAIR APOSTOLAKIS: But again, though, I understand this approach. But if go with number one, I'm becoming very conservative.

MR. CANAVAN: It is actually quite common, number one.

CHAIR APOSTOLAKIS: Yes, and conservative. And now I can study our problem.

MR. CANAVAN: Correct. And that's actually quite common, which is why I made the statement before that PRAs are actually quite conservative. Because when you look at these 20 and you look at how they are attacked, a lot of them are attacked with number.

CHAIR APOSTOLAKIS: You are giving it to me as a possible approach. And I don't know, just to avoid quantifying the uncertainty to be so conservative, when I have problems both -- remember, now where you have to be realistically conservative, or conservatively realistic, and although the staff of course doesn't care if you are conservative conservative.

I don't know about John's concern about -

(Simultaneous voices)

MEMBER BLEY: You're masking?

CHAIR APOSTOLAKIS: Yes, you are masking other things. It is not a solution. I mean I'm wondering whether -- well, it's a possible approach.

MR. VANOVER: Right, and it could be a solution for some applications, but that conservatism could push you above the limit in other applications, and you'd be more pressed to refine the model and try to develop more credit.

MEMBER SIEBER: And you've got to refine your procedures.

CHAIR APOSTOLAKIS: Got it?

MR. PARRY: Yes, I think you've got to look at it in the context of making decisions again. If this conservative modeling is sufficient to support the case you are trying to make, then I think that is a solution. In fact it's the best solution because you will have real competence in the answer that you use. It's straightforward.

It's when you have to do something more refined I think that you start getting a little more worried about the significance of that.

MEMBER ABDEL-KHALIK: But if the decision involves more than just one model uncertainty then you may run into this masking problem. And I was just wondering if there was a requirement for a sort of consistent approach toward conservatism?

MR. PARRY: No, I think there is a requirement to look at combinations of sensitivity studies and combinations of issues.

CHAIR APOSTOLAKIS: Logical combinations.

MR. PARRY: Logical combinations that can affect the decision. And that's what you would be looking at, and you would be looking to see if this were able to mask something else.

I mean you have to look at all the ramifications of it.

MEMBER BLEY: Is it a fair worry that if you take this bounding approach for one decision, maybe with a combination of things, and you accept the position, and some months later you do it for another and then for another, that you may have corrupted your base case such that this is no longer a valid approach?

MR. CANAVAN: Interestingly enough, you probably started at the other end; you probably started with many more conservatisms in the studies in the `80s, and how you've come is, you've evolved, and you've been removing them one at a time, and now you have gotten down to this set where you have either decided that you are not impacting the overall result significantly or not; there wasn't a reason for you to remove it; in other words you haven't done an application where there is a cause and effect. There has been no driving force for you to address the conservatism.

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

it's relatively conservative. I would be expected then to look at the case where, let's assume that operator action didn't work, then how does that affect my delta CBF? And if I'm still below the threshold, and I can say, I'm still okay, but for my delta CBF, delta LERF requirement, and that I'm done.

If I'm not, then it's going to be incumbent on me to explain to the decision maker why that case, assuming it fails all the time, doesn't really apply to me. I've got portable fans that I use that are gas powered. I have lights that I have in the room or whatever, a store unit.

MR. CANAVAN: Or even add, maybe you put in point one, and you find that if you stick in the one you don't make it, but if you stick in point nine, you do.

So hey, point nine, I definitely make it, so I'm going to leave the model hte way it is. I guess I was answering your question from the --

MR. TRUE: Okay, but my model is still predicated on number two. I don't go back and change my model to make it assume number one in every case. It's still a sensitivity case.

Now let's take the other case where I come in, I'm number one to start with. I've been conservative; I'm done. I don't go look for the goesdowns, as we were referring to this morning with John. I'm at the goesup reporting --

MEMBER STETKAR: This is like goesups and goesdowns.

(Laughter)

MEMBER STETKAR: Refer to your dictionary.

(Laughter)

MR. TRUE: I'm done. And so in a sense certainly I'm conservative. I've limited the amount of work I have to put into my conservative analysis. If I can live with that decision, that's fine.

But those are the two kind of cases. If you had case three, then you'd do successive cases, or you might jump to the top and say, am I okay at, assuming it always fail. And if not then you might do the middle case, and say, well, I can use some more bounding HEP and -- but you lead the model the way it is.

MR. CANAVAN: We're in violent agreement except in the cases where you are number one and you don't make it. And then you go do number two, and then you finish that, well, you put that in the model.

MEMBER STETKAR: I mean in principle there should be one PRA, not 25 different PRA models for 25 different applications.

MR. CANAVAN: And I might even argue that you might do number three, but be really uncomfortable, like you really razored down the credit, and you feel for this particular application that you are doing, or in that particular circumstance -- well, I was going to make a case that you might end up back at two if you weren't comfortable with three. But I think if you did three and you thought it worked, then you'd stick with three too. If you did the right job.

MR. TRUE: And then tying this back to the overall risk-informed decision and performance monitoring and all the other things, you might -- let's say you were doing this for diesel AOT. You might take some compensatory measures, where I've done some special things to train a certain set of operators, or dedicate a person that if we have a station blackout, it's your job to go get that diesel powered fan and put it in there so I can justify a different HEP in that case or even the HEP I use in my basement, if I have felt I had to, as sort of a compensatory measure to bolster the overall decision.

So that we are feeding back the insights from these uncertain aspects of the model into the decision making process in a productive manner, not just a go-no go manner.

CHAIR APOSTOLAKIS: Let me understand what all this means. Are you claiming that I can take care of all the model uncertainty issues this way?

MR. VANOVER: Go to the next slide. What we are trying to do as a first step is identify and characterize what's in our model. And that's a useful exercise for people as Gary said this morning, the analysts have to understand what's in their model. And going through this process that we've outlined here, we'll make sure that everybody understands the important sources of uncertainty, and how they are -- what assumptions are related to those sources of uncertainty in their model, so that when they get to applications, they know what they've done.

So -- what we- we're still looking at the base model at this point, and what the guidance is referring to. We haven't gotten to an application yet. We are still at identifying, characterizing, what we do with the subset of the sources of uncertainty.

MR. WALLIS: I'm a little puzzled here, because it seems to me that you have two plants, one plant can makes all sorts of very, very conservative approaches and come up with a certain value, and then it comes in to ask for something. Another plant is taking credit for everything it can possibly get. It's fiddled around with all these assumptions to get everything done his way. And he comes in with an application to do something, does he get treated the same way if he's got the same number?

MR. CANAVAN: If he makes it.

MR. WALLIS: It seems very strange.

MR. TRUE: Well, actually in this case he wouldn't. Because he would be expected --

MR. WALLIS: He'd be expected to go back and do these other things?

(Simultaneous voices)

MR. WALLIS: He's just looking for change, and the change may be the same for both plants.

MEMBER CORRADINI: You would have to -- I can't imagine -- I think what Graham just asked is, if I had the same end result but I got there be a different set of assumptions would that bother you? It would have to -- you would have to try to analyze that and then come to a conclusion that something is up with one plant and different than another plant.

MR. WALLIS: These folks come to us, they come to us for all kinds of things, power uprates and stuff, and they give us a CDF value. We don't ask them, are you right on the border of taking credit for all these assumptions.

MR. VANOVER: Well, I think that's what this process is trying to help the utilities as well as the decision makers to provide a mechanism to identify those types of assumptions and when they become important in decisions.

So if I was the guy who was taking credit for all those things --

MR. WALLIS: How do we know? If somebody comes before ACRS?

MR. VANOVER: Well we'll get to what to do in applications, but it would be incumbent upon the licensee to identify and provide results of different sensitivity cases with different alternative assumptions. Then it's up to the decision maker to weigh those results.

MEMBER SIEBER: It's probably fair to say that the ACRS as opposed to the staff or the plant management doesn't have the opportunity to look at all these details. People who are the actual decision makers have to take the time and put forward --

CHAIR APOSTOLAKIS: Incidentally, don't we have to go to the plant to look at these things now?

Or is that something different? Don't we hvae to go to the plant to look at the PRA now?

MEMBER SIEBER: Yes.

MEMBER MAYNARD: I would be bothered if two identical plants came in, one had done an ultraconservative, and the other had taken advantage of everything it could, and you come out with the same number, then I'd be wanting to know why. But if I have two different designs, two different plants, I think either one of them you've got to try to understand --

MR. WALLIS: I just wonder how someone like ACRS would know that that's the case, that one plant was being very conservative, and the other was not.

MEMBER CORRADINI: The staff would tell us.

MR. WALLIS: They would tell us?

MEMBER CORRADINI: Sure they would.

MR. WALLIS: They would?

MEMBER SIEBER: No, they wouldn't. They're shaking their heads no.

CHAIR APOSTOLAKIS: So uncertainties in success criteria could be handled the same way?

MR. TRUE: We have some success criteria that we believe are the main areas of uncertainty that we have identified that we treat the same way.

MEMBER BLEY: Are your list of 20 topics already laid out?

MR. TRUE: They are not in your handout.

(Simultaneous voices)

MR. CANAVAN: You get to descend into the black hole on your own time.

MR. TRUE: When you get the report from us at the end of January, they will certainly be in there with this characterization around them.

And if there are -- I guess we do, in visual form, have the list. At the end when we have lots of time, we want to go just scan through that list.

MEMBER BLEY: It'd be interesting, but January is probably. But a matter of form, do you and NRC expect that when you new report comes out, and their new report revision comes out, that all of these diagrams that show the process are going to be the same pictures, or is that going to be quite different?

MR. CANAVAN: They will be --

MR. VANOVER: We believe that this diagram here is consistent with what I believe is Figure 5.1 or 5.2 in the draft NUREG in terms of identification categories and qualitative screening.

We haven't made them exact at this point.

MR. CANAVAN: They are not identical, but the intents are the same. Whether they become identical -

MEMBER BLEY: Are you going to try to make them the same?

MR. CANAVAN: That's a good question. We hadn't even discussed that.

MR. VANOVER: We talked about making sure they were consistent.

We have -- we're looking at another opportunity to get together, is that correct, Mary? And at that time -- and there will be post-publication. So there will be another opportunity for us to share everything including diagrams.

We hope to make the documents' companions. They are going to rely on each other; neither is stand alone. They are going to reference each other in the appropriate spots, our document being a little more detailed and a little more pragmatic, and the NRC's document being a little more overview, and a little more regulatory based, which makes perfect sense.

MEMBER BONACA: I was asking just a description on the three possible approaches you used before. Are you providing those, some information on the questions that the analyst has to go through?

For example if you take credit for something, is there a procedure how credible the action is? You must have a checklist.

MR. VANOVER: Right now the list is pretty short, and we have to work on how much detail we want to provide for each of the possible approaches.

MR. TRUE: I think in principle the answer is going to be yes. The example you gave, though, probably is something we would expect to be handled by human liability methods. We expect to have a procedure on those kind of things.

But in principle, other cases where there are clearly things that would have to be investigated, we would include that in additional types.

There will be a page or so on each of this will explain in more detail the approaches -

CHAIR APOSTOLAKIS: And these will be in the report?

MR. TRUE: And they will be in the report.

MR. WALLIS: I am getting very puzzled. You have 20 of these different things, and there are all kinds of approaches to each one. Which one of these many things is used in the number which is submitted to the NRC? Or is this a parametric uncertainty type of thing where it looks at all of these possibilities and calculates some means and all of that?

My impression is, it's not --

CHAIR APOSTOLAKIS: I think in the context of an application, they plan to -

(Simultaneous voices)

CHAIR APOSTOLAKIS: They would not even show them to the NRC.

MR. TRUE: We should, just to clear this up. So you have a base model. You have a model that you have used, and it has some approach to each of these 20 items.

MR. WALLIS: Like number two, let's say.

MR. TRUE: Like number two, okay. And number two isn't the conservative approach. And so you would report to NRC, here is my result, and -- but in considering my own uncertainties I have identified these other cases where I haven't either used a consensus model or been conservative, and I've done a sensitivity case on each of those to identify what the result would be if I used that more conservative approach.

So the NRC would get that result as well. Then there is also a requirement to look at logical combinations.

CHAIR APOSTOLAKIS: And then the NRC somehow integrates all this knowledge without having any way of doing it in terms of what's the probability that one, two or three is right, which is George's point? It seems to me you are putting an awful lot of judgment on the requirements for judgment, and the power of hte NRC.

MR. CANAVAN: No, it's actually submitted to the NRC saying, here's my model. And in cases where you weren't conservative, you then assess, well, if I was conservative, what the answer would be. And then you do logical combinations of the 20 items along with any plant specific ones you've identified and you say here's where that number would leave me.

And if you are below the criteria, since this is regulatory --

MR. WALLIS: So I've got 10^-5 when I use my base model. If I make everything as conservative as possible I get 10^-4.

MR. CANAVAN: And if you are above the criteria --

(Simultaneous voices)

MR. WALLIS: So what is the regulator going to say?

MR. VANOVER: It might be helpful to think about it this way, Graham. What has to happen is that the licensee has to make a strong case that he has met the criteria.

If he has demonstrated that the very conservative case leads him to exceed the criteria, then he has to put a lot more effort into justifying why he should be using something less than that conservative case.

But I think it's a matter of, in some cases, like for example, crediting the Madrigal action, he would have to demonstrate that this action had been demonstrated to be feasible, that there were procedures, that there was training, and that the numbers had been calculated in accordance with an acceptable HRA approach.

MEMBER SHACK: If you looked at this diagram, if the guy picked number one, he would come down to the supply conservative bias, and he would say, I'm done. The guy that picked number two would probably get kicked over into a candidate for a model uncertainty assessment.

MR. KRESS: But why wouldn't they all choose number one?

MR. VANOVER: It might not give him the answer he wants.

MR. KRESS: But if he chooses first.

MEMBER SHACK: But still you ave covered. When you go through this second process, you've gone through these things, but you are still going to be addressing conservatism, I mean uncertainty, somewhere along the way. And if you pick number one you get to do it with a simple yes-no. If you pick number two you got more work ahead of you.

MR. CANAVAN: In some cases, number one, number two, number three in this case are interesting because, in this example, they are all treatable. We can do number one, number two, number three.

Some of the other cases, number one, number two, number three are logically or debatable identical, or they are reasonable alternatives, or there is not an answer, right.

I guess you could conservatively bound it, but there might be other answers. In other words, there might be two twos.

MEMBER SHACK: but you still have to explode this last box.

MR. CANAVAN: Yes.

MR. TRUE: The applicable candidate --

MEMBER SHACK: Yes.

MR. TRUE: Yes. This is one -

(Simultaneous voices)

MR. VANOVER: This is the base model, right. So this is the process you would follow to meet the requirements in the context of the base model. And then we would take that as a starting point for how we look at uncertainties in the context of applications.

MR. TRUE: So remember those ASME standard requirements for QUE, this helps you meet that requirement before your peer review comes in.

MEMBER ABDEL-KHALIK: How were the 20 issues identified or selected? Why not 30? Why not 40? Why not 100?

MR. CANAVAN: Excellent straight man. Well, go back to that green slide.

MR. VANOVER: We didn't have a goal of picking 20. The process we followed was on this slide where we took the original list and screened out the ones that were clearly approximate methods or scope level detail issues. And then we were left with the 20-some we have. It's still a work in process, and I'm sure we'll get feedback once we release the report.

But the intent is to make it a subset of issues that we know are important from practice, and we know are likely candidates as sources of model uncertainty.

But we didn't go in advance and say we want to get 20. We said, here is the process we are going to take. Let's screen -- let's make the list smaller.

MEMBER ABDEL-KHALIK: But in the back of your mind, did you have sort of some idea that this has to be a reasonable number; otherwise the whole process will become unwieldy.

MR. CANAVAN: It started with Appendix H, Appendix H in the technical basis document, which I think was 630 items.

MR. VANOVER: Not quite that many, about 200 plus.

MR. CANAVAN: I think we had more before.

(Simultaneous voices)

MR. TRUE: Let's back up to that. Because what we did there was back in 2003 or `4. What we did there was, we looked at these different references. And the things we'd identified were model issues and PRAs. And then we utilized the ASME standard and its technical requirements for the BRA, and we sourced our lining up the things we identified with where they affected the PRA model.

And we went through a process of winding all those up.

And then we went back with five -- what did we call them -- seven causes of uncertainty, and we asked ourselves systematically, for every technical requirement of the ASME standard were there phenomenological issues that could affect requirement. Were there human realiability issues. Were there temporal variability? Were the discretization, which is the level of detail issues there.

We had seven questions, and we identified some more, and that ends up with this 200-odd thing.

Then we took that list, and as Don said, we separated out all the ones that were basically modelers' decisions about level of detail and scope. And we said those are separate issues that will come up as part of the specific application and how that gets exercised.

And that left us with the ones that were phenomenological, or human reliability --

MR. VANOVER: Interpretive behavior.

MR. TRUE: Interpretive behavior where you had to make some inference about how the plant or component would respond. And that popped out in 20 odd -- the reason why we're little evasive on an exact number is, we're still debating what that exact list is, and we've bee going back on forth with the staff on that. And then we passed it around among various people and have them look at it. And it seems to be heading toward a reasonable estimate.

MS. DROUIN: Would you not add to that is that that is a generic list, and it doesn't preclude -- the applicant is still required to look on a plant-specific basis to see if there are other uncertainties that are unique, you know, to his plant and his application.

So the list is not intended to be the list.

MR. TRUE: And then there is also, and we are getting way ahead of Don here, but there is also a step where if there is some new state of knowledge changed, not like the correlation thing, but a change in our state of knowledge about a plan or system behavior that has come up generically, that gets brought in too. So like the sump issue. If we'd made this list five years ago we wouldn't have had the sump issue probably on our list.

But in some time period prior to all the sumps being fixed, we would have that on our list.

Or the grid stability is now on our list actually, and it wouldn't have been 10 years ago.

So we've brought in -- so when there were new issues that come up for the industry, they get added to the list too. It's not intended to be the final word on every model uncertainty that could ever occur.

MEMBER BLEY: Let me state something just occurred from an earlier discussion. Somebody mentioned the AEOD, and I don't know what they're called now, those risk studies they were doing looking at plant data against system and partial system modeling. A number of those identified problems in modeling that could lead to errors in -- essentially errors in PRA results.

Have those been systematically factored back into people's PRAs? Is anybody tracking that on the industry side to see if any of those things are worthy of being included?

MR. TRUE: I don't know anything about it.

MR. CANAVAN: I know what you're talking about, actually. I've seen one of the reports.

MEMBER BLEY: One of the more interesting ones had to do with the diesel generators and when they broke it into pieces, some of the ways we were modeling those was a little optimistic.

So those aren't really systematically

being tracked?

MR. CANAVAN: No, but the peer reviews are primary vehicles to catching that, along with the internal reviews of the utilities of their own product. But the peer reviews are the other way of catching errors in the model; also seeing how you line up against the standard, and promoting consistency, I think are a few of the things that come out of the peer reviews.

CHAIR APOSTOLAKIS: So how would I do this for human error?

MR. VANOVER: For Three Mile Island?

CHAIR APOSTOLAKIS: For human error.

MR. VANOVER: I'm sorry.

(Laughter)

CHAIR APOSTOLAKIS: I don't know what the conservative approach is. I don't know which model to use.

MR. VANOVER: But we can help you with that. We have generated a general human reliability analysis as a generic source of model uncertainty. And for the base model, in the upper report what we are recommending is some sensitivity cases, with all human action set at the 95th percentile value. Just to get some insights to how important it is.

CHAIR APOSTOLAKIS: You don't have the 95^{th} percentile. Because you are going to go with one model to get it. My problem is that there are many models.

If I use Athena, I get one thing. If I use HCR I get something else. You know I have a problem because I don't know which model to use.

I think you should try to put some limitations to this list up front. It's a very useful thing, but it does not resolve all the issues.

MR. VANOVER: But I think we identify that in the context of human reliability analysis.

MR. TRUE: But we didn't want to spend too much time trying to force people to do other methods, but just to get an understanding -- it's an unsolvable issue. I mean there is no practical solution at a utility's disposal on how to handle that.

CHAIR APOSTOLAKIS: It's very interesting. It's very important. It's unsolvable. So what do we do? We accept anything the licensee says. That's what we do. Come on, the power uprates.

(Simultaneous voices)

CHAIR APOSTOLAKIS: This is a change and 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 that in the probabilities.

What you are finding is that there are lots of actions that have to be taken in the same event, and the probably of subsequent actio --

CHAIR APOSTOLAKIS: Can we move on to slide #27? Let's do that then.

MR. VANOVER: Okay, so the next objective was to provide guidance --

(Simultaneous voices)

MR. VANOVER: -- in logical combination. So moving to slide #26 --

CHAIR APOSTOLAKIS: Seven.

MR. TRUE: He wanted to jump to 27.

CHAIR APOSTOLAKIS: I want to jump to 27.

This is a new topic, so I wanted to have some discussion on it.

MR. VANOVER: Our feeling as far as sensitivity studies is it should not be an exhaustive set of sensitivity studies, and that's consistent with the guidance that is currently in Reg. Guide 1174.

I think -- so what we are trying to provide here is, from your base model assessment you have identified that subset of the subset of issues that are retained as applicable sources of uncertainty.

I think we need to go back to the prior slide a second. You also need to look at, when you get in the context of an application, what your application-specific key contributors are? Is there a cause-effect relationship between assumptions and the key contributors?

And that helps formulate your set of sensitivity cases. I think we are a little bit concerned that the guidance and the draft NUREG would -- one interpretation would be that you need to be exhaustive, and we don't think that's what you need to do as far as the sensitivity cases that are included, or look at every basic event and whether it's risk achievement worth would put you above a factor of two or exceed the acceptance guideline.

So what we are trying to provide is guidance to say, look at your results. Look at what cuts have changed that are contributing to your delta CDF, if that is the application. Look for cause-effect relationships between assumptions and your key contributors, and then use those insights by looking at your results, as well as the insights you've already established by performing the process on your base model, to identify a set of sensitivity cases, and we are thinking in the range of five to 10 sensitivity cases.

CHAIR APOSTOLAKIS: Why do you think looking at each cut certain, doing all this stuff, is simpler or quicker than just calculating the raw? I don't see that counting is quicker. We have all identified the big ones. Then I go the table like yours and see what the model uncertainties are; do a matching there and -

MR. VANOVER: But I do an application. If I'm doing a delta CDF application there is only a sub-subset of all my cuts that are the change. So raw could be unimportant in all the -- it could be a role of 3.6, and by base model it's a role of 3.5 in my application. But none of the concepts changed in the context of what I changed.

(Simultaneous voicies)

MR. TRUE: -- that has nothing to do with your EDGAOT.

CHAIR APOSTOLAKIS: You find the role of delta CDF. So all that stuff is out.

MR. TRUE: We actually don't do the raw thing.

CHAIR APOSTOLAKIS: What I'm saying is that it is not obvious to me that looking at the cut sets is simpler than finding the role of delta CDF, not of the whole thing.

MR. VANOVER: I think if you do an application is it is incumbent on you to look at what cut set has changed, and what is driving your delta CDF calculations.

(Simultaneous voices)

CHAIR APOSTOLAKIS: -- as your statement we should go back and invalidate a lot of the stuff we've done.

MEMBER STETKAR: Raw can be -- get away from raw. Raw can be super misleading. Because unless you appropriate the aggregate things and do a raw of some group, which is what this whole examination process goes for, raw is just a simple basic event value. It doesn't really tell you much of anything. It's not an issue; it's a component.

It's just a number. It can be useful if you are looking at this pen, or a diesel generator. But it really may not -- it often does not tell you what hte real sources of uncertainty, or the real sensitivities of a particular application.

MR. TRUE: I think John is right. It will not answer questions for example to do with success criteria, because they changed the logic on that.

CHAIR APOSTOLAKIS: Raw doesn't?

MEMBER STETKAR: Raw will not tell you for example when, if you assume that I lose ventilation to this room, and I have a bunch of solid state electronics in here, your model when does that electronics fail in terms of time, and what is the failure mode, raw will tell you nothing about that. It might tell you a particular fan is important, but it won't.

CHAIR APOSTOLAKIS: And the cut sets will?

MEMBER STETKAR: The cut sets won't either. But your knowledge of the model will.

CHAIR APOSTOLAKIS: Well, the question is, what initial step will help you focus on something that is important. Then you ask tehse questions about timing and all that. You can do it for groups too, but it's a little more work. It's not always individual; you can do it for groups.

You changed the model. I understand all that. But it is not obvious to me that by looking at the cut sets you are doing a better job.

MR. TRUE: If somebody wants to use raw as a guide, that's fine.

CHAIR APOSTOLAKIS: I mean that's an initial step. It points you to something that is important. You don't stop there.

MEMBER STETKAR: I have asked people for example how important are seal LOCAs to your overall risk results. And they can't tell me just by looking at raw values.

I mean you can if you look at, oh okay, there is this combination of pumps and these conditions over here, and by implication it must be going through a seal LOCA. But using raw values alone you can't determine that.

MR. VANOVER: In fact, I did do that, at a Limerick pilot application, I did look at raw in the first context, and that wasn't necessarily pointing to the right sources of model uncertainty.

MEMBER STETKAR: If loss of onsite power, if station blackout is your dominant contributor, then the diesels will show up important. But that's not very useful.

MR. VANOVER: The key point is, you want to do a reasonable set of sensitivity studies, and choosing that set of sensitivity studies requires a lot of judgment and an in depth understanding of the model.

We think that hte performance of the assessment on the base model will go a long way in establishing a base line of what might be a good set to look at, and then in the context application you have to decide what other things that are really scope level detail issues that could be key contributors to the application.

In some cases it may be appropriate to provide a bounding sensitivity case for their example of no credit or some credit for operation of RCIC or aux feedwater after loss of DC. We could easily set that to 1.0 and see what the impact would be, and see if we still meet the risk metric. If we are good to go, we're good to go.

And then here we talked a little bit about both increases and decreases in the risk metrics should be investigated as appropriate, not just things that go up, but there could be uncertainties that would drive your answer even further away from the acceptance guidelines.

The other issue that needs to be addressed is to look at other logical combinations of things that need to be considered. Perhaps in a specific application as an example combinations of human actions that weren't important in the base model became more important in an application. And we were relying on tech support center guidance for a bunch of actions at once. And that would be a potential logical combination.

If we hadn't discussed the pendency appropriately before, it would be more important to address that pendency in an application. That's an example of a logical combination.

The other potential logical combination would be if things that are driving the answer are from the same data source, or some of the same assumptions.

So we did have some guidance in the original EPRI report on these issues, and we are carrying that forward and trying to expand it to provide even more guidance moving forward based on the comments that that was an area that could be improved.

MR. TRUE: You don't want to end up 20 factorial logical combinations.

MR. VANOVER: I should say the guidance we are providing in the context of application really isn't changing much from what was in the original technical basis document. What really changed was addressing the base model, and then we're looking at different criteria when we get into interpreting results, which I think we'll get on the next slide. Yes, go to the next one.

The last objective was to provide guidance for interpreting results of sensitivity studies. And this may address Graham's question, how far off can we be when we look at different sources of uncertainty.

This slide is duplicative of one of Mary's slides this morning. Again, the definition of key is only -- key can only be used in the context of an application related to an assumption or a source of model uncertainty that could change the decision being made or drive you into a different region for an application.

Some important things to consider when presenting the results to a decision maker for interpreting results of sensitivity studies.

Obviously, we've already met the acceptance guidelines in the base case analysis or we wouldn't be making the submittal.

So what we need to document in the sensitivity studies is a proper characterization of, if we were to make different assumptions, why the risk metric would still be acceptable; for example, still below the limits. Or why we think the risk metric variation is an artificial result, and therefore, should not be a show stopper for the application because one potential reason is it's unreasonable variation in the parameter. We've guaranteed fail something that is very unlikely to be guaranteed fail.

A lot of times in applications we identify compensatory actions that for example we briefed the crew of the need to do certain human actions which should improve their likelihood of performing the action, but we didn't make any adjustments to the human erorr probability. So there could be compensatory actions that would help to reduce the risk associated with certain calculations.

Or there is just no real way to effectively treat the uncertainty other than performing a bounding assessment. So a bounding assessment may be an unreasonable variation to an input parameter.

And there could be other valid reasons, again, incumbent upon the licensee and the model owner and the PRA analyst to characterize why he thinks, or he or she thinks, the base case is the best estimate, and meeting the acceptance guidelines is the right answer.

They've already been met, the acceptance criteria have already been met, and we want to make sure, and provide confidence to the decision maker as well as everyone else involved, that the associated uncertainty does not adversely impact the decision.

Now this is the concept. The original version of this had a factor of two going all the way out to the one minus 5N. We realized that we need to potentially provide different criteria.

And the important thing to take away from this is, the closer you get to a limit, either the one minus six limit --

MR. WALLIS: Could you explain to me what hte coordinates are in this blue-yellow thing?

MEMBER BLEY: Just walk us through the whole thing. I can't read a thing.

MR. VANOVER: This is in the original report. This is in the context of the Reg. Guide 1.174 application. The first axis is the delta CDS --

CHAIR APOSTOLAKIS: Why don't you use the cursor? Because you need to be close to the microphone. Use the cursor. All right.

MR. VANOVER: Okay, so this first axis is the delta CDF per year, and it's minus six, minus five, minus four. And then the second axis is delta LERF with the decade difference on each of those.

CHAIR APOSTOLAKIS: And the vertical?

MR. VANOVER: And the vertical is the ratio of the change, a factor if -- but delta CDF was a certain amount. It's the ratio of the new delta CDF compared to the base delta CDF as an example.

So the closer I get to the limits, the more restrictive -- more certain they have to be, correct.

And variations in results, you know, if they keep you in the same range -- and that's we slid the scale back a little bit to the five minus seven and five minus six range for the factor of two, because even in that range it would keep you in the same region.

MEMBER ARMIJO: What is that ratio at that point? What is the number?

MR. VANOVER: This axis, this is the 10 up here, sorry. And then this is a two down here, and then this goes to 1.1 at the end.

MR. TRUE: This is still a point of debate between the staff and EPRI, and it's sort of trying to get at the bright line, fuzzing the bright line. Then if we are close but we are still within a factor of two, sneak over a little bit; that's still should be acceptable.

MR. CANAVAN: And remember, the mean met, the uncertainty that is not meaning.

MR. VANOVER: Or the sensitivity study.

MR. CANAVAN: Or the sensitivity study that is not meeting. So the mean, when you did the application and you analyzed the mean, you were in region --

MR. WALLIS: Well, there is no mean for model uncertainty. You're just telling me you used one, two and three. You don't do any mean calculations?

MR. CANAVAN: No, you used the mean model, which is the base model --

MR. WALLIS: Which is which one, 203?

MR. CANAVAN: It's whatever your base model had in it.

MR. WALLIS: So it doesn't really mean anything?

MR. VANOVER: Well, for example, let's go back to that aux feedwater case. Let's say my delta CDF was five minus seven when I had my base case assumption which was case two, or I did take some credit for --

MR. WALLIS: Taking a lot of credit, or it's not the most conservative.

MR. VANOVER: Right. So now that is my base case. Now for my sensitivity study I would fail that action altogether, and I would have a new delta CDF. I'd have to calculate both the new base CDF as well as the delta CDF, and that would give me my -- so whatever that delta CDF was for that sensitivity study I would compare to the original base case and compare to this act, to this figure and that would dictate how many compensatory measures I would need to consider; you know, then it's up to me to characterize the degree of confidence in my base case assumption.

And in either case, the other changed from what was in the original EPRI report, the results of all the sensitivity studies would be documented and summarized to the decision maker. We had previously screened even reporting results of sensitivity results before, but we thought it was important, and agree with the NRC that they see the results, in any context.

So the idea is to provide as much information as possible, and only when you exceed the limits by some amount would it be more incumbent upon you to consider additional compensatory measures, or provide more information that --

MR. WALLIS: So you tell us we should get out of all this by always making the most conservative assumptions.

MR. VANOVER: Not if that doesn't give you a good answer.

MR. CANAVAN: If you make the conservative assumptions --

MR. WALLIS: Then you don't have to do al this.

MR. CANAVAN: Then you don't have to do all this. Doing all this is a function of being more realistic, the more realistic you get.

MR. WALLIS: You never seem to introduce the idea of best estimate or realistic, we don't worry about it.

(Simultaneous voices)

MR. CANAVAN: Well, because uncertainty isn't always specifically becoming more realistic. The example that we provided --

MR. WALLIS: Well, there must be something which is more realistic. Presumably, amongst all these choices, there is something that is more realistic than others.

MR. CANAVAN: I tend to your model. Others thing that for example if you take two theories of the beginning of the universe, who is to say who's right.

MR. WALLIS: Well, you have evidence now for these things.

(Simultaneous voices)

MR. CANAVAN: Pardon?

CHAIR APOSTOLAKIS: The compensatory measures --

MR. CANAVAN: Well, they are typically qualitative.

CHAIR APOSTOLAKIS: Work with probability one. Is that correct?

MEMBER BLEY: They may not even be assessed qualitatively. It would depend. If you were seeking credit, yes, they would generally be quantitative.

Again, it's risk informed regulation, so as you approach a line, and as you get closer and closer, the onus is on the applicantee, the person applying, to provide a solid case that they are operating in a safe manner.

So I think what happens is, the burden of proof goes up and up and up as you get closer to the -

MR. TRUE: It's hard sometimes to quantify them, George. If you think about the example of the pre-shift briefing, when you're in a condition where you want to have this higher probability of the human action succeeding.

Quantifying the benefit of the pre-job brief is sort of outside our traditional HRA methods. But it is certainly a good thing, and if you were on the ragged edge for that action it gives you some confidence.

CHAIR APOSTOLAKIS: I think what you are doing here is very useful. I think though you ought to think about cases where you can't apply this.

I'm not sure you have solved all the issues related to model uncertainty by the approach you have proposed. So there may be others that may need some other treatment, especially Level 2. So I think you are very good --

MR. TRUE: We deal with more issues, but not all Level 2. Not all Level 2. There are some complicated ones.

CHAIR APOSTOLAKIS: Are you done?

MR. VANOVER: I am done.

(Simultaneous voices)

MR. CANAVAN: Okay, I am going to summarize in a minute or less.

We're working -- we're continuing to build on the prior industry work and take advice from learned folks like yourself, on proof of documents.

MEMBER CORRADINI: Nice try.

MR. CANAVAN: Well, I'm trying to save the day. Did well working with the staff on 1855 and we see a need to continue to address, potentially address other events.

And now as I promised here's a surprise for all the good members. Here is the list.

(Simultaneous voices)

MR. CANAVAN: It's not complete. It represents I think I said 600 items before. We started with some huge list. We worked it down to some 200 items that were in the Appendix H, which is one of the reasons why we don't want to give up the old document. We like that list. A lot of those are level of detail, but we still think it's important.

MR. WALLIS: Do you have any written material on item #12?

MR. TRUE: Not that we can give you yet.

MR. WALLIS: I'd really appreciate some written material on item #12.

MR. CANAVAN: We can take a look at what we have.

MEMBER CORRADINI: Can we see the next round?

MR. CANAVAN: Yes, you can. Actually this is being left with you.

MR. TRUE: Does that mean it has to go into the public record?

MR. WALLIS: Does it mean what?

MR. NOURBAKSH: If you present anything

it's under -- unless you request it you don't want it to be public.

MEMBER CORRADINI: I don't think they want it. I think that's what I just heard.

MR. CANAVAN: It is not fully baked. It is only half baked.

MEMBER CORRADINI: Does that mean it could grow or shrink?

MR. CANAVAN: It could grow or shrink.

MEMBER CORRADINI: So can we ask some things now? It's starting to get interesting. I want to look at #19. Explain --

MEMBER MAYNARD: I am sorry, but right now if we continue it's going to be in the public record. I think you guys need to decide whether this is something that can be put in the public record or not. Whether we need to go into a close session.

(Simultaneous voices)

MR. TRUE: It's your project. I am just the contractor.

(Laughter)

CHAIR APOSTOLAKIS: I think we should stop today, because you know, there may be a reason to go off the record.

MEMBER SIEBER: On the advice of counsel.

CHAIR APOSTOLAKIS: We can wait for a month.

MR. CANAVAN: At the end of January you will have the list with the descriptions.

CHAIR APOSTOLAKIS: Very good.

MR. CANAVAN: Thank you for your patience.

CHAIR APOSTOLAKIS: We thank you very much for coming here. Thank you guys very much.

I think the last thing that's remaining for us to do is to go around the table and maybe give some preliminary thoughts on what we have heard.

CHAIR APOSTOLAKIS: Is it Jack or Mario who starts? Mario? Okay.

MEMBER BONACA: All in all I am encouraged by what I saw today. One thing that I sensed in the NUREG that would have been very helpful to have examples.

So again the EPRI work is bringing about and addressing that kind of issue there. Some of the comments I gave before, there is some part of the discussion on chapter three that seems to almost make statements there is arbitrariness in the way that the analysts can do this or not do that, et cetera. I don't think that was the intent, and I don't believe that it should be there.

And I think that there will be a suggestion that as you review the final draft you look at that and get the final impression.

I think the approach taken is good because it addresses most of the applications that are being made of limited scope PRAs right now.

So all in all I think it was -- I was pleased with what I saw.

CHAIR APOSTOLAKIS: Tom.

MR. KRESS: I agree with Mario. I thought it was a good doctrine of determining the types of uncertainties that need to be looked, and approaches that might be used to look at it.

Originally I was concerned about how one chooses between these approaches and what to do with them once you got them. I think the EPRI document might help out there.

I guess within the scope that they took on, that it does pretty well. I was expecting a larger scope in some sense. Maybe that's for something in the future.

For example I was expecting to hear things like what is the basis for the acceptance guidelines that we have, acceptance guidelines on things like CDF. What is that a good basis? I mean why should the mean be the right basis?

And I was expecting to see more in terms of discussing the range of uncertainty on how they relate to margins and to depths.

We got some discussion on that today, but I was still left a little vulnerable in that area. I get the impression that this should be touted as a kind of uncertainty for BWR plants in terms of 1.174 which has as its basis maintaining very small changes to licensing basis. I don't know how you would apply that to something like future plants, or to something like where the regulatory objective might be to meet some acceptance criteria rather than maintaining small changes to the licensing basis.

I'm still a little -- have some reservations about how to apply uncertainties to things like selection of SSCs using importance measures.

All in all I think given the scope that they undertook it was a pretty good document, and well written. And I'm anxious to see the EPRI report.

CHAIR APOSTOLAKIS: Thank you.

MEMBER ARMIJO: I'll pass.

CHAIR APOSTOLAKIS: Pass. Bill.

MEMBER SHACK: When we originally sort of proposed this to the NRC I was expecting something more like a focus on parametric modeling or parametric approach to modeling uncertainty, so I'd get 1150 kind of results.

I think what hte staff did is really the right approach. To focus it on the impact of uncertainty on the decisions that they have to make. That is really where it was at.

And I just thought it was very interesting reading. And an interesting approach. So I'm looking forward to future developments.

CHAIR APOSTOLAKIS: Said.

MEMBER ABDEL-KHALIK: Well, I don't have any comments on the mechanics of this whole process.

My concern is sort of more philosophical, as to how this entire process affects the decision maker.

Are we trying to make the decision sort of -- the decision maker superfluous? In a sense, what is the value added by the decision maker at the end of the day?

And I'm not sure how or where you can address that.

CHAIR APOSTOLAKIS: Are you saying that they seem to be in fact determining the decision?

MEMBER ABDEL-KHALIK: Right. Right. In a sense you are moving the process to the point where it becomes a fait accompli. The decision maker doesn't have to do anything. He looks at the results and says, okay, that's reasonable, stamp it. Got it on.

MR. PARRY: I'm only going to say that this is not the decision. This is one input to the decision. The decision maker still has to integrate all these decisions. So we are not making the decision maker superfluous. We are making his job easier is what we are trying to do.

MR. VANOVER: I think the other intent is, I think we would end up providing more information to the decision maker than they are being provided right now with this process; so that he would be more informed in making the decision.

MEMBER SIEBER: As a former decision maker, I find this process helpful to the system making the decision, because you have a larger understanding of the basis upon which it's made, and how -- what happens when you go to the other side, either side. I think that is a good thing.

I also think it's a good thing for decision makers to understand what this process is, not only the analysts and the staff but plant managers and site officials.

MEMBER ABDEL-KHALIK: But there are a lot of decisions in which this is going to be the primary input, information. Whether or not to take a piece of equipment out of service. Whether or not to repair piece of equipment A before equipment B, whether or not to spend more money on repairing equipment A during this outage, or wait until next outage.

And this, I just don't really see that what the role of the decision maker in those situations will be.

MEMBER ARMIJO: That is risky.

MEMBER BONACA: He has to make a decision. He can make it in the absence of any information. Or he can do it in the presence of good information. I think what is important is that the decision maker should almost exhaust the number of questions around, for example, an alternate configuration that you might have.

MEMBER ABDEL-KHALIK: And that's where my concern comes up. You know the decision maker has to provide feedback to the process, and that I don't see here.

MEMBER CORRADINI: In fact I'm guessing what these guys are saying is, if these guys present them, since I'm wearing all this anyway, if these presented this, I would expect a decision maker who is able in his or her job will go, I don't like that. Tell me if you wiggle that, tune that knob, tell me how the result changes. I would assume.

(Simultaneous voices)

MEMBER BONACA: Consider this additional attribute. I mean clearly there is interaction that has to be there between the guy who makes the decision, and hopefully he is familiar enough with the PRA process that he will ask the questions. And these people from the PRA will be ready to provide the answers to those questions.

CHAIR APOSTOLAKIS: One area may be, after all these sensitivity studies, the decision maker may have to decide how reasonable these things are, and how much should the decision be based on some of these studies, and maybe more on others.

As we said in the LOCA frequency case, the decision maker would have to use the totality of the sensitivity studies to form an opinion. That formulation of an opinion is outside what they are doing. So that is one part maybe where the decision maker comes into the picture.

But what they are doing in the context of the risk of decision making, they are also giving advice where the risk information is not good enough, and you have to move also to more defense in depth by putting these compensatory measures.

But the decision maker will have to make a decision as to whether to accept them. So they are giving a lot of advice. But ultimately I think a decision maker will have to take action.

In some cases maybe it will be obvious. You know if you do the calculations, and in fact I understand through the grapevine that they are giving more and more weight now to the risk information as opposed to, say, nine years ago. Is that correct?

MR. PARRY: I'm not in the decision making process.

CHAIR APOSTOLAKIS: All right, so you don't know what the decision makers do.

Dennis.

MEMBER BLEY: Yes, a few things. Said's comments got my interest up a little bit. But I guess I felt pretty strongly on the side of not seeing this as taking away decision making responsibility at all. And I think as more cases process through, the key people who do have to make decisions will begin to understand their PRAs more thoroughly, and what their limits are.

I mean they're in a spot they have to question this and have to make sure that they are convinced the information coming to them, and maybe put their own uncertainty limits on the outside of that.

I see it as a plus. I was disappointed when I first read all three documents, surprised that I saw nothing in there except a word or two here or there on expert elicitation. And I understand now that that is intention. I'm not 100 percent convinced that at least what seems to me to be having the judgments more intrinsic rather than getting it out to be examined and thought about is a good thing. But I have to think more about that.

I think I'd like to compliment both the industry and staff on the way this is coming together. It's like nothing I've quite seen before. I think it's really a good exercise.

If we could have three reports that really link together from both sides and they help address this issue across the board, I think that will be great.

Personally, there is an awful lot here, an awful lot that is very important to the future use of

PRA, and I got to study it a bit more; not a bit more; a lot more to get really comfortable. I have questions, but I can resolve some of those on my own.

CHAIR APOSTOLAKIS: Otto.

MEMBER MAYNARD: Overall, I think a lot of good work has been done, and this provides a lot of good information.

I do want to go back a little bit to Said's comments just a little bit, because while I do appreciate this type of information for a decision maker is very valuable and very helpful.

We do need to remember, however, that PRA is a tool, and it does not replace the decision maker, and will not ever replace the decision maker.

And I think we have to be careful. You are never going to be able to totally quantify everything and be able to put them in boxes where it removes others; sometimes the more you try to do that the less effective the decision maker is. I think sometimes a little bit of nervousness on the decision maker's part is good at keeping it going. Not to have too much confidence in maybe a number or something like, and to be a little more questioning.

So I think we need to recognize that.

Also recognize that the acceptance

criteria for most of what we are dealing with here, the acceptance criteria was established with the consideration that the mean has some uncertainty. And we need to be careful that we don't start trying to double count uncertainties and add it on top of adding and adding and adding. There are a number of things already in PRAs. And we are quick to point out the deficiencies that might be there, but there's also a lot of strengths.

You know codes already have uncertainties built into them. Instruments are usually taking into account. We use go/no-go type of things where in reality a little bit less may still work.

No real credit for fixing things that may not work. If it breaks, we say it's broken forever, unless it's something we have taken credit for an operator action. And in reality things get fixed that don't work the first time, a lot of times through a scenario there.

As far as on 1855 itself, again, I think it provides a real good question and a great overview. I enjoyed reading it; relearned some things, and found it very useful.

I was expecting it to have more guidance in it as to exactly how you do it. I'm not sure what the intent of the NUREG was. It does provide a lot of useful information that is needed to establish that guidance. And it can be done either by endorsing an industry standard, the EPRI document, or a reg guide or something coming out later. But at some point it needs to turn into, what's the acceptance criteria?

We focused on this primarily decision maker from the utilities side in a lot of what we've been discussing lately, but the regulator has to have a criteria that it uses to decide, is this acceptable or not?

And I want to get back to a little bit of my degree of specificity in the decision making. I think it's important that there is flexibility left there for the decision maker both from the industry side, the utility's side, and also from the regulator's side.

I think if we try to establish criteria that is too tight we take that process away from it, I don't think we end up with the best product out of this. And I think the regulatory decision maker, the industry decision maker, leave some room there. They may have to have some negotiations; it might be a little painful, but I think you come out with a better answer that way than trying to establish a criteria, a sharp black and white line.

That's all.

CHAIR APOSTOLAKIS: John.

MEMBER STETKAR: I think again I would like to compliment both EPRI and the staff. I think you are doing a really good job trying to pull everything together.

One thing I would caution, and I was a bit disappointed in the NUREG, but I understand now a little bit more of the focus on reliance more on the EPRI documents to provide a little bit more concrete guidance and specific examples.

I think one thing I'd caution the whole process, and I've mentioned it a couple of times, is to be sensitive to the fact that these documents, this process, will be used now and in the future for addressing the issues of uncertainty, and that some of the examples and specific screening criteria, numerical things that you have, you may want to be careful about the implications of those specific examples and criteria for newer plant designs, applications in areas that perhaps we haven't yet seen but may be coming forward.

So I think that those examples and you know we had a lot of struggle here today saying, show us how it will be done. And I think you should be sensitive to those issues when you show us how it will be done.

CHAIR APOSTOLAKIS: How about your earlier comment about being conservative is not always --

MEMBER STETKAR: I already made that. As a summary that's true. I mean the approach as a wrap up is indeed I believe too heavily focused at looking at the -- I won't use the term, goesup, the increases in core damage frequency or the risk metric without being equally sensitive to sources of uncertainty that would numerically decrease, or sources of uncertainty that might mask the changes in the results from particular applications.

CHAIR APOSTOLAKIS: Professor Corradini.

MEMBER CORRADINI: Okay, thank you. I guess I am kind of new to all of this, so half the reason I came today was to learn. And so I think this was really beneficial for me. I think the staff's document is -- was quite good in explaining background information, and kind of giving you a perspective on it.

I guess like others I was looking for examples. I think now I understand how the two or the two groups and the three documents will eventually marry together to do that.

I guess I am kind of looking forward to a month from now when we see the list that we heard might occur, how they treat some of these. Because some of them actually involve some physical variations versus operator actions or how operators can take action, or I can't remember what you call them, but I'll call them state variables in terms of how the system parameters are.

So I guess I am very interested in that, because I tend to on a new topic, or I'm not sure about the basis of it, I try to work from the examples to try to understand. So that's what I was looking for.

Other than that I guess the one thing I'd suggest for the report writing, and I'm -- not to repeat, because a lot of the things I pretty much agree with all the other things that the other folks have said is, that I think early in the chapters some historical perspective for the reader, however much that reader is the expert, as to what some of this, what has been seen in the past relative to past studies, such as NUREG 1150, and what you might expect in the future in terms of what the decisions might be would be good, only because I think it will last a whole lot longer.

I think John's one comment about this will probably, once out, will be used again and again is important. So if you want to have a long life, you actually want to give it some historical perspective, and also some examples that transcend where you were, but where you might go. And I think that's kind of important.

But other than that I think I pretty much agree with a lot of the other points that others have made.

CHAIR APOSTOLAKIS: Very good.

Graham.

MR. WALLIS: Well, I've got to write a report on the NUREG. I think we had a very useful descriptions from the staff and EPRI on what's been going on and the work they've done.

I was looking for more specific guidance from the staff on what to do, and particularly on what hte outcome should be from all these activities. The list of activities described, chapter four, there were descriptions of what could be done, but there wasn't an indication of which one of these would be useful for what purpose; which ones had certain advantages; why you'd want to submit this rather than that. And so on. And what kind of an output should this process finish up with, and why.

I thought there would be a benefit to stand back and have a fundamental look at what are we trying to do about uncertainties in the kind of terms that can be expressed in the most useful way for certain kinds of decisions. And what kinds of things can you have as an outcome of a study which really help a decision maker in hte most useful way. And I didn't see that.

The NRC has a lot of description of activities and assessments to be performed. There were lots of box diagrams. I wasn't really sure if this was sort of an idea of how it might be done, or whether it was realistic that this is what people could do.

This is where EPRI helped me, because I got the feeling that people actually did do some of these things, and that it was realistic to require them.

In that context it would have helped to have had many examples. Examples, this is the kind of thing I mean, by this sort of an assessment and this kind of valuation.

At the end of the day I was left with a

feeling, I've said it several times, this is too complex information for the decision maker. For the decision maker to look over 20 different alternative things with one, two, three, four options, and all that, and somehow assess, did they do reasonable things, I think a decision maker needs more specific metrics of uncertainty that everybody understands; something which is crisper; is focused down to something that is meaningful. Not just a mean value. Probably some way of characterizing the uncertainty which we understand.

I was surprised not see things like best estimate and upper and lower bounds and all that as we asked for, the specifics. We are asking you to do this, make your best estimate, give me an upper and lower bound. Give me 95^{th} percentile -- something like that rather than leaving it all up to the analyst to figure out what to submit and how to be prepared to answer questions when the NRC has them.

But anyway, I will put a lot of this into more mature form.

CHAIR APOSTOLAKIS: Just so people don't panic.

Tom and Graham are here as consultants, and they are expected to write a report to me. The other members don't have to. So -

(Simultaneous voices)

CHAIR APOSTOLAKIS: Okay, he is expected to write a report.

MS. DROUIN: Is there a page limitation?

CHAIR APOSTOLAKIS: Anything you want.

(Simultaneous voices)

MEMBER SIEBER: I have a number of comments. First of all I thought the presentations by the staff and by EPRI were good. They helped my understanding of the various phases. When I prepared for the meeting all I had available to me was NUREG 1855 and the companion documents that have come out over the years, and with just that, I did not comprehend what it is you are going to do with this stuff in a practical way. And I think EPRI has filled that box, and I will certainly visit their website tonight, and call them in the morning. And to get the documents, because even those presentations where you were, there was not enough detail and meat today to fully understand this.

CHAIR APOSTOLAKIS: I thought the documents up on the website now are the ones we have.

MEMBER SIEBER: Yes, but I don't have them.

In the role of the decision maker,

decision maker, you know, TRA is only one tool for a decision maker to make decisions. And there are a lot of factors that a decision maker has to take into account. And the decision maker in PRA world is not going to go through all these uncertainty analyses and calculations. It's going to be a briefing by the PRA people where the PRA people bring out the pertinent facts.

On the other hand the decision maker has to know enough about the process, and enough about uncertainties, to be able to ask the right questions. And I think that's important.

When the original PRAs were asked for by the NRC, we did one in our plant and found a few things in the original design that had an impact on the risk that was significant for our plant, and we changed it.

Now we find out that a lot of plants, after they did their IPEs or PRAs in the initial round these little things that were having significant risk impacts.

So decisions are being made in a practical sense way back before there was a regulatory structure to do it, and before there were all these techniques to be able to do it and to define what the uncertainties are, and how much you should believe this and how much you should believe that.

So for me as an industry and as a government agency there has been a lot of progress made. And I think it's important to that process.

So I would consider today from my viewpoint a success. I've learned a lot. I have a better understanding of the issues, and how problems are attacked. But I also think I still need to do more homework.

MEMBER BONACA: Can I add one thing? I totally agree with that. We have lived through, 20 years ago we were doing PRAs and making decisions. The issue was that the decision was always to be made. The question is, what information did you have? The questions you are asking of the analyst are no different from what you were asking before. Simply you didn't have quantitative information, nor you had a relational data to help in the decision.

That's when PRA came of age, anybody in the plant who was an electrical engineer or a civil engineer, they were marveling about the insights that the PRA would bring to the table. Because they could see them themself, and they had to deal with analytical circuit, for example, and here you have a guy coming in with an analytical tool that shows him things he hasn't seen. And they say, oh, gee, I never realized that. You are absolutely right.

So I think from that perspective, this is very important, because it provides a means of channeling information, and doing the right questioning of the uncertainties.

CHAIR APOSTOLAKIS: That's why I think it's a little bit of a strong statement to say that PRA is just a tool. I mean it is a tool, but it's really a very important input.

I agree with what I've heard, so I don't have to repeat it. The only comment that I haven't heard, and maybe I can make it for the benefit of the staff, I think NUREG-1855 is too wordy, repetitive. It really needs a good editing job. Somebody has to sit down and read it from beginning to end, and tighten it up. And that of course, I would like to see more examples and concrete guidance maybe by reference to the EPRI document, which is what hte staff is planning to do.

But I think the editing would help a lot. A lot of hte stuff is repetitious from the regulatory guide 1174, and so on. And we don't need all that. And then some stuff is repeated from chapter to chapter. So I think that would be a good thing to do, and make it shorter and more meaty.

Other than that, unless a member or a consultant has a comment or the staff, I think we have reached the end of the day.

Any comments from anybody?

MS. DROUIN: A lot of good insights y'all gave us. I took a lot of notes. I think I have a good idea of where we need to go and make the document more useful.

I look forward to coming back. The reason I'm hesitating here is because several people said they want to see more in hte presentation; more in the presentation. And I struggled with that to be honest. I can't tell you how much time we spend on trying to figure out what to put on the vugraphs, what not to put on the vugraphs.

You know as you saw we had 44 vugraphs. So you're telling me you want more meat, I'm not sure how to answer that and developing vugraphs that are useful to be frank without taking the 100 page document and making every page a vugraph.

So I really need some assistance.

CHAIR APOSTOLAKIS: Okay, let me give you some assistance. All this elaboration on what is model uncertainty and this and that and diagrams, I would say model uncertainty; here are the three ways we are proposing for handling it. Way one, couple of slides; two, three. And if anybody like somebody who may not be here asks you, what do you mean by assumption, then you give the definition. But don't include those things in the presentation. Go straight to what you are telling people to do. That's one way.

MR. PARRY: And that way you promise not to ask what uncertainty is.

(Laughter)

CHAIR APOSTOLAKIS: As usual, I gather somehow the staff, not just today, likes to present history, management issues, you know, overall approach, process. This committee tends to be focused more on what you are actually recommending that people do. It's a very performance --

MR. WALLIS: I would start off by saying, this is what the -- it's the kind of decisions that have to be made. This is the kind of information decisoin makers need, and this is why he or she worries about uncertainty.

And we're answering those by what we're doing here.

MEMBER CORRADINI: I was going to say, what

Graham just said is kind of the age-old way in which I've stumbled into over many years. Work the problem backwards. What is the final result you expect, and work backwards from is.

CHAIR APOSTOLAKIS: And then we can see how you get there. But for example, the slide that PTRI had with the batteries, this is telling me what to do. That's a good one. Here is an example. That's the kind of slide that I think will go a long way.

In fact, I would start with the decision like Graham suggest, then give maybe three or four different situations, because the decisions are not always -- they are not all the same. And work backwards.

MR. WALLIS: And that's the output that you have from getting all this assessment and understanding which helps the decision maker.

MS. DROUIN: I mean I have no problem with doing that. But I'll be honest, we come to the meeting with an assumption that since the document has been out there for 30 days that y'all have read it and have read the details, and that we don't have to repeat the details and we want to get into those discussions.

CHAIR APOSTOLAKIS: Well, the message from the committee is, we should focus on the details and forget about the general discussion of, there are uncertainties due to incompleteness and models and that kind of stuff.

If you have a new something that settles it, you know, what is model uncertainty, by all means. But if it's a traditional thing, we have parameter and model, who needs that. We know that.

Anyway, I think we reached the end of hte day. I thank the speakers, the staff, the industry and everybody else.

And we'll see you after the New Year, when we see you.

(Whereupon at 4:28 p.m. the proceeding in the above-entitled matter was adjourned.)