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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

+ + + + +

SUBCOMMITTEE ON RELIABILITY AND RISK ASSESSMENT

+ + + + +

TUESDAY,

SEPTEMBER 30, 2008

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ROCKVILLE, MARYLAND

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The subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B-3, 11545 Rockville Pike, at 10:00 a.m., George E. Apostolakis, Chairman, presiding.

COMMITTEE MEMBERS:

GEORGE E. APOSTOLAKIS, Chairman

DENNIS C. BLEY, Member

MARIO V. BONACA, Member

DANA A. POWERS, Member

WILLIAM J. SHACK, Member

JOHN W. STETKAR, Member

ACRS/ACNW STAFF:

HAROLD VANDERMOLEN, Designated Federal Official

MICHAEL BENSON, ACRS

ED HACKETT, ACRS

PANELISTS:

KEN CANAVAN, EPRI

MARY DROUIN, RES

JOHN LEHNER, BNL

GARETH PARRY, NRR/DRA

DON VANOVER, ERIN Engineering

TIMOTHY WHEELER, SNL

NRC STAFF:

DON DUBE, NRO

MICHELLE GONZALEZ, RES/DRA

JOHN MONNINGER, RES/DRA

DARREN PICCIRILLO, RES/DRA

ALSO PRESENT:

BIFF BRADLEY, NEI

T-A-B-L-E O-F C-O-N-T-E-N-T-S

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

10:03 a.m.

CHAIRMAN APOSTOLAKIS: The meeting will now come to order.

This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Reliability and Risk Assessment.

I am George Apostolakis, Chairman of the Subcommittee.

The Subcommittee members in attendance are Dennis Bley, Mario Bonaca, Dana Powers, William Shack and John Stetkar.

The purpose of this meeting is to discuss draft NUREG-1855, the Guidance on the Treatment of Uncertainties Associated with PRAs and Risk-Informed Decision Making as well the companion EPRI Report Treatment of Parameter and Model Uncertainty for PRA, dated April 2008.

The Subcommittee will gather information, analyze relevant issues and facts and formulate proposed position and action as appropriate for deliberation by the full Committee.

Harold VanderMolen 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 August 27, 2008.

A transcript of the meeting is being kept and will be made available as stated in the *Federal Register* notice.

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

We have not received any requests for members of the public to make oral statements or written comments.

This is a subject model uncertainty that has been of interest to this Subcommittee and, of course, the ACRS.

MEMBER POWERS: Why do you restrict to model uncertainty?

CHAIRMAN APOSTOLAKIS: Why do I what?

MEMBER POWERS: You said only the model uncertainty is of interest to the Committee.

CHAIRMAN APOSTOLAKIS: I think that was of particular interest. The parameter --

MEMBER POWERS: Particularly of interest to you.

CHAIRMAN APOSTOLAKIS: So you're

interested in other uncertainties. Okay.

So the Subcommittee except Dr. Powers thought that model uncertainty was very important and he thinks that everything is important, parameter uncertainty.

The reason I make a distinction is because parameter uncertainty has been handled, one way or another, every since the reactor safety study, whereas model uncertainty has not. In some very important cases, very prominent cases, yes it has been handled. But it never came to being part of the routine evaluation of uncertainty.

So the staff has been working on it. EPRI has been working on it. So we'll hear today, I believe this is the second or third briefing of the Subcommittee. Because their work has been evolving over the years.

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

Mary?

CHAIRMAN APOSTOLAKIS: Thank you, George.

MS. DROUIN: But I'm going to turn it over to John Monninger to make some opening remarks.

MR. MONNINGER: Good morning. I'm John Monninger. I'm the Deputy Director of the Division of

Risk Analysis from NRC's Office of Nuclear Regulatory Research.

I want to thank you very much, Professor Apostolakis and members of the Subcommittee for having us here today.

As Professor Apostolakis indicated, this is a collaborative project which is very important for us. In addition to our staff, NRC's Office of Nuclear Regulatory Research, we have also active participation from NRC's Office of Nuclear Reactor Regulation. We have EPRI, the Electric Power Research Institute and their consultant ERIN Engineering. In addition to that we have representatives from the Brookhaven National Labs and Sandia National Lab working on this project.

We consider this to be a very important project for the staff and for industry as we move forward in our phased approached to PRA quality that the staff has been working on for probably the last eight to ten years or so.

In that regards, it is in support as the ASME PRA standards as the staff continues to endorse those standards within Reg. Guide 1.200.

I believe this is the second meeting. I had attended the previous meeting and there were some very good questions and comments that the ACRS had provided and we're actively working to address them.

In moving forward, we view this to be a living document and recognize that there is the potential need for updates as lessons are learned in its use and application. We also anticipate that in order to make sure that people fully appreciate its value and use, there could be the need for workshops both internal and external with regards to its content.

So with that, we look forward to a very active and engaged. And I turn it back over to Mary.

CHAIRMAN APOSTOLAKIS: I have a question. What is the role of the NUREG in the regulatory structure? I understand what the regulatory guide is, but the NUREG is just there to report the staff's thinking on this issue. But is there any requirement that the licensee that requests something should do any of the stuff that's in the NUREG or are we on our way for a regulatory guide later?

MR. MONNINGER: You want me to try, Mary?

I think there is a hierarchy in the agency's documents. I mean, if you go back to of course the Atomic Energy Acts and our rules and regulations within 10 CFR, and below them supporting guidance documents for applicants such as reg guides.

And then supporting guidance documents for the staff such as standard review plans. Below that there are documents such as these NUREGs that discuss the staff's views and opinions about particular topics or approaches.

It would be appropriate for us to reference this within Reg. Guide 1.200, which we have, or any of the Reg. Guide 1.174 through 1.178 series.

So it is appropriate for the staff to reference NUREGs or other technical documents within a reg guide.

CHAIRMAN APOSTOLAKIS: So at the next reference of 1.200 there might be a cite reference to this.

MS. DROUIN: Not might be, there is. We have referenced this NUREG in revision 2 to Reg. Guide 1.200 as an acceptable approach for the treatment of uncertainties. And we also reference implicitly, you know, the EPRI work because EPRI work is referenced in our NUREG and vice versa.

DR. PARRY: And in revising Reg. Guide 1.174 we'll also -- because as you know in Reg. Guide 1.174 the subject of these documents is addressed.

CHAIRMAN APOSTOLAKIS: So it will be cited there as well?

DR. PARRY: It will be cited there as well.

CHAIRMAN APOSTOLAKIS: For the next revision?

DR. PARRY: Yes.

MS. DROUIN: Right. But all these reg guides that deal with risk-informed activities where they talk about the issue PRA quality, they are being revised to reference Reg. Guide 1.200. So in referencing 1.200 you automatically always will bring in this NUREG.

CHAIRMAN APOSTOLAKIS: Sure. And then we have the EPRI document, which is mentioned in a few places in the NUREG. Is there an implication there that what is in the EPRI document is acceptable or do you need to be more specific and say, for example, Appendix B is great and you say it is okay, Section 3.5 we bless but 3.4 we don't like? I mean, how does that work?

MS. DROUIN: Okay. We've been working with EPRI, you know, under the MOU. Now when the program first started several years ago, you know at the time we thought we may have an appendix that would go in and say here's what we like about the EPRI work and here's what we don't. That was a final way we wanted to go. We didn't really want to go that way.

So both of us have been working very closely, they looking at our document, we looking at their document and ironing out the differences. And so at this point in time we've pretty much converged with each other and we're both liking each other's work. So at this point we're not seeing a need --

CHAIRMAN APOSTOLAKIS: Well, it's not an issue of disliking. For example, the point of view or the tone of certain things which are acceptable, but you may not want to recommend going that way. And in particular, I mean we'll come to it later, but in the EPRI report at least my impression is that they're going out of their way using sensitivity analysis up front to dismiss a more rigorous approach. Only when everything fails you're supposed to go and do the right thing. Not that the rest of the stuff is not the right thing, but there is this attitude.

You know, use point values, and this and that, and don't do this, don't do that it's not important. But if all else fails, then unfortunately you have to be rigorous.

You may not want to endorse that way. That doesn't mean it's wrong. What they're proposing is not wrong. There is nothing to dislike. In fact, it's an engineering approach. So that's why I'm asking. I mean, how do you reconcile that if you guys disagree? Because if you agree, there's no question, there is no problem.

MS. DROUIN: Well, as I said, we've been reconciling things that as we march through and look at each other's documents and see how the two documents fit together. You know, because our document will say in certain places go see this part of the EPRI document to answer this question.

So on the parts where we're sending a reader to view the EPRI document, to read the EPRI document to have the full story, then that's where we're working with EPRI to make sure we're all in agreement and that we agree with what's in there.

So all I can ask is that as we go through, and this is why we thought it was important to give a combined presentation today so that you all understand how these two document work together. Because we've developed them together.

CHAIRMAN APOSTOLAKIS: Okay. So maybe the issue will come up later when Ken has a chance to present his stuff.

MR. CANAVAN: Sure. This is Ken Canavan.

Just to chime in here real brief. I think we've had some feedback on the tone of the document, mostly from our esteemed colleagues working with us. And we've been trying to improve that tone I think to represent a little bit of a consensus approach to tackling the problem.

CHAIRMAN APOSTOLAKIS: Okay. Good. So the answer to my question is that you will try to converge as much as you can, so one can go --

MS. DROUIN: Right, which is what we've been trying to do.

CHAIRMAN APOSTOLAKIS: Yes. Okay.

MR. CANAVAN: And I think if you go through the NUREG and you take where the references are in the NUREG, I think what Mary was trying to say is when it references a part, that part that's referenced is deemed acceptable by the staff. Don't let me put words in your mouth, but that's what I think where we're headed.

MS. DROUIN: That's where we're trying to head.

MR. CANAVAN: So those parts that had tone that was not desirable for the parts where it was referenced, that tone was definitely changed to be a more acceptable approach and have a more acceptable tone from the staff.

CHAIRMAN APOSTOLAKIS: We'll have another opportunities to comment to this.

MR. CANAVAN: Sure.

MS. DROUIN: You know, we have provided EPRI with a lot of comments and vice versa. Are we completely there right now? Probably not, but I think we've gone as far perhaps as we can go until we start actually using these two documents. So that's why I think John's comment about this being a living document.

I personally view us doing a revision to this NUREG. Because it is a complex topic, how these two documents compliment and work together. I think we're going to learn a lot once we get it out and we're going to have to come back and make some revisions.

MEMBER BLEY: I'm sure you're going to get it because there are planned applications already on the books.

MS. DROUIN: Officially --

MR. CANAVAN: Yes, Ken Canavan.

MS. DROUIN: The reason I hesitate because, you know when you answer over here in the NRC you talk about pilots. You know, are people going to be using it right away? Absolutely. Has there been a pilot that's been singled out on the regulatory side? No. Are we talking about it? Yes.

CHAIRMAN APOSTOLAKIS: Dana, you wanted to say something?

MEMBER POWERS: I mean, I think your characterization of the EPRI document was nice what you stated. And you say you're changing the tone, I mean it seems to George was right. It's always do the most expedient thing.

MR. CANAVAN: I think when we walk through some -- I'll hold you off to some of the slides. Because they may offer a different interpretation of the order and the comments may be to reorder it and to more accurately state the cases where you apply a successive screening approach and where you do not apply a successive screening.

MEMBER POWERS: The danger I see, George, is in all these things. When you get an outcome that you want, we never look at it any further.

CHAIRMAN APOSTOLAKIS: What do you mean?

MEMBER POWERS: If you get a desirable outcome, you stop and never pursue it any further. You get it as an outcome that you don't want, you sharpen the pencil until you do get an outcome that you want. And it strikes me as not the right way to do things.

DR. PARRY: I'm not sure that that's right, Dana. And I think just to sort of maybe recelebrate just a little bit. The tone of the NRC NUREG is that this is very much done in the context of an application. And I think that's probably the tone of the EPRI document, too, is that we're looking at specific applications and we're addressing the things that we need to address to demonstrate that the results that we're generating are robust for that application. And that's the purpose of doing things this way.

CHAIRMAN APOSTOLAKIS: I think the issue has been put on the table. So let's continue -- start, actually and we'll see how that goes.

MS. DROUIN: Okay. I'm Mary Drouin with the Office of Research.

I want to introduce the NRC team. And to the right is Gareth Parry from NRR.

To my left over here is John Lehner from Brookhaven.

And down at the end is Tim Wheeler from Sandia.

I do want to recognize two other team members who have been heavily involved in this work is

Jeff LaChance from Sandia and Gerardo Martinez from Brookhaven.

And, Ken, I'll let you introduce the EPRI.

MR. CANAVAN: Sure.

I'm Ken Canavan and I'm the Senior Program Manager for Risk and Safety at EPRI.

To my left is Don Vanover of ERIN Engineering. And Don had a lot of input into the development of the document.

There are several folks that aren't here today. The first one is Doug True of ERIN Engineering who also contributed very much to the early drafts of this report.

And last I did want to point out that this document is brought to you by a really large group of folks, The EPRI PRA Scope and Quality Committee which is comprised of over 14 utilities, U.S. and a few international members. And they were responsible and reviewed the earlier versions of this report all the way to its current state. So I did want to mention that they not only fund, but they participate.

CHAIRMAN APOSTOLAKIS: Who are the principal contributors to the appendixes?

MR. CANAVAN: Appendixes?

CHAIRMAN APOSTOLAKIS: Very experienced

PRA people, as far as I'm concerned.

MR. CANAVAN: Yes. That was primarily a subgroup of the PRA Scope and Quality Committee; Don, Doug, myself and some other folks. And PWR Owners Group, for example, had a significant input to that as well.

CHAIRMAN APOSTOLAKIS: Don, which office of ERIN are you?

MR. VANOVER: West Chester, Pennsylvania.

MS. DROUIN: Good.

CHAIRMAN APOSTOLAKIS: All right.

MS. DROUIN: Okay. The main focus of today's meeting is going to be discussing the actual work in the document. At the end of the day we do want to go through and let you know what the status of these reports are and what future work we have planned.

CHAIRMAN APOSTOLAKIS: So you're not requesting a letter, right, at this time?

MS. DROUIN: Not at this point, no. Now we're going to be coming back in November to the full Committee.

CHAIRMAN APOSTOLAKIS: And then? Yes.

MS. DROUIN: We may or may not be requesting a letter.

CHAIRMAN APOSTOLAKIS: Oh, you're not sure even in November?

MS. DROUIN: Well, I mean you know if you say good things, then of course I want a letter. If you say bad things, I don't want a letter.

CHAIRMAN APOSTOLAKIS: Yes. Yes. Such a problem.

CHAIRMAN APOSTOLAKIS: All right.

MR. MONNINGER: I guess the staff had committed because this topic, you know the treatment of uncertainty and risk-informed decision making and within PRAs had come up several years ago back in 2003/2004. So this was a staff commitment to the ACRS to do this.

CHAIRMAN APOSTOLAKIS: Yes. Yes.

MR. MONNINGER: So this was in previous ACRS letters and correspondence. So whether there's need to close the loop, we believe we are responding in part to --

MEMBER SHACK: When do you plan to go final with it?

MS. DROUIN: At the end of this calendar year. But again I want to emphasize I think we're going to very quickly start working on a revision to it. I think it's important to get this out on the street, people to start using it, start learning lessons. You know, we're going to try and have a major workshop. But I think there is a lot of stuff that is going to come out where we're going to very quickly see the need. But I think until you get it out and really start using it, and I think that's important.

CHAIRMAN APOSTOLAKIS: Okay. We'll wait then and see what your position will be in November whether you would want a letter, or maybe an interim letter, you know, on the present state of the thing with the understanding that there will be a document or application that will create some feedback.

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: So we'll have to see.

MS. DROUIN: Okay.

CHAIRMAN APOSTOLAKIS: Of you don't want a letter, that's -- I'm not going to be very upset.

MS. DROUIN: I always want a letter from the ACRS. I even accept the negative ones. But I've never gotten a really negative letter from --

CHAIRMAN APOSTOLAKIS: We don't say how you accept a letter.

MS. DROUIN: Okay.

MEMBER SHACK: Watch what you wish for, Mary.

MS. DROUIN: Okay. When I talk about the program, I'm really talking about across the work between NRC and EPRI here. So when you look at these two documents together, we're really trying to provide guidance in two areas. One is to support the ASME/ANS standard. As you know, the standard tells you what to do, it doesn't tell you how to do. So this is, in a sense, going to the next step and providing some of that how.

The other thing the standard doesn't do, it doesn't tell you what to do with that information. You know, the standard tells you got to identify your uncertainties, characterize them, et cetera. But then it doesn't tell you what to do with that, which is appropriate because that's not the purpose of that standard.

So this standard picks up there and tells you what to do with this information in your decision making process.

MR. CANAVAN: Before you go on, Mary.

MS. DROUIN: Yes.

MR. CANAVAN: If I might?

MS. DROUIN: Absolutely.

MR. CANAVAN: I wanted to add a little bit to the purposes. We started this, there's been some references back to 2004. I think we actually started in 2003 after reviewing part of this effort. And the fundamental reason at that time was to help the broader PRA community, those people performing PRAs and doing applications, with the consent treatment of uncertainty in those in both base PRA and the applications as well. And not only to be consistent with the standard, but also with the expectations of the peer review.

For example, there were a number of peer reviews going on and the expectations of well how do you actually comply with the standard, what analysis methods do you use to treat uncertainty. And we needed to get a little bit more consistent there and provide guidance in that area. And, again, that's when the PRA Scope and Quality Committee was formed, and this was their first major task. So this is one of their big efforts in that area. So that was a purpose of hours.

CHAIRMAN APOSTOLAKIS: Incidentally, this issue of what to do with the uncertainties. I mean, for years now people have been asking that question.

I remember going to Ashok Thadani's

office, he was Director of Research at the time. And that's the question he asked. He says, "Okay. If you give me those uncertainties, now tell me what I should do with them. 1.174 says you should use the mean value to look at the uncertainties and then it's up to you, essentially, to decide what to do."

So you guys are going to give a little bit more guidance along these lines?

MR. CANAVAN: Yes. Yes.

CHAIRMAN APOSTOLAKIS: And that's good.

MR. CANAVAN: Yes.

CHAIRMAN APOSTOLAKIS: Because I was very pleased to see that you're addressing the issue. The ultimate utilization of the results of the quantification.

MS. DROUIN: Right.

MR. CANAVAN: Right.

CHAIRMAN APOSTOLAKIS: Which really is the decision at the end?

MS. DROUIN: Yes.

MR. CANAVAN: Yes.

CHAIRMAN APOSTOLAKIS: Okay.

DR. PARRY: However, we do stop short of telling people how to make decisions.

CHAIRMAN APOSTOLAKIS: As I was speaking I was trying to remember exactly what specific guidance gave, and I failed. So I think I agree with you. But at least you have a whole discussion.

MR. CANAVAN: Yes.

CHAIRMAN APOSTOLAKIS: And maybe something will come out of our interactions. I don't know.

MR. CANAVAN: We leave a little by saying what you can do.

CHAIRMAN APOSTOLAKIS: Yes.

MS. DROUIN: And we're going to go through that part.

CHAIRMAN APOSTOLAKIS: Yes, I know. I know. That's good. Even the fact that we have a separate discussion on that is a good step forward, in my view.

MS. DROUIN: Yes. And in our minds that's what we understood was the ultimate objective or purpose, whatever, of the document was to take us there.

CHAIRMAN APOSTOLAKIS: Yes. Yes.

MS. DROUIN: And you can see on this slide to accomplish that there's a lot of things, though, that the document had to undertake before we can ultimately get to the guidance of what do you do with this information. So these are just some of the things. But I'm going to try and move forward now.

All I want to do with this slide, and it's important that you see the one up on the screen, because the only purpose of this slide is to show you that we have this whole program. And the different colors here mean different things.

And where you see blue is primarily where the NUREG is addressing this work.

CHAIRMAN APOSTOLAKIS: We have a black and white. Okay. Okay. I know. I know.

MEMBER SHACK: It's too much information. Too much.

CHAIRMAN APOSTOLAKIS: Yes. But when I go home, I don't know what I'm going to do.

MEMBER STETKAR: Look on your computer when you go home, it's in color.

MS. DROUIN: I will send you a copy of this one.

CHAIRMAN APOSTOLAKIS: Okay. Okay.

MS. DROUIN: But the only purpose of this is to show you that there's certain parts where the guidance is strictly in the NRC document. There's certain places where EPRI has it. And then there's certain places where we both cover it to different levels of detail.

So when you look at this slide, you know we get into -- you're going to hear what we're doing on parameters uncertainties. And you can see it's a purple color on my screen. It's a sort of purple color there. You know both documents deal with this, but each of us do something a little bit different.

On model uncertainties, both of us deal with it but in different areas.

Over here in the blue we're getting into completeness, you know what's not in the PRA and how do you deal with your completeness uncertainty.

And then ultimately how you factor all this information into your decision making.

So the reason I wanted to put this slide up here because as we go through we aren't going to go through all the NRC stuff then the EPRI. We're going to talk to each of these topics and our roles in each of them.

CHAIRMAN APOSTOLAKIS: Now would you go back?

MS. DROUIN: Okay.

CHAIRMAN APOSTOLAKIS: Back. Yes.

If you look at the color code in the upper right hand.

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: The bottom one.

MS. DROUIN: This one here?

CHAIRMAN APOSTOLAKIS: Yes.

MS. DROUIN: NRC/EPRI.

CHAIRMAN APOSTOLAKIS: Right. That means you guys agree there or you're both working on it.

MS. DROUIN: It means that both working in that area.

MEMBER SHACK: They're both addressing it.

CHAIRMAN APOSTOLAKIS: They're both addressing it. Okay.

MS. DROUIN: So that's why I was trying to say like here, both of us are providing guidance on parameter uncertainties, but we're not duplicating each other. You know, we're getting into the characterization and propagation. They're getting into abbreviated methods and guidelines.

But we're going to go through each of these at this point now. But before we get into it, here's what we're not going to get into because it was my understanding that you really didn't want us to spend time going through the background information.

So there is discussion in the document about what is the decision making process. You know, what is the role of the PRA in the decision making process? And what are the different types of uncertainties? You know, what is a model uncertainty? What is a parameter uncertainty, et cetera? So there is one or two chapters that get into this, all this background. But we are not going to discuss that today.

CHAIRMAN APOSTOLAKIS: You mean by first sub-bullet? I mean, I thought you were going to discuss --

DR. PARRY: I think what we mean by that one is the risk-informed decision making process. If you --

CHAIRMAN APOSTOLAKIS: The general approach.

DR. PARRY: The general one, Reg. Guide 1.174.

CHAIRMAN APOSTOLAKIS: Okay.

MS. DROUIN: Now we're going to get in at the end how this all factors into the decision making process. But we aren't going to take you through all the elements of the decision making process.

CHAIRMAN APOSTOLAKIS: No. No.

MS. DROUIN: No. So all that --

MEMBER SHACK: There's some peculiarities of your definitions of model uncertainty that I thought we might to discuss today.

MR. CANAVAN: We'll get to that.

MS. DROUIN: Well, you know, at the end if we want to come back.

MEMBER SHACK: Get to that, yes, okay. You said you weren't going to discuss it.

MS. DROUIN: We weren't planning on it. We do have a couple of background slides because we thought well even though they didn't want to hear about it, they may want to hear about it. So --

MEMBER SHACK: Okay. Well I'll bring it up then.

MS. DROUIN: Okay. As I said earlier, you know one of the main things was to get into supporting the ANS/ASME standard. And we're going to get specifically into these. But when you look at the ASME/ANS standard what you see in the standard in terms of uncertainties are requirements that deal with: characterization of the parameters; calculation of event probabilities; calculation of your different risk measures, you know CDF and LERF; identification of the sources, and; characterization of the model uncertainties, the sources of the model uncertainties.

This is what the standard requires you to do. And this is the what. So we're going to get a little bit into the how and then ultimately how is this factored into.

So with that, let's get right into the first one, which is the parameter. And John Lehner is going to walk us through that part.

MR. LEHNER: Good morning. I'm John Lehner from Brookhaven National Laboratory.

And we contributed to the NUREG mainly in the chapter on parameter uncertainty.

The standard has a number of requirements that deal with parameter uncertainties. Those are geared towards requiring characterization of the parameter and its uncertainty for basic events as well as the propagation of that uncertainty and how you get to a risk metric, mean value and uncertainty interval in this rick metric.

Though in NUREG-1855 the chapter on parameter uncertainty provides guidance on these requirements in the standard, the EPRI report which we'll hear about in a few minutes from Don Vanover, they also provide some guidance on when it may be acceptable to avoid explicit calculations of the state-of-knowledge correlation. But the issues -- can we go to the next slide?

MEMBER POWERS: Before you get off that.

MR. LEHNER: Yes.

MEMBER POWERS: It seems to me my recollection there's much discussion of when you have data, you calculate means and standard deviations for that data. And it seems like you're precluding the use of stable distributions for these parameter uncertainties. Is that true? Do you preclude certain classes of distributions?

MR. LEHNER: No, I don't think so. We're keeping the guidance -- we're not talking about what distributions are appropriate for a particular basic event, for instance.

MEMBER POWERS: And if you don't, then how do I propagate. If you don't tell me what distributions I can or can't use, then I'm free to use anything, right?

MR. LEHNER: Well there's guidance in NUREG CR-6823, the Data Handbook that basically provides guidance on what are acceptable distributions for various basic events. So we're not covering that again here.

MS. DROUIN: The Data Handbook goes into quite a bit of detail on this. So we opted not to, in essence, be repetitious with that NUREG and we refer the reader on those kind of details to go to the Data

Handbook.

MEMBER POWERS: Please provide me the Data Handbook.

MS. DROUIN: Absolutely.

CHAIRMAN APOSTOLAKIS: So you're making a statement of fact there at the last bullet, right?

MR. LEHNER: The fact being that the report provides some guidance.

CHAIRMAN APOSTOLAKIS: Yes. That's a statement of fact. Do you agree with this? Are you endorsing it? Are you -- what --

MR. CANAVAN: Let me --

CHAIRMAN APOSTOLAKIS: And I don't understand that, Ken. Why are you going out of your way to --

MR. CANAVAN: Can I --

CHAIRMAN APOSTOLAKIS: Which code that is being used now cannot handle this? How big a deal is it?

MR. CANAVAN: I would suggest that we get through the EPRI slides on it and then we have a nice detailed discussion about it.

CHAIRMAN APOSTOLAKIS: So there will be a set of EPRI slides on this topic soon?

MS. DROUIN: Yes. Immediately.

CHAIRMAN APOSTOLAKIS: Immediately.

MR. CANAVAN: Next set of slides.

MR. LEHNER: One other slide and then the--

CHAIRMAN APOSTOLAKIS: But what is the purpose of you putting it there? What does it mean? That you are approving it you are just observing that this happening.

DR. PARRY: Actually, George, if you'll look at the standard, the standard for certain capability categories allows you to do this. So this guidance is to give guidance to people of how they can address the requirements of the standard. Even Regulatory Guide 1.174 allows you not to do the complete state-of-knowledge correlation, but you have to demonstrate that it's not significant at the outset.

CHAIRMAN APOSTOLAKIS: Right, and I agree with that.

DR. PARRY: Yes. That's why it's here.

CHAIRMAN APOSTOLAKIS: I mean, but I'm just curious. I want until Ken takes the floor.

I mean, it's not a big deal anymore.

DR. PARRY: No. Well --

CHAIRMAN APOSTOLAKIS: Well what?

DR. PARRY: We'll get into that. Yes.

CHAIRMAN APOSTOLAKIS: Because in here he's getting into distribution. Anyway, we'll get there.

MS. DROUIN: Well, I did have in the backup slides -- I'm trying to find where it is. Here we go, QUE3.

CHAIRMAN APOSTOLAKIS: That's okay.

MR. CANAVAN: Yes, it's QUA.

MS. DROUIN: Okay. Yes, we debated about having some of this.

CHAIRMAN APOSTOLAKIS: What are we looking at now? I don't know.

MS. DROUIN: This is the actual wording from the standard. I'm trying to figure out how to go back to my slide --

CHAIRMAN APOSTOLAKIS: Do we have somewhere?

MS. DROUIN: Well, I thought I had --

CHAIRMAN APOSTOLAKIS: Well, whatever. We'll talk about it when Ken addresses it.

MR. LEHNER: So why don't you go to the next slide?

MS. DROUIN: Okay.

MEMBER POWERS: I still have what is an

uncertainty and what is an uncertainty interval.

MR. LEHNER: The uncertainty interval that we talk about here in the risk metric is the interval that you've -- well, the uncertainty that you propagated from the basic events through to your relevant risk metric, be it a sequence frequency, a core damage frequency, a large early release frequency. And then, you know, do you want the fifth or 95th percentile? I mean, it's up to you to decide what interval --

MEMBER POWERS: How do we decide that? I see the thermal hydrolysis, like you use 95/95. I see the seismologists like you use the 85th percentile and I see the source term guidance using the 70th percentile. How do I decide among those?

DR. PARRY: It's decided by the acceptance guidelines of the application. So if in the case of Regulatory Guide 1.174 it was decided there it should be the mean value of the distribution that you compare with the guidelines. So it's a summary of what the distribution does for you. We don't do anything with the 95th specifically.

MEMBER POWERS: Yes. You're going to calculate the mean value?

DR. PARRY: From the distribution.

MEMBER POWERS: And if I propagate all kinds of things through only use the 85th, I don't get a mean value? I mean if I truncate my distribution and create a finite interval, I don't get a mean value when I'm done?

DR. PARRY: Nobody's talking about truncating distributions here.

MEMBER POWERS: Then tell me again what an uncertainty interval is. I really do not understand--

DR. PARRY: The second bullet on the slide.

MEMBER POWERS: -- what you mean by an uncertainty.

DR. PARRY: It's what John said, it's whatever you decide to call it. I mean, you could present it as the 5th and 95th percentile, but those are summaries of the overall distribution of the uncertainty. Thus, we mean the uncertainty distribution.

CHAIRMAN APOSTOLAKIS: That's what I thought. I mean why --

MEMBER BLEY: After you're all done with the calculation.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER BLEY: You're not suggesting you

propagate a truncated --

DR. PARRY: No, no, no, no. That's not what we're doing. No.

CHAIRMAN APOSTOLAKIS: Why didn't you say obtaining the mean value in uncertainty distribution of a risk metric? That's really --

MR. LEHNER: Well one reason is because the standard, and we'll get to it in a minute, depending on the category you don't have to -- in some cases you can just estimate. In category 1 you can estimate the uncertainty so you don't have to provide--

CHAIRMAN APOSTOLAKIS: Estimate meaning expert judgment? Because you cannot propagate --

MR. LEHNER: That's correct.

MEMBER STETKAR: But you're not propagating in category 1 --

CHAIRMAN APOSTOLAKIS: So you're just saying I think the mean is ten and the upper percentile is --

MR. LEHNER: In category 1 --

MEMBER STETKAR: That's right.

CHAIRMAN APOSTOLAKIS: That's -- handling uncertainty. I mean in category 2 you have to propagate uncertainty?

MR. LEHNER: Yes. Right. Categories 2 and 3 you have to propagate uncertainty.

CHAIRMAN APOSTOLAKIS: Aren't we really talking about category two here?

MR. LEHNER: Yes. Primarily, I suppose, yes.

CHAIRMAN APOSTOLAKIS: Yes. So let's use the language of category 2.

MR. LEHNER: Okay. Since our guidance is mainly concerned with differentiating between the category and the standard as to how to meet your various categories, that --

CHAIRMAN APOSTOLAKIS: Yes. But this doesn't say category 1. It just says obtain the mean value of uncertainty. So in general --

MEMBER STETKAR: It is a function of capability category.

CHAIRMAN APOSTOLAKIS: Yes. I don't know. Where is category 1 being used now? I understand that it's something we put there, but is anybody really going category 1?

MR. LEHNER: Actually, for MSPI we did determine that which of the requirements should be met capable to category 2 and others could be met capable of category 1.

CHAIRMAN APOSTOLAKIS: Yes, which tells me that category 1 is used very rarely.

MEMBER STETKAR: Well, for design certification there's an interim staff guidance that specifically says category 1 is acceptable for design certification.

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: The design PRAs that I have seen all propagate uncertainty, at least--

MEMBER STETKAR: But that's a pragmatic --

CHAIRMAN APOSTOLAKIS: Right.

MEMBER STETKAR: -- consideration.

CHAIRMAN APOSTOLAKIS: Why should these then need to be driven by a category which is not the primary category? That's my question. Now to try to find cases where category 1 is used, fine, they are. But it seems that the whole effort here is focusing or should be focused on category 2.

DR. PARRY: It's okay if I may comment, John. Because if you look at the -- I think the reason we have uncertainty interval in there because that's the word that's used even in the standard even for capability category 2. Where it talks about the statistical representation of the uncertainty, I don't think any of us thinks it should be anything different than the distribution that case.

CHAIRMAN APOSTOLAKIS: Yes, maybe you don't think about it.

MR. LEHNER: I think it's fair to say that in --

MR. CANAVAN: That's what the guidance says.

MR. LEHNER: -- in delving into this and providing the guidance we -- it was useful to actually, I hesitate to use the word, but interpret the language in the standard. So as Gareth just pointed out, that that interval really means distribution.

MR. CANAVAN: We find ourselves in a unique position I think. The goal and the focus is on a capability category 2.

CHAIRMAN APOSTOLAKIS: Yes.

MR. CANAVAN: Gut we do not know the range of applications that may present themselves. And if we limit ourselves to only capability category 2 and not a comparison, then if the case does arise where we can't perform a propagated uncertainty, then we can't do the application without changing all the guidance.

CHAIRMAN APOSTOLAKIS: On the other hand, you don't --

MR. CANAVAN: So the thought here is to de-emphasize the capability of category 1 at the same time leaving it as a less desirable option.

MEMBER BLEY: George, I was just looking through here. And it's on all three categories.

MS. DROUIN: It is on all three.

MR. CANAVAN: The words are on all three categories.

MEMBER BLEY: Yes. So we might not like it, but it's in the standard.

MS. DROUIN: I mean those are the words that are in the standard. But, you know remember that one of the purpose is we didn't come in at the beginning of the document and say okay we're only going to give you guidance on how to meet capability category 2. We're giving guidance on how to meet the standard, which means we have to address all three capabilities.

Now whether or not somebody ever uses capability category 1, we can't second guess that. But, you know, we cannot not -- it would be a disservice for us to come out with a document that leaves out guidance on part of these standards and part of these requirements that deal with uncertainty.

Now does the standard always use the

appropriate language? No.

CHAIRMAN APOSTOLAKIS: So category 1 uncertainty, the interval comes from where?

MR. LEHNER: I think it's on a case-by-case basis. There is no -- I mean, when we try to provide guidance for it, it was really up to -- it depends on the particular situation. There is no general guidance that you can give.

CHAIRMAN APOSTOLAKIS: Are these their method for getting it?

MR. LEHNER: No.

MS. DROUIN: The standard doesn't provide that kind of guidance. Those kind of requirements.

CHAIRMAN APOSTOLAKIS: On the NUREG? Does the NUREG provide it?

MR. LEHNER: Not from category 1.

MS. DROUIN: As I said, when it comes -- on a lot of this stuff we refer back to the Data Handbook.

CHAIRMAN APOSTOLAKIS: Category 1, as far as I know, it's just a judgment for somebody.

MS. DROUIN: I'm sorry?

CHAIRMAN APOSTOLAKIS: It's a judgment. There are no rigorous methods. You are not required to propagate anything. You are not required to develop to distributions.

MS. DROUIN: That's right.

CHAIRMAN APOSTOLAKIS: So if I do some point calculation, the result is 10. And I'm telling you, I think it can be as high as 15. That's not a method. That doesn't deserve a NUREG.

MS. DROUIN: It's not a whole lot of stuff in the NUREG on this. I mean, the main focus is on category 2, and a lot of the guidance focused on category 2. I'm just saying we just don't go silent.

CHAIRMAN APOSTOLAKIS: Yes, that's what I'm saying, though, it really is category 2 --

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: -- and possibly 3 that we're dealing with.

We can move on. But I mean --

MEMBER BLEY: This is in category 2, this one.

CHAIRMAN APOSTOLAKIS: The problem is that, you know, when we reviewed these volumes it's very hard to look at every single word and raise objections. And then, of course, it comes back a few years later and bites you. In that respect, this should not have been approved for category 2. But what can you do? Now it's done.

MR. LEHNER: I think category 1 does say that you have to provide a basis for your estimate of the uncertainty.

CHAIRMAN APOSTOLAKIS: Yes, and I asked my buddy John and my buddy Bob and we agreed. That's amazing.

Let's go on. You are on slide what?

MS. DROUIN: Eleven.

MR. VANOVER: My name is Don Vanover from ERIN Engineering. And I've been working with EPRI on providing input for this report.

Chapter 2 of the report, and I just wanted to clarify that the latest version is dated August, and hopefully that's the version that got distributed. You had mentioned April in the opening remarks, George.

CHAIRMAN APOSTOLAKIS: That's the one we've got here.

MR. VANOVER: So the key issues that we're trying to address in chapter 2 of the EPRI report are the two supporting requirements that John alluded to, QUA-2B which requires an estimate or a propagation of the mean value and QUE-3 which requires an estimate or a full propagation of the uncertainty interval.

So that's the focus on how to meet the

standard on those two particular issues of our issue.

MS. DROUIN: Don, let me just jump in.

If you're curious to see the actual wording in the NUREG report, on my copy page 38 and 39 and 40 give you the actual wording from the standard. That's if you want to see it.

Sorry.

MR. VANOVER: What we learned in moving forward with our efforts since 2003 time frame there are other supporting requirements in the standard that have reenforced the need to provide mean values and distributions for all the basic events in the PRA models. And most of the utilities have gone through the effort of providing that information, providing the appropriate correlations in their databases. And as you all are aware, all of the current PRA tools support full propagation to determine the mean and the uncertainty interval which includes the state-of-knowledge correlation. So that's the context that we're coming into in today's world in providing the current guidance.

So if we move to the next slide, we've also recognized that some applications can be difficult to propagate the state-of-knowledge correlation, and in particular those applications relying on importance measures. Not all of the software products provide uncertainty intervals on the risk achievement word for Fussell-Vesely in fact very few dp. And there's also applications that require rapid quantification of multiple cases. For example, on line maintenance configurations to meet A4.

So realizing that, what EPRI has developed in chapter 2, and which builds off work that was developed in the technical basis document that EPRI published in 2004 is how to meet the standard and to meet the supporting requirements related to these issues for both the base model and in applications.

So if we move to the next slide, Mary.

Given today's state of affairs the recommended approach for the base model is to just do it.

CHAIRMAN APOSTOLAKIS: That's not the impression I got when I read it.

MR. CANAVAN: I realize that.

CHAIRMAN APOSTOLAKIS: Is that changing now?

MR. CANAVAN: That's the tone we're trying to reflect. So I think the slides will present -

CHAIRMAN APOSTOLAKIS: Don, I'm with you.

MR. VANOVER: I think for the base model

the first guideline clearly says do it.

CHAIRMAN APOSTOLAKIS: Now let me --

MR. CANAVAN: We need to put in the words that's not confusing.

CHAIRMAN APOSTOLAKIS: -- make a comment here on the importance measure of this. If the purpose of dismissing state-of-knowledge correlations is -- the importance measures are not calculated with uncertainty, maybe there is another way around it and not touch the state-of-knowledge correlation. Let's stop calling it -- anyway.

It doesn't bother me if somebody does the importance measures just with mean values assuming independence. The reason why it doesn't bother me is because the utilization of these importance measures is so conservative. For example in 5069 we're saying, you know, anything we draw greater than two should be treated this way. I mean, that's pretty serious. And it's not just that. I mean, we have an expert pattern that looks at these things and are going to always elevate something to the bad more rigorous category.

So that would be another way of saying something about it. That, yes, for importance measures the mean values, et cetera because in the applications we are so conservative in our setting the threshold values and so on, that it really doesn't matter. And there are some studies in the literature where you see that in order to have a very significant, you really have to go all the way to very large distributions. So the combination of the two, it seems to me, is fine and could be mentioned.

In other words, this is another case where the actual risk-informed decision making process tells you that being very rigorous in calculating the uncertainty in RAW is worth it.

Two is such a low value, for heaven's sakes, you know for RAW. And for Fussell-Vesely, it's .005 or something. And then you have an expert panel which -- you can never reduce the significance, but you can always increase it.

MEMBER SHACK: Just remember the conservatism in the success criteria will be an acceptable substitute for uncertainty, George, when we come to discussing ESBWR PRA.

MR. CANAVAN: You recorded him, huh?

CHAIRMAN APOSTOLAKIS: I will remember it. And I remembered it in the past, too, when I made some comments. Didn't I say that I'm convinced?

MEMBER SHACK: No, but then you changed your mind.

CHAIRMAN APOSTOLAKIS: Candidates for President can change their mind, I can change it, too.

Anyway, you understand where I'm coming from in spite of what our Chairman here says.

DR. PARRY: I think actually we're referring -- because there was a study by EPRI that looked at this 5069, right?

MR. CANAVAN: Yes.

DR. PARRY: And came up with the same conclusion that it wasn't a particularly --

CHAIRMAN APOSTOLAKIS: In other words, do not -- the way I see it, maybe it's because you know my perspective's different is do not try to dismiss the correlation in general. In the context of importance measures you say, yes, you don't need to do it. Use mean values. And the reason means that later on we'll use those in an appropriate way. That's what--

MR. CANAVAN: Yes. And again in this bullet, and perhaps it's a matter of tone or phrasing, the thought isn't that we dismiss it. The thought of that is some cases it's difficult to assess. So we need to use alternate methods of finding a surrogate or verifying that surrogate is within a band.

CHAIRMAN APOSTOLAKIS: And that's where

you can give the argument about the utilization.

MR. CANAVAN: Right.

CHAIRMAN APOSTOLAKIS: No. I agree that this is -- so the August version we have reviewed is in flux?

MR. VANOVER: I think if we go back to the guidelines in section 2 in the August version for the base model, which are guidelines 1 and 3, 1A and 3A clearly say the preferred approach to perform the parametric uncertainty analysis in the context of the base model to meet the standard supporting requirements. So if the tone did not come across that way, that's not the intent. We'll take another look at how it's --

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER STETKAR: Yes, I think it's there. It just if you look at the relative volume of --

MR. CANAVAN: Yes. Okay.

MEMBER STETKAR: -- devoted to those two points versus all of the other, it doesn't come across.

MR. CANAVAN: We may need to introduce as the preferred approach is this.

MEMBER STETKAR: Right.

MR. CANAVAN: Oh, by the way, there's a

secondary approach.

MEMBER STETKAR: Large neon flashing lights or something like that.

MR. CANAVAN: We'll try and add the neon lights.

MR. VANOVER: And then the lesser preferred options if for whatever reason you can't do the parametric uncertainty analysis, which should be pretty rare nowadays with the work the utilities have put in to populating and adding the information to the databases, is to perform a detailed comparison to another site or sites to estimate the mean and the uncertainty interval. And that would be a difficult task to try to pull off. But there is -- since the supporting requirement only requires an estimation of the mean in certain intervals for category 2, category 3 requires propagation, then there is still some room for utilities to do this if they would choose to. But I think it would probably be less work to just go ahead and do in the long run.

CHAIRMAN APOSTOLAKIS: I don't remember. Maybe I missed, that you say that it cannot be included in the calculation when we evaluate or calculate importance measures. Did they say that?

MEMBER STETKAR: Yes.

CHAIRMAN APOSTOLAKIS: I thought it said somewhere that in some cases it cannot.

MR. VANOVER: No.

CHAIRMAN APOSTOLAKIS: It was broader than it should be. If I missed it, I missed it.

MR. CANAVAN: It might say in some cases. We would have to look.

CHAIRMAN APOSTOLAKIS: I mean if it's specifically importance measures, it seems to me it's a --

MEMBER STETKAR: I know the NUREG, just spend some time on that. Because --

CHAIRMAN APOSTOLAKIS: No, but I'm talking about the EPRI report.

MEMBER STETKAR: -- the NUREG --

MR. CANAVAN: It doesn't give examples. It just says in some cases it may be difficult. It doesn't elaborate.

CHAIRMAN APOSTOLAKIS: Right.

MR. VANOVER: Okay. Next slide.

MR. CANAVAN: We may want to restrict that.

MEMBER POWERS: Since I'm going to have put up with all the model uncertainty for many, many, I'm going to come back to my parameter uncertainties.

And it says the current PR2 will support full propagation of parametric uncertainties. How do they handle correlations?

MR. VANOVER: The correlations are handled within the reliability databases. So if all the pump failed to start terms came from the dataset, those are correlated when you run the uncertainty analysis through Monte Carlo or similar type propagation. And similar you could correlate any number of events, and that's part of meeting the other supporting requirements is to standard is to ensure that those correlations are accounted for appropriately.

MR. CANAVAN: And it's a 100 percent correlation. In other words, if there are two terms in the element that you're looking at and each one of those terms comes from the dataset, it's sampled one time so it's assumed 100 percent correlation within those terms. So the same dataset is assumed to have--

CHAIRMAN APOSTOLAKIS: Yes, we know that it used correlation coefficients. I mean, it's either 100 percent or independent.

MR. CANAVAN: Yes.

MEMBER STETKAR: There are some software codes that I'm aware of that do indeed allow you to correlate not specific parameter values, but for example if some phenomenon can on happen during the springtime and you have a distribution of the fraction of the year that you're in the springtime, you can indeed correlate things. There is at least one code that I know that will handle that type of correlation so that you can -- for example from other otherwise independent distributions and correlations.

CHAIRMAN APOSTOLAKIS: No. The question is, I mean when I say "correlation --"

MEMBER STETKAR: I think that might be what you --

CHAIRMAN APOSTOLAKIS: -- the bifurcate normal distribution, is anybody using that? I haven't seen it with the correlation coefficient --

MEMBER STETKAR: No, no, no, no. No, it's a different level of correlation.

DR. PARRY: I think you're talking an aleatoric correlation whereas we're talking about epistemic.

CHAIRMAN APOSTOLAKIS: We're talking epistemic, yes.

MEMBER POWERS: These are all Pearson many of the correlations?

CHAIRMAN APOSTOLAKIS: I don't think so. I think it's 100 percent or zero.

MEMBER STETKAR: Typically for the parametric stuff it's 100 percent or zero. They're either fully correlated or fully independent.

CHAIRMAN APOSTOLAKIS: And the truth is probably somewhere in between.

DR. PARRY: Yes, especially after Bayesian. But, yes.

MR. CANAVAN: The limit is 100 percent.

MR. VANOVER: Next slide, Mary.

MS. DROUIN: I just want to make sure. Did we address your concern, Dana, because I'm not sure I understood what your concern was? I mean, I felt like there was. I mean, I felt like there was more to your concern then we got to. Not that I want to delay this, but --

CHAIRMAN APOSTOLAKIS: You just did.

MEMBER BLEY: We may as well do it now.

MS. DROUIN: Well, that was kind of my feeling; pay the piper now or later.

MEMBER POWERS: The heart of my concern is that when people generate under estimate uncertainty in parameter values and narrow the distribution way too much. They're not liberal enough in the breadth of the distributions. And what I also know is that I can control entirely the outcome of a parametric uncertainty analysis if you give me access to the correlation coefficients. I can control it. it doesn't matter -- I can control it.

MR. CANAVAN: You could, but and right now we don't allow that.

MEMBER POWERS: So I'm concerned about correlation. It sounds like you keep a fairly simplistic view of correlation and it's either on or it's off. And so it's less susceptible to abuse that way.

DR. PARRY: Right.

MEMBER POWERS: But it's probably susceptible to under abuse.

DR. PARRY: I think the way you would have to worry about it in this case is in defining which of the sets of parameters would be correlated. Not so much how it's treated because that is pretty extreme.

MEMBER STETKAR: Your example the Bayesian updating, a lot of people make the decision that if I have two pumps in each of two systems and I use only generic data, they're fully correlated. But as soon as I collect any plant specific data I'm justified as treating them as correlated but only within each system, for example. Which is a black and white on/off type switch when in fact depending the strength of the plant specific data there still might be a relatively high correlation.

CHAIRMAN APOSTOLAKIS: What is correlated to the values?

MEMBER STETKAR: But that's essentially what you said is making that decision about when do you split those groups.

CHAIRMAN APOSTOLAKIS: As long as the prior dominate, they're still correlated.

MEMBER STETKAR: That's right.

CHAIRMAN APOSTOLAKIS: Not a 100 percent, but --

MEMBER STETKAR: But that's an analyst judgment.

CHAIRMAN APOSTOLAKIS: Yes. Yes.

DR. PARRY: You can't --

MR. CANAVAN: Well, there's another twist on that which would be are you modeling CCF between that group of four that --

MEMBER STETKAR: But that's a different issue, Ken. That's a completely different issue.

CHAIRMAN APOSTOLAKIS: I can draw, Dana, distributions that are correlated might be used the seismic analysis. And we'll come to that. I mean when you have two components on a certain floor and the whole thing is shaking, now how do you handle that, you know. But that would be aleatory correlation

DR. PARRY: That's right.

MR. CANAVAN: That's 100 percent --

DR. PARRY: Yes, it's true. And it's usually treated as a 100 percent also for most, which is kind of strong.

MR. CANAVAN: Which is kind of strong. Yes, We're trying to work around that, too.

MS. DROUIN: But I think adding discussions to the reports in addressing, you know discussing what the concern is to me is nothing but helpful. And one of my concerns on the document is that while we have an incredible team here, it is written by people who are experts in the field and a lot of the knowledge is not I think getting appropriately enough discussed in the reports so that it doesn't take another expert to understand the report and understand some of these subtleties. So I really welcome these kind of comments because one of my fear is, you know, you want this document to be useable.

CHAIRMAN APOSTOLAKIS: Do you want it --

MS. DROUIN: It has to be useable beyond just the people at this table.

CHAIRMAN APOSTOLAKIS: I think the fundamental issue you're facing is do you want your average PRA practitioner or engineer who is going to use this, first, to understand what the state-of-knowledge correlation is? Do you feel that you have to explain it in a paragraph or two before you go on or not?

MS. DROUIN: Well, that's --

CHAIRMAN APOSTOLAKIS: That's the only example, maybe I was --

MS. DROUIN: -- the balance we're trying to do?

CHAIRMAN APOSTOLAKIS: Yes?

MS. DROUIN: You know, we're not trying to make this long tutorial but try to give some information.

CHAIRMAN APOSTOLAKIS: Right.

MS. DROUIN: The trick is where do you draw that line.

CHAIRMAN APOSTOLAKIS: Yes. Okay.

DR. PARRY: In that case we put that tutorial and then the appendix and then the chapter, right?

CHAIRMAN APOSTOLAKIS: Right.

MR. LEHNER: Right now the state-of-knowledge correlation the tutorial is in the appendix.

CHAIRMAN APOSTOLAKIS: Because as I remember, maybe I'm wrong, you're just jumping into it and you don't explain really what it is, is that correct?

MR. LEHNER: Well, we do --

MR. CANAVAN: It's in the appendix.

MR. LEHNER: Yes, we do one paragraph introduction to it and then refer the reader to an appendix where it's discussed in some detail.

CHAIRMAN APOSTOLAKIS: Where it's explained what it means?

MR. LEHNER: Yes.

MR. CANAVAN: Ken Canavan.

We have a couple of paragraphs of explanation in the current report and the current report refers you back to the technical basis document, which is about 350 some odd pages of everything you ever want to know about uncertainty. So we refer you sort of back to that tutorial.

CHAIRMAN APOSTOLAKIS: Yes. But I think Mary's point is a good one. Because there will be very, very few practitioners who will bother to go find other documents.

MS. DROUIN: Right.

CHAIRMAN APOSTOLAKIS: And then another document, you know, to understand something. It's always nice to have a quick description of what it means. And then if they want to go deeper, that's different.

I think the Data Handbook does a good job of that. The NUREG on data.

MS. DROUIN: Oh, yes.

CHAIRMAN APOSTOLAKIS: Because it gets into various esoteric mathematical and statistical methods but it tells you what we are trying to do with this so you have an idea as an engineer, you know, where you are going.

MS. DROUIN: We're trying to add that kind of stuff to this document.

CHAIRMAN APOSTOLAKIS: Yes. That'll be good. That'll be great.

MS. DROUIN: And I think that, you know, once we get it out on the street and have a workshop and start using it, I think that will provide us some more areas where I think we've just been, in my opinion, a little bit too cryptic.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER BLEY: You'll be happy to note or if you missed that pat of the appendix that right off the bat they refer to a very old paper by some guys Kaplan and Apostolakis.

MEMBER SHACK: Well that's why I figured they were buying George off. They kept referring to him on it.

MEMBER BLEY: He didn't know it's there.

CHAIRMAN APOSTOLAKIS: But my point earlier is exactly that. You read this, it refers you to the EPRI report. You go to the EPRI report, it refers you to the technical document. You go to the technical basis, it refers you to the original paper.

I don't think anybody was going to follow that sequence to go back, so we need some description.

MS. DROUIN: Right. And that's what we're trying to find, that balance.

MR. CANAVAN: It summarizes it.

CHAIRMAN APOSTOLAKIS: But that's a general commentary. I mean, it's not just in this issue.

MS. DROUIN: Yes. One we have among ourselves.

MEMBER SHACK: I will point out in the EPRI document. You use the acronym SOKC once and you use state-of-knowledge everywhere else. I'd either use it more often or I'd get rid of it.

CHAIRMAN APOSTOLAKIS: Oh, let me ask you guys, this is a historic moment. Do you want to call a epistemic relation from now? That's really what it is. Since we're using aleatory epistemic.

MEMBER BLEY: That's the first time I've seen that.

DR. PARRY: We're just using your old terminology from how many years ago? Twenty-seven years ago.

MEMBER SHACK: I'm sorry, 30. Yes, almost 30.

MEMBER BLEY: That's a good suggestion. I didn't even think about that.

CHAIRMAN APOSTOLAKIS: See, they will think about that. I've been -- now for 15 years, not once has the staff said we will do it this way.

MS. DROUIN: And we do think about it.

CHAIRMAN APOSTOLAKIS: I know you do.

DR. PARRY: Giving us advice.

CHAIRMAN APOSTOLAKIS: No, no. You're doing the right thing. You can't make decisions here.

MR. VANOVER: Okay. So I think the guidance in the EPRI --

MS. DROUIN: Are we on slide 14?

MR. VANOVER: We're on slide 14. For base models is fairly straight forward.

For applications, not all applications require the parametric uncertainty analysis we performed. For example risk rankings, as you mentioned, do not require that and they have other conservatisms built into the methods. But for applications that do require mean value estimates, for example Reg. Guide 1.174 type applications, then the EPRI guidance includes some possible options to look at the cutsets and verify that there's no state-of-knowledge correlation present in the relevant cutsets for that application, the relevant cutsets being either the dominate the cutsets that appear. Maybe there's only a few cutsets that are involved in the calculation. Or in the other example there could be lots of cutsets involved in the delta CDF calculation but the need would be to verify that there's no state-of-knowledge correlation in the dominate cutsets in that case.

So those would be the two sort of caveats to work around not having to perform the uncertainty analysis when required for using the mean value.

And then similarly, there's not too many applications, none that I'm aware of, that specifically require the uncertainty interval be included as part of the application. It has been provided in some applications like license renewals and things like that. But I don't think any of the guidelines specifically require the uncertainty intervals to be --

DR. PARRY: Usually the mean values.

MR. VANOVER: As input to the decision makers. But if it is required a similar type guidance is provided that it would require review of cutsets and perhaps refer back to the base model. If it really didn't change much from your base model evaluation, again or do a comparison to other site. Ultimately if it's required, the best way to do it is to perform the full propagation to determine the uncertainty interval.

MEMBER STETKAR: Don, let me ask, and this was something I was looking for in both documents and I didn't see it, so I was curious. You in particular talk an awful lot about examining the relevant cutsets and performing a propagation of the state-of-knowledge correlation through the relevant cutsets.

When I hear the term "relevant cutsets," I immediately think of the cutsets that I can see, the one that survive the model truncation process when the model is solved.

There doesn't seem to be a discussion or significant warning in either document about the fact that not treating the state-of-knowledge correlation when you solve that model will indeed artificially suppress perhaps many, many cutsets below that truncation value. So you don't even have the opportunity to examine them to see where they are relevant.

MEMBER BLEY: They can elevate a whole lot.

MEMBER STETKAR: Oh, they can elevate a whole lot if you've got third or fourth order cutsets. I mean, the EPRI document does have a pretty good figure that shows given the uncertainty range the effect on the mean value.

The NUREG has an example of something that I think came out of an Apostolakis/Kaplan paper a long time ago to show how the mean value of even a second order cutset can change by a factor of like 2½ to 3. It's characterized as very broad uncertainty but in fact the uncertainty distribution that's used for that example only has an error factor of five, which is relatively moderate uncertainty.

The thing that I was missing was this warning to say that perhaps you really need -- if you're sensitive to the state-of-knowledge correlation and its effect on the results or your decision for a particular application, given the fact that you're sensitive to that perhaps you should be more sensitive to examining how that population of cutsets changes as you vary your truncation value.

In other words, if you do the truncation at ten to the minus 12, let's say, you get a certain population. You look at those and you say, ha ha, state-of-knowledge correlation is not an issue because I don't have any cutsets in my set that are susceptible to that. Well perhaps if you dropped it to ten to the minus 13 you might suddenly populate that set of cutsets with several hundred in an extreme case that could be susceptible to it.

And I didn't find that type of warning or that type of sensitivity. If both of these documents are being written for a user and trying to sensitize the user to issues that you need to be aware of -- it's actually something I've run across in the past.

MS. DROUIN: I thought --

MR. LEHNER: There's a mention in the Appendix, the NUREG that talks about --

MEMBER STETKAR: There is. You're right. You're right, John. That's the only place that I found it.

MR. LEHNER: Yes.

MEMBER STETKAR: But it is, and it's only in the Appendix. And it's toward the end of the Appendix, if I remember right.

MR. LEHNER: That's correct.

MEMBER STETKAR: Okay. You're right.

MS. DROUIN: I thought in one version it might have gotten deleted because again we go back and forth of how much information to put in here. But I thought at one time we had a paragraph on that.

MR. LEHNER: We did display it more prominently in a different version, yes.

MEMBER STETKAR: I didn't see it anywhere in the EPRI document.

MR. CANAVAN: Yes. There's an implicit assumption in the EPRI report that if you have a small enough set of cutsets to viewing and manipulating, that you're verifying that they're the right cutsets.

MEMBER STETKAR: Well, but they might be the right cutsets based on the point estimate. You know, everything that you've thought about. But the EPRI document immediately then says okay, now operate within the space of that set of cutsets.

MR. CANAVAN: Right. Yes, there are no

warnings on truncation, which we may want to consider.

MEMBER BLEY: Especially for this because this is a case where it can really matter.

DR. PARRY: Yes. It gets complicated. And I think some of the thing that mitigates against that is that very often you're going to also have the common cause failures in there which --

MEMBER STETKAR: But that's a different issue.

DR. PARRY: No, it's a different issue. But it means, though, that you're going to capture -- but that would be a way, actually, of looking to see whether you should worry about the multiple. Maybe I'm trying to solve a problem here.

MEMBER STETKAR: You're trying to solve a problem.

DR. PARRY: But this is not the right place to do it.

MEMBER STETKAR: I think it's important to keep this issue of common cause failures as a surrogate for worrying about this --

DR. PARRY: No. No. No. That wasn't what I was saying, actually. No. Because we've had that discussion amongst ourselves, and that's not what I was saying.

MEMBER STETKAR: Okay. I was just looking for the warning. I wasn't looking for the how to do it.

DR. PARRY: Yes. Okay. Okay.

MEMBER STETKAR: It's just that the -- and you're right, John --

MS. DROUIN: I know that in one version we had a little bit more. And to make George happy here since he says we'll just go back and think about it, I can say this one we'll do more than think. We will add something.

CHAIRMAN APOSTOLAKIS: Now let me say something about the tone of the document and why I was misled. In your EPRI document section 2.1 -- you don't necessarily have to find it. But 2.1 title is Problem Statement does talk about importance measures and that says usually calculated with point values, which I agree with.

The thing, though, that threw me off was 2.4 where you guys really -- 2.3 and 2.4 where the focus now is in general calculations of CDF and why the state-of-knowledge correlation may not be important. If that in those two sections were focused on the importance measures, then I think that would be a much better exposition of what you're trying to do.

Because that's where you don't want to do it. But to generalize a discussion that in calculating the CDF here are ways to avoid doing it, that I think is more general than you may want to -- because Don already said that the available computer codes do that. They do allow for it. It's a trivial matter to do and calculate the CDF.

So I think in 2.1 you're correctly citing importance measures, but the words "importance measures" disappear in 2.3 and 2.4. And the focus now is the CDF itself, which is not the way I understand it was not your intent.

MR. CANAVAN: Well, again, I think we need to be a little bit careful. Because the importance measures as an example.

CHAIRMAN APOSTOLAKIS: And that's the most important example.

MR. CANAVAN: Yes, that's the biggest.

CHAIRMAN APOSTOLAKIS: The most important example.

MR. CANAVAN: That's one of the largest ones. But, for example, if you're going to assess your testing intervals for 50 or 60 different types of tests and you're going to assess five or six different testing intervals, you might want to work with a series of cutsets rather than core damage. And you might want to work rather just continually doing core damage estimates and blindly going through, you might want to look at the cutsets that have the testing in it to look at their interval changes. And in those cases since you're just looking at the cutsets rather than the manipulation of the whole model, you might not want to get into verifying state-of-knowledge correlation going back to the whole model and trying to propagate that for all the 50 tasks and for all the different testing intervals.

What I'm saying is that this becomes a -- this is a small added step which if repeated many times becomes a relatively large effort.

CHAIRMAN APOSTOLAKIS: But again, you can--

MR. CANAVAN: And it goes back to the point that the importance measures was just an example. There are other cases. And we didn't want to get specific in starting to try and list them out.

CHAIRMAN APOSTOLAKIS: But you can open up this section by saying that there are cases --

MR. CANAVAN: That we can do.

CHAIRMAN APOSTOLAKIS: -- like importance measures, whatever else, where you may not want to do it for such-and-such reason rather than giving a general --

MR. CANAVAN: Yes. It can start with this is the way --

CHAIRMAN APOSTOLAKIS: -- a general approach of how to avoid it.

MR. CANAVAN: Well, I look at the slide, I find it very interesting. Again, we led with the verify it's not relevant, not perform it if required. Oh, by the way, if it's not relevant, you might not have to do.

So I think some of it's in the order that it's presented as well.

CHAIRMAN APOSTOLAKIS: I think that's true, too. But 2.1 does become specific. 2.3 and 2.4 broaden it up, and I think some guidance there as to what they really want to do is --

MR. CANAVAN: Perhaps start them off.

CHAIRMAN APOSTOLAKIS: Yes, I agree that in every single calculation specific thing you probably don't need to. But this is much bigger.

MR. CANAVAN: I think we agree as well. I think maybe these sections should start off with something like it's preferable to do the full propagation, however if you decide that that's not appropriate to the situation, here's --

CHAIRMAN APOSTOLAKIS: It's not just that. I mean for importance measures you really do want to do it.

MR. CANAVAN: Yes.

CHAIRMAN APOSTOLAKIS: John?

MEMBER STETKAR: One thing, I'm glad you brought it up, George, because I've made a couple of notes on the same thing, same area.

I think it's important -- now these documents, this issue of importance is important. Uncertainty is important. You know, today these documents are being written hopefully in 2008, published in 2008.

MR. CANAVAN: Yes. Yes.

MEMBER STETKAR: We should be sensitive, I think, to look forward to what types of risk assessments we're going to be seeing and starting to see now and in the future. And in particular only because we're heavily invested in this now, we're starting to see risk assessments published for new plant designs that rely on much higher degrees of redundancy than we have in our existing plants in the United States. Some four fold, in some cases higher levels of redundancy that also include things like passive equipment failure modes that typically have much larger uncertainties. So we're now facing risk assessments for new plant designs that are coming in that are being reviewed that are in principle highly susceptible on the base CDF now, not application. Base CDF to the particular issues that we're talking about here in the state-of-knowledge correlation. And that is larger redundancies than we're typically used to seeing in PRAs for existing plants in the United States that perhaps have two or three levels of redundancy and equipment failure modes that may indeed be quite uncertain. You might see those very large uncertainty distributions.

And I think that both documents should be careful to keep that forward thinking in mind. These documents aren't being written as guidance for treatment of uncertainty looking at only today's applications for today's PRAs of plants that were built 30 years ago in the United States. People are going to pick these up and they're going to use them as guidance for how do I treat uncertainty on my PRA today for -- and I'm not going to mention a particular design, but my new design that I'm going to be developing and marketing in the United States in the next decade.

CHAIRMAN APOSTOLAKIS: That's an excellent point.

MR. CANAVAN: Yes.

CHAIRMAN APOSTOLAKIS: And I, in fact, am glad you brought it up.

I was thinking, and maybe on second thought -- I was thinking about something drastic to put in the title of the documents for LWRs, or current generation or something. Because if I can push the argument a little further, John mentioned SBWR and so on. People are going to use it also in studies they will be making for sodium cooled reactors, you know. And some of the stuff you say here doesn't apply there.

For example, in your report you seem to be pretty happy with the thermal-hydraulic codes. Now you try to use RELAP-5 with sodium, you've had more than uncertainties that are -- you know, with water it's different.

So I fully agree with John, but we need to say something about it that some of the observations are specific to LWRs, maybe a current generation LWRs, they don't even go to three plus which has the passive systems.

Somehow you have to make that clear.

Because this is the only document from an official agency and organization.

MS. DROUIN: I thought that, and I'll have to be honest, chapter 1 has not been revised in the version that you have. And what I mean by that is section 1.2 objectives and scope. It is on our plate to fix that section and it was to get into these kinds of issues. Because, you know, if you go back historically when we started this document, which was a couple of years ago, the focus really was on current operating plant. And the whole thing that we laid out in the program was for that.

MEMBER STETKAR: Right. Had this been published in 2005 or '06, that would have been fine.

MS. DROUIN: Yes.

MEMBER STETKAR: But recognize that it --

MS. DROUIN: And when we did publish it for draft and public comment, we got so many comments. And time has overtaken us.

CHAIRMAN APOSTOLAKIS: There is no reason to apologize.

MEMBER BLEY: And there are two ways to go. One is to limit it and the other is to make a few changes to address where you need to think harder if you're looking at new ones. And I would much prefer that. Because whatever we say, this is what people are going to use. They're already using the old standard for the new plants because they don't have anything else. So I don't think it takes that much to be --

MEMBER STETKAR: I don't think it does either.

MEMBER BLEY: -- to point out where you need to be careful and where maybe some comments are specific to current LWRs. I'd just like to see it broaden just a little bit.

MS. DROUIN: Well, I don't know that I agree with you on that.

MEMBER BLEY: Think about it.

MS. DROUIN: We will think about it.

MEMBER BLEY: Good.

MS. DROUIN: But I want to give you some of my early thinking right now. You know, sometimes we think these things aren't so simple. You know, we go through and then we just put a little thing here and little thing there; that takes care of it. And then what happens it turns around and comes in and causes a lot of problems. Because really to do, you have to do it right. Because if you just do it -- and I know this is not what you mean and so I'm not putting these words in your mouth. But, you know, that's almost kind of a sloppy way to try and just find those few places where you really systematically have to go through the document. And that's not as easy as it sounds.

MEMBER BLEY: understand the concern. But I think there are places even for current reactors, some of the cases we've talked about where that kind of language needs to be included, some caveats and warnings. Given you're doing that, just think about how much it would take. Because I think it could be generalized. But look.

MS. DROUIN: Yes.

MEMBER BLEY: I understand the concern.

MS. DROUIN: And, you know, we recognize that we want to get this document out there and being used. I would much prefer to bring in the new reactor people and maybe some of the advanced reactor people to have them also do a thorough scrubbing and keep that as something to do in the next revision. But we certainly have to do something right now.

CHAIRMAN APOSTOLAKIS: And that's the suggestion, that you have to do something. Now you guys think about what's the best way.

DR. PARRY: I think, John, getting back to your issue on the truncation issue John and Mary are right. It was in an earlier version. I think the reason we took it out primarily was that we felt that for at least the current generation of LWRs it typically was not that much of a problem because of the way that the truncation was done if you do the truncation right.

MEMBER STETKAR: Yes, maybe, perhaps.

DR. PARRY: I mean we may be wrong, but that was our most --

MEMBER STETKAR: That may be true. And I tend to think more in the context of some of the larger redundancy plants that I'm familiar with.

DR. PARRY: Okay. Yes.

MEMBER STETKAR: And which extends into the new plant designs that we're looking at.

DR. PARRY: The Swiss ones, for example?

MEMBER STETKAR: A Swiss one for examples comes into mind. But, you know, the EPR is subject to the same thing, the ESBWR, the four train redundancy and the safety systems.

DR. PARRY: Yes.

MEMBER STETKAR: And, you know, you're starting to see much higher levels of redundancy. So I start to think of cutsets that are four fold redundancy and multiplied by other things. That's kind of the context that I think these days and worry about what might be suppressed on that. We've beat that issue too hard.

CHAIRMAN APOSTOLAKIS: Yes, but since we're talking about high level issues before we break for lunch, two comments. Yes, it's 11;30, I think that's what it says here.

I don't think you have addressed the issue of uncertainty when it comes to external events. You seem to be focusing on internal events only.

For example, the issue of hold uncertainty. You know, if I use a particular -- I mean a fire analysis, for example, we have this major project with NIST. I think it's still there. Where they evaluate how good is this code to calculate the thermal environment in a compartment, and so on. In seismic analysis there are serious model uncertainties, or at least there used to be. Now I don't know where they are.

I think you're really focusing only on the internal events.

MS. DROUIN: That's an absolute true statement.

CHAIRMAN APOSTOLAKIS: So we have to put that somewhere then that this is really what you're doing. And I don't know, again, if it's going to be in section 2 or in the title, or somewhere to alert people that when they're doing a fire analysis and they have uncertainties, this document is not going to -- and the EPRI document, too, is focusing on the internal events.

MS. DROUIN: The process -- let me try and address it. But the process is independent on the scope of the PRA that you're going to follow now. When you are concerned with what are the particular sources of model uncertainty, we have focused on level one internal events. Internal fire and seismic is not there.

CHAIRMAN APOSTOLAKIS: But the issue of model uncertainty when I'm using a computer code you are not really addressing. And that is important when I go to external events. A computer code that calculates a thermal environment in a compartment.

DR. PARRY: Well in principle --

CHAIRMAN APOSTOLAKIS: We have a peak project with NIST. I mean, we had a presentation a couple of years ago where, you know, this code does a good job calculating the flux, but this other code does a better job calculating something else.

DR. PARRY: But in terms of providing the specific examples, no we haven't. But I think the general considerations, particularly in the treatment of model uncertainty could cover that.

CHAIRMAN APOSTOLAKIS: At some high level.

DR. PARRY: Well, at a high level and details.

MEMBER SHACK: Just look at your definitions. You have no model uncertainty if you're using your consensus model.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER SHACK: And if you have a reasonable alternative assumption as one with as least as good as the data of the assumption being made. Well if you pick the model with the best technical basis, there's nothing else with at least as good so you have no model uncertainty. Bingo. I'm done.

DR. PARRY: Those were taken from the standard, I believe, and that's --

CHAIRMAN APOSTOLAKIS: I think it's something that you ought to think about.

MS. DROUIN: But we wrote that, so --

MEMBER SHACK: I know. That flavor certainly comes through that if I have a consensus model, I'm golden.

DR. PARRY: No. And that was specifically our intent that if we have a consensus model, then we take that as an issue off the table because that's the one that we've agreed to use for these types of applications. That was --

MEMBER SHACK: And I can understand that in the context of a certain context of one kind of discussion of model uncertainty. But it's certainly not a complete discussion of model uncertainty.

MEMBER STETKAR: The area that I stumbled over, and I don't particularly care whether it's fire codes or thermal hydraulic codes or seismic codes because I understand codes anyway. But for example in the EPRI document where you have the tabulations, I think you generally conclude -- and I looked for the area of thermal hydraulic codes because I've seen wildly different answers depending on whose codes you use. And since I don't understand them, I can't tell which is better or worse.

The general flavor in that area seems to be well the standard tells you to use a code that's really good. And because the standard says use a good that's really good, the issue of uncertainties and thermal hydraulics code isn't an issue. I mean, that type of circular logic seems to come through.

I don't want to pull out pros and poetry, but it seems to come through that says well the standard says use something that's really good, and we're going to rely the standard to make sure that what you used is really good, and therefore it's not an issue.

MR. CANAVAN: Thermal hydraulics, basically all you need to do is MAAP, it'll be fine.

MEMBER STETKAR: Right. But I mean, see that type or sensitivity them extends into the things George was talking about. Because by implication if the standard says use something that's really good, you said I used something that's really good, therefore there is no uncertainty in the area --

MR. CANAVAN: I think we're crossing a line. If you look at the MAAP thermal hydraulic applications guide, that will steer you to a number of sensitivity cases that you should do when you apply MAAP.

So I'm thinking that that -- and then if those change your real success criteria model, if those sensitivity cases turn out to be important, then MAAP will tell you, well you know consider what case you need to use in the model. So I think it transitions from a model uncertainty to -- well, I think it becomes a model uncertainty driven by MAAP, not by --

MEMBER STETKAR: If MAAP is appropriate for that particular application.

MR. CANAVAN: Yes, if you use it. But I think there are other codes that have the same --

DR. PARRY: But that's what the standard says. It says use a code that's appropriate for the application.

CHAIRMAN APOSTOLAKIS: I'm sorry?

DR. PARRY: I was saying that what the standard says is that use the code within the region of applicability. That's the statement that it makes.

MR. CANAVAN: Right.

CHAIRMAN APOSTOLAKIS: I think that as an ASME standard on internal events, it would be fine to have a NUREG under ASME uncertainties with respect to that standard. There are ANS standards on external events I can see us having another NUREG that deals with those uncertainties citing this one as appropriate. But right now I think it's appropriate for you to stay that you're really focusing on level one -- I mean on internal event PRA. Even what you say -- that a lot of the stuff you say have both applicability --

MS. DROUIN: That's an absolutely true

statement, George. You're absolutely correct.

CHAIRMAN APOSTOLAKIS: What?

MS. DROUIN: You are absolutely correct.

CHAIRMAN APOSTOLAKIS: Oh, okay. So as long as you put some caveat somewhere there --

MS. DROUIN: And I go back to, you know, some of the things that John Monninger said at the morning is that, you know, we do view this document as a living document. We view it as a living because, you know when we first started this we had level one standard. And that really was our focus.

CHAIRMAN APOSTOLAKIS: Fine.

MS. DROUIN: That was our focus. Now, we did try at a very high level put the process in place that would be independent of the scope, and we think we had succeeded there. But now when you get into the details, the details are focused on level one. And it is totally our intent to keep this document updated as more and more of the standards come out.

CHAIRMAN APOSTOLAKIS: Okay. So maybe at this point even in the title you can put internal events.

DR. PARRY: Except -- except I bring you back to --

MS. DROUIN: Well, I wouldn't change the

title, but I would explain it in chapter one --

CHAIRMAN APOSTOLAKIS: Somewhere prominent. Somewhere prominent.

MS. DROUIN: -- with the scope and all of that.

CHAIRMAN APOSTOLAKIS: Go ahead.

DR. PARRY: Except I would point out the fact that in chapter 7 of our document we specifically talk about the combination of different hazard groups.

CHAIRMAN APOSTOLAKIS: I remember that. Yes.

DR. PARRY: And the reason we did that was because that has been a major topic of conversation.

CHAIRMAN APOSTOLAKIS: And that's fine. That's fine.

DR. PARRY: But that does address the other things.

CHAIRMAN APOSTOLAKIS: It addresses them in a specific way.

DR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: But I mean in the seismic, you remember there was paralysis for ten or twelve years due to model uncertainty on propagation of the wave in the ground.

DR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: I mean, that's a pretty serious type, which brings me to another thing that you are not aware. You completely -- you are silent on the NUREG-1150 severe accident handling using experts, assigning weights to different models and all that. I mean, that's an extreme case, I agree, and a very expensive to do, but shouldn't it be mentioned someplace that in very serious situations unless internal event PRAs you don't see anyplace where this can be used. But for example going back to the EPRI -- very good appendixes, by the way, A, B and whatever. They talk about the frequency of LOCA. Nothing on the work that the NRC has done the last three years with expert opinions to get the frequency LOCA and all that stuff. Zero.

I think this is an extreme case and a very serious problem or issue we do consult with expert, we elicit their opinions and it should be presented as an extreme case, but it should be stated someplace that that's another way of handling with.

When all else fails, in other words, you are going to experts. I think it should be somewhere.

MS. DROUIN: This is a topic that we have gone back and forth on whether to put that in the document or not. Our fear of putting it in the document that we were going to open up Pandora's box, in essence. You know start bringing in expert judgments and expert panels and just have a mention of it --

CHAIRMAN APOSTOLAKIS: But it is being done.

MS. DROUIN: We didn't disagree that it's not being done. It's just whether given the time and scope and resources was that something -- you know, could we really attack that -- address that. That wasn't a Freudian statement.

CHAIRMAN APOSTOLAKIS: No. I'm not asking you to actually give the procedures for doing it. But at least mention it.

MEMBER BLEY: It's nowhere else in your chapter 1 that you're talking about redoing as far as the scope and what's happening. Because it is an integral part of the issue that we're talking about.

MS. DROUIN: Yes, and chapter 1 has to be fixed.

MEMBER BLEY: So it could be addressed there.

CHAIRMAN APOSTOLAKIS: What would be?

MR. VANOVER: What we had in Appendix A of the EPRI report was a shot of what different approaches people use, and we clearly say it's not exhaustive. We didn't want to make it a big research project to make it all inclusive, list every possible reference.

CHAIRMAN APOSTOLAKIS: This is a method that was used 20 years ago. It not something that developed last week. Twenty years ago, it is being used by this agency where appropriate, the last one being the frequency of LOCAs.

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: So the ATHEANA people have used it. I don't think you should be completely silent.

Now how you handle it, it's up to you. Just mention it. Just say it's a limitation that you don't address it, or whatever. But somehow it has to be there. I think these are high level comments. The issue of passive systems, the issue of external events, the issue of expert judgment: I think these are glaring omissions in my view.

DR. PARRY: I think you're bringing up a lot of different issues, though.

CHAIRMAN APOSTOLAKIS: Three issues that are very important.

DR. PARRY: I know. But the use of expert judgment on an expert elicitation from them, you can use that in the narrow ATHEANA sense of coming up with a human error probability for a single human failure event, that's one aspect. And I think in a sense we have mentioned I think somewhere that you could use expert judgment to provide these distributions. That's the easy case.

I think when you bring up the NUREG-1150 case where they have these spaghetti graphs on consequences and things, that is -- I mean, I think that's still a fairly controversial exercise in terms of how you interpret those results. So --

CHAIRMAN APOSTOLAKIS: But we did use it recently for a lot of frequencies. We did use it.

DR. PARRY: Well, but no that's again, that's focused on the specific parameter. I'm talking about the whole consequence, the whole severe and accident analysis, the level two part of it. That was way more difficult.

CHAIRMAN APOSTOLAKIS: If you have serious model uncertainty where all the sensitivity studies EPRI is proposing fail in the sense that they don't lead to consensus, they don't lead to a definitive conclusion, the standard approach is to go to expert judgment and then the regulators will use the results in an appropriate way, as we found out with the LOCA frequencies where, you know it was 8½ inches and they said no it's 12. So it's again managing risk that is important.

All I'm saying is that this an approach that has been used extensively in important matters by this agency. And I just don't see how the NUREG can be completely silent. Mention it someplace.

You want to say we don't get into the details, this approach applies when it's a very important issue of great significance and this NUREG is not addressing those; that's perfectly legitimate in my mind. I mean you don't have to -- I mean if it's so important, then NRC and EPRI probably will establish a separate project.

DR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: But say something.

MS. DROUIN: I agree with you, George. I think we need to make it very clear in the document what this document is covering and what it is not covering.

CHAIRMAN APOSTOLAKIS: Okay. Is anybody--

MS. DROUIN: Abundantly clear.

CHAIRMAN APOSTOLAKIS: IS anybody objecting to having lunch right now? John, you were the presenter -- oh no, I'm sorry, Don.

MR. VANOVER: No, that was the last slide for me.

CHAIRMAN APOSTOLAKIS: Okay. If it's the last slide, we'll be back at 12:45.

(Whereupon, at 11:45 a.m. the meeting was adjourned, to reconvene at 12:47 p.m. this same day.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

12:47 p.m.

CHAIRMAN APOSTOLAKIS: Okay. Let's start again.

Slide 14 or 15.

MS. DROUIN: Fifteen.

CHAIRMAN APOSTOLAKIS: Okay.

MS. DROUIN: We're now going to get into the part of the work between NRC and EPRI that deals with the model uncertainties. This is where you're now going to start seeing a lot more that gets into the decision making and much more guidance because the standard does not tell you a lot of the hows here. It's only telling you to identify and characterize, which is the right thing to do. Because when you try and do more, and there was a lot of discussion with this in the standard. And we first tried to clarify this with the standards when we sent out our clarification in a *Federal Register* notice last year was to explain that when you try and do more, it has to be in the context of an application. You can't do anything more on the base PRA than identify and characterize. To do more it has to be within the context of the application.

So both the NRC and the EPRI provide the supporting guidance for the identification characterization but then it expands on that to go into how to use in the decision making.

So based on that lead-in, Tim who was our lead in this part of the work, will start.

MR. WHEELER: Okay. As Mary said, for this part of the NUREG the high level objective is to provide guidance on understanding and finding concepts of key forces of uncertainty. And then to provide guidance for a process to identify those key sources of uncertainty.

The focus of the NRC here is to provide guidance on the qualitative and quantitative processes for identifying those key sources, whereas EPRI's focus was more on what I call the building blocks or the starting point and it's identifying and characterizing the actual sources of model uncertainty from the PRA.

So, as I said, we see that EPRI is providing the building blocks of our starting point.

Next slide.

So some of the significant points to be made here, and this is where EPRI is providing a lot of the effort, the generic and plant specific sources of uncertainty have to be evaluated. When one is making an application for a decision, those sources of uncertainty that exist in the base PRA must be evaluated as to their relevancy for the application process.

The relevant sources of uncertainty then once it is decided what the sources of uncertainty are relevant to your application, the determination must be made are they key or not. And we provide guidance on two different approaches. One is a conservative assessment approach, the other one realistic assessment or realistic sensitivity approach.

The nice feature about conservative assessment is it does not necessarily tell you if a source of uncertainty is key, but it can tell you what is not key. The process through an conservative assessment if it gives you a result that suggests that a uncertainty issue could be key, one has to go and perform a realistic sensitivity analysis to make the ultimate determination as to whether or not it's a key uncertainty or not.

MEMBER STETKAR: Tim?

MR. WHEELER: Yes.

MEMBER STETKAR: Back up to the first bullet, the big bullet.

MR. WHEELER: Here. Okay.

MEMBER STETKAR: When you say you're going to use the EPRI guidance to identify those sources of uncertainty in particular, and I had a little bit of trouble working through the NUREG on this, is it correct to interpret the guidance, the collective guidance to say that if I now as an analyst want to use this guidance, I only need to look at EPRI tables A1, A2 and A3? Because table A4 has completely dispositioned any source of uncertainty. Is that a correct interpretation from both sides now I guess I'm asking, but in particular from the NUREGs?

MR. WHEELER: That's how I personally see it. What I did see is I think the analyst always has the option, and indeed the responsibility, to try to satisfy themselves that every possible modeling concern issue that could be brought to bear on the base PRA and the application at hand has been identified.

MEMBER STETKAR: Yes. I didn't -- I struggled quite a bit reading it because up front the NUREG says a lot of that but as you get more and more focused at the details, you start to talk about look at EPRI table A1, look at EPRI table A2. And I couldn't find ever any reference in particular to table A4. And table A4 in the EPRI report, my interpretation anyway of the EPRI report, was here is a large laundry list of potential issues that have been examined but have been determined to be unimportant.

And I'm honestly asking because I'm a bit concerned about how people will use those EPRI tables as a way of ticking off boxes in a sense that I don't need to look at anything in table A4 because the NUREG has not mentioned it as a reference and EPRI seems to treat it as we've taken care of these issues.

DR. PARRY: I think the way to look at it is, and we struggled a lot with this, both things, is that we were trying to focus on those things which we felt were true model uncertainties in the sense that they related to not sure how to model things as opposed to things that were related to more level of detail which could be picked up by a peer reviewer and could in fact be addressed by making a more detailed model. Those things tend generally to make the model more -- in most cases, you would expect them to make the model more conservative. So they introduce biases, really. Okay?

MEMBER STETKAR: We'll talk about.

DR. PARRY: I mean you can argue about that. But I mean that's the general intent. But the idea is that the level of detail issues should be resolved by understanding what you need to perform the application.

MEMBER STETKAR: Right.

DR. PARRY: Okay. So what we were trying to focus on was the specific things where we really didn't know how to model things. And that's what you'll find in tables A1 to A3.

MEMBER STETKAR: In general that's true, Gareth. The only thing when I was going through the EPRI table, I read the EPRI document first and when I was going through those tables trying to understand what they were trying to tell me as a practitioner, I made a laundry list of things to see.

For example, in my opinion there are substantial modeling uncertainties with the treatment of ATWS events --

DR. PARRY: Yes. Yes.

MEMBER STETKAR: -- as a category of things. Now table A4 dissects ATWS in various ways to say that the treatment of this is a level of detail, the treatment of this is a level of detail and essentially all of ATWS is removed through table A4. There is never any mention of ATWS as a source of modeling uncertainty in table A1, A2. I think A3 --

DR. PARRY: A3, there is --

MEMBER STETKAR: But that's when the context of specific applications, not as a base PRA source of modeling uncertainty. And ATWS certainly can be a source of uncertainty in your base PRA results. Perhaps not in current PRAs for current operating plants.

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: John, which part is the primary modeling concept? Which part of ATWS, the analysis, is --

MEMBER STETKAR: The thermal hydraulic progression of ATWS events, the definition of core damage criteria for ATWS.

MR. CANAVAN: Definition of ATWS.

MEMBER STETKAR: Definition of ATWS -- well, I mean that is what is an ATWS. I mean, those are model uncertainty issues not success criteria basically type stuff.

MR. CANAVAN: Yes, right. Modeling 100 percent ATWS.

MS. DROUIN: Well I think it's a mixture. You make an assumption what you define by that. And depending on the assumption, well then --

MEMBER STETKAR: I just took ATWS as an

example because it's kind of crosscutting sort of issue --

MS. DROUIN: Right.

MEMBER STETKAR: -- that I found disposition in. And the only reason I mention this is what Tim said, is what I was hoping to hear as a focus. That you don't want to just categorically remove all potential sources of modeling uncertainties from any examination. My concern was would an actual practitioner using both documents together immediately draw the conclusion that I do not need to even think about anything that's listed in EPRI table A4 because everyone agrees that this is not a potential source of modeling uncertainty. That this laundry list is not important.

And I agree, Gareth. Many, many of those items in A4 are level of detail issues rather than true modeling uncertainty issues in the context that we're talking about here.

MS. DROUIN: Well, those tables in the EPRI are supposed to be a generic list, which is an important point. Because the analyst is still required on a plant-specific and application basis to go beyond that table.

MEMBER STETKAR: Well, I'm interested,

though, to understand how -- I'd like to hear it. Because I hear that, and that's good. I think that's the way I was hoping that those tables would be used as a generic laundry list.

MS. DROUIN: Now if you aren't finding those words, then that's our fault. Because those words should be there.

MEMBER STETKAR: I wasn't finding that, and I was finding references to specific tables in the EPRI document, in particular A1 and A2 which were the more focused. And in the EPRI document I was reading things that essentially said as a practitioner should care about tables A1, A2 and A3 and, oh by the way, we also looked at this other laundry list of things, here it is, A4. But you don't need to worry about that. That was kind of my interpretation of that. That might not be a fair interpretation, but it's what I came away with.

MR. VANOVER: If I may? The context -- there's two purposes of the EPRI report. The first purpose is to meet the standard for the base PRA model and the disposition of what's in A4 was these are agreed that we don't really have to identify and characterize all of these issues to say we meet the standard from the context of the base model.

If we get into an application, if there's any application specific contributors, they would come into the process when we get into the context of making a decision.

MEMBER STETKAR: The A4 ones would?

MR. VANOVER: But they could. Many of them may still be excluded.

MEMBER STETKAR: Okay. I didn't come away with that somehow. Perhaps I didn't read it carefully enough because I was very, very confused about how I should interpret A4 in either of those cases.

MR. VANOVER: Yes.

MEMBER STETKAR: And I got more confused because in the NUREG I saw absolutely no mention of A4 but specific mentions of the other tables. So I started to become somewhat concerned that list of things on A4, many of which are not candidate modeling uncertainty things. But there were a few in there, and I made some notes, that could be both --

MR. VANOVER: Well, the list is purposefully added to the EPRI report and maintained out of versions of the report for exactly what you mention. Because the list is generic and it's there for you to reference when you do your plant-specific or application-specific check that you go back and forth and say, yes okay it's on the list. Do I need to consider? No. Do I have anything that should be added to the list:?

MEMBER STETKAR: That's good except for the fact that there are four lists.

MR. VANOVER: Yes.

MEMBER STETKAR: And in practice people tend to look at lists and say which one of these lists is someone telling me, the experts, that I need to be concerned about. And if everyone's telling me that I need to be concerned about lists number 1, 2 and 3 and again I might not be coming away with the correct impression. But if I can interpret something as saying I don't need to be concerned about list 4, people will not be concerned about list 4 even though it might be a wonderful list.

MS. DROUIN: That might be --

MEMBER STETKAR: And I think it is. By the way, I think those lists are great. Somebody put an awful lot of work into not only identifying the issues, but also --

MR. CANAVAN: There's a summary characterizing.

MEMBER STETKAR: -- providing some guidance about how people have thought about them in the past. They're great. They're a wonderful reference.

CHAIRMAN APOSTOLAKIS: Did you have anybody review those outside your group?

MR. VANOVER: The lists starts from what was in the technical basis documents in the 2004 report.

MR. CANAVAN: And there were 20 participants -- approximately 20 participants in the development of the basis document. It's pretty broad. So, yes, a lot of people --

MEMBER STETKAR: No, I thought the lists are -- I mean you know you can always think of other things.

MR. CANAVAN: Well, a lot of people had input.

MEMBER STETKAR: But as a --

MR. VANOVER: My thought was that what's in table A4 we can exclude to meet the standard for our base model.

MS. DROUIN: For our base model. That's right.

MR. VANOVER: So when I put my model uncertainty appendix together for my summary notebook, I don't have to worry about what's in A4. I can just identify and characterize what's the first couple of tables.

MEMBER STETKAR: But I didn't come away, and maybe I didn't read or think about it carefully enough, I didn't come away for particular applications. That came across pretty clear on the base model.

MR. VANOVER: Okay.

MEMBER STETKAR: There might be differences of opinion about that, but it came across pretty clearly.

When you started talking about applications, I didn't across with the impression that says go look at A4. Because the applications seemed to focus on -- and I always get A2 and A3 mixed up. But one or the other of those it says you can application-specific and plant-specific and it's really clear that it says you need to think about your application and your plant and think that there might be additional things. But people are never brought back to that.

MR. VANOVER: I agree, we didn't reference A4. And we didn't want people to have to go through everything in A4 for every application. But when you identify the application-specific contributors, it's possible that some of those things could come up.

MEMBER STETKAR: Well, it is and it's a great reference, though. So it seemed like it would be worthwhile to at least mention that people ought to do that --

MR. VANOVER: We didn't want to force people to have to address everyone of those issues for every application.

MEMBER BLEY: I think, though, if you just go back and look at the old human reliability handbook the Swain book, you get an example of how people don't use available information. They go to just what they think they have to go and pick things out.

MS. DROUIN: Let me try and clarify.

MEMBER BLEY: Yes. Exactly.

MS. DROUIN: We didn't want them to have to go back. We didn't want them to have to go back and go each one by each one by each one and document and write up why it wasn't. We weren't trying to do that. And in maybe not trying to do that, then the other flavor which we weren't trying to get rid, got lost.

MEMBER STETKAR: That's the problem of I think putting things into this discrete black and white tabulated lists of things.

MS. DROUIN: Yes.

MEMBER STETKAR: Because there's some gray areas between there that might be worthwhile.

MS. DROUIN: Because they are supposed to go back and on an application go beyond the generic table, you know, for things that could be applicable to their plant. And there might be some things on A4 that would rise up that we didn't want them to have to go through and just systematically go through that.

MEMBER STETKAR: I understand that in terms of the criteria.

MR. VANOVER: Yes, and from a hierarchy perspective what's in A1 and A2 are generically applicable. Everybody needs to address them to meet the SRs for their base model. A3 are the first ones to look at in an application because they're the more likely ones to contribute in specific applications. And then the lowest order would be what's left in A4 that's not in one of the three table, which may come up in the context of an application.

MS. DROUIN: But it's a comment. We will address it.

MEMBER STETKAR: The only caution is just to make sure that -- and don't interpret it as a fact that okay here's a nice list of things, and I do not need to look at this list.

DR. PARRY: Yes. And I think what Don is saying that when Tim gets to the figure that talks about identifying the sources of uncertainty that are relevant to the application, there is a box in there that says "modifications to the base PRA to support the application." That's another area where you could look in more detail.

MEMBER STETKAR: Oh, there are hooks. It's the --

DR. PARRY: Yes, okay.

MS. DROUIN: Let's not jump ahead. You want to go.

MEMBER STETKAR: Keep going.

MR. WHEELER: Okay. Next slide.

So we've outlined this process as a three step process.

Step 1 as we've already discussed, we are working closely and leveraging strongly with the EPRI work. But that's specifically. But conceptually the important point in step 1 and it's as directed from the standard is you need to understand your base PRA. You need to have identified -- not just identified your sources of the model uncertainty, but you also should have characterized those so that you understand the nature of how those sources of model uncertainty impact your base PRA.

And out of step 1 you have a set of candidate or a set of model uncertainty related assumptions, all of which that are potential candidates for the application.

In step 2 you are looking at the application and understanding the context needed for the decision. And from that you are identifying those sources of model uncertainty that are relevant and must be dealt with within the context of the decision of the application.

And then that subset, if you will, of model uncertainties and related assumptions is then analyzed to come away with a final determination of which ones rise to the level of key sources of uncertainty meaning that they could actually impact the decision by the decision maker regarding the application.

The next slide.

This side you'll see again when EPRI also does their analysis, because again this is parallel and consistent with what I called step 1 and reflects their effort to identify both generically a set of uncertainty issues which are shown in Appendix A1 and A2 of their document. But also reenforces the requirements of the standard where the analyst has to be familiar with their base PRA and identify and characterize all the various sources of uncertainty associated with their base PRA. And then from that we see we have a list of model uncertainties and related assumptions that have been characterized so that the analyst is aware of not only what the issues are, but how they impact their model.

Next.

MEMBER BLEY: This --

MR. WHEELER: Yes?

MEMBER BLEY: This suggests a question to me I hadn't thought of before, more it's more into industry.

MR. WHEELER: Do you need to go back on the slide?

MEMBER BLEY: No. You don't need it.

MR. WHEELER: Okay.

MEMBER BLEY: Earlier Mary told us how NRC is kind of cross correlating references to 1855 and all the other guidance documents that are related to it. IS the industry doing something similar to incorporate the ideas here into the PRA review process and that sort of thing, other kinds of guidance that's available through the industry?

MR. CANAVAN: Yes. What happens is the PRA Scope and Quality Committee has in total now includes almost the entire nuclear industry. We're missing one or two members. They get the information anyway, the same way you get it, it's public.

As part of the peer review process there is no formal way to put this -- we don't formally put this into the peer review process but what will happen is this will become the document that people reference in their peer review. I do it in accordance with 1855 and EPRI 1015737. And this is my analysis for you to review as a peer review group.

And so this will become by default, since it's the only thing available, referenceable when it comes out. It will become by default the methodology that's used by the industry in total. But there is no official formal way to make people use this more. We basically just --

MEMBER BLEY: Or point of --

MR. CANAVAN: Well, since they're all members and since they all get a tutorial on it, and since they all get the product and this is the only product they tend to gravitate to it.

MEMBER BLEY: Okay.

MR. CANAVAN: And there is a workshop

planned as well.

MS. DROUIN: Right. I was going to say, you know, EPRI hosts and NEI hosts these forums and then we are planning a workshop. And, you know, those are major vehicles for getting this out.

MR. CANAVAN: Yes. This is the centerpiece of the PRA Scope and Quality workshop happening in early '09 is this document and how to start using it.

MEMBER BLEY: Okay. Great.

MR. CANAVAN: And this will be the people who are there.

CHAIRMAN APOSTOLAKIS: Have we settled what is a consensus model? When do we reach the point where we say this is a consensus model?

MS. DROUIN: Well, at the last Committee meeting you all liked it.

CHAIRMAN APOSTOLAKIS: It's what? I'm sorry.

DR. PARRY: We have a definition there, which is in the document. We'll have to find it.

CHAIRMAN APOSTOLAKIS: Yes. There is one. Yes.

MS. DROUIN: And I do have it --

CHAIRMAN APOSTOLAKIS: Which document now? We're talking about the EPRI or --

MR. CANAVAN: NUREG.

DR. PARRY: It's in both documents.

MS. DROUIN: Both documents.

CHAIRMAN APOSTOLAKIS: Okay. Let's find the consensus.

MS. DROUIN: It'll be in chapter 5.

CHAIRMAN APOSTOLAKIS: Okay.

MR. CANAVAN: Here we go, page 63.

DR. PARRY: Page 63.

CHAIRMAN APOSTOLAKIS: Page 63?

MS. DROUIN: It's page 61 in my copy.

CHAIRMAN APOSTOLAKIS: Of the NUREG?

MS. DROUIN: Yes, of the NUREG.

MR. CANAVAN: Yes. In the NUREG, yes.

CHAIRMAN APOSTOLAKIS: Okay.

MS. DROUIN: Now I will have to say this definition has had a lot of debate among us and among the standards committee because this is also what shows up in the standard. It shows up in Reg. Guide 1.200. I'm not going to sit here and say that we're totally happy with it, but it's a consensus definition for consensus model.

CHAIRMAN APOSTOLAKIS: So in the most general case that's what you're saying.

DR. PARRY: Yes. Yes.

CHAIRMAN APOSTOLAKIS: That it is a model that has a publicly available published basis. It has been peer reviewed and widely adopted by an appropriate stakeholder group. Widely accepted PRA practices may be required as consensus models.

I don't know. Is that clear to everyone what the consensus model is?

MEMBER POWERS: That you would use the source term code package.

DR. PARRY: Look at the last sentence as well.

MS. DROUIN: The last sentence is very important.

DR. PARRY: It's very important for us, at least.

CHAIRMAN APOSTOLAKIS: A risk-informed application the decision is the consensus model approach is one that the NRC has utilized or accepted for the specific risk-informed application for which it is proposed.

MEMBER POWERS: So you could use the source term code package.

DR. PARRY: Yes, we could but unfortunately we're dealing mainly with CDF and LERF so we don't really need to calculate source terms.

But I mean as an example, yes.

MEMBER POWERS: At a date approved by wide numbers of experiments.

CHAIRMAN APOSTOLAKIS: But it is conceivable, though, that you may have more than one model satisfying all these conditions.

MEMBER POWERS: And they will get a different look.

CHAIRMAN APOSTOLAKIS: Yes, with different design. That was the case with the seismic thing again where it was a big deal except for one model --

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: -- which was sort of discredited by most members of the community. The other four or five, I mean nobody would say --

MEMBER BLEY: Nobody could say.

CHAIRMAN APOSTOLAKIS: Huh?

MEMBER BLEY: Nobody could say.

CHAIRMAN APOSTOLAKIS: Nobody could, yes. So in that sense you had four of those, so you still have a problem. You have to do something with the different results.

DR. PARRY: Then that would not be a consensus model.

CHAIRMAN APOSTOLAKIS: But that's a set of models.

DR. PARRY: Well, then that's a consensus set of models introduced for your sensitivity studies. But I think the key comment for us, at least you know the poster child for model uncertainty used to be the seal LOCA model. And now we've all agreed on the seal LOCA model to use for Westinghouse plants. That as a source of model uncertainty for all the applications has been taken off the table. That's not to say that there are still uncertainties as whether that model is the correct one, but it's the one that's been accepted.

CHAIRMAN APOSTOLAKIS: Yes. So there is a model that is a consensus model, but there may still be uncertainties regarding the approximation of others using it --

DR. PARRY: Sure. Yes.

CHAIRMAN APOSTOLAKIS: -- which you have to do something about.

MEMBER SHACK: That's what's not clear to me. That's the tricky point.

MS. DROUIN: What's implicit is that once we said this is the consensus model and using the seal LOCA as an example, what we've said is that we have accepted those uncertainties associated with the model and are not going to be factored into the decision making.

MEMBER BLEY: I just -- I guess there's the thing that leaves me uncomfortable with that. Well it's a little bit of mixing deterministic with probabilistic which always gets you a little nervous.

The other is while it's generally conservative in most things, maybe there are some application or point where it no longer is, but it's a consensus model so we use it and it could lead us badly astray.

MR. CANAVAN: And may I --

MEMBER BLEY: And you have an answer, so I'll hear it.

MR. CANAVAN: Well, the consensus model would be evaluating sources of uncertainty that are not cause and effect with the application. So, for example, if you're doing a diesel generator AOT extension.

MEMBER BLEY: Okay.

MR. CANAVAN: And you have a sealed LOCA model, that's consensus. That does mean that you do not do sensitivity analysis or uncertainty evaluations associated with that seal LOCA in that application as a cause and effect.

MEMBER BLEY: That clear from the document? I thought there --

MR. CANAVAN: I think there are the words "positive --

CHAIRMAN APOSTOLAKIS: I thought Mary said no.

MR. CANAVAN: Not in the definition.

MS. DROUIN: It's not in the definition.

DR. PARRY: However, what the definition says is utilized or accepted for the specific risk-informed application which --

CHAIRMAN APOSTOLAKIS: Let me give you another example. In the old says, 25 years ago the fire analysis we had this COMPBRN code. It was the only one. So in that sense it was everybody was using it. It was a consensus. But we all agreed that there were uncertainties associated with the approximations of the code. That in fact the developers of the code offered some judgment as to off the code result could be.

Now could the user of this NUREG and the EPRI document appreciate this? It is a model, but the model itself is uncertain.

DR. PARRY: I think the answer to that one is that may not be a consensus model; it's the only game in town. But if the uncertainties associated with that model have been identified by the developers of the model, then I think it behooves the analyst to recognize those and deal with those as a source of model uncertainty.

MEMBER BLEY: No one could disagree with what you just said.

CHAIRMAN APOSTOLAKIS: Absolutely.

MEMBER BLEY: But is there a sentence in either of these reports that makes that point? And it seems to me there's not.

DR. PARRY: I could not tell you. I could not tell you.

MS. DROUIN: No, I think not.

MEMBER BLEY: I don't think there is, but I'd sure like to see that in there.

CHAIRMAN APOSTOLAKIS: Yes, I'd like to see a paragraph in there, actually.

MEMBER BLEY: Well, yes. But that was a very good sentence.

DR. PARRY: Yes, a very long sentence.

CHAIRMAN APOSTOLAKIS: Yes, a very long sentence, yes. With a few commas and maybe semicolon.

MR. CANAVAN: In previous versions we had some language, but we may have removed it. I'll have to look back and find it.

MEMBER BLEY: Yes. It comes through as kind of if you have a consensus model, you don't need to think about uncertainties.

MEMBER SHACK: You're done.

MR. CANAVAN: There used to be a word in there about cause and effect, but that has a different connotation, so we removed --

CHAIRMAN APOSTOLAKIS: I want to ask this question now because I'm going to forget it. If I have one model and it is uncertain, is there any guidance anywhere in the documents how I can handle that uncertainty? If I have three models and I don't manage to perform successfully what EPRI proposes, namely do some sensitivities or eliminate it; three models that somehow they're all legitimate, is there any guidance how I can use all three and come up with some uncertainty distribution of the outcome?

DR. PARRY: No. No.

CHAIRMAN APOSTOLAKIS: Should there be? Maybe not now, maybe in the future. But it seems to me there should be something.

DR. PARRY: I think the philosophy we have adopted is one of understanding the separate effects basically.

CHAIRMAN APOSTOLAKIS: But you do all the way and say --

DR. PARRY: We don't go all the way and define, no, because I think --

CHAIRMAN APOSTOLAKIS: What do you think? Should there be some guidance?

DR. PARRY: Personally I think not. I tell you the reason I think not is that when you start doing that, you can alter things so much by the degree of belief you associate it the different models, which is another dimension which is not necessarily going to help you make decisions.

CHAIRMAN APOSTOLAKIS: But then, you see, you avoid that. But it seems to me the decision maker will do that in the back of his mind. And the question is which one is preferable.

DR. PARRY: Yes. And I think part of what we get into is a description of what the analyst should tell the decision maker. And the analyst may be forced to make a value judgment of which of these --

CHAIRMAN APOSTOLAKIS: You know, there was a whole debate in a different context many years ago in one of the very early incarnations of the Yucca Mountain, one of the ways the repository performance assessment where some guys at Sandia were arguing exactly that point. That, you know, we're not going to quantify these but we're going to make sure that the decision maker knows about these uncertainties. The counter argument was you really expect the Commissioners to do these evaluations without the help from you. In other words, you're shifting the burden now from the analysts to the decision maker. And I think you can make a good argument that the analyst is much more qualified to say something about the uncertainties with the appropriate caveats rather than the decision maker. Because they're going to do that.

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: You say if I put relevant weights, I can get anything I want. They're going to do that in the back of their minds.

MS. DROUIN: But I think the decision maker ultimately has to make the decision. Now the decision maker needs all the information to make the appropriate decision.

CHAIRMAN APOSTOLAKIS: Yes.

MS. DROUIN: And it is up to the analyst, though,, you know to make sure that that decision maker has the information and understands the context of it.

CHAIRMAN APOSTOLAKIS: So if the analyst

provides, say, three or four sensitivity calculations with numbers, or we asked a couple of our guys and here are the weights and here's the result. But you could have different weights, here is the result. And they limit at that, I think that's great service without saying this is their result. But to keep silent again and say, yes, there are these three modules. They are uncertain. Now you decide. I think that's taking an extreme position.

DR. PARRY: No. And maybe this hasn't come properly, but I don't believe that's what we're saying.

I think what we're saying is that what should be presented to the decision maker, and we're really getting ahead of the game here, but is that the various -- the results you're getting from the model which could be a number of different sensitivity cases have to be qualified in terms of you the analyst has to say something about the level of competence you have in those --

MEMBER BLEY: You're slide 25. Yes, exactly. And I don't think that's in there, there's not a hint of that, or even more importantly what kinds of things lead to that evaluation. Is it understand conditions? Is it -- you know, is it just we don't know, they're equally likely or sometime. But the basis for that level of confidence; that's what I don't see anywhere. I don't think I see it. I don't think it's there.

MEMBER BLEY: I think it's there, but it's maybe cryptic.

MEMBER STETKAR: I'm not sure.

CHAIRMAN APOSTOLAKIS: It's not there.

MEMBER STETKAR: There is guidance that says sometimes you may need to quantify your model -- your PRA using two or three different models.

DR. PARRY: Right.

MEMBER STETKAR: If you have no other means of understanding this problem.

DR. PARRY: Right.

MEMBER STETKAR: But both documents I think stop at that.

MS. DROUIN: Well, I come back to --

MEMBER SHACK: Well, they tell you you have to characterize the agreed assessment. I mean there's a whole step for that.

MR. CANAVAN: Characterize the degree of confidence.

CHAIRMAN APOSTOLAKIS: But it's very simple, guys. If I had three models, I would add one of the paragraphs and say, you know, you can assign weights which mean this. You can that in extreme cases with a big expert opinion elicitation. In not so big cases you can do it, you know, the technical whatever it's called in the NUREG, integrator or facilitator. I mean, there are gradations, if there is such a word, that you can do that. One paragraph or two and leave it at that and give a reference.

MS. DROUIN: I agree with you, George.

CHAIRMAN APOSTOLAKIS: Yes, that's all I'm saying. I'm not asking for a while treatise.

MS. DROUIN: I don't think any of us disagree. And I come back to where I think, you know, which to me one of the greatest things that to me I'm getting out of this meeting is you are helping point out where the places I think we've been overly cryptic. I think that we had sentences in there that have incredible meaning behind them. And, you know, when you just read it the first time you aren't going to really understand the significance and some of the subtleties in that particular sentence.

MEMBER BLEY: Okay. Great.

MS. DROUIN: And I do say that I do think--

MEMBER BLEY: There would be some, yes.

MS. DROUIN: -- that we have these kinds of things all through this document.

MEMBER BLEY: And I think something you said earlier, Mary, is right on target. If you have the right PRA analyst using this, none of these things you worry about because you know they're thinking about them.

MS. DROUIN: Exactly.

MEMBER BLEY: But what if you don't? What if you have some of the other folks? There needs to be enough guidance to help them along.

MS. DROUIN: Right. And that's the negative side when you bring together such a great team. You can very easily go down that road.

MEMBER BLEY: How can anybody know that?

MS. DROUIN: Yes, exactly. Into that mindset.

MEMBER BLEY: Well, maybe they don't.

MS. DROUIN: And I know that we've been guilty of it in this document.

CHAIRMAN APOSTOLAKIS: All right. So maybe we can go to this slide. We didn't discuss this is.

MR. WHEELER: Okay. Okay. Step 2 identifying the application -- I'm sorry. Understanding the application and identifying those source of uncertainty that are relevant to the application. An important feature of this step is, as you see from the top, not only do we bring to bear the entire set of sources of uncertainty that were identified initially in step 1 where we understand the base PRA as well as just general knowledge from the historical work that's been done as embodied in tables A1 and A2 of the EPRI document, but on the left you can see there's two manners in which the application can impact the sets of sources of uncertainty itself.

And first of all, the application at hand defines the manner in which the PRA model is going to be used. And that will, in essence, serve as a filter or determine which sources of uncertainty from step 1 are going to be relevant to the decision or not. And obviously if your application involves the exercise, you know the base PRA, then the entire set of issues coming from step 1 will be relevant.

But additionally, as you can see the bottom loop there, the PRA model may have had to have been modified in order to address the application that you're dealing with. And in that case you have to, in essence, repeat a process of step 1 and verify that you are identifying or catching any possible new sources of uncertainty.

CHAIRMAN APOSTOLAKIS: What does characterize uncertainty mean?

MR. CANAVAN: Don's going to have examples of it.

MR. WHEELER: Don will be giving specific examples about that.

MEMBER BLEY: All right. Okay. Just the discussion we had a little bit before, that little box under other sources of model uncertainty --

MR. WHEELER: Yes.

MEMBER BLEY: -- only points to table A3.

MR. WHEELER: Yes. And so I think you're suggesting that perhaps this is where we need to go back and revisit the way we've handled table A4 in this. And I think that's a good point.

CHAIRMAN APOSTOLAKIS: So it should say A4, is that the argument? Or somehow cite it.

MEMBER BLEY: Think about it.

MEMBER STETKAR: What they said makes perfect sense is that you have to go back and revisit all potential sources of uncertainty for a particular application. That's what's said. But, again, I came away --

MR. WHEELER: Right.

MEMBER STETKAR: -- and this slide kind

of reenforces it that what you really only need to think about in those --

MR. WHEELER: What's not on table A4, yes.

MEMBER STETKAR: -- three tables. And that we don't need --

MR. VANOVER: My initial thought is we wouldn't open it up on the right side. It would be on the left side as a subset of what's in the application specifically.

MEMBER STETKAR: However it gets in there.

MEMBER SHACK: And there's a statement that you need to examine the amount of detail that you need for one application.

MS. DROUIN: Right.

MEMBER SHACK: And that you might refer to table 4 for.

CHAIRMAN APOSTOLAKIS: And I agree with that, but I must say even going to A1, A2, A3 is a huge step forward. I mean, compared to what's happening now, it's a small step for the -- but a huge step for --

MEMBER STETKAR: The difference is --

CHAIRMAN APOSTOLAKIS: I mean come on, guys, nobody does it.

MEMBER STETKAR: But when you think from a perspective of meeting criteria, when you place yourself in a roll that says an applicant must enumerate, you know, several hundred things and write a sentence or a checkbox by each one of those several hundred things. No, I did not address this for the following reasons. No, I did not address this. When you take that perspective, indeed the list in table A4 becomes quite cumbersome.

On the other hand, as a general reference to remind people about things that they should think of without having that requirement that indeed they must address each one of those individually and disposition each one in their particular application; if that thought process could somehow get folded in there.

MS. DROUIN: Right. And what you just said -

MEMBER BLEY: That's a good point.

MS. DROUIN: And what you just said was the intent.

MEMBER STETKAR: Yes. But I think in practice you would find people who would take the approach that says A4 is not a problem.

MR. CANAVAN: The first pilots were done

by making everybody write a sentence or two for each item.

MEMBER STETKAR: That's a lot of work.

MR. CANAVAN: It was extensive.

MEMBER BLEY: That led you drop it.

MR. CANAVAN: Yes.

MEMBER STETKAR: And 99 percent of the people would take 99 percent of those items and write precisely the same sentence.

MEMBER BLEY: N/A.

MEMBER STETKAR: N/A. Well, 99 percent for 99 percent of the items perhaps is too much. But a large number of people.

MS. DROUIN: You know, you've all here been taking notes. But one of the things that we will do is that we will get a copy of the transcript and we will go through the transcript and find all these issues. There certainly hasn't been anything that has been raised today that we would come back and say absolutely no. We would have said it at the time.

So, you know, we will go through the transcript and capture all these things.

MR. WHEELER: Okay. Next slide.

CHAIRMAN APOSTOLAKIS: Very good.

MR. WHEELER: Okay. Here we have an

illustration of step 3, which is the ultimate step where those sources of uncertainty that have been identified as being relevant to the application are now evaluated to determine whether or not they are key sources or not. And the idea here has been that the analysis should not have to defend every single source of uncertainty from the context of the application, but should be able to identify only those sources of uncertainty that could actually be key, which means they could actually impact the decision that might be made based on the application.

As you can see here, we have again a reference to both the conservative screening approach and a realistic sensitivity assessment approach. And we had originally written this document for this to imply a sequential approach where first the analyst would look at everything from a conservative screening approach using elements such as risk achievement worth and also setting parameters values to one. Seeing what could possibly from a mathematical point of view result in an unacceptable result and would could not possibly cause an unacceptable result.

CHAIRMAN APOSTOLAKIS: Some of these conservative suggestions are questionable. I don't know if it's appropriate to raise it here. But for example, you say for human error probabilities, put all of them in the 95th percentile. I don't think that's conservative. I mean, there may be another model that's way out there, right? That assumes that this division that you have already is on a pretty good foundation, and that I'm going to the 95 percentile, I'm a conservative. You know, I'll hate to say that. But if you go back to the ISPRA exercise, you're talking about two or three orders that are different.

So in cases perhaps going to an extreme value of a distribution is a conservative thing to do. But in other cases where you might have serious differences among models, it may not be. So to rely so much on the 95th percentile doesn't really mean that you have done a conservative screening analysis.

MR. WHEELER: I'm wondering if perhaps there was a discussion on sensitivity analysis where we said that.

CHAIRMAN APOSTOLAKIS: Yes.

MR. WHEELER: Okay. What we're calling conservative would be even more conservative now.

CHAIRMAN APOSTOLAKIS: I think that's also declared as conservative.

MR. WHEELER: Okay.

CHAIRMAN APOSTOLAKIS: This is a conservative sensitivity analysis, as I recall.

MR. WHEELER: Okay. I would have to -- because --

MEMBER SHACK: I'd be surprised. I think that's in the EPRI guidance.

MR. CANAVAN: I don't think we characterize it as conservative.

MR. WHEELER: It's just a way to do it.

MR. CANAVAN: It was just one of the ways to assess the uncertainty about specific --

CHAIRMAN APOSTOLAKIS: Let's see what it says here. I have it in front of me.

DR. PARRY: Actually, in the EPRI document it says "a reasonable range," not a conservative range.

MR. CANAVAN: Right. Conservative. Conservative.

CHAIRMAN APOSTOLAKIS: Huh?

MR. CANAVAN: That's a reasonable range of values.

DR. PARRY: That's what the EPRI document says.

CHAIRMAN APOSTOLAKIS: The EPRI document-- yes, therefore a standard set of four sensitivity cases is recommended. All right. All HP probabilities set to their 95th percentile, OCCF probabilities set to--

MR. CANAVAN: Let me weigh in here too on why that's in there. It was mentioned earlier that not everybody here who is going to exercising this methodology is necessarily a expert -- they're a practitioner, not necessarily an expert. And one of the thoughts about originally requiring at least these four minimum cases is when you finish your base PRA the least you can do, the least you can do is exercise some of the major contributors around a range of appropriate probabilities that you may see and to get additional insights. And we're not convinced that everybody is doing that as a matter of course. What this does is it requires them to do it as a matter of course.

So as a matter of course when you finish your PRA results for your base model you would run through these four sensitivity cases even if you weren't planning on applying it just to at least do that minimum amount of work to start understanding how sensitive your model is to these particular traditionally very dominant items.

CHAIRMAN APOSTOLAKIS: But the closing

sentence, though, it says do these four and then it is say --

MEMBER BLEY: What page you on?

CHAIRMAN APOSTOLAKIS: Which page am I on?

MEMBER BLEY: This is the EPRI document?

CHAIRMAN APOSTOLAKIS: EPRI document 45 it says here but -- 3-13.

MR. CANAVAN: 3-13? Okay.

CHAIRMAN APOSTOLAKIS: Okay. So this sentence: "There's also these analyses can be compared to the Regulatory Guide 1.174 CDF and LERF to obtain insights into the sensitivity of the base PRA model results to these generic high level sources of model uncertainty."

You may not be using the word "screening" or "conservative," but there is a clear implication here that if I use a 95th percentiles and I'm still below the limit of 1.174 what's the natural conclusion? But I mean, and it would change.

So the words probably have to change or something to say that in some cases maybe taking the 95th percentile is meaningful, but in other cases it might not be. Because there is a fundamental assumption behind all this, although this division I have is good.

MR. VANOVER: I think that -- I had a specific example that if we ever to slide 49 I'll think we'll come up on that outside of the context of human reliability.

MR. CANAVAN: And I don't want to belabor this too much, but one would hope that the methods that you used in your PRA were at least acceptable to some level that the mean value meant something.

I guess I see your point that there may be an alternative method that produced a different set of values. But this model has gone through peer review. I mean, you produce a set of results, it's going to be peer reviewed. And this is one of the sensitivity cases that you don't peer review, the model must at least be acceptable for the peer review and meet the standard to have gotten this far.

So I guess I look at it as well it's definitely an accepted method. You theoretically have done it appropriately since you've gotten a peer review. And now you've done a sensitivity case to understand that case effects the model. And so the goal was at a minimum for the base model you do this so you understand your results.

I'm not sure it was a testament to--

CHAIRMAN APOSTOLAKIS: There are a few

cases where this is not meaningful, even granted what you're saying about the base PRA model. I mean, we recognize that in a few cases a different model uses very different result.

MEMBER BLEY: I guess to me these kind of studies are useful to do, not so much for the reason given here.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER BLEY: It's more of a test on the structure of your model to see if there's something funny in it, which I've usually seen pop up when you run something like this.

MR. VANOVER: The more interesting --

MEMBER BLEY: It's an idea that you're covering the full range of these uncertainties doesn't ring too true.

MR. VANOVER: Okay. I understand.

MEMBER BLEY: Because there it's more issues of dependencies and other things it could be--

MR. VANOVER: But the more interesting part when I see these sensitivities is not the upper bound because the upper bound pretty much goes with the uncertainty interval --

MEMBER BLEY: Yes.

MR. VANOVER: -- is the lower bound. And

if you zero out or put very low all the human error probabilities, that's a more interesting figure of merit.

MEMBER BLEY: Yes.

MR. VANOVER: Forty percent of the CDF is all related to human actions or 45 percent of CDF is related to common cause. So the more interesting insight is the inverse case, which is the lower bound sensitivity.

MEMBER BLEY: It's not always obvious what that means, but it's a useful thing if something jumps to go try to figure out and understand why.

CHAIRMAN APOSTOLAKIS: You always get insights by changing things.

MEMBER BLEY: Yes.

CHAIRMAN APOSTOLAKIS: There's no question about it.

MEMBER BLEY: Yes. But they might not be what you thought it might be.

CHAIRMAN APOSTOLAKIS: It might not be what you thought you were doing.

MEMBER BLEY: Yes.

MS. DROUIN: I'm a little bit concerned, George, about where we are in the presentation.

CHAIRMAN APOSTOLAKIS: Yes. But this is

important.

MEMBER BLEY: And the time.

MS. DROUIN: Yes. And as I said --

CHAIRMAN APOSTOLAKIS: This is the purpose of the Subcommittee meeting.

MS. DROUIN: I understand. We're going to go back and look at the transcript --

CHAIRMAN APOSTOLAKIS: Okay.

MS. DROUIN: And take the position --

CHAIRMAN APOSTOLAKIS: Okay. Let's move.

MEMBER SHACK: But wouldn't slide 25 be the place where human errors would be, in fact, one of the places you're using approach A, B and C. Presumably it seems like a prime candidate for it.

CHAIRMAN APOSTOLAKIS: Okay.

MR. VANOVER: Let's wait for an example that we get away from human error if we ever get to slide 49. I have a non-human error example.

CHAIRMAN APOSTOLAKIS: Okay. So you're done with 21?

DR. PARRY: Yes.

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: Twenty-two.

MR. VANOVER: Okay. I guess that goes back to EPRI.

So the context of what we're doing in the EPRI report, there's two major pieces. Chapter 3 is the focus on the base model assessment and that's to address the four listed supporting requirements here. And then all of the related elemental supporting requirements that have you identify and characterize, source of uncertainty related to each element for example initiating events or data.

And how we got to where we are is we looked back at the technical basis document and the original applications guide from 2006 and went through the process of screening those items that were related more to scope level of detail rather than model uncertainty issues.

So to streamline the original list to a smaller subset we need to look at slide 23. So we came up with a definition to look at to help us identify what were the candidate sources of model uncertainty from the original list.

So the first category is phenological type events where the nature of the event or failure mode is not completely understood. Some examples of that would be operability of equipment beyond design basis environments or some level 2 phenological events related to vessel failure modes or containment response given a severe accident.

The second category is where significant interpretations are required to infer behavior. This would ge where there might be separate effects tests or separate thermal hydraulic analysis to help us identify that assumptions are made in the models. Battery life calculations or CPC LOCA assumptions fall into the interpretative category of model uncertainty.

And then there's the sort of the catch-all third definition which we can't pinpoint any one specific issue, but there's general agreement that it's a source of model uncertainty. This is the human reliability analysis and method cause failure data falls into this category.

CHAIRMAN APOSTOLAKIS: So this is another consensus?

MR. VANOVER: Consensus that it's a source of modeling uncertainty, yes.

So that was the process that we went through to streamline the long list of about 250 items to the current list of around 25 that appears in table A1 of the EPRI report.

So what do we do --

MS. DROUIN: Now before you go on, I just want to ask George a question.

We have members here who have to leave at 3:30 to catch planes so that's why, you know, I'm concerned about the time. And we certainly want to hear everything, but I just want to just quickly take 30 seconds to tell you what we have to go through and where you like us for us to emphasizes because --

CHAIRMAN APOSTOLAKIS: Who is leaving at 3:30?

MR. WHEELER: No.

MS. DROUIN: I thought you had a plane and I thought you had a plane, and I thought Don --

CHAIRMAN APOSTOLAKIS: You are going to Brookhaven and you are leaving at 3:30?

MR. LEHNER: I have a 7:15 flight.

CHAIRMAN APOSTOLAKIS: So, Mary, is anybody leaving at 3:30?

MS. DROUIN: I mean I was -- I was under the impression that people had 6:00 flights to catch.

CHAIRMAN APOSTOLAKIS: Okay. I understand that.

MS. DROUIN: Okay.

CHAIRMAN APOSTOLAKIS: But let's ask now who has to leave when? Tim, what time do you have to leave?

MR. WHEELER: Tomorrow. I can stay all

night.

MR. LEHNER: I have a 7:15 flight.

CHAIRMAN APOSTOLAKIS: 5:00.

MS. DROUIN: 5:00. Okay.

MR. LEHNER: I have a 6:50 from Baltimore. So probably around 4:00.

CHAIRMAN APOSTOLAKIS: Okay. So the earliest is 4:00, close to 3:30. That we can meet.

Okay. Go ahead. You wanted to say something. Go ahead.

MS. DROUIN: I mean, I'm not saying we could go past 4:00, but you do work as an entire team.

Anyway, what we have is EPRI's going to go through the model uncertainties, then we are going to go through how we're dealing with completeness. And then we have to walk through the whole decision, you know how do we bring this into the decision. And then we have an example we were going to walk through.

CHAIRMAN APOSTOLAKIS: So walk.

MS. DROUIN: So it's a lot. So my question is do you want to just keep going and just keep pushing through and we end where we end?

MEMBER BLEY: Or get over to the decision stuff sooner, right?

CHAIRMAN APOSTOLAKIS: That would be

interesting. I don't know. You tell us.

DR. PARRY: I think it's important for you to see this part of what Don is talking about.

MS. DROUIN: Well, I'm not saying we aren't going to do that.

DR. PARRY: I know.

MS. DROUIN: If we aren't going to have enough time, what is that you really want to hear, and then I'll pay attention to the time as we go through?

CHAIRMAN APOSTOLAKIS: Well, certainly the impact on decision, that's for sure we want to hear that. Risk-informed decision.

We want to hear about incompleteness, right? And the example you mentioned.

So the question is really to which of these parts is John Lehner the principal player so we can put him up?

MS. DROUIN: He is not. He's not going to give any more of the presentation.

CHAIRMAN APOSTOLAKIS: He's not.

MS. DROUIN: But like, you know, every participates so --

CHAIRMAN APOSTOLAKIS: So let's keep going.

MS. DROUIN: We'll keep going.

CHAIRMAN APOSTOLAKIS: To tell you the truth, these diagrams I don't know how important they are compared to other stuff that's coming up. I mean, they're really an organization of approaches and making the approach systematic. We can very quickly over them. We have Don here, the guy who can tell whether it's worth, for example, spending time on 25.

MR. VANOVER: I think it's worth going through and we can go through them pretty quickly just in context of where this fits into the report.

CHAIRMAN APOSTOLAKIS: Sure.

MR. VANOVER: You don't think we need go through it?

MEMBER SHACK: I think you need to go through it. To me, they're sort of the heart and soul of your approach.

MR. CANAVAN: I mean I would go through as planned and when we get a little closer to the end time, let's make some decisions.

MR. VANOVER: Okay. So on slide 24 the left part is we're starting with the generic list of model uncertainties, which is table A1 and A2 of the report. And then there's some guidance on trying to identify plant-specific features or modeling approaches.

Now this is all in context of the base model and meeting supporting requirements for the base model assessment. So the things you need to do to meet those supporting requirements are in the middle box. Identify the part of the PRA model effected; identify what assumptions you have selected for those issues; what the impact on the PRA model is and also to identify conservative bias approaches in some cases.

We used to have that as a screening but that doesn't necessarily screen for all applications of the model. So we moved that back over into the middle box.

And then the only way we can screen is if a consensus model is used. And right now we really only have one consensus model and that's the Westinghouse seal LOCA model. Nothing else meets the sort of high level bar that's written down for what a consensus model is. And we originally had differentiated between consensus models and accepted best practices. And I think a lot of what we think about consensus models are really accepted best practices that still have uncertainty associated with them and that have to be dealt with. So that what is a consensus model has a pretty high level of rigor associated with meeting that standard.

MEMBER SHACK: Unless you have to find a reasonable alternative approach, which has to have a technical basis as least as good as the other one, which is why aren't you using it in the first place.

MR. VANOVER: Exactly. So you have to provide confidence that your decision in what you're using provides the best estimate response.

So in the context of the base model we would go through the list and end up with a characterizations of the sources of model uncertainty and the final list of what the candidates are that at a minimum need to be addressed for applications.

So to help do that on the next slide this sort of outlines what's in Appendix A of the EPRI report where we've defined the issues and the part of the model effected. And those two facets of the description would be applicable to everyone. They could just copy that for their particular assessment.

Then in the far right of what's in Appendix A we listed possible approaches, not that anyone of those is preferred for every application. It might be preferable to use a different approach depending on the application. Or not that we're endorsing any of these approaches or anything like that; that if you do this you're okay. It was a list of what things could be done related to those issues.

So that's what's in Appendix A is up to, the list of possible approaches. And they're not exhaustive. There could be other approaches for each of the individual issues.

And then it's left to each licensee or utility model owner to then specify what particular approach they've taken, what the impact on the model is and what the characterization assessment is. And an example of that is done in Appendix B for representative BWR MARK II plants. So I'll walk through one of those examples in the next two slides.

MEMBER SHACK: Just on this one, since Gareth didn't get a shot in about human errors before, and I notice the inter-HFE dependence is in table A4, which means it's one of those details you're not necessarily looking at in the base PRA because it's a consensus model.

MR. VANOVER: That is part of table A2.

MEMBER SHACK: Well, I see it in -- you know, the statement here "The ability to systematically quantify HFE dependence is more of an art than a science. The existing guidance, while considered to constitute a consensus model, is also considered a source of uncertainty." Table A4.

MR. VANOVER: What page?

MEMBER SHACK: What page is that? A-43. I got the page number at the bottom.

MR. VANOVER: Okay.

MEMBER SHACK: This went back to when Gareth looked shocked when I said I would take approach A, B and C to human error and he was shaking his head that hell no.

MR. VANOVER: For human failure events we categorize every issue related to human events as one of those type 3 model uncertainty issues. We acknowledge that there's going to be uncertainty associated with your human failure event values. And that's why we recommend a global sensitivity on all your human failure events first and then you need to--

MEMBER SHACK: But that comes back again to George's problem that when you do that global sensitivity, if you do a global sensitivity on one model, you have another --

MR. VANOVER: That's just to meet the standard in the case model. For particular applications the first thing you need to do when you identify application specific contributors is look for important human actions.

MEMBER SHACK: Okay.

CHAIRMAN APOSTOLAKIS: Human error is a problem because there's the issue that Bill just talked about, but also in the report, I don't know which one now, maybe both, it says you know in general, not about human error, but if available one should use another model as well.

I think it's hopeless to say that for human error.

DR. PARRY: Okay. That's what I was saying, too.

CHAIRMAN APOSTOLAKIS: If somebody, say, uses the EPRI calculator one of the models are there, then to ask that guy to also ATHEANA or some other model is just a waste of resources in time and -- you know.

DR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: So I don't know how to handle it. I really don't. I don't think anybody else does.

DR. PARRY: I think that's why we -- no. I think that's why we separated it out, though, as a special case. But I think the point you brought up, though, is a good one in some ways. In many ways, George. Sorry. That perhaps, you know, there should be some review of other models for similar events, for instance just to get a feel for what the range is. But remember, this PRA should have gone through a peer review. And the peer review should really have been addressing those issues. And I think the HPE values is probably one that they will look at. And if something is very much out of line, I think as the base model it would be identified.

CHAIRMAN APOSTOLAKIS: I think there are very few peer reviewers who will actually raise that issue. They might say that there is uncertainty with--

MEMBER BLEY: Oh, I don't think --

CHAIRMAN APOSTOLAKIS: I don't know. I mean, it seems to me that most of the industry now is happy with the EPRI calculation and the three or four models it has in it. In fact, we had here the Chairman of your Immediate Human Factors -- it was very forceful, you know. He was shocked that we were raising questions. And then at the end he said well gee, I'm surprised how much you guys know.

So, you know, it depends on who the peer review -- if Dennis is part of your peer review, yes, he's going to raise the question. But I think most industry types will not.

MEMBER BLEY: But the PRA reviews I've seen, and I've only seen a few, go through the HFE pretty thoroughly and look for issues of dependency. If you use different models, they made you tell about why you used them.

CHAIRMAN APOSTOLAKIS: But do they ever raise the issue that if you used another model, you would get a different result? I'm not sure that's--

MEMBER BLEY: Well, not in those words but almost -- well, for this you used one model, for this you used; why are they different. And it's getting real close to what you're saying they never look at.

MR. CANAVAN: I think you would be surprised how thorough they are on all the elements.

CHAIRMAN APOSTOLAKIS: And then what's the result? Let's forget about the thoroughness. What happens at the end? All the PRAs I have seen here use one model.

MR. CANAVAN: Yes. Okay.

DR. PARRY: Yes. A conservative model probably.

CHAIRMAN APOSTOLAKIS: How do we fix that?

DR. PARRY: Probably a conservative model.

MR. VANOVER: In the context of an application you want to know what human actions are integral to that decision being made with the acknowledgement that there is uncertainty associated with -- well the value assigned to human actions if I'm going for diesel generator AOT and my action to cross tie the buses given diesel failures is very important, then that's a prime candidate to be subject to a pre-job brief when I enter that AOT. And that's the kind of insight you're looking for in doing these analysis. But what actions are important for specific applications, when are those applications going to be--

CHAIRMAN APOSTOLAKIS: True. True. I'd like to know where I can go in the documents and find some specific guidance regarding human error. I think that's a separate beast. You can't just say this is part of the models and -- maybe in the risk-informed decision making processes you can say something.

DR. PARRY: Maybe. And I think Don got part of the answer in a sense that you understand what's driving the results that you need for your application.

I think when you look through the different applications, the human error doesn't necessarily drive it. It might influence it somewhat, but it's not a big driver in many cases.

I think where you will find human reliability being the driver and the really most important thing is like STP calculations. And that's pretty much --

CHAIRMAN APOSTOLAKIS: In the license -- I mean power uprates. Invariably the staff finds that the change is human, in the available time. And we have all agreed without looking at any other models that yes, yes the model may not be that important, but what is important is the difference of ability. So, we let it go. Plus, of course, we're reminded 15 times by the staff that this is not a risk-informed application. So the combination of things --

DR. PARRY: I did not realize --

MR. CANAVAN: Can we come back to this?

MS. DROUIN: I disagree that --

CHAIRMAN APOSTOLAKIS: I really want to know what's going to happen to human error. I don't think it's just another model uncertainty.

MS. DROUIN: I agree with you, George, and I disagree with the comment that I do think that there are good peer reviews out there. Don't get me wrong.

CHAIRMAN APOSTOLAKIS: I didn't say they were bad.

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

CHAIRMAN APOSTOLAKIS: I never said they were bad.

MS. DROUIN: I'm getting ready to say I think some of them are bad. I think some of them are good. But this idea that we say that all these peer reviews are good and are going to get into this kind of depth I think is very dangerous. I've seen some good peer reviews, but I've seen some awful peer reviews.

CHAIRMAN APOSTOLAKIS: And I agree with you.

MS. DROUIN: So to come back and say okay, well this going to be handled into the peer review, in an ideal world that's true. But, you know, to be quite frank industry hasn't done a 100 percent job across all the peer reviews.

CHAIRMAN APOSTOLAKIS: My comment is very specific. In the document it says in some cases use an alternative model. My thesis for human reliability this is not practicable.

DR. PARRY: Right, and we agree with you.

CHAIRMAN APOSTOLAKIS: Somehow another you guys think about it, what you want to say in the report. That's all I'm saying.

DR. PARRY: Okay. I --

MEMBER SHACK: Put in table A4 which puts it out of there, yes.

MR. VANOVER: I'll try to quickly get through these next two slides, Mary.

Here's an example what's in Appendix A, the characterization template. And this is the guideline for other model owners to follow to fill in their plant-specific characterization.

For the example is what the issue is. The issue is the impact of containment venting or core cooling system NPSH.

What part of the model is affected. That's important because depending on what the application is, that part of the model may or may not be effected. So that's one way to identify what could be involved.

So we're looking at loss containment heat removal scenarios in these cases in BWR accident scenarios where we've lost all containment heat removal and we eventually get to the containment vent pressure, primarily containment pressure limit pressure and are instructed to vent containment. What does that do on system taking suction from the tours for the suppression pool?

So possible approaches on the next slide are, you know one model may take no credit for injection from suppression pool because they assume that's the best responsible or they just consider it a conservative treatment that I won't take any credit for it.

Other utilities may have specific procedures to control the vent and maintain NPSH, turn on and off their pumps while they're venting to make sure they don't lose NPSH. So if they have that kind of procedure, then they probably want to take credit for that in their assessment.

Other models might rely on engineering analysis to show that their pumps can still work even with the vent in process and they don't have to worry about NPSH or other issues related to steam binding or anything like that when a pool is flashing from the vent process.

Or it may be the lesser desirable assumption from this perspective would just do not worry about it and assume that injection continues.

So, again, these are not recommended approaches or anything on that line. The list is just our brainstorming of what possible approaches could be taken for the different generic list of issues that were defined.

So then on the next slide this moves to

what would appear in Appendix B of our report, an example of plant-specific characterization where the characterization is what assumptions were that I made and what the impact on the model is.

In this example plant we did not credit any ECCS taking suction from the pool for a variety of reasons, NPSH being one of them. But this particular plant also did not have a hard type events so there's ge other environmental conditions in the reactor building that would occur. So in reality this is somewhat conservative, but it's also maybe the realistic at least plant response.

So the impact on the model would be that these systems are not credited for success after containment venting. If this were too conservative assumption, that may overemphasize other systems that may be credited post-venting. So that's an insight that needs to be --

CHAIRMAN APOSTOLAKIS: Is that a minor impact?

MR. VANOVER: I'm sorry?

CHAIRMAN APOSTOLAKIS: Is that a minor impact?

MR. VANOVER: Is that a --

CHAIRMAN APOSTOLAKIS: To heat pressure --

none of these is credited.

MR. VANOVER: None of them taking suction from --

MEMBER SHACK: He didn't say it was a minor impact.

MR. VANOVER: Yes, I'm looking for the word "minor," I didn't find it.

CHAIRMAN APOSTOLAKIS: You're wiping out most of this.

MR. VANOVER: Well what you're relying on is injection from external sources. So you have to have condensate storage tank systems or for hot well systems condensate CRD, RHR service water cross ties or --

CHAIRMAN APOSTOLAKIS: Let's keep going on.

MR. VANOVER: So other things could be--

MEMBER SHACK: This is a BWR, there's lot of these.

MS. DROUIN: Remember on all of these, a lot of these systems you can switch the section back to the tank and then under those circumstances you would credit it.

CHAIRMAN APOSTOLAKIS: Aren't we getting a little bit into the management of uncertainty?

MR. VANOVER: Yes, we'll get into how to deal with uncertainty in the next few slides.

So the last slide on the assessment, which is the characterization is for this particular plant it's slightly conservative bias. It's, you know, expected plant response but given this sort of conservative bias treatment if we're within the acceptance guidelines of our applications and we're looking at delta CDF application, then this should not be a source of model uncertainty for that particular application. So that type of information is provided for each of the 23 issues identified in table A1.

If we go to the next slide this is very similar to the slide that Tim showed with the exception of the additional boxes on the right half where what we're trying to do is -- and this is where we're consistent with the process in chapter 5 of the NUREG. The first step would be to characterize the manner in which the PRA model is used.

Identify application specific contributors. And the example we'll get to later, I think this is where we picked up some items that may not have been on table A1, 2 or 3 but they still propagated up and were potential sources of uncertainty.

Tim talked about the other parts of this process. I won't go into detail on that. I'll just point out the addition in the EPRI table is then the next step, once you've identified the potentially relevant sources of uncertainty for the application, is to think about sensitivity studies including logical combinations of sensitivity studies and look to interpret the results of those cases.

CHAIRMAN APOSTOLAKIS: Just a question that's a little off. Are we addressing anywhere the uncertainties of the margins we have in the success criteria?

MS. DROUIN: No. It's out of scope.

DR. PARRY: No.

CHAIRMAN APOSTOLAKIS: That's not relevant?

MEMBER BLEY: Why is it out of scope or where does it say it's out of scope.

MR. CANAVAN: It doesn't say it's out of scope.

MS. DROUIN: But it --Sorry, what?

MR. CANAVAN: It does not say it's out of scope.

MS. DROUIN: Again, we didn't get everything fixed in chapter 1, but it was out of scope from the beginning of the program. We were not looking at margins.

CHAIRMAN APOSTOLAKIS: You know, I understand the issue of scope. But from the technical perspective is that a major -- not source, but a major player in all this?

MR. CANAVAN: I would say for the existing set of plants your impassive safety systems, which is where you're going to end --

CHAIRMAN APOSTOLAKIS: Yes.

MR. CANAVAN: I'm going to say no, margin is not a significant contributor. In general our failure rates and the whole PRA infrastructure is developing assuming that you have a margin, any margin; small, medium or large, that the generic failure rate applies.

CHAIRMAN APOSTOLAKIS: Applies, I agree. I agree. But you know --

MR. CANAVAN: That's criteria --

CHAIRMAN APOSTOLAKIS: -- we are producing a CDF which really represents the failure of redundancy, those failures. So if you don't have two pumps, you're done. But in fact we could do it 1.3 pumps. And that's not included. So there is a conservatism there which I don't know, it may be very significant.

MR. CANAVAN: In the past people have--

CHAIRMAN APOSTOLAKIS: How can we talk about model uncertainty and say nothing about-- am I missing something there?

MR. CANAVAN: Well in the past what you'll find is that the way the data is collected is past bound. So you didn't miss that. For example, let's say service water has to put out 3000 GPM. When you collected your failure rate if you had 2999 GPM, that failed the surveillance test, which counts it as a failure.

CHAIRMAN APOSTOLAKIS: Yes.

MR. CANAVAN: Now it would likely be success in most cases.

CHAIRMAN APOSTOLAKIS: Right. Right.

MR. CANAVAN: Sometimes people use some judgment in the collection of the failures on some more realistic flow criteria. And in those cases you're actually -- the failure rates include the margin, right, for example. Especially if you do it by task like you do a heat up cal; you passed, you don't necessarily -- you might have passed be a degree or two degrees. It doesn't really matter in those cases.

So there's only a few cases where it matters, the flow rates. And in general if you go back, it comes down to failure rate and how you collected your data versus --

MEMBER SHACK: But when you do your thermal hydraulic calculations and you're doing realistic ones without really looking at the uncertainties in there, I mean isn't part of that 1.3 versus 2 covering your uncertainties in your thermal hydraulic analysis?

MR. CANAVAN: I think some of it does. I think --

MEMBER SHACK: But nobody ever systematically looks at that.

MS. DROUIN: But even that you're doing up against a margin. Because, you know, you're typically defining your core damage as your peak cladding temperature which has a hell of a lot of margin in it.

MEMBER SHACK: Yes. And again, I mean there are questions of what you're using as definitions for the success.

MS. DROUIN: Right.

MR. CANAVAN: And they're all connected.

MEMBER SHACK: And they're all connected.

MR. CANAVAN: Right. And chances are --

there are projects to look at margins and there have been efforts in the past to look at margin and its impact on PRAs.

MEMBER BLEY: To go back to the earliest PRAs where they argued this out quite a bit.

MR. CANAVAN: Yes.

MEMBER BLEY: For the current generation plants even though you have margin in PCA, most of the failures that get you to core damage, that margin ends up just being a delta time.

MR. CANAVAN: Yes.

MEMBER BLEY: And it's not a time that's within the same time frame as repairing the equipment, so it's not a big deal. I think on the newer plants it's going to be something we really have to think hard about.

MS. DROUIN: Well, I don't know that I would agree with that. I mean if you --

CHAIRMAN APOSTOLAKIS: No, but that's a specific aspect of it. This is a specific aspect of it, but in general --

MS. DROUIN: If you look over time the margin and you talk about core damage, for example, and just talk boilers, I mean I remember the days, you know, where your core damage was topped with active fuel. And then we slowly went away, went away. Now, it did add time, but it also added the ability to take credit for a lot of systems that, you know, 25 years ago were never credited in a PRA which are credited now.

So it's not just timing that is the ability to credit a lot of other systems.

CHAIRMAN APOSTOLAKIS: So then the conclusion that I'm drawing from this is that there is some -- not some. There is conservatism in the success criteria which we are not touching in all this evaluation.

MR. CANAVAN: Yes.

MS. DROUIN: Yes.

DR. PARRY: I think there's another way, too. And I think we do address that, at least in one sentence in here. Basically saying that we're looking at the uncertainties given the model is being constructed according to specific boundary conditions.

MS. DROUIN: Right.

DR. PARRY: And those boundary conditions are, for example, the way you construct the accident sequences where you typically take the limiting time to judge the success criteria.

CHAIRMAN APOSTOLAKIS: Let me change the

question. I remember sometime ago, Mary, you made the comment --

MS. DROUIN: Was it a good comment? I would deny it.

CHAIRMAN APOSTOLAKIS: It was a good comment.

We presented something and you said but you are not considering a change in the structure of the PRA.

DR. PARRY: Which was the success rate.

MS. DROUIN: What?

CHAIRMAN APOSTOLAKIS: Are you considering it here?

MS. DROUIN: No.

CHAIRMAN APOSTOLAKIS: Oh, okay. All right.

MS. DROUIN: I mean it's part of -- when you're giving something to the decision maker and he has a decision, for example, and if we stay with peak cladding temperature, you know the fact that your whole result of your PRA may be very different if that boundary condition initially changed, that doesn't go. We live with peak cladding temperature and --

CHAIRMAN APOSTOLAKIS: So we are not changing the basic structure --

MS. DROUIN: That's correct.

DR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: -- of your success criteria. We're dealing about cases where due to incomplete knowledge we may have a number of models--

DR. PARRY: Right.

MS. DROUIN: Exactly.

CHAIRMAN APOSTOLAKIS: -- we're not so sure.

DR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: Okay. Fine.

MS. DROUIN: And if that isn't clear, then this is another good thing we will pick up when we read the transcript and make sure we make this clear.

CHAIRMAN APOSTOLAKIS: I don't remember whether it's clear. I remember your comment.

MS. DROUIN: I probably isn't.

CHAIRMAN APOSTOLAKIS: The way you made that comment, you made it as if it was really the real issue. Now you're saying no. It depends on whether you are being critic or you're critquing.

MS. DROUIN: I think it's something that ultimately --

CHAIRMAN APOSTOLAKIS: Or you're selling, right. Your representative says no, you're not looking at the success rate. Wow, would that be committing suicide, I'm not looking.

That's okay, Mary. I know you're a friend.

MS. DROUIN: But that wasn't the question whether I was a friend. But we won't go there, George.

CHAIRMAN APOSTOLAKIS: Right, right, right.

MS. DROUIN: I do think that at some point in time how these, and I'll use now the term safety margins, are dealt with in the PRA and the influence they could have in how you make changes and they impact these I think is a very important issue that needs to be --

CHAIRMAN APOSTOLAKIS: I think you should make it clear up front.

MS. DROUIN: -- pursued, it's just not under this program. Whether the program ultimately down the road should be expanded to look at that --

CHAIRMAN APOSTOLAKIS: No. But I think you're right. When you revisit the opening sections I think you may want to put a sentence or two there about what is not done.

MS. DROUIN: Right. I think we have a lot of sentences or two to put there.

CHAIRMAN APOSTOLAKIS: All right.

DR. PARRY: Actually we italicize the phrase in one place.

CHAIRMAN APOSTOLAKIS: There is one phrase. Okay.

DR. PARRY: That's under the boundary conditions created by the level of data.

CHAIRMAN APOSTOLAKIS: Oh, God. We have to think deeply about it, what it means.

DR. PARRY: It's italicized.

MS. DROUIN: And you have to go find it somewhere in the report.

DR. PARRY: Page 31.

CHAIRMAN APOSTOLAKIS: Are you guys ready for a ten minute break.

MR. VANOVER: Let me wrap my part up.

MS. DROUIN: We're almost finished with this part of the presentation.

CHAIRMAN APOSTOLAKIS: All right. Don.

MR. VANOVER: A couple of more minutes for a few more slides on my part.

CHAIRMAN APOSTOLAKIS: Okay, Don.

MR. VANOVER: Three.

CHAIRMAN APOSTOLAKIS: You have three minutes.

MR. VANOVER: Three minutes. Okay.

So the key part of the process that we're looking at is to identify structured sensitivity cases, identify where multiple models may exist and perform sensitivity cases on individual as well as logical combinations.

We can go to the next slide quickly to get to a break.

Again, this figure is identical to what Tim showed with the exceptions of the additions to the bottom right where once we've identified the potential sources of model uncertainty we can perform either screening sensitivities or realistic sensitivities. Screening could not necessarily require a sensitivity case. It could be just looking at importance measures and ruling out certain things right off the bat. But for those situations where we do identify some sensitivity cases that may challenge the acceptance guidelines, we're looking for those issues that could change the decision being on the wrong side of the acceptance guidelines. And that's where the onerous would be on the analyst to characterize the degree of confidence with the base case assumptions that presumably met the acceptance guidelines.

So from our perspective we're not leaving all the work in the hands of the decision maker, and we're providing the decision maker with what we think the best estimate response is and why we think that's the right answer. And then we would identify, you know other people might think this is a valid assumption but here's why we think this a good reason.

The last slide, Mary.

So for anything that could change the decision, those things that are key sources of uncertainty or assumptions, basically it's up to the analyst to provide justification of why that is really the best estimate or if they can't do that, list compensatory measure that could be introduced, perhaps the pre-job brief example, for important operator actions or other things that would reduce the uncertainty associated with the risk metrics that given different reasonable alternative assumptions would exceed the acceptance guidelines.

So the whole point of the process is to identify those issues that could influence the decision and provide justification why they shouldn't change the decision.

CHAIRMAN APOSTOLAKIS: Are you done?

MR. VANOVER: Done.

CHAIRMAN APOSTOLAKIS: Okay. So -- huh?

MS. DROUIN: The only thing I was going to add that this was a long time coming to get to this point. And what I'm talking about is the key sources of uncertainty. You know, we went round and round with industry because in the standard, you know if you go back to Reg. Guide 1.200 Rev. 1 we had taken objection to the word "key" and made a conforming change because we felt on the base PRA what is key. On the base PRA you need to know where all your sources of model uncertainty and something only becomes key in the context of an application.

And it seems like it's a very straightforward simple idea, but it was a long time coming to get everybody to understand that very significant point.

CHAIRMAN APOSTOLAKIS: Very good.

All right. So we'll be back around 2:35.

(Whereupon, at 2:17 p.m. off the record until 2:32 p.m.)

MEMBER STETKAR: If they told me they didn't want me, I'd be out of here.

CHAIRMAN APOSTOLAKIS: You are being recorded. Mary will read the record line-by-line.

MEMBER STETKAR: I hope so.

MS. DROUIN: Yes. And John just thought

you didn't want him here.

MEMBER STETKAR: Huh?

MS. DROUIN: You just you didn't want him here.

MEMBER STETKAR: No. I said that if you didn't want me here, I would be out of here in a minute. If not --

MEMBER BLEY: That's good information.

MEMBER STETKAR: Just say the word.

CHAIRMAN APOSTOLAKIS: Very good piece of information.

I think we've insulted the guy, that's why he left.

MS. DROUIN: No. He took a break.

MR. CANAVAN: No, he's around. He's on the phone out there.

CHAIRMAN APOSTOLAKIS: He took a break? What's that supposed to do?

MR. CANAVAN: Oh, he's back.

CHAIRMAN APOSTOLAKIS: Is he back?

John, did we insult you and you decided to leave?

Who is speaking now? No. 34, who is doing this?

MS. DROUIN: Okay. We've gone through

parameter uncertainties. We've gone through model uncertainties. And the last thing is what we complete completeness.

CHAIRMAN APOSTOLAKIS: At the end I want to reserve a few minutes to go over some comments I have on the actual document.

MS. DROUIN: Okay. All right.

CHAIRMAN APOSTOLAKIS: And anybody else, of course.

MS. DROUIN: Now the standard addresses completeness in the sense that when you look what was section 3 and I think it's 1.3. But anyway, when you go into the standard on the process part when you're looking at your PRA and something is not in your PRA but is covered by the standard, you know the analysts two choices. He can either go revise his PRA and include it in there or he can use some other alternative but then you're outside the scope of the standard and the standard doesn't give any kind of requirements of what makes that alternative acceptable.

So our NUREG does address what are those things that are not modeled in the PRA but, of course, have to be factored into your decision making. And Jeff LaChance, who is now the primary person for this pat of the document couldn't be here today, so Gareth volunteered to be Jeff today.

DR. PARRY: Yes. In this chapter really what we're doing is discussing guidance on only one aspect of this completeness uncertainty, and that's to do with the incomplete PRA scope the level of detail and how that plays into risk-informed applications.

So in this particular section of the report we don't get into the unknown unknowns because those were dealt with through the whole risk-informed application process through the other principles, not the risk one. So we're really talking about what do we do with the scope of the PRA. And in particular we focus in on the use of screening analyses and conservative and bounding analyses.

And I think rather than necessarily talk to these slides, I'll maybe digress a little bit and talk about the problem of the use of the word "screening." Because we use screening in a couple of ways, and it's used in a couple of ways in the PRA standard and we have to address those issues here.

In one sense it's used to screen something out of the analysis. You don't need to put it in. In another way it's used as a surrogate for a detailed analysis. And in some cases we talk about using screening values of human error probabilities, for example. They're not taken out of the model, they're just put in presumably conservative values. And there are values that are put in instead of a detailed assessment.

The same with the fire PRA, although this document doesn't really deal with the fire PRA, but in the combined ANS/ASME standard you will find that there is a whole section on quantitative screening in the fire. There's a whole technical element called quantitative screening. It really doesn't screen things out. It's actually a limit on the amount of detailed modeling that is done. So it's representing a contributor in a conservative way.

So we've tried to do in this document is to give some guidance on determining the required scope and level of detail that we require to support an application.

There's some discussion of the different types of screening and conservative bounding analyses and the way they interplay.

The EPRI report doesn't address completeness uncertainty. Deliberately that wasn't its intent.

So I think some of the questions that we have to address are, you know, when do we use conservative bounding analysis and what makes them acceptable. And as a sort of backdrop of this whole thing I should mention, really, the Commission's phased approach to PRA quality. Because what that says is that any significant contributor -- let me back up.

Any hazard group which is a significant contributor to a decision has to be modeled using a PRA that meets the applicable standard. And pretty soon those hazard groups will include internal events, internal flooding, fires internal to the plant, seismic events, high winds and other external events. So if those things turn out to be significant to an application, they need to be addressed using a PRA.

So the way we've talked about screening and bounding analyses here in this document is to use screening primarily as a means of showing or demonstrating that, say, a particular hazard group or a particular contributor need not be considered in the model, which means that it's really got to show that something is insignificant.

Conservative and bounding analyses, obviously these can be used to demonstrate that something is insignificant from, if you were looking at frequencies, for example. But in some cases it's nice to leave some of these in the model even if they're not significant contributors but they're good placeholders. So you might still want to put something in the model. If you don't want to develop it to the same level of detail, you can put it in using the conservative or bounding model.

Now what that means for the decision later on is something we'll discuss in a few minutes.

So what this chapter does it gives some examples of the types of screening analyses and it talks about them in terms of-- I think we need to back up a little bit.

MS. DROUIN: One more?

DR. PARRY: One more, yes.

There's a qualitative screening analysis. And typically the way you qualitatively screen something is to show that it has no impact on an application. I mean it really has to be pretty convincing. And one of the examples here is that, for example, that if we're only looking at power technical specification changes, we don't have to worry about the low power and shutdown modes of operations. Okay. So if that's not in the PRA model, it's no big deal for that application.

MEMBER POWERS: Why is that obvious?

DR. PARRY: Because it's an out of tech --

MEMBER POWERS: How has it change your operating history so that the decay heat load which we had at full power shutdown has increased?

DR. PARRY: I'm talking about things like allowed outage times, diesel generators at-power. I don't see how that would impact power shutdown.

MEMBER POWERS: Well, the point I'm making is that it's not transparently obvious to me that anything that you do at-power is guaranteed not to have an effect at shutdown,

DR. PARRY: No. No, you're right. I mean if a power uprate would have an effect on the low power shutdown because you'd have a higher decay heat level. But this specific to that particular application, which is a a tech spec change.

MR. CANAVAN: An AOT change.

DR. PARRY: An AOT change. Let's make it even more specific to that.

MEMBER STETKAR: Okay. Well, I'd grant you an AOT. But if my tech spec allows me to increment my operating power 100 percent --

DR. PARRY: Okay. Not that one.

MEMBER STETKAR: -- is that obvious that

it --

DR. PARRY: All right. Maybe we weren't precise enough.

MEMBER STETKAR: Or, say, a tech spec change on the allowed amount of radioactivity in the coolant.

DR. PARRY: Okay. I wasn't --

MEMBER STETKAR: Again there seems to be an impact here.

DR. PARRY: You're right. I wasn't precise enough. I was thinking of AOTs. I was thinking of maybe tech spec initiative 5B, for example, which would certainly would not impact the low power and shutdown. But you bring a good point, and that's basically that we have to be very clear when we say that something is not effected.

MEMBER STETKAR: Well the interesting one is fire. Most of our risk-informed applications come in without fire PRAs.

DR. PARRY: Yes.

MEMBER STETKAR: And it becomes much more challenging for me because we know fire is the connector between safety and non-safety systems. To say that changes during the operation will not effect the risk of fire.

DR. PARRY: And that's not something that -- you can't make that determination, then you will have to consider the fire risk.

MEMBER STETKAR: So anybody who comes in here with a risk-informed application that doesn't include fire in it, we get to say go home?

DR. PARRY: Actually, even now I think they have to address the issues of fire as it effects those applications.

MEMBER STETKAR: And they say it doesn't have any impacts.

DR. PARRY: Well, okay. That's --

MEMBER STETKAR: I mean I know what they'd say. They'd say it every time.

DR. PARRY: Right.

MEMBER STETKAR: And you cough and you sputter and say what about this, what about this, what about this. And they say we know that's not a problem. Don't bother us. Go away.

DR. PARRY: Okay. I think that's a different--

MEMBER STETKAR: That's a different question.

DR. PARRY: It's a different question. We're not saying that here. What we're saying is that qualitative screening you can apply it when it's clear that something doesn't effect it. Okay.

Okay. Quantitative screening analyses. Typically to do this you have to demonstrate that the scope item has a small impact on the changing risk. And there are a number of different quantitative screening criteria you can find in the various documents, such as the PRA standard, various NRC documents that relate to different things.

For example, you'll have screening criteria for initiating events. I think in the standard it has if an initiating event is less then 10 to the minus 7 per year, then it needn't be considered in the model.

MEMBER STETKAR: I --

DR. PARRY: You can argue about that, but that's --

MEMBER STETKAR: No. I don't want to argue. I recognize it's in the standard. But do we need to perpetuate that in this NUREG being published in 2008 recognizing that there are new plant designs that purport to quantify a total core damage frequency all operating modes, all hazard groups that is on the order of, oh, five times ten to the minus eight, let's say, which by implication says that I don't need to do anything with anything.

DR. PARRY: I think you're right, John. And I think there are some words in here that may refer to that, but that's --

MEMBER STETKAR: I couldn't find them. I was really looking for those.

DR. PARRY: Okay. That's maybe --

MEMBER STETKAR: Because I'm really sensitive to these specific numbers.

DR. PARRY: I agree. And I think that we need to look at that in the light of what we said we would look at, too --

MEMBER STETKAR: Yes.

DR. PARRY: -- in terms of the scope of this document.

MEMBER POWERS: Because a guy comes in and says --

MS. DROUIN: Also this --

MEMBER POWERS: -- I have five times ten to the minus 8 core damage frequency and I want to leave out something that's one times ten to the minus seven.

MEMBER STETKAR: Well, this would say it's okay.

MEMBER POWERS: Yes. And why isn't that

okay?

DR. PARRY: We would -- we're not saying that's okay right now. I mean that the current PRA standard has those limits in it, but they are for standard -- it states in the beginning the scope for current light water reactors, where it may make --

MS. DROUIN: Current operating.

DR. PARRY: Current operating reactors, right.

MEMBER STETKAR: The other thing, Gareth, and this is just again pulling back from giving the individual numbers --

DR. PARRY: Yes.

MEMBER STETKAR: -- is that the examples of quantitative screening have guidance that speaks about screening on frequency, screening on consequences and screening on both. And you may want to think about the fact that separate screening on frequency and consequences may not be always appropriate. Again, thinking of really small numbers for current new plants and things like that. But just to say that the frequency of an initiating event or the frequency of a specific scenario is less than X may not appropriate when you're starting to think about large early release frequencies that may be generated from that scenario, for example.

DR. PARRY: Yes. I agree. I think those need to be looked at in the context in the scope.

MEMBER STETKAR: And that's regardless of what the number is.

DR. PARRY: Right. You're exactly right.

MS. DROUIN: Okay. But when we get to these new plants, first of all you know these risk measures are not necessarily even going to be the same. For new plants, and when I talk about new plants I'm talking about your advanced LWRs, it's core damage frequency in large release, not large early release. When we start moving away from the light water reactors, you know core damage, in and of itself, starts having little meaning.

So again I caution that everything here should be taken into the context of an operating LWR. Everything was written with that mindset behind it.

DR. PARRY: Yes. And I --

MS. DROUIN: Particularly with the --

DR. PARRY: The more I'm thinking as I'm talking to here, coming back to that question that you asked earlier, George, of whether this applies just to internal events, I think you'll find that most of what's discussed in this section of the report actually is looking at different contributors and primarily hazard groups. So it's not really -- I mean and we do discuss the various types of screening that takes place within the PRA model. For example, the screening of certain human failure events related to pre-initiators, for example, where you have certain conditions such as a post-maintenance test and enunciators, and that type of thing. So while those are discussed, I think the main focus is really in screening hazard groups because that's where I think we're going to find most of the completeness issues with PRAs.

The other issue is like have we got all the failure modes of components. I think they're fairly well addressed in the standard.

So that's really all I wanted to talk about on that particular section, unless you have any other questions in that regard.

MEMBER STETKAR: One general comment, and that's on this absolute numerical. There are elements in there and people have adopted in many cases a relative screening approach.

DR. PARRY: Yes. Right.

MEMBER STETKAR: That as long as something is less than one percent, one tenth of a percent of your quantified core damage frequency, it's okay to screen it. And that's fine. It doesn't make any difference whether your core damage frequency is ten to the minus 5th or ten to the minus eighth as long as something is less than one percent of that is okay.

There are some elements in this discussion of screening that have that mixed in with these absolute things. So if you're thinking about trying to retain a more generic applicability outside of the existing operating LWR fleet kind of focusing on those relative aspects of screening rather than absolute might help.

DR. PARRY: Yes.

MEMBER STETKAR: You know, depending on which way you head with the caveats up front.

DR. PARRY: Yes.

MS. DROUIN: And we do have some of that relative in here.

MEMBER STETKAR: It is. But it's interspersed right now.

MS. DROUIN: Right, it is.

DR. PARRY: I think a lot of it relates to different failure modes, for examples. You know if the failure mode is a couple of orders of magnitude lower than the dominant one and the impact is the same, you know --

MEMBER STETKAR: That's fine. I'd just kind of stepping back to say that --

DR. PARRY: No, that's fine.

MEMBER STETKAR: -- if you want to keep the focus of the entire NUREG somewhat applicable to new generation of plants, new even LWRs --

DR. PARRY: Right.

MEMBER STETKAR: -- if that's kind of the decision of the way to go, then I'd sort of recommend keeping the relative screening rather than absolute context in there.

DR. PARRY: Yes.

MEMBER STETKAR: If you want to focus it to only existing LWRs, then fine. You know, the absolute --

MS. DROUIN: Well, we have to be careful because when we start dealing with these numbers we're into the realm of some policy issues here. And when you look at these numbers, these absolute, the CDFs and LERFs all find their tie-in to the safety goals and what the Commission has spoken. When we start moving into the area of advanced reactors these are all policy issues that we're raising to the Commission but the Commission has not spoken it.

MEMBER STETKAR: Just be careful, though, on this slide it says "missing items has a small impact on the change in risk." So that's not -- that is somewhat related to the policy issues, I guess.

DR. PARRY: Yes.

MEMBER STETKAR: Anyway, go on.

DR. PARRY: Okay. Move on.

Okay. Going now to the discussion of the use of the results and the risk-informed decision making process. And so in doing this what we give guidance on is a number of issues. First of all, on describing the supposing risk assessment. And a lot of the comparison of the results with the acceptance guidelines.

Another issue that we discussed briefly is addressing uncertainty in SSC categorization, although that's a very small section.

We also address the use of qualitative approaches to address uncertainty, and this is typically to deal with the completeness issue again.

And then finally we'll give guidance of results to decision makers. Now in light of some of the comments you've already made, I think we realize that that needs to be beefed up a little bit.

So let's talk about comparison with the

acceptance guidelines. We decided to spend a lot of time on this issue because it seems -- well, the first thing we wanted to do is to talk about the need to understand the risk contributors. Because I think there has been a tendency for people to focus on the bottom line numbers. And clearly if you're going to deal with uncertainties, you've got to do more than that. And so we've tried to address in great detail there what you need to do to understand the risk contributors. In p[articular we try to separate out the issues that arise from the level of resolution of the model and the things that arise because you've made approximations in the model. And also things that arise because of scope assumption. Because those are not truly model uncertainties as such, but they set the boundary conditions for the model that you have.

And the reason that we specifically wanted to address this is because we've had this dreadful aggregation term going on for a long while. We've been having a lot of discussions. For example, we were being told that you cannot add the results from the fire PRA and a seismic PRA and internal events PRA because they're different. And our response has always been well, yes, but you've got to because they all contribute to the risk.

So what we were trying to do is to recognize and make sure that everybody understands that these models for the different hazard groups, in fact are modeled in different ways and they have different levels of approximation in them. Some of them may be more conservative than others. So you have to understand what the different contributors mean so that when you combine them, you can understand what the result means.

So what we have decided or what we've proposed, at least in this document, is that the way that you should decompose the results that are giving you the analysis results is first of all, do it by hazard group.

Now, as you pointed out, most of the specific guidance we have in the documents is for internal events. So we don't have a corresponding table of model uncertainty fires and seismic. But I think we will gradually work towards that in the future, right, Ken?

MR. CANAVAN: It's on the schedule.

DR. PARRY: It's on the schedule. Okay. So we will get to that. But at least before we get there we need to be able to set the ground rules.

So the first step is to identify the different hazard group models.

CHAIRMAN APOSTOLAKIS: If I were doing a good job quantifying the uncertainties, then there should be no question as to whether I could combine fire with seismic and internal events because the distributions would reflect my true state of knowledge, right?

DR. PARRY: Except for the fact that you got to remember that the models may be done to different levels of --

CHAIRMAN APOSTOLAKIS: That's what I'm saying. If I quantified my uncertainty in the models--

DR. PARRY: I don't know if we quantify biases, though. Because I think --

CHAIRMAN APOSTOLAKIS: Everything.

DR. PARRY: Well, I don't know if you can quantify biases.

CHAIRMAN APOSTOLAKIS: What if I -- you know there is a lot of work going on on the fire models now.

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: We had seven sessions at the last PSA conference in Tennessee.

DR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: They had a whole week in Los Vegas. And even there the degree of the situation is truly impressive. I quantify all that and I come up with a distribution of core damage frequency based on that point. I see no reason why I shouldn't combine these with internal events. I don't think internal events are much better, right? It's just that we're more familiar with them.

MR. CANAVAN: I would argue that fire since there is a significant lack of understanding of fire growth and propagation, how fires truly grow, how they propagate and over what periods of time. For example, even the fire cable testing that we do, we don't actually overheat the cable and make it go on fire. What we do is we use an accelerant and a torch; that's the way we can get it to go on fire.

CHAIRMAN APOSTOLAKIS: But my point is that I would quantify that. I would display my uncertainty in terms of probability. So, you know, I would have a broad distribution. But then there is no reason why I can not combine it.

MR. CANAVAN: The problem is -- well the issue is you don't know what the alternate model is. In other words, you have one model that you know produces conservative results in terms of timing and what actually gets failed and you don't have an alternate realistic model for the fire. And you don't have it because you can't even do the test cases. We try to overheat the wires by passing extra current through them. They don't go on fire, they melt and don't do anything. So what we do is to do cable testing, we actually put them in either a radiant heat transfer device or we actually ignite them with an accelerate and a torch.

CHAIRMAN APOSTOLAKIS: Well, that's a practical problem, Ken. My point is given all that, I display my uncertainty --

DR. PARRY: Wait a minute, George.

CHAIRMAN APOSTOLAKIS: So I mean we're making a much more bigger deal than we should when it comes to combining these things And I'm not saying do not decompose. No, I'm not saying that. I think it's useful to do that and get the insights and maybe do as NEI suggests years ago find separate importance measures for fires, for seismic and this and that, and then combine. All these insights I think are very helpful. But to keep saying that you should not really combine, I think that's a --

DR. PARRY: No, we're not saying that.

That's not what we're saying. What we're saying is you do combine them, but to understand what that result means you have to understand what the constitute part is.

CHAIRMAN APOSTOLAKIS: Absolutely. Nobody--

DR. PARRY: Okay. And that's all we're saying.

Now to get to your comment, though, on setting the distribution on the fire model, for example. I think what Ken says is right. What you have is one end of the spectrum. You have a model that you know you believe is conservative; that's all you've got. So there's a bias in there. Now you can live with that if that bias does not alter your decisions. And I think that's the approach we're taking is to look at this as a determination of whether what you've got is sufficient to make your case with confidence that your decision is acceptable.

Okay. So let me carry on a little bit in terms of the decomposition. We do the decomposition in three different ways.

First of all, you do it by hazard group because that's a good way of doing it.

The other thing you might want to do is

look at significant accident sequences or cut-sets.

And even look at the significant basic events.

And this is part of the task that if you remember where there was a figure that both Don and Tim showed where we're looking at a box that says the results -- I'm not sure if these are the right words-- but these are the results that you need to guide the analysis.

Looking at this stuff, it acts as a filter for the genetic list of sources of uncertainty that will tell you which ones are relevant to the results that you're using.

So this decomposition is a means of identifying the relevant sources of model uncertainty.

MS. DROUIN: I'd like to add something there. Because I think we're in violent agreement. The NRC's position in this NUREG and the position we've taken in Reg. Guide 1.200 has always been and will continue to be you add these together, period. You add them. You want to get the total risk. However, you know once you've added them, we want you to understand what those results mean. And so what we're presenting here is the guidelines or how we want you to understand the results. But we're not moving away from don't add these together.

DR. PARRY: This fundamentally hasn't changed since Reg. Guide 1.174. It's just making clearer. I mean even there it said that you had to understand the results.

Okay. Let's move on to the next one.

And those are the comparison with the acceptance guidelines then. Again, we look at this in sort of a hierarchical sense, which I think is probably the only way you can do starting first with the parameter uncertainty. And typically the way that parameter uncertainties are dealt with in these decision making acceptance guidelines is they're prescribed by the acceptance guidelines. And most of the guidelines that we have say compare the mean value. So that's really what you need to do with a parameter uncertainty.

And the EPRI document and our chapter 4 in the NUREG tell you what you need to do to generate that kind of response.

Now overlaying on top of that we deal with the model uncertainty. We have some guidance based on the EPRI work and the work in chapter 5 on choosing alternate hypotheses, and also recognizing that some of these different sources of model uncertainty might be synergistic in a sense. That there might be logical combinations that can effect the results. Logical combinations don't necessarily need to be all related to one facet. They could be diverse.

For example, you know when we were doing the MSPI as an example, what we looked at was we were looking at the importance parameters associated with a particular component. And where did that make a difference? Well, it was effected by all the other stuff that was in the same cut-sets of that component. So all those things are logically connected by association, if you like. We give some guidance on that.

CHAIRMAN APOSTOLAKIS: But, again, a bold statement.

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: You are not quantifying model uncertainty, are you?

DR. PARRY: WE're quantifying the effects of model uncertainty.

CHAIRMAN APOSTOLAKIS: If I look at this slide --

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: -- can I say okay, they're going to give a distribution of CDF due to parameter uncertainty, or whatever, not just necessarily CDF.

DR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: They're going to give me a distribution for the contribution from models, a model uncertainty. Then I can take the convolution of the two and I will have a distribution that would represent both

DR. PARRY: Yes. But we're not doing that--

CHAIRMAN APOSTOLAKIS: Why not?

DR. PARRY: Well, because --

CHAIRMAN APOSTOLAKIS: The second bullet is not quantified. You're doing all sort of sensitivity analyses --

DR. PARRY: Right. But it's quantified.

CHAIRMAN APOSTOLAKIS: -- but it's not quantified.

DR. PARRY: But the impact is quantified.

CHAIRMAN APOSTOLAKIS: And I'm asking why not.

MR. CANAVAN: The impact is quantified.

DR. PARRY: The impact is quantified, but not --

CHAIRMAN APOSTOLAKIS: The impact, the

impact; what does that mean?

MR. CANAVAN: Only in one direction.

DR. PARRY: The effect that it could have on the result.

CHAIRMAN APOSTOLAKIS: Right. But if I -- yes. But I mean --

MEMBER STETKAR: Not the likelihood of that.

DR. PARRY: Well, because it's not a likelihood is it, really? It's a --

MEMBER STETKAR: Well, no, but that's right. That's what you were saying.

DR. PARRY: -- a degree of relief from that effect.

CHAIRMAN APOSTOLAKIS: Heaven forbid we never use that, right?

DR. PARRY: Well, no. I mean --

CHAIRMAN APOSTOLAKIS: I think you could. I think you could give some guidance.

DR. PARRY: Well, I --

MS. DROUIN: It's not a case of not giving guidance.

CHAIRMAN APOSTOLAKIS: How to quantify, that's how to manage it.

MS. DROUIN: You know, I mean you can

certainly go do that extreme NUREG-1150 very formal uncertainty analyses, you know.

CHAIRMAN APOSTOLAKIS: That's an extreme. I agree.

MS. DROUIN: But to me when you start saying okay I'm going to put distributions and everything on every single one of these model, sources of model uncertainty and propagate that's what you're asking for, George.

CHAIRMAN APOSTOLAKIS: Yes. But you make it sound like it's a huge job. It's not necessarily a huge job.

MS. DROUIN: I'm --

CHAIRMAN APOSTOLAKIS: Because after I do everything you are suggesting under the second bullet, I will be left with very few uncertainties that I will need to quantify.

MS. DROUIN: I think assessing the impact--

DR. PARRY: And you may be right.

MS. DROUIN: -- you know for a particular application on a model uncertainty that's relevant to that one is a lot less. And I think you get the same amount of -- I think you'd get the needed information you need for your decision making versus going through and do a very formal uncertainty analysis.

CHAIRMAN APOSTOLAKIS: I'm not going about it very formally. But let me give you a situation where you have in a particular case two hypotheses. That one of these, plus everything else, you are below the limit of the regulatory guide. Under the other one you go above the limit. If you leave it at that, you're not really helping the decision maker. But if you say that one of these hypotheses is much more likely than another and you give some range or something, then you are becoming very useful. And that's what I'm asking.

DR. PARRY:

MEMBER POWERS: Okay. And I think that's our intent. Okay. And it's probably not come out in the way this is written.

CHAIRMAN APOSTOLAKIS: You do it, you mean?

DR. PARRY: No. Did you ever get a presentation on LIC-504.

MEMBER STETKAR: On what?

CHAIRMAN APOSTOLAKIS: Do I have what?

DR. PARRY: It was a process that we developed for guidance for decision making on emergent issues. I think you expressed an interest in seeing it at some point at the Committee, but I guess you didn't do so.

MEMBER BLEY: What was the name of it?

DR. PARRY: It's L-I-C 504.

MEMBER BLEY: LIC-504.

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: No.

DR. PARRY: What we did there was to set up a scheme where -- this was very similar to this. Okay. You develop the different options to the decision maker and then you decide to the decision maker which of the options you would choose and why.

And I think where you use a similar thing here is that what the analyst has to do is to present this information to the decision maker, present all the options and then he has to say why he believes the decision or the recommendation that he's making is believable. If he can honestly not choose between for the model uncertainty that puts him above the line rather than below the line, then I think you have to tell the decision maker that. If you're in the happy position but they're all on the same side of the line, then you're in great shape.

CHAIRMAN APOSTOLAKIS: But there is a probability. I mean, it's inevitable. These are not always equally likely.

DR. PARRY: I know, but whose probability, though?

CHAIRMAN APOSTOLAKIS: But you're hiding it.

DR. PARRY: No, you're not, you're not hiding it. You're just --

CHAIRMAN APOSTOLAKIS: You're hiding it.

DR. PARRY: I wouldn't know how to assess it.

MEMBER BLEY: Well, again, we're talking in general. But what I've seen is when you have specific examples, generally you know enough to know to some extent how to assess it because you know the conditions that drive you to one or the other. But this 504 you're talking about sounds like just the kind of information we're talking about.

CHAIRMAN APOSTOLAKIS: I don't know. I don't know what it is.

MEMBER BLEY: Well, it's the information of what leads you to favor one option over the other and what are the basis for that. And I would expect, as you said earlier, some measure of what you think the likelihood of one of them is.

DR. PARRY: But I wouldn't use the word

"likely." You'd say it give you relative confidence in one of those with the other.

MEMBER BLEY: Okay. I'm sorry. Not only confidence. Well, an arguability. The probability was not likely --

CHAIRMAN APOSTOLAKIS: When you get done this, we're doing it routinely, guys. You're telling me that the degree of belief is not acceptable.

MEMBER BLEY: I don't know that --

CHAIRMAN APOSTOLAKIS: I think the steam explosion issue was settled based on expert opinion, informed expert opinion which based off of Sandia and to no end not this one.

1150? What's wrong with 1150? All of a sudden 1150 is the bad thing and we refer to it -- 1150, yes, it's a major study. We do that all the time.

DR. PARRY: Well, I believe there's a danger in if you have one hypothesis that comes out with a very low consequence, okay, and one that comes out with a very high consequence and you weight the one that has the high consequence with a very low probability, then on average --

CHAIRMAN APOSTOLAKIS: But there will be a reason why you do that. You're not going to do --

DR. PARRY: I accept that. I accept that.

CHAIRMAN APOSTOLAKIS: -- it perfidiously.

DR. PARRY: Yes. I know you don't. But if you only look at the average then, then you're not going to get the answer --

CHAIRMAN APOSTOLAKIS: No, because I have a slide number 42 or 41 -- 41, the previous one, that says that I have to understand it. You gave me also to guidance how to understand that.

DR. PARRY: I don't think we're disagreeing. I think we're just not going to call it a probability.

CHAIRMAN APOSTOLAKIS: But you're refusing to put a number.

MR. CANAVAN: I'd like to weigh in on --

MEMBER SHACK: I think you're refusing to propagate it.

MR. CANAVAN: I really do have to weigh in here just because --

MS. DROUIN: Because what you said --

CHAIRMAN APOSTOLAKIS: Let's let Ken weigh in.

MR. CANAVAN: Well just because the assumptions being made -- I think we're under an erroneous hypothesis, which is this a small number of events. It's not. It's a really big number of things to look at. The reason why it's small is because we treat them with a conservative bias and we dismiss them, right? The fire and propagation is an example, uninsolated steam LOCA is outside the containment, venting and losing NPSH, how do we treat it? Well, we say everything fails. When there's an uninsolated steam LOCA in the reactor building and a boil, or what happens, everything fails. It doesn't impact our results and it doesn't really want that much difference so we move on.

The alternative model is what? A zone of influence models? Time dependent dynamic models to show how the steam eventually works its way down to the corner room and fails the pumps? I fail to see how we're going to make an alternate model weighed in probability that we could effectively evaluate for the myriad of things and it's literally --

CHAIRMAN APOSTOLAKIS: It doesn't have to be an alternative model. You can still elicit judgments, informed judgments as to how uncertain this model is and use some peripheral evidence, some --

DR. PARRY: Well, what do you mean by how uncertain the model is? Are you really saying that I don't believe that this model or at least I don't believe very strongly that this model represents reality. Because really you've got two different models of reality.

CHAIRMAN APOSTOLAKIS: Yes. Yes. I'm saying that.

DR. PARRY: Right.

CHAIRMAN APOSTOLAKIS: I'm using the code and I think it's perfectly legitimate to say the result is off maybe by a factor of two to three. Why is that strange?

DR. PARRY: That's not something we're arguing about.

CHAIRMAN APOSTOLAKIS: And then based on some comparisons with some real life or experiments and so on you form a judgment and you say well gee, instead of saying two to three, it's probably some distribution that has a 50th percentile here and some uncertainty range in this --

DR. PARRY: I think we're talking about different things, George.

CHAIRMAN APOSTOLAKIS: Well, maybe we are, but that's what I'm talking about.

DR. PARRY: I think we're talking about two alternate models. And I don't --

CHAIRMAN APOSTOLAKIS: My point is that

you don't have model uncertainty when you have all the models only.

DR. PARRY: No. Right.

CHAIRMAN APOSTOLAKIS: You have model uncertainty on a situation like what Ken described where we know we have made assumptions -- again, 25 years ago is a good example. That was the only one. You asked Nathan and me is you, you know, when it says five is it five? No. There is uncertainty. But that was the only model. So you look around. You say, you know, can I model this. Do I have -- I have an experiment from Sandia. I can look at this. Boy, we are off by a little factor here. Then we form the judgment and we say well here is a normal curve.

Why is that legitimate?

DR. PARRY: I think what you're doing is you're translating that into parameter uncertainties--

CHAIRMAN APOSTOLAKIS: Yes.

DR. PARRY: That's fine.

CHAIRMAN APOSTOLAKIS: But if you ask a mathematician, by the way, and you say I'm talking about modeling parameter, they go crazy.

DR. PARRY: I know.

CHAIRMAN APOSTOLAKIS: They say it's all parameter.

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: Because I can put a theta in front of a -- it's all parameter.

DR. PARRY: I would say it was all model, but --

CHAIRMAN APOSTOLAKIS: It's all parameter. Theta --

MR. CANAVAN: We've now decided the difference between mathematician and an engineer, right? So the model is all parameters?

CHAIRMAN APOSTOLAKIS: My point is that if I go back to your three bullets on 43 , you have a reluctance to quantify the second bullet. You are doing all sorts of things with it, which are great, I agree they should do those things, but at the very end you're hesitant -- well, not hesitant. Reluctant to actually take the extra step and say this is now the uncertainty on this.

DR. PARRY: I think what --

CHAIRMAN APOSTOLAKIS: And if you don't do it, that's a problem. if you don't do it, then people will not do it.

DR. PARRY: No. I think that what we're reluctant to is we're not reluctant to give a value judgment on whether we think that hypothesis is comparable to another hypothesis.

CHAIRMAN APOSTOLAKIS: And it's not just only the hypothesis, is take again the example with one code, one model. We know it's uncertain. I mean, I don't need another model to tell me that.

DR. PARRY: No.

CHAIRMAN APOSTOLAKIS: Ken told me I made all these assumptions. Yes, sure, I made them. I know.

DR. PARRY: Right. But again, I think what you're dealing with there though is you're converting into a parameter uncertainty --

CHAIRMAN APOSTOLAKIS: Yes.

DR. PARRY: -- because you will turn that into a probability of fire growth, for example.

CHAIRMAN APOSTOLAKIS: The result being, you know, yes.

DR. PARRY: Yes. But that's dealt with under the parameters --

CHAIRMAN APOSTOLAKIS: Oh, no, it's not.

DR. PARRY: Well, it is.

CHAIRMAN APOSTOLAKIS: No, it's not.

DR. PARRY: Well, it is because parameters could be almost anything.

CHAIRMAN APOSTOLAKIS: No, it's not. Can you add the couple of paragraphs explaining that these approaches that people may follow, at least to open up the door?

MS. DROUIN: I think we're going to have to have a lot of discussion on this one. We certainly are going to discuss it. Where we're going to end up I don't know because I'm not convinced at this point that what we're doing is insufficient that I haven't been convinced, at least in my mind. But, you know, again when we go off and discuss a lot more. But I'm not convinced right now that doing what you want to do is really --

MEMBER SHACK: Improve your decisions?

MS. DROUIN: Improve the decision. And that's the bottom line, you know. What is it that we're doing or not doing that could really effect the decision. And I haven't seen that yet.

CHAIRMAN APOSTOLAKIS: And I don't know that it's not necessary for the decision.

MS. DROUIN: But if it's not going to effect our decision, this whole work is, you know, is factoring in the uncertainties to make sure we're not making bad decisions. We're factoring all of this into our decision making. And if it's not going to effect our decision --

MEMBER SHACK: Degree of refinement.

DR. PARRY: I think --

CHAIRMAN APOSTOLAKIS: I'm not going to disagree you with you say if it's not effecting my decision.

DR. PARRY: No.

CHAIRMAN APOSTOLAKIS: But what if it does? Then I have to understand where you're coming from.

MS. DROUIN: I think it does, I'm just not convinced right yet.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER SHACK: I mean, you could do those first, George --

MS. DROUIN: That's not to say I won't be convinced.

MEMBER SHACK: -- and then find out whether it would impact your decision.

CHAIRMAN APOSTOLAKIS: Did I ever say not do it? I keep saying having done all this --

MEMBER SHACK: Consider this as a first model, then Rev. 1 --

CHAIRMAN APOSTOLAKIS: No, no. Having done everything that you guys have presented, having screened out a lot of stuff, having, having, having I reached a point where now I can't screen anything anymore. Then I quantify. And you're saying no, you are not quantifying.

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

CHAIRMAN APOSTOLAKIS: But when I come to the decision maker --

MR. CANAVAN: Oh, no, I think --

MS. DROUIN: That's not what we're saying.

CHAIRMAN APOSTOLAKIS: I didn't see it in the report and ask you, do you quantify the second bullet and you said no.

DR. PARRY: No, well not in the way that it's written here, okay. We're clearly talking about alternate hypotheses, not alternate models, if you like. We're not talking about a single model with uncertainty that you can characterize. Because that will be -- that will ultimately find its way into a parameter that I can associate with an event on an event tree or a fault tree. And to me is, yes, it's a model uncertainty and you've used that model to generate the uncertainty distribution on a parameter. And I thought we discussed that somewhere, but I guess we didn't.

CHAIRMAN APOSTOLAKIS: You're expecting the user to be so sophisticated as to understand all these subtleties.

DR. PARRY: No. I think --

CHAIRMAN APOSTOLAKIS: All I'm saying is one or two paragraphs opening up in the second bullet--

DR. PARRY: Okay.

CHAIRMAN APOSTOLAKIS: The possibility of quantifying. And maybe in two years we can do it.

DR. PARRY: Actually, I think what I would prefer to do is make sure that that gets captured under the parameter uncertainty, but gets a home somewhere.

CHAIRMAN APOSTOLAKIS: As long as you say what it is.

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: I mean, a clear statement of model uncertainty is not only the case of alternate models. It can be a single model and we all know its uncertainty.

DR. PARRY: It's uncertainty in the predictions of a model?

CHAIRMAN APOSTOLAKIS: Yes. Now, of course, you can call it a parameter but it is model uncertainty in common parlance.

Does it complete the code? It does not give me, you know, the exact result. Like it's not

MAAP, for example.

MEMBER STETKAR: Gareth, let me --

MEMBER SHACK: I don't understand, George. MAPP is exactly alike in all cases.

MEMBER STETKAR: -- completely separate -- avoid confusion about uncertainty within the context of a specific model or what you're really trying to address specifically in that bullet. I didn't come across with the feeling that either document was instructing me as a practitioner very clearly that it is incumbent upon me to express my level of confidence in each of those models. There was a lot of guidance that says I must present to the decision maker these models and these results. But I didn't come away with that one next step; not how to do but that I must do it.

MEMBER BLEY: Level of confidence and the basis for it.

MEMBER STETKAR: Yes. Yes. That I must say I bet this amount of money that this one is correct and this amount of money that this one is not correct.

DR. PARRY: You're right that it's not explicitly in there. I think the intent was to --

MEMBER STETKAR: If the intent is there, I think you should really make a statement.

DR. PARRY: No. I agree.

MEMBER STETKAR: Not how to do it --

DR. PARRY: No, no. I agree.

MEMBER STETKAR: -- but whether you do a 1150 elicitation or whatever. But I as the --

DR. PARRY: That was the intent.

MEMBER STETKAR: -- as the analyst who is presenting the results of all of this to the decision maker --

DR. PARRY: Yes.

MEMBER STETKAR: -- who has no basis to actually independently make that judgment.

DR. PARRY: Right. I agree. And I think that was the intent.

MS. DROUIN: We've already agreed on that.

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

DR. PARRY: Okay.

MEMBER STETKAR: But, yes.

CHAIRMAN APOSTOLAKIS: That's exactly what I'm saying. I would go a little bit further than mention 1150 --

MS. DROUIN: We've gone a step further.

CHAIRMAN APOSTOLAKIS: No, I'm sorry.

First of all, it doesn't -- can I endorse what John just said, but I would mention 1150. It's a major study sponsored by this agency. So I don't know why we have to hide it. You don't have to say you have to do it that way, but in extreme cases --

MS. DROUIN: We're not hiding it, we're just saying --

CHAIRMAN APOSTOLAKIS: Then mention it.

MEMBER SHACK: Well on page 35 they actually do have embed a characterization of model uncertainty in the PRA by including several alternate models and providing weights, probabilities to represent the degree of credibility of the individual models.

CHAIRMAN APOSTOLAKIS: In what context? In what context?

MEMBER STETKAR: Model uncertainty.

CHAIRMAN APOSTOLAKIS: Okay. No. But in the context of the final quantification --

MEMBER STETKAR: No. This is way up front, though.

CHAIRMAN APOSTOLAKIS: Yes, way up front.

MEMBER STETKAR: Yes.

CHAIRMAN APOSTOLAKIS: I want it way at the end.

MS. DROUIN: We just don't want people coming away thinking that they have to. That's the key thing, that they have to go through and do a very formal uncertainty analysis as was done in 1150.

CHAIRMAN APOSTOLAKIS: And nobody ever said that.

MS. DROUIN: No.

CHAIRMAN APOSTOLAKIS: Nobody ever said you had to do it.

MS. DROUIN: And we mentioned that that's--

MR. CANAVAN: And I interpreted your question incorrectly at first. I think it was each one of the items which would take us --

CHAIRMAN APOSTOLAKIS: And in that case it wouldn't take you more than half an hour to look at the opening section or the section that deals with what kind of to do on seismic. Go to that SSHAC report and there is a table that tells you what kind of effort you need to do depending the problem.

MR. CANAVAN: Oh, I know that.

CHAIRMAN APOSTOLAKIS: You know that?

MR. CANAVAN: Oh, yes.

CHAIRMAN APOSTOLAKIS: Why doesn't that or something similar apply here? Something similar, it seems to me, applies here. That there we saw on issue of extreme national importance you do the complete 1150. But then most issues are not of extreme national importance, and the least one is where you pick up the phone and say "Ken, what do you think about this? I think A, and you put down A.

No. There is a graded approach, okay, and that's a NUREG, too.

So I think something graded here would be very helpful. Because at least you are keeping open the door for a later development. This NUREG doesn't have to cover everything.

MR. CANAVAN: I agree. But I think going down that road has its own set of difficulties which we've experienced before in terms of expert solicitation. I can provide you a couple of good examples. But in any event, I think the future holds doing more of that. So I think that maybe the paragraph should consider additions.

MS. DROUIN: I think we've understood your comment and we will take it under advisement.

CHAIRMAN APOSTOLAKIS: Good. Good.

MR. CANAVAN: Yes.

DR. PARRY: And also I think your other point about the single model that it's uncertainty, we need to somehow fold that in here too somehow. We'll need to find a home for that concept, too.

CHAIRMAN APOSTOLAKIS: I trust you are familiar with some publications that go -- background?

DR. PARRY: Sorry.

CHAIRMAN APOSTOLAKIS: Are you familiar with some papers that are dealing with issues like that? I mean, it's not entirely new.

MS. DROUIN: No, it's not.

DR. PARRY: No, no, it's entirely new. No, no, no.

CHAIRMAN APOSTOLAKIS: Okay.

DR. PARRY: Not specific ones.

MS. DROUIN: Okay.

DR. PARRY: Okay.

MS. DROUIN: I thought we would get to the example that in terms of the technical part of walking you through this was the last thing is to walk you through an example and then we were going to cover, of course, the status and future work. And then should, hopefully, still leave us with enough time because, George, said you had some things you wanted to go over also at the end.

CHAIRMAN APOSTOLAKIS: Well, I don't need much time. But we also need time for each member to comment.

MS. DROUIN: So Don's going to walk through the example.

MR. VANOVER: Okay. I'll try not to take too long. In section 453 of the EPRI report we included an example application of the whole process. And the first slide is just a re-echoing of what the process says we're going to follow in doing this in walking through the example.

So the important parts are across the middle where we're going to first characterize the manner in which the PRA model is used. We're going to identify application specific contributors.

In this example we didn't make any modifications to the PRA model so we don't have to worry about the down branch to the logic structure of the model.

We're going to assess the sources of uncertainty in the context of application specific contributors from the work we did on the base model.

We're also going to look at other sources of model uncertainty. And what's not shown here, but I think you'll see an example, that other issues come up that aren't in any of those tables but they show up as specific contributors for this example.

And then we're going to continue on with what we do with the candidate source of uncertainty in the context of providing sensitivity studies.

So the first part, the first box in that picture is to characterize the manner in which the PRA model is used. So a hypothetical example is a surveillance frequency change on the HPCI pump valve and flow test per the approved NEI 04-10 methodology which allows the surveillance frequencies to be controlled by a licensee process.

As part of the description of how we're going to use the PRA model we would also include what the acceptance guidelines are for the application. In this case CDF and LERF. The other part of how we're going to use the PRA model, we're going to look at the HPCI fail to start contribution and assume that all that fail to start probability can be time related.

We also have to put some information regarding the other components, the valves. This test is to uniquely test the pump, but there's other tests at the site that stroke the valves. So the limiting test interval is not defined for the valves by this test, but it is for the pump. So we've minimized the scope of what we're impacting to just the pump block for the application.

So that would provide the context of how we're going to use the PRA model and what we're going to do.

The next block we're going to characterize any modifications to the PRA model. Here we're not making any logic model changes. We're not introducing new basic events or new sequences to the model or new assumptions related to logic structure. The only thing we're going to change is to increase the man failure probability of the HPCI pump turbine, assessing a change from the test interval from quarterly to semi-annually. So the figure on the right shows the simplified model where the failure probability for the component is estimated approximately based on lambda T over two such that if we doubled the test interval, we would double the failure probability for the component.

So that's the model uncertainty is our choice of model for the change in the failure probability given the change --

CHAIRMAN APOSTOLAKIS: What's the model uncertainty again?

MR. VANOVER: The choice -- the standby failure rate model that lambda T over two is appropriate representation of the change in the failure probability given the change in the test interval.

So the next step in the process would be to identify application-specific contributors. From a paramative uncertainty perspective we reviewed all the cutsets involved in the change, the calculation of delta CDF and LERF. And there's a large number of cutsets with diverse types of contributors. So our assessment was given that and the fact that our mean value in the base model was fairly close to the point estimate to begin with. When we calculated the delta for this application we're going to assume that that's close enough for this application considering uncertainties involved and everything.

So we document that process. Talked about calculating delta CDF only based on the point estimates of the means rather than re-performing the propagation and comparing the deltas that way.

The next part of identifying the application-specific contributors is we look at all the cutsets in detail and identify what things show up that are impacting our change evaluation. So obviously the fail to start of the pump shows up in every cutset that matters. What shows up with that basic event is the operator failure probably to depressurize given other failures of the HPCI and RCIC systems.

The RCIC fail to start probability becomes important, so --

CHAIRMAN APOSTOLAKIS: Operator fails to depressurize the HEP values?

MR. VANOVER: Right. So one of the accident sequences that could get to core damage given a change in the HPCI failure probability would be their failure to depressurize given failure of HPCI and RCIC.

CHAIRMAN APOSTOLAKIS: Sorry. Just keep going.

So, Don, what you're saying here is that there are additional model uncertainties that come into the picture?

MR. VANOVER: There are additional sources of uncertainty that come into the picture based on the specific application.

CHAIRMAN APOSTOLAKIS: Good.

MR. VANOVER: All the initiating events that show up in combination with the HPCI fail to start, the transient frequencies, the medium LOCA frequency. More importantly in this case the LOOP initiating event frequency given that we're sensitive to LOOP initiating event frequencies, the recovery probabilities, the fail to recovery probabilities.

So we look at everything and try to identify what is important for this application of the model. Some of these issues are model uncertainty, some of them are not.

CHAIRMAN APOSTOLAKIS: And you do this by using the tables that you have.

MR. VANOVER: We do this by looking at the cutsets for the application first. Once we identify those important set, we have that list, and then we compare this list to the tables.

CHAIRMAN APOSTOLAKIS: I thought the tables were going to help you identify.

MR. VANOVER: They will.

CHAIRMAN APOSTOLAKIS: That's the wrong impression?

MR. CANAVAN: No, no. He did that.

CHAIRMAN APOSTOLAKIS: Huh?

MR. VANOVER: So we still have to go back -- okay, so that's what mattered in my base case assessment, what contributed in my delta CDF and delta LERF assessment. Well what didn't show up in the cutsets, but might matter.

So then I look at table A1 and A2 and A3 sources and try to look at what parts of the model are affected, realizing that I'm sensitive to the LOOP scenarios and the early time frame scenarios that I need HPCI to operate.

After I had done my base model assessment in Appendix B of the EPRI report, I identified four of those issues. I had about 15 issues in Appendix B that were sort of the generic list that I need to look at for every application for this plant. And given that, I was able to screen some of those as being not part of this application. But the set that could matter was this set of four. The fact that I don't have explicit representation of: Load shedding for battery life; the percentage of time I'm assuming two diesel HVAC vans are required; the credit I take for core melt arrest at high pressure for LERF considerations, and; also for LEFT considerations the likelihood that if I have a core melt progression past vessel failure, that it overwhelms my vapor suppression capabilities.

CHAIRMAN APOSTOLAKIS: The original model approximation of lambda T over two now is not important?

MR. VANOVER: It's not part of this assessment. What I'm looking at here is a qualitative and -- okay. What parts of the model are impacted from my base that I identified in Appendix B, the sequences I'm concerned about for this application are early high pressure loss of injection scenarios given I'm changing the HPCI failure probability --

CHAIRMAN APOSTOLAKIS: So what happened to this lambda T over two --

MR. VANOVER: It got changed in my base case assessment. I changed the failure probability of HPCI. So slide 51 were given I made that change to the failure probability. These are the things that showed up as important given I made that change to the model.

MR. CANAVAN: George is a slide ahead.

MR. VANOVER: In slide 52 then I go back and look at all the other candidate sources of uncertainty are what -- you know, what else might be important beyond that initial one.

MR. CANAVAN: It's sort of looking and make an assessment of what it is.

MR. VANOVER: Okay. So here I did some of the combination of screening and realistic sensitivity.

Okay. My initial go through was well the battery life might be important. But when I looked at the sequences that are involved with the HPCI failures, I don't have any scenarios that get me up to four hours to begin with. I'm only getting up to two hours given HPCI fails. So that assumption I screen qualitatively as not being relevant to this application even though it could have impact these scenarios.

I looked at the risk achievement worth for the percentage of time that the two diesel HVAC fans are required and was able to screen that as a bounding case. Even if I assumed it was all the time, it wouldn't have changed my answer. The risk achievement worth of that event was very small.

Similarly for the third bullet if I assumed that I couldn't credit core melt arrest in-vessel at high pressure, high pressure scenarios were also the sequences that are important in this application given, again, that I'm looking at HPCI failures that typically led to early high pressure core damage sequences.

I could not exclude the last bullet, the ex-vessel core melt progression overwhelms vapor suppression. It didn't show up in my dominant LERF cutsets, but given I had identified that as a candidate source of uncertainty, I retained that for a sensitivity study. So it sort of truncated out in the base model assessment but I retained that since I had identified that a potential from the base assessment.

So on slide 53 and 54 after I did this initial screening, some of it qualitative some of it quantitative, to narrow down the set of issues I was most concerned about, I did a sensitivity on the standby failure rate model. The NEI 04-10 methodology actually requires that that sensitivity be done anyway. So if my assumption that it's a lambda constant linear failure probability goes out of whack and maybe it increases geometrically, I look at a three times factors in the standby failure rate used for the assessment that's dictated by the NEI 04-10 methodology.

So I did a sensitivity on the standby failure rate. We did sensitivities on all the human errors associating with failure to depressurize --

CHAIRMAN APOSTOLAKIS: I'm sorry. Now I think I'm lost. The sensitivities done on which one? What is sensitivity here?

MR. VANOVER: I'm recalculating --

CHAIRMAN APOSTOLAKIS: The CDF? On the delta CDF?

MR. VANOVER: I have to recalculate both to get a new delta CDF. So I have to re-establish --

and this is in Tim's discussion where we have -- you know, you make a modeling assumption change or a change -- you not only change your delta assessment but you change your base case assessment.

CHAIRMAN APOSTOLAKIS: So you're looking at both?

MR. VANOVER: Right. So you have to calculate what your change in the base is in addition to your change for the application and then measure the delta from that.

CHAIRMAN APOSTOLAKIS: Sometimes things that may be important for a delta are not important for the base case?

MR. VANOVER: Right.

CHAIRMAN APOSTOLAKIS: Here you say all these are important to both?

MR. VANOVER: Well, my acceptance guidelines is in the context of delta for the NEI 04-10.

CHAIRMAN APOSTOLAKIS: So you're looking at delta?

MR. VANOVER: I'm focusing on delta, but to calculate the delta I have to adjust the base also.

CHAIRMAN APOSTOLAKIS: Yes.

MR. VANOVER: Okay. I didn't screen the

RCIC fails to start probability even though that wasn't on table A1, 2 or 3. It showed up enough in the cutsets that it was deemed an important issue to investigate further.

And then the ex-vessel core melt progression.

So we picked alternate hypotheses for these values, some of them were 95th percentile values. For the ex-vessel core melt progression we made more than a 95 percentile because the low likelihoods associated with them, it wasn't enough to just go to 95th. We wanted to look at a thousand times increase because we assumed that that's very unlikely in the base model. So we looked at what if it did happen for high pressure scenarios and was more likely in low pressure scenarios.

The sort of qualitative evaluation which shows up in table 41 of the report also identified some logical combinations of sensitivities where individually these things wouldn't necessarily change our decision, but if we looked at them combined would they change our decision. So we also performed sensitivities with these combinations. Given LOOP was a big contributor and the RCIC failed to start, we identified the LOOP related issues, diesel common cause. And then we also identified the RCIC failed to start with the failure to pressurize human error probabilities.

So we ran different -- all the sensitivities for these eight cases that we had identified, the goal being to identify which are the most important modeling uncertainties that could change our decision.

When we got done with the sensitivity analyses, we were left with just two issues for this particular application. The first one and the utmost importance being the standby failure rate model used for the assessment. If the failure probability were to triple over the extended time period rather than double, then it could have an impact on our acceptance guidelines.

And we also identified the failure to depressurize human error probabilities as a key source of uncertainty for this application.

CHAIRMAN APOSTOLAKIS: Just to understand, why did you triple a failure rate?

MR. VANOVER: As a sensitivity case, that's the guidance per the NEI 04-10 methodology.

CHAIRMAN APOSTOLAKIS: You should triple it?

MR. VANOVER: You should triple it because that's about -- on a log normal tripling the probability would be at about the 95 percentile.

MEMBER STETKAR: Did you really triple it or did you set it equal to the 95th percentile?

MR. VANOVER: I really tripled it.

MEMBER STETKAR: Well, in the report I think it says you set it at the 95 percentile.

MR. VANOVER: For a lot of the other ones I set to the 95th. But --

MEMBER STETKAR: You didn't tell us in the report.

MR. VANOVER: For the standby failure rate I tripled it, I believe.

MEMBER BLEY: Can I sneak something -- oh, I'm sorry. Go ahead.

MR. VANOVER: Okay. You're right. I did--

MEMBER BLEY: It's going to be quick. It's quick.

MR. VANOVER: You are correct. I did say at the 95th. In this case I tripled it. On the other ones I didn't necessarily triple it.

MEMBER STETKAR: Okay. That doesn't change what I'm going to eventually ask.

MEMBER BLEY: What I really liked about the example was this idea it's like looking for knock-on events, the events of this one changing, looking at all that. I think that's really dynamite. It's a thorough good look.

What I didn't like is I guess related to NEI 04-10, the thing that I always worry about --

MR. VANOVER: I didn't write that one.

MEMBER BLEY: -- if you start -- well, the thing I'd worry about, you know and your table flags the standard failure rate model is a key issue, and you've got that all the way along. But when you start stretching these out, eventually you can stretch them so far that you get a new failure mode.

MR. VANOVER: Oh, right. Exactly.

MEMBER BLEY: And if that happened, we don't know where that happened.

MR. VANOVER: I agree.

MEMBER BLEY: If that happens you're going to hell of a lot more than triple rate.

MR. VANOVER: That's exactly right. And I've been at the expert panel meetings saying just that. Okay. When people try to -- the process is very -- this is one input to the process for the NEI 04-10 methodology.

MEMBER BLEY: Yes.

MR. VANOVER: One of the inputs is the risk assessment. Another part is the system managers typically do operating experience reviews. They look at other sites that might already be testing at different intervals. They look at for similar type components, they look for qualitative reasons to also say why it's okay.

When we tried to change one of the surveillance intervals from quarterly to every refueling outage, that exact issue came up. You know, the standby failure model, we can't extrapolate it that far. I've said that. But we --

MEMBER BLEY: Okay. Well, I guess the only thing I'd say with respect to that in the write up there was no hint at the end. You know, at the last thing you said about it was it was conservative and everything's grand. So that's the --

MR. VANOVER: -- check of the PM basis. So they look back the reasons why they're doing the PMs to check if they move a PM, are they going to get a failure mode that they haven't seen before because of the PM.

MEMBER BLEY: That's good, but I didn't get a hint of that.

MR. VANOVER: Yes, I didn't fully explain the NEI 04-10 methodology but it --

MEMBER BLEY: Just to say that might go better.

I'm sorry. That was longer than I expected.

MEMBER STETKAR: But it touched on something I was going to bring up, but a little more specifically. And that is I thought that this -- by the way, I thought was a great example of how you systematically go through and hunt for sources of uncertainty even dredging up thins that other people wouldn't normally think about. However, in this particular case, this HPCI standby failure rate model, this is a prime example in my mind of a way to treat model uncertainty that in fact is not addressed. It's a great example, but I was really troubled by it. And in particular there are three models that I'm aware of that people have used to treat standby failures. One is the linear standby failure rate model lambda T over two which has a lot of conceptional problems with it in many cases, especially if you go too small. Because the implication of that is that that the best test interval is zero, meaning I start something infinitely fast --

MR. VANOVER: Right.

MEMBER STETKAR: -- and therefore I will see no failures, which is absurd. So there's that physical criticism of that model.

So is it the consensus model that everyone believes in? No. So there are other models.

One model is that there's a combination of something that some people call shock failures that some component of something failing on demand is simply because I demand it to change state. It has nothing to do with the interval that it's a standby, and a combination of standby. So that's a different type of model which gives you a much different implication about the effect of extending a test interval.

And then there's a third one that Dennis mentioned, and you did also, Don, that there might be not a linear relationship with time but some time based relationship which would potentially make extensions even further look worse.

This example shows that the standby failure rate model within the context of that model according to the rule of setting something equal to the 95th percentile or tripling it, I don't care what you do, could be an important source of uncertainty.

Well if I use the SSHAC failure rate model with a fairly high fraction of the failures due to SSHAC, I would be immediately led to the conclusion that there's no problem to extend this interval. Now that's an important piece of information to me as a decision making about which model I use.

You've fortuitously identified the standby failure rate model as a source of uncertainty only because the value of lambda and the value of extension of T that you use happen to put you over that numerical threshold. If the uncertainty in lambda had been less or the absolute value in lambda had been less or the extension in T had been less, you would not have identified this as a potentially important source of uncertainty.

Now I don't want to get hung up on a specific example. I'm trying to get to the process of saying how does variation in one parameter, lambda, within the construct of this particular model tell me anything about the uncertainty in my decision, the confidence in my decision from those two other models that are out there that I have not even examined? I have examined, I haven't thought about them, I haven't even mentioned them. And that's the thing that bothered me about this particular example.

I thought that it was a fine candidate of showing how you could address two or three different alternate models as an impact on the final decision, and this wasn't there.

MR. VANOVER: Well I mean it clearly could influence the decision. So given that is the case, then when we got to the integrated decision panel process, we would be more reliant on looking at other operating experience, looking at well how likely are the failures that we have had time related or are the failures we had really SSHAC related. So that --

MEMBER STETKAR: But that conclusion to go do that is simply fortuitous in this case because of the specific parameter distribution that I have for lambda. If I had a different parameter distribution, I would not have identified this as an important source of uncertainty. And the SSHAC model would have made things look better. So, okay, I grant you that.

The time dependent, some sort of time dependent exponential model might have pushed things over the limit, and I would not have been forced to look at that possibility from that model if the uncertainty in this parameter, lambda, this linear parameter, had been small enough such that whatever you did with it or if the absolute value -- I don't care whether you multiple the mean by three or whether you set the value to the 95th percentile about that mean. If that had been small enough, I wouldn't have been forced to go look at that other model recognizing that it's another model.

CHAIRMAN APOSTOLAKIS: I think that in this case something that would have happened would go back to your comment that you really have to understand and dig deeper into what's going on. So what I would say, let's say I'm ignorant of the SSHAC model and I'm looking to the linear model, lambda T over two. Then it seems to me in order to understand what's happening there I say what am I assuming here. I'm assuming that the probability of failure in a small delta t is constant, right, given that I do that at the beginning. And I'm saying that out loud. And somebody who understands what's happening there might jump in and say "But wait a minute." When I change state, when I demand the thing, I'm imposing a lot of stresses the thing and I have a higher probability of failure. So can you say, you know, lambda, that the probability of failure is constant over all core delta T? And that would be the beginning.

In other words, by understanding the physics more, you might question even though you are unaware of another model. You're saying I'm failing really the moment I demanded or there is a very high probability that I will fail then. And then you look around for some other way.

MR. VANOVER: Yes. For this to get approved, the systems manager would probably have to dig up information that said the types of failures we experience are more SSHAC related than time related.

CHAIRMAN APOSTOLAKIS: Right.

MR. VANOVER: And that would provide added confidence to the panel that, indeed, this assessment is most likely conservative so that --

CHAIRMAN APOSTOLAKIS: Or is not appropriate.

MR. VANOVER: Is not appropriate so that we're bounding the delta that we're calculating so that we're not going to -- the decision to change the surveillance frequency would be acceptable given all the inputs to the process.

DR. PARRY: I'm remembering now that there was some discussion of this in the SER on the IST pilot for Comanche Peak. Because this was one of the issues that came up at that point.

MR. VANOVER: I'm not familiar with that one.

DR. PARRY: No. That was back in 19 -- no. I say about a century -- early this century, anyway.

MEMBER STETKAR: If I can be a little careful here, and I was afraid that this was going to refocus a bit. My concern is that -- and the problem with this particular example is that everyone falls back to the case that this particular application and this example demonstrated that this was a potential important source of uncertainty, and therefore now we need to go examine it.

I'm concerned about the opposite case. I'm concerned about the case that simply because you vary the value of a parameter, let's say you did that parameter variation and everything came out fine. I met all of the acceptance criteria, therefore this is not a key source of uncertainty, therefore I do not need to examine it anymore.

I have not examined whether the uncertainty introduced from using the SSHAC model versus this model could effect my decision. Now knowing about those models I know that the SSHAC model could only make things better. I happen to know that, but I haven't examined that. Maybe I'm an analyst who doesn't know that. I haven't examined that model.

If the results come out favorable that it is not a key source of uncertainty, I have not examined a nonlinear model, an exponential models could perhaps depending on the exponential relationship, it could put me over the boundary and therefore identified that particular model as a key source of uncertainty. And I haven't looked at that at that function. I wouldn't have.

MR. VANOVER: In the context of the full NEI 04-10 methodology the standby failure rate model is always a candidate source of uncertainty and it needs to be examined with sensitivity cases.

The methodology also requires other inputs to the process. There's performance monitoring, there are staggered approached, phased approaches to the changed that provide checks and balances to just the risk-informed piece of the puzzle.

MEMBER STETKAR: The concern, it's troubling because I like to use specific examples to illustrate a broader concern. This specific example is an example to me of the broader concern of using variations in the value of a specific parameter as a surrogate for looking -- identifying uncertainties from different possible models.

MR. VANOVER: Right.

MEMBER STETKAR: That's the broader

concern. Not that the standby failure rate model is always an important source of uncertainty or that NEI 04-10 or whatever, or that this is the easiest example that I could find in the report that didn't have anything to do with common cause failures or human reliability, or anything where using variation in a parameter value, a lambda in this case, as a surrogate for identification of sources of uncertainty from different possible models may not work.

MR. CANAVAN: Broader point well taken. I think that's important.

I will point out, though, that we're going to be in this case a lot where we have a case where 9401 is a methodology at looking at testing intervals. 9401 specifies how to proceed and the methodology on how to do that. What we're doing is we're not assessing whether or not the methodology provided, which actually I do believe considered time-based linear, time-based nonlinear and SSHAC model. I'm a big fan of SSHAC model.

MR. VANOVER: I like SSHAC.

MR. CANAVAN: Yes, so do I. Because it works better.

But in any event, I think they looked at that and said for the kind of intervals we're talking about and the PM basis generally tells us the failure rates are linear, you know they're very linear because PMs that they're designed, they're doing PMs monthly for components that shouldn't be switched out for two years or three years. So if we go to quarterly, we haven't hazarded that model.

And I think for the SSHAC model they said it's always positive. So I think they had some of that discussion.

But broader point well taken. We need to make sure that when we have a methodology that's given us, sort of envelops the uncertainties that we might not have to consider because they already "took care of it," we need to make sure that it's taken care of for the cases we're using the methodology for.

CHAIRMAN APOSTOLAKIS: I still think -- first of all, I do agree.

MR. CANAVAN: Yes. And I agree too.

CHAIRMAN APOSTOLAKIS: And the complaint about a human error probability is in a similar nature. But you taking the 95 percentile does not really tell me that you are conservative or anything.

It eventually comes down to the physics of it. I mean, you know say exponential model. What is the basis for it? What are the assumptions you have?

You know. So if I start out with being ignorant of the explanation, if I start with a linear model and then I question what is the assumption behind it and whether it's valued, then I think I'll be on my way of seeing whether there are other assumptions I can make.

MEMBER STETKAR: I am very sympathetic, though, to the practicalites of doing things. You know, in a real world application you have to be a little bit careful about not telling people to go back and reinvent the physics every time.

CHAIRMAN APOSTOLAKIS: No, but --

MEMBER STETKAR: But in cases like this where there are fairly -- going back to what is a source of modeling uncertainty --

MR. VANOVER: The model is important.

MEMBER STETKAR: -- you know, are there different models that are being used and are generally well accepted throughout the community? Yes, there are. Now how many of them are there? I don't know, I can name three. There might be others, i'm not sure. So that it satisfies the criterion that I don't have to go back and reinvent physics in terms of going back to examining all of the assumptions about everything.

CHAIRMAN APOSTOLAKIS: You're not reinventing.

MEMBER STETKAR: No, but just in terms of the practicalites in terms of what guidance do you give people. The principle is good, George. But --

CHAIRMAN APOSTOLAKIS: In this case I think it would have worked. Because if I said that lambda is close and you were present, you would say no. My experience is that during the demand that then we're starting out.

MEMBER STETKAR: That's okay.

CHAIRMAN APOSTOLAKIS: That's what I say. That is one way of approaching it, I mean because you don't have to be necessarily be aware --

MEMBER STETKAR: It is a way.

CHAIRMAN APOSTOLAKIS: Yes.

Anything else you guys want to say?

MR. VANOVER: I think if you were the reviewer of this application and you said well what about this other exponential growth, then it would be incumbent upon me to provide confidence that I'm dominated by SSHAC, say, or I'm going to have compensatory measures in place for performance monitoring.

CHAIRMAN APOSTOLAKIS: That's my point, though.

MEMBER STETKAR: If I were the right

reviewer, perhaps I would have raised it. You know, that comes back to what Mary was saying earlier that some reviewers might raise it, other reviewers might not. However, if I back myself up as I'm the decision maker and you're presenting this to me, and again not in the particular context of this example where it was identified as an important source of uncertainty but in a reverse context. You did the variation over lambda and concluded this is not an important source of uncertainty.

MR. VANOVER: But I would still show you that sensitivity and you could say I think it is important because if I use this alternate model --

MEMBER STETKAR: Not as a decision maker I'm not going to do that. I don't know about those models.

CHAIRMAN APOSTOLAKIS: So let me now push this to the point I was making earlier. There are the three models. Okay. And the explanation takes you over. Then what I was suggesting earlier is to look at the three, look at the assumptions behind them. I don't know what the assumption behind the explanation is. Look at the SSHAC model, which I understand what the assumption is. Look at the linear model, I understand the assumption. And then make a judgment as to how likely these assumptions are to be the true behavior. Because I'm not going to kill the application because somebody has a body which is crazy.

MR. VANOVER: Right. Right.

CHAIRMAN APOSTOLAKIS: That's my point.

MEMBER STETKAR: And it's a great tutorial example if you take it out to that. If instead the way it's put together, which I recognize from a real plant real application. But as a tutorial that's precisely true. A lot of the things that were being said over small time intervals, there's a lot of evidence that things do behave more linearly than exponentially. That's all very, very good, excellent information as supporting evidence to the decision maker that yes indeed this one model might push me over the limit, but in this particular application we are not going to assign very high credibility to that model. High confidence, let's say, in that model for this particular application.

If you're extending the test interval lap to 37 years, one might draw a different conclusion.

CHAIRMAN APOSTOLAKIS: Have we exhausted this issue? I think we understand your point.

MS. DROUIN: I think we have.

DR. PARRY: Yes, we have. And I think we agree with what you were just saying.

CHAIRMAN APOSTOLAKIS: Good. Now the second bullet. "Need to provide confidence" I mean that means I really want this to go through.

MR. VANOVER: I'm sorry?

CHAIRMAN APOSTOLAKIS: Why do you need to provide confidence to the decision maker that these will not change their decision. All you have to do is evaluate whether it changes or not.

MR. VANOVER: No, I have to provide that type of information to the decision maker.

CHAIRMAN APOSTOLAKIS: If you are making the case that --

MR. VANOVER: That I'm okay.

CHAIRMAN APOSTOLAKIS: Right. All right.

So the last slide, please, or the last two.

MS. DROUIN: Okay. As we started off at the beginning this morning that our intent is to finalize this revision of the NUREG, you know it's not by the end of the calendar year, again we think it's very important to get it out there, have a workshop on it, have people start using it, get lessons learned and at the same time, you know, look to see what's happening on the standard. Bring all that together. I mean, I already have it in our budget for the next two years to already start on the revision to this, but we need to get it out the door.

CHAIRMAN APOSTOLAKIS: Right.

MR. CANAVAN: Let me chine in real quick. As you mentioned from the peer reviews and from our own knowledge of the industry, we're a little bit behind on this. I don't think we're doing the kind of job, this is a significant improvement over what's out there. So we'd like to get it out as quick as we can and get people getting using it and then go through the processes of --

CHAIRMAN APOSTOLAKIS: If you set the limitations up front of what you're doing, I think it's fine. You can issue it. I mean, we're going to have some comments.

MS. DROUIN: We have a week we have set aside among the team here that we're just going to go front to back. We put enough time after this so that we've given --

CHAIRMAN APOSTOLAKIS: Good.

MS. DROUIN: -- ourself time to get the transcript and do a final scrubbing and the changes that we can make to get it out the door.

CHAIRMAN APOSTOLAKIS: Now if you come before the full Committee in November, then we'll have to have it three weeks or so before. Are you going to have it?

MS. DROUIN: Absolutely not.

CHAIRMAN APOSTOLAKIS: So you come in December? I mean if we're going to write a letter, it should be on the final version, don't you think? Is it terrible if you come in December?

MS. DROUIN: It's not terrible.

CHAIRMAN APOSTOLAKIS: You're going to get the letter a few weeks later.

MEMBER SHACK: Well, they're already scheduled to come in November.

CHAIRMAN APOSTOLAKIS: I thought with the power vested in you, you can change just like that.

MS. DROUIN: Yes, but I guess the question is, I mean I thought when we come to the full Committee, it's for like an hour.

CHAIRMAN APOSTOLAKIS: Yes. But, you know, we'll write a letter and what am I going to say?

MS. DROUIN: I mean in your letter you can say take these things into account. I'm just trying to give you some options here.

CHAIRMAN APOSTOLAKIS: But what is bad

about coming in December?

MS. DROUIN: I have no problem with coming in December.

CHAIRMAN APOSTOLAKIS: Good. So we'll do that.

DR. PARRY: What day in November were we coming?

CHAIRMAN APOSTOLAKIS: November is the first week. So we need the thing two or three weeks earlier, I think it's very tight for you guys.

MS. DROUIN: But my problem is I don't want to make a promise that if you back out three weeks, that we're going to have this thing ready.

MEMBER STETKAR: Even by the second week in November, for example.

MS. DROUIN: Well, I don't know that we're going to have -- the chances of us having it ready is not going to be good.

CHAIRMAN APOSTOLAKIS: I think the Committee only comments on what it has in its hands. So if you -- you know, they would comment on the current version. Because we've had that problem with the ESBWR PRA.

MS. DROUIN: Well, I know. But you haven't had problems with us.

CHAIRMAN APOSTOLAKIS: No, never.

MS. DROUIN: But what we would do is we would come in and tell you and walk you though what we have done. I mean, I can promise that we will do that, and that's what our intent would be. To come and show you here's what we've done in this version. And if we didn't do something, you know we're not going to hide it. We'll let you know we didn't do something.

CHAIRMAN APOSTOLAKIS: Well if we say December, will you be able to send it to us by the 15th of November.

MS. DROUIN: I can't guarantee it. You know, we've just got -- you know, if there was nothing else on this team's plate but this document, it would be close. But we have to wait for the transcript. I mean, we aren't going to wait for the transcript to get started, but we aren't even scheduled to get together until almost the last week of October to start walking through all of this.

CHAIRMAN APOSTOLAKIS: But you understand our problem, too?

MS. DROUIN: Yes.

CHAIRMAN APOSTOLAKIS: Okay. So let's leave it up in the air and the management will --

MS. DROUIN: But you can get a sense of whether we're talking a November or a December full Committee meeting?

CHAIRMAN APOSTOLAKIS: I don't know. I don't know what kind of letter we can write if we don't have the report.

MR. CANAVAN: Whenever you want it, I'll get you --

CHAIRMAN APOSTOLAKIS: We cannot write a letter. We cannot write a letter.

MS. DROUIN: Now wait --

CHAIRMAN APOSTOLAKIS: It's not just me. I mean, the Committee wants --

MS. DROUIN: No, no, no, I understand. But you all have written letters interim in the past without the final --

CHAIRMAN APOSTOLAKIS: On the documents that we had at the time.

MEMBER STETKAR: Well, but I think --

CHAIRMAN APOSTOLAKIS: If it's on this, that's fine.

MEMBER STETKAR: What I hear, Mary, you have no problem writing an interim letter on this document.

MS. DROUIN: No. Because I don't think

you all had serious problems with the report.

CHAIRMAN APOSTOLAKIS: Okay. So there's no problem.

DR. PARRY: You're probably being nice.

CHAIRMAN APOSTOLAKIS: I think Mary is right.

MS. DROUIN: Well, I mean and you all --

CHAIRMAN APOSTOLAKIS: There will be suggestions for revision.

MS. DROUIN: -- are going to make recommendations. And we have agreed. I hadn't heard any recommendation that gave us heartburn.

CHAIRMAN APOSTOLAKIS: I don't think, as a person now because I can't speak for the Committee, that the recommendation will be do no publish. I don't think, no.

MS. DROUIN: And that's the only one that would concern me.

CHAIRMAN APOSTOLAKIS: Yes, but the Committee has to agree with it.

MS. DROUIN: Right.

CHAIRMAN APOSTOLAKIS: Not me.

MEMBER SHACK: Now the point is that can we write that kind of a letter based on this document. I think that's Mary's question is can we do that?

CHAIRMAN APOSTOLAKIS: Do what?

MEMBER SHACK: Do you think the Committee has enough information on this document to decide that the changes we're talking about are likely to be so substantial we would change our mind about the publish or not to publish?

CHAIRMAN APOSTOLAKIS: I don't know.

MEMBER SHACK: Well that's something we need to discuss as a Committee.

CHAIRMAN APOSTOLAKIS: Yes, that's right.

MS. DROUIN: Right.

MEMBER SHACK: But I think that's the kind of input she's looking for here. Not --

CHAIRMAN APOSTOLAKIS: When you're holding these workshops, what do you mean by workshop?x

MS. DROUIN: Okay. That's the next slide.

Thank you, Don.

You know, we wanted to develop and hold a workshop. We're still talking about this workshop when and where and how long. We were trying to do it as early as possible in the year. And it may be more than one workshop. But I would anticipate a lot of insights coming out of that workshop.

CHAIRMAN APOSTOLAKIS: But what is the format? What do you do in the workshop?

MS. DROUIN: Well, that's what we have to figure out. I mean I can tell you my vision.

CHAIRMAN APOSTOLAKIS: Okay.

MS. DROUIN: I mean, my vision is to really walk them through, and it would be more than today. It's not just presenting the NUREG, but try and walk them through, provide examples, find out what are they not following, what they are following. Give them something ahead of time of the workshop so they aren't seeing everything cold at the workshop. Because I would visualize the workshop as a two-way thing for them to understand but also us to get feedback. And if they're just seeing this stuff in the real time, you know at the workshop it's not going to -- they haven't had a chance to really digest it.

MR. CANAVAN: It's not just strictly the mechanics. It's the fundamentals behind uncertainty analysis. Things that we all take for granted that will need to be passed on to the next generation of risk personnel. And that's who comes to these things.

So I think what we will be doing is a fundamentals exercise and then a practical exercise which is more the NUREG in front of you was originally NUREG and the EPRI report. We tended to be more practical and the fundamentals was intended to be the technical basis report. And we've moved a lot of that forward in the interest of sort of having both in one document. But I think we would want to transfer a lot of the fundamentals as well. That's why it's over a day.

I think practically we could this in half a day. But fundamentals we'd need a whole day. So a day and a half type of thing on this is what we --

CHAIRMAN APOSTOLAKIS: A day and a half for all this? I doubt it if you want feedback.

MR. CANAVAN: Yes.

MS. DROUIN: But I can't hold the workshop if we haven't published the document. The document needs to be out there.

MR. CANAVAN: Yes.

MS. DROUIN: The public needs time to have read it and tried to digest it.

CHAIRMAN APOSTOLAKIS: Okay.

MS. DROUIN: And the last thing is, I mean I personally have made at least in my mind that we need to already be starting and planning for the next revision of this NUREG. And we have factored that into our budget for 2009 and 2010, but how far this next revision goes is to -- the decision to be made, you know how much more do we put in this next revision or do we wait until Rev. 2. Because I can guarantee you there will be a Rev. 2 as much as there'll be a Rev. 1. Because the standard is stabilized, you know, this will always be a revision behind the standard.

CHAIRMAN APOSTOLAKIS: You done?

MS. DROUIN: I'm done.

CHAIRMAN APOSTOLAKIS: Okay. Any questions?

Let me give you a few comments here. A lot of them have been covered already.

I have a question really on page 48 of your NUREG where you saying that in a Monte Carlo simulation, you're trying to give guidance as to how many times one should under Monte Carlo stuff. And you say that there is a standard there of the mean equation one sigma over square of the event, correct? Page 48.

MS. DROUIN: What section are you in? Okay. 4127. Okay.

CHAIRMAN APOSTOLAKIS: That's not page 48 for you?

MS. DROUIN: No. For me it's 49. But that's okay.

CHAIRMAN APOSTOLAKIS: Oh. And then you go on and say, you know, that basically what you do you do it for a number event, you calculate I guess sigma is the standard deviation of the resulting distribution, correct?

DR. PARRY: Of the sampling distribution, yes.

CHAIRMAN APOSTOLAKIS: Yes. And which is the same thing as maybe doing it, say, for a thousand times if you calculate the mean of the output or some case in time you do it for 2000; if it doesn't change much essentially the good.

There was another approach that I found in an old book by Shooman where he gives you think in terms of a quantity epsilon. These are two little equation. I can give them to you if you want. It's on page 504 of the book. Do you have the book? You're an old timer.

DR. PARRY: No, I don't have that book.

CHAIRMAN APOSTOLAKIS: *Probabilistic Reliability*?

DR. PARRY: No. No, I don't have that.

CHAIRMAN APOSTOLAKIS: Okay. So you want me to send them to you?

DR. PARRY: Yes.

CHAIRMAN APOSTOLAKIS: All right. Okay.

MEMBER STETKAR: The important point,

though, George is that they do have -- I think in the previous version it mentioned X number of samples as examples. And this version is much, much better because it gives you the context that indeed you have to run enough samples so that your mean is converging. So how you determine that convergence is less important than -- but the fact that you need to do that and be aware of it. Because so many people just say I ran at 3,000 samples because somebody told me to run 3,000 samples.

MEMBER SHACK: While George is looking I had another specific question, and that was there's a comment in there that 5069 requires an uncertainty analysis and contains an uncertainty analysis method. The rule certainly doesn't.

DR. PARRY: Where did you find that comment?

MEMBER SHACK: Just before section 5.3.3

MS. DROUIN: What page are you on?

MEMBER SHACK: What page is that?

MR. VANOVER: Try 65, Mary.

MS. DROUIN: Sixty-five.

MEMBER SHACK: There's a misprint that says 5059, but it's clear in the context it's 5069.

DR. PARRY: Okay.

MEMBER SHACK: But it really is a puzzle to me.

DR. PARRY: You're right. The rule does not contain a --

MEMBER SHACK: Sure doesn't.

DR. PARRY: Okay.

MS. DROUIN: It's probably in the associated Reg. Guide.

DR. PARRY: You mean the NEI guidance.

MEMBER SHACK: The rule itself is not even contain the word "uncertainty."

DR. PARRY: Yes, I think you're probably right. I think --

CHAIRMAN APOSTOLAKIS: That's too sophisticated for a rule.

MR. VANOVER: It's NEI.

CHAIRMAN APOSTOLAKIS: By the way, the document we have does not have a list of references, right?

MEMBER BLEY: One of them did.

MEMBER SHACK: The EPRI one does. The EPRI one does.

CHAIRMAN APOSTOLAKIS: Yes, the NUREG does not.

MEMBER BLEY: No.

CHAIRMAN APOSTOLAKIS: Okay. So now if we go -- I think we've covered this, but just point out--

MS. DROUIN: Well, wait. You didn't get chapter 8. Chapter 8 is the list of references.

CHAIRMAN APOSTOLAKIS: No, we don't have chapter 8.

MS. DROUIN: Okay. We do have a list of references.

CHAIRMAN APOSTOLAKIS: You can send it to us separately.

On page 62, maybe 63 for you, they don't say that there is a citation EPRI 2008A, and I tried to find it, and couldn't find it. So I don't have the list of references.

So on that page now is again the following examples. You know, an alternate HRA model may produce different HEPs or introduce new human failure events. And my comment was that this is maybe completely impractical to run another HP model.

DR. PARRY: Yes. I think if you look, George, on page -- just to give you a hint there's something in there. It is sort of addressed because on page 107 --

CHAIRMAN APOSTOLAKIS: 107.

DR. PARRY: There's a brief discussion.

CHAIRMAN APOSTOLAKIS: Okay. Let's find - yes, I found it.

MS. DROUIN: Okay. But first what you pointed out does not mean that you're doing anything. These list of bullets are just saying here are examples of model uncertainties may impact.

CHAIRMAN APOSTOLAKIS: That's true, but I mean --

MS. DROUIN: And that's all it's saying.

CHAIRMAN APOSTOLAKIS: -- the practicality of doing it always.

MS. DROUIN: Right. But we're not asking anybody here to do anything on page 63.

CHAIRMAN APOSTOLAKIS: So where are you now? 107 what -- where?

DR. PARRY: There's a paragraph that talks about human reliability analysis and the discussion of models.

CHAIRMAN APOSTOLAKIS: 7332.

DR. PARRY: Yes, 7332.

CHAIRMAN APOSTOLAKIS: Okay.

DR. PARRY: There is a paragraph on that, which I think gets to your point.

CHAIRMAN APOSTOLAKIS: Human reliability, yes.

DR. PARRY: I think it gets to your point actually. It may need more than that.

CHAIRMAN APOSTOLAKIS: While it would be previously possible to perform the HRA using an alternate model, this might not be -- yes, absolutely. Absolutely. Absolutely. Yes, that's exactly what I'm saying.

DR. PARRY: Okay.

CHAIRMAN APOSTOLAKIS: And acceptable approach is to perform a studying varying all the HEPs by the same factor. Choosing the factor might be -- okay.

As I say, most of these have been covered, but I want to make sure.

You know, maybe the big comments we made earlier cover a lot of that stuff. Because I have comments here or there about mentioning 1150 and all that.

DR. PARRY: Okay.

MS. DROUIN: I don't know if this is appropriate, but I'll be more than willing to do it if we don't violate any kind of procedure. I don't have a problem with once we've gone through our notes and the transcript to let you know here's where our understanding of where your issues were with the document, and sending that to Harold.

DR. VanderMOLEN: We can do that.

MS. DROUIN: We can do that?

CHAIRMAN APOSTOLAKIS: Do what?

Oh by the way, a bigger comment that we didn't make. I really think this NUREG needs a good editing job by a single person --

MS. DROUIN: Oh, yes.

CHAIRMAN APOSTOLAKIS: To make sure. It's very repetitive.

MS. DROUIN: Okay.

CHAIRMAN APOSTOLAKIS: And that would be nice.

MS. DROUIN: And that's why I wrote that big note up front.

MEMBER SHACK: You should lessons in word processing from EPRI who uses a nice consistent style sheet for their documents.

MS. DROUIN: Okay. Okay. Right now I'm going to defend myself --

CHAIRMAN APOSTOLAKIS: All right. All right. All right, guys.

MEMBER SHACK: Just borrow their style sheet.

MS. DROUIN: Because Dennis who has worked on programs knows how -- at the beginning of a program I send every writer on our NUREG --

MEMBER BLEY: Already has a style sheet.

MS. DROUIN: -- has a style sheet.

MEMBER SHACK: It doesn't help, huh?

MS. DROUIN: And he's been one of the worst abusers, but I won't point any fingers anywhere.

MEMBER BLEY: Actually, it was WordPerfect that would always reformat my stuff after I got it right.

CHAIRMAN APOSTOLAKIS: Now EPRI claims--

MS. DROUIN: Well, we have very strict style guides. And I'll tell you I will take any suggestions that someone that I can figure out to get these people --

MEMBER SHACK: Well EPRI manages to do it somehow.

CHAIRMAN APOSTOLAKIS: Page 2-1.

MEMBER BLEY: I think they have a full time writer.

CHAIRMAN APOSTOLAKIS: The beginning of the paragraph and the problem statement, in general the point estimates used for the input parameters --

MS. DROUIN: I'm sorry, George, what page are you on?

CHAIRMAN APOSTOLAKIS: I'm EPRI now. Doing EPRI.

MS. DROUIN: Oh, EPRI.

CHAIRMAN APOSTOLAKIS: In general the point estimates used for the input parameters correspond with the mean values of the probability distributions representing the uncertainty leaves parameter values. I don't think that's true. I mean, if you have the distributions, probably you would select the mean. But many times people use one value and they say it's the mean. And I don't know --

MR. CANAVAN: Well, the peer reviews have been pushing -- because the standard --

CHAIRMAN APOSTOLAKIS: The peer reviews do what?

MR. CANAVAN: The peer reviews now push the mean value.

MEMBER STETKAR: Well that statement should say in general or not in general, the point estimate values should always been the mean values--

MEMBER BLEY: That is a much better way.

CHAIRMAN APOSTOLAKIS: You wouldn't have any problem.

MEMBER STETKAR: Because that's the whole tenure of the thing.

MR. CANAVAN: Yes. And actually right now via the standard it's required.

MEMBER STETKAR: The EPRI report makes that pretty clear.

MR. CANAVAN: IT should say always be.

MEMBER POWERS: Because if they aren't you're just denying anybody uses flight distributions.

MEMBER BLEY: Flight distributions?

MEMBER POWERS: Yes.

CHAIRMAN APOSTOLAKIS: Flight distributions.

MEMBER POWERS: They have no --

CHAIRMAN APOSTOLAKIS: Everybody's just stunned.

MEMBER STETKAR: This is a legitimate concept.

MEMBER POWERS: And they're stable.

MEMBER BLEY: So send a paper around.

MEMBER POWERS: They're stable as you gather more information.

MEMBER STETKAR: And they may be useful.

CHAIRMAN APOSTOLAKIS: Now let me -- I'm sorry, did you make your point?

MEMBER STETKAR: We have to drink some wine next week over this one.

CHAIRMAN APOSTOLAKIS: Page 2-7.

MEMBER BLEY: IF they're estimates, these estimate are not stable, huh?

CHAIRMAN APOSTOLAKIS: Where it starts --

MEMBER POWERS: You betcha, that's why they're things to think about. When you're talking about diffusive processes that don't involve millions of molecules but rather a few things. And they tend to follow flight distributions. And they have real heavy tails. And no moments. So you can't find a mean.

MEMBER BLEY: Well then you don't have to worry about it, do you?

MEMBER POWERS: Well, that's why you use medians instead of means.

CHAIRMAN APOSTOLAKIS: Flight you said distributions? Flight? Or is it the name of the guy?

MEMBER POWERS: The name of the guy that actually did the most work on this is named Levy.

MEMBER BLEY: Okay.

CHAIRMAN APOSTOLAKIS: So coming to this part, right? You found it?

MR. VANOVER: Section 23.

CHAIRMAN APOSTOLAKIS: Page 2-7.

MR. VANOVER: Okay.

CHAIRMAN APOSTOLAKIS: The paragraph it says: "The ASME/ANS PRA standard..." You found that?

While many computer codes of capable of handling this quantitative is now to the state-of-knowledge correlation, not all models have been developed in a manner that allows this to be done. I think today we said that all the codes do that, right"?

DR. PARRY: Most the ones we're familiar with. But we're still --

CHAIRMAN APOSTOLAKIS: Yes, but we're not going to write a document advising people what to do based on what one strange code cannot do.

DR. PARRY: I understood it's the code, I think it's the way they've set up the --

MR. CANAVAN: It's the way they set up their database. But I still think --

CHAIRMAN APOSTOLAKIS: They should change it.

DR. PARRY: That's a pretty major task, actually.

CHAIRMAN APOSTOLAKIS: Okay. So we're reporting -- and then he goes on and says "capability category 2 of the standard does not require quantification. It simply requires estimation of the uncertainty in the code. Unfortunately, no guidance exists on how to perform this estimation."

Come on, guys, you propagate the uncertainty.

DR. PARRY: No, that's quantification.

CHAIRMAN APOSTOLAKIS: Yes. So I think you should change the language here a a little bit to make it a little -- the impression I got was here they are again playing with words. And that's not fair.

MR. VANOVER: I thought it was statement of fact. We weren't recommending that you not do it. It was just that --

CHAIRMAN APOSTOLAKIS: Unfortunately no guidance exists on how to perform this estimation? I mean --

MR. VANOVER: In lieu of propagating.

MEMBER SHACK: In lieu of propagating it, that's what they mean.

MR. CANAVAN: In other words you should propagate because that's what we know how to do.

CHAIRMAN APOSTOLAKIS: And where does it say that?

MR. CANAVAN: Well, it doesn't say that.

CHAIRMAN APOSTOLAKIS: In lieu of propagating? No. There isn't.

MEMBER SHACK: It requires estimation of the uncertainty interval. Unfortunately, no guidance exists on how to perform this information estimation in lieu of propagating.

CHAIRMAN APOSTOLAKIS: And that's understood? No, it's not understood by me. There is a way of doing it, and that's propagating the uncertainty.

MS. DROUIN: No, no. The distinction, George, is between the categories. One category --

MEMBER SHACK: Well, we should put the parenthesis around the estimation the second time.

MS. DROUIN: -- only requires you to estimate. The next capability category requires you to do the propagation.

CHAIRMAN APOSTOLAKIS: Which one?

MR. CANAVAN: Three.

MS. DROUIN: Three.

CHAIRMAN APOSTOLAKIS: You haven't talked about three yet. Just category 2.

MR. CANAVAN: That's because I think here we're discussing.

CHAIRMAN APOSTOLAKIS: Category 2, and it says you can't do it. And I think you should say you can do it.

MR. CANAVAN: That's estimation.

MS. DROUIN: In the standard, the standard for category 2 requires you to estimate. Then the distinction between category 2 and category -- this is a real problem with the standard. And then category 3 says, okay, you know category 3 is always what you have to do more than category 2. And category 3 says quantify by propagation. Well, we're saying how do you do number 2 without doing 3?

CHAIRMAN APOSTOLAKIS: But here then it should say category 2 does not require quantification and says estimation, unfortunately no guidance exists to perform this estimation other than propagate the uncertainties. I mean --

MR. CANAVAN: I agree.

CHAIRMAN APOSTOLAKIS: Yes. That's all I'm saying.

MR. CANAVAN: Yes. Theoretically you could compare to a sister plant. I'm not sure that that's a --

MR. VANOVER: Yes. I think if we also add a sentence that says doing the propagation is the recommended approach for the base model that'll --

MR. CANAVAN: That'll solve multiple problems.

CHAIRMAN APOSTOLAKIS: Now you guys have agreed that the tone will be revised, right?

MR. CANAVAN: We're going to try again.

CHAIRMAN APOSTOLAKIS: Yes. Broaden the consensus within the community, I mean we discussed this. The issue of percentiles.

Now I have a question is this true. What the hell is that? Oh, sorry. Oh, yes, that's correct.

MEMBER SHACK: Just him and his computer chatting away.

MEMBER POWERS: Mr. Chairman, and given these times ---

CHAIRMAN APOSTOLAKIS: Subcommittee, you're the one who always claims that we should ask all these questions of the Subcommittee. I have no other way of giving them to you. I will not write a separate memo.

MEMBER POWERS: All right. Now I will amend my criticism to say and you should have your questions mapped out ahead of time.

CHAIRMAN APOSTOLAKIS: Okay. I'm trying to be modern here like my colleague Shack and put everything in the computer. But it's done.

MEMBER BLEY: You've got to learn how to

find it.

CHAIRMAN APOSTOLAKIS: So now we have to go around the table -- no, I think we have to excuse you first.

So unless there are any more questions, we can let the staff and the EPRI representatives go.

MS. DROUIN: Okay. I just want to verify from my understanding we owe you two things. We owe a copy of the Data Handbook --

CHAIRMAN APOSTOLAKIS: Not to me. I have it.

MEMBER BLEY: I have it. Dana needs it.

MS. DROUIN: Right. Go it. To Dana, Data Handbook. And we're going to provide Harold a list after we've gone through, talked among ourselves, our notes and looked at the transcript we're going to provide Harold a list of what we think were all the issues raised by the Subcommittee today.

CHAIRMAN APOSTOLAKIS: But not the ones that you agree with.

MS. DROUIN: We aren't going to tell you whether we agree or not agree. We're just going to say here's all the issues that the Subcommittee raised. To make sure we didn't miss something.

CHAIRMAN APOSTOLAKIS: Fine. And they

show the letter still up in the air.

So thank you very much for coming here. This was at least was very useful to us, maybe to you as well. Especially you guys coming from out of town.

DR. PARRY: Not any other comments from anybody else?

CHAIRMAN APOSTOLAKIS: I asked them, nobody said anything.

MEMBER BLEY: When we get off the record you're going to go around, right?

CHAIRMAN APOSTOLAKIS: When we get off the record they will give me advice. And you can be here. It's not going to be on the record.

DR. PARRY: Okay. Okay. I'll wait.

CHAIRMAN APOSTOLAKIS: So coming back to my statement, I thank you very much for coming here. This was very useful. And hope to see you in November or December.

We're adjourned.

(Whereupon, at 4:35 p.m. the meeting was adjourned.)

Treatment of PRA Uncertainties in Risk-Informed Decision Making

Advisory Committee on Reactor Safeguards
Subcommittee on PRA

September 30, 2008

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Presented by:

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Objective of Meeting

- Discuss NRC and EPRI work
- Status of reports
- Future work

Purpose of Program

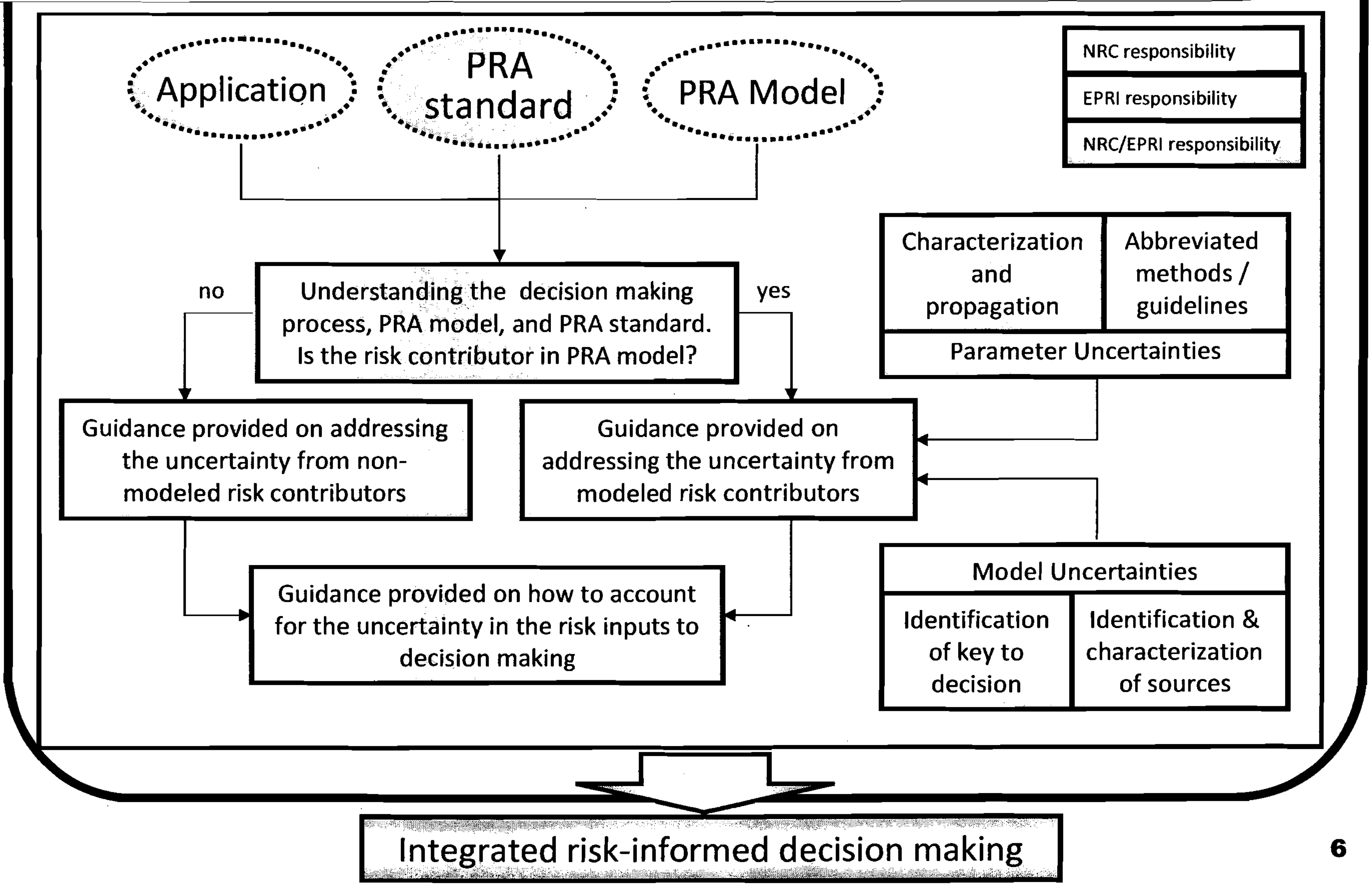
- Provide guidance in support of the requirements addressing uncertainty in the ASME/ANS Probabilistic Risk Assessment (PRA) Standard
- Provide guidance on how to treat uncertainties associated with PRA in risk-informed decision making

To Accomplish the objective. . . .

- Need to understand
  - The risk-informed decision making process
  - The role of the PRA in the process
  - What are the uncertainties
  - What the standard requires
  - How are the uncertainties addressed in the PRA
  - What are the uncertainties that could influence the decision
  - How the results from the uncertainty analyses are factored into the decision making

⇒ ***NRC and EPRI working together***

NRC and EPRI Working Together



Background Information

- Information and guidance in the reports but not discussed at today's meeting
  - Decision making process
  - Role of the PRA in the decision making process
  - Uncertainties associated with PRA

ASME/ANS Standard

Requirements include --

- Characterization of parameter uncertainties
- Calculation of event probabilities
- Calculation of core damage frequency (CDF) and large early release frequency (LERF) and associated uncertainty interval
- Identification of sources of model uncertainty
- Characterization of model uncertainties and related assumption

⇒ ***Both NRC and EPRI providing supporting guidance***

Parameter Uncertainties – NUREG 1855

- Guidance provided on meeting the Supporting Requirements (SRs) of the ASME/ANS PRA Standard related to parameter uncertainty:
  - Characterization of parameter uncertainty of basic events
  - Obtaining the mean value and uncertainty interval of a risk metric
- EPRI report provides practical guidance on when it is acceptable to avoid explicit calculation of the state-of-knowledge correlation (SOKC)

Parameter Uncertainties – NUREG 1855

- Major issues:
  - Proper characterization of the parameter uncertainty of basic events as a function of Capability Category* in the PRA Standard
  - Proper evaluation of a risk metric and its associated uncertainty interval as a function of Capability Category in the PRA Standard
  - Acceptable guidance for using a simplified approach to estimate risk metric and its associated uncertainty interval

*Capability category in the standard differentiates a requirement by level of scope and detail, plant-specificity, and realism.

Parameter Uncertainties – EPRI

- EPRI addressing use of point estimate calculations for mean value comparisons and uncertainty interval characterization
  - ASME/ANS standard and peer reviews have reinforced the need to utilize best estimate mean values and distributions in PRA models
  - Current PRA tools support full propagation of parametric uncertainties, including the SOKC, for base models

Parameter Uncertainties – EPRI

- Addressing the SOKC can be difficult in some cases:
  - Applications relying on importance measures
  - Applications requiring rapid quantification of multiple cases
- EPRI has developed guidelines to support meeting the related PRA standard supporting requirements

Parameter Uncertainties – EPRI

- Guidelines for Base Model
  - Preferred approach is to perform parametric uncertainty analysis
  - Otherwise perform detailed comparison to another site to estimate mean and uncertainty interval

Parameter Uncertainties – EPRI

- Guidelines for Applications
  - Verify SOKC not in relevant cutsets
  - Otherwise, perform parametric uncertainty analysis to calculate mean and uncertainty interval (if required)

ASME/ANS Standard – Model Uncertainties

- Standard only requires analyst to identify and characterize the sources of model uncertainty
- NRC/EPRI provide supporting guidance and expand the guidance of how the information is used in the decision process

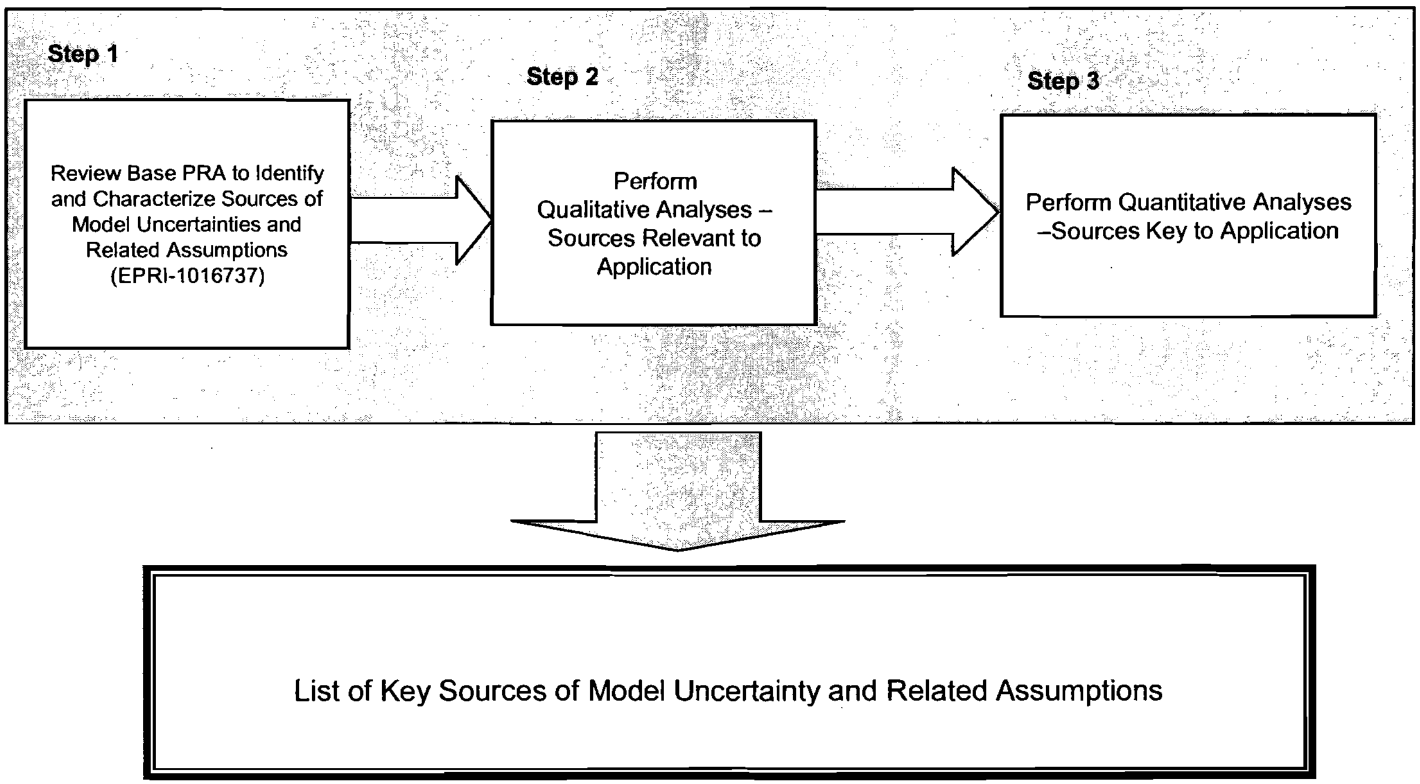
Model Uncertainties – NUREG 1855

- High level Programmatic Objective
  - Provide guidance on
    - understanding concepts of key sources of model uncertainty
    - process to identify and characterize key sources.
- NRC focus
  - Guidance on qualitative and quantitative process to identify key sources
- EPRI focus
  - Identification and characterization of sources of model uncertainties and related assumptions

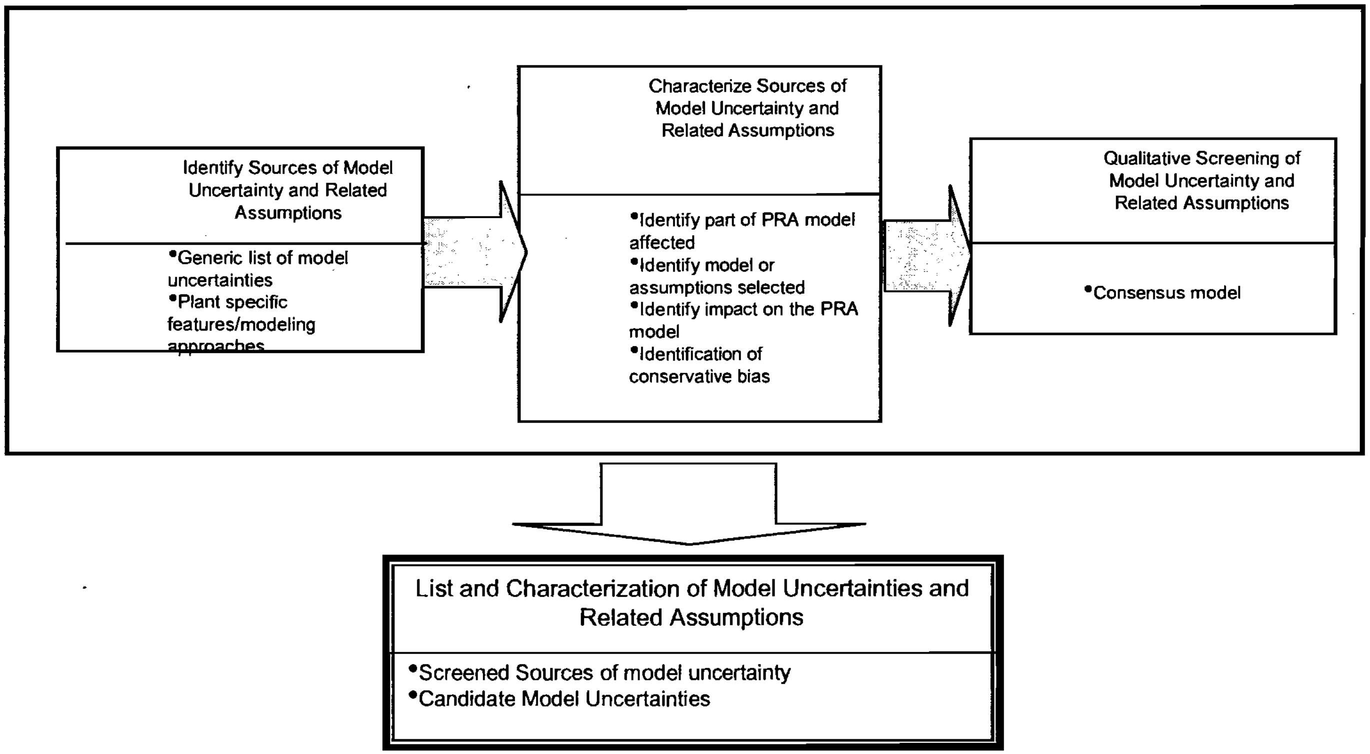
Model Uncertainties – NUREG 1855

- Major issues addressed by NRC
  - Generic and plant specific sources of uncertainty (from EPRI guidance) must be evaluated as to their relevance to an application
  - Relevant sources of uncertainty must be evaluated to determine if key or not
    - Conservative assessment
      - Utilizes risk importance concepts to identify potential key sources
    - Realistic assessment
      - Utilizes realistic sensitivity analyses to identify actual key sources

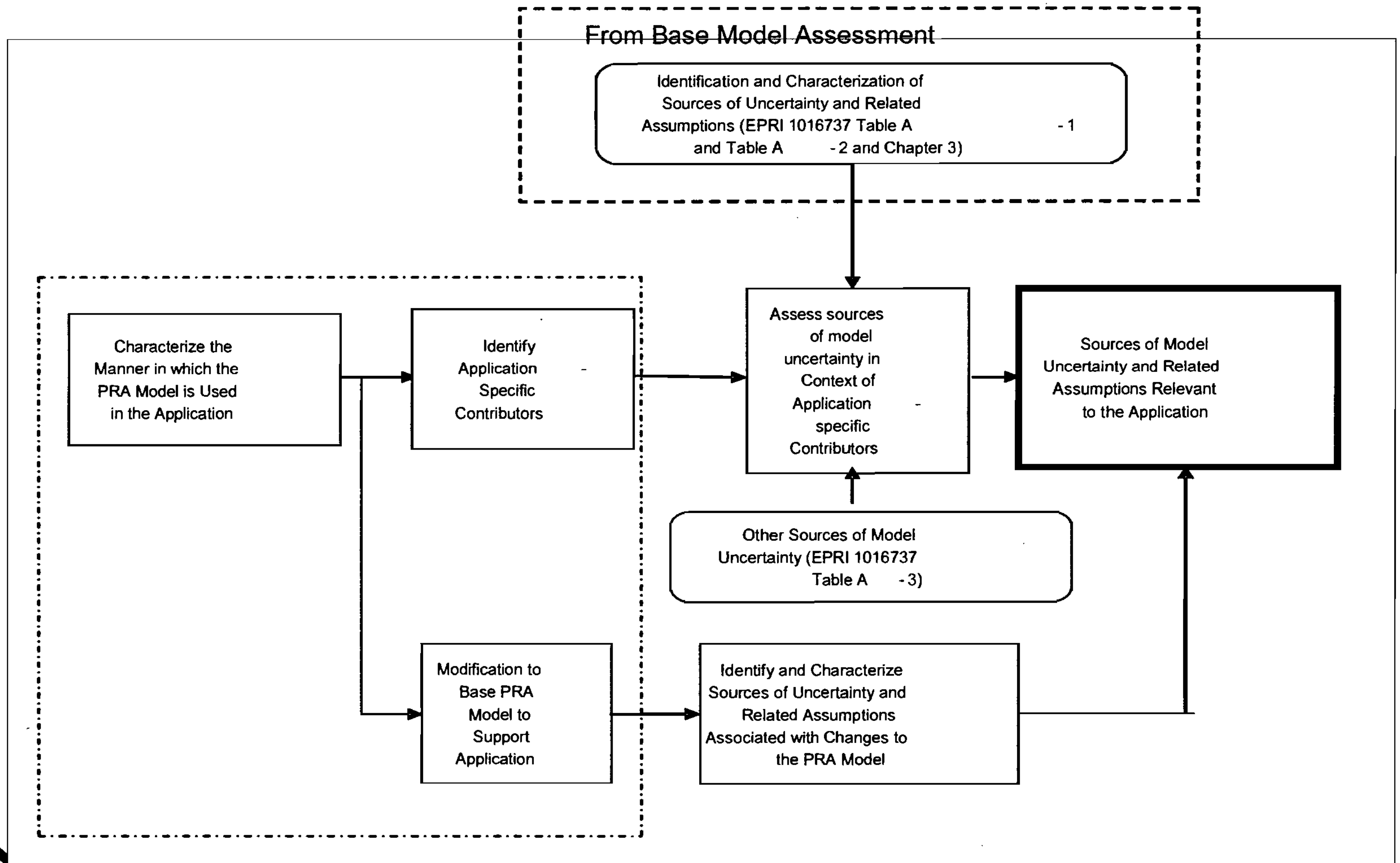
Model Uncertainties – NUREG 1855: Key Sources of Uncertainty



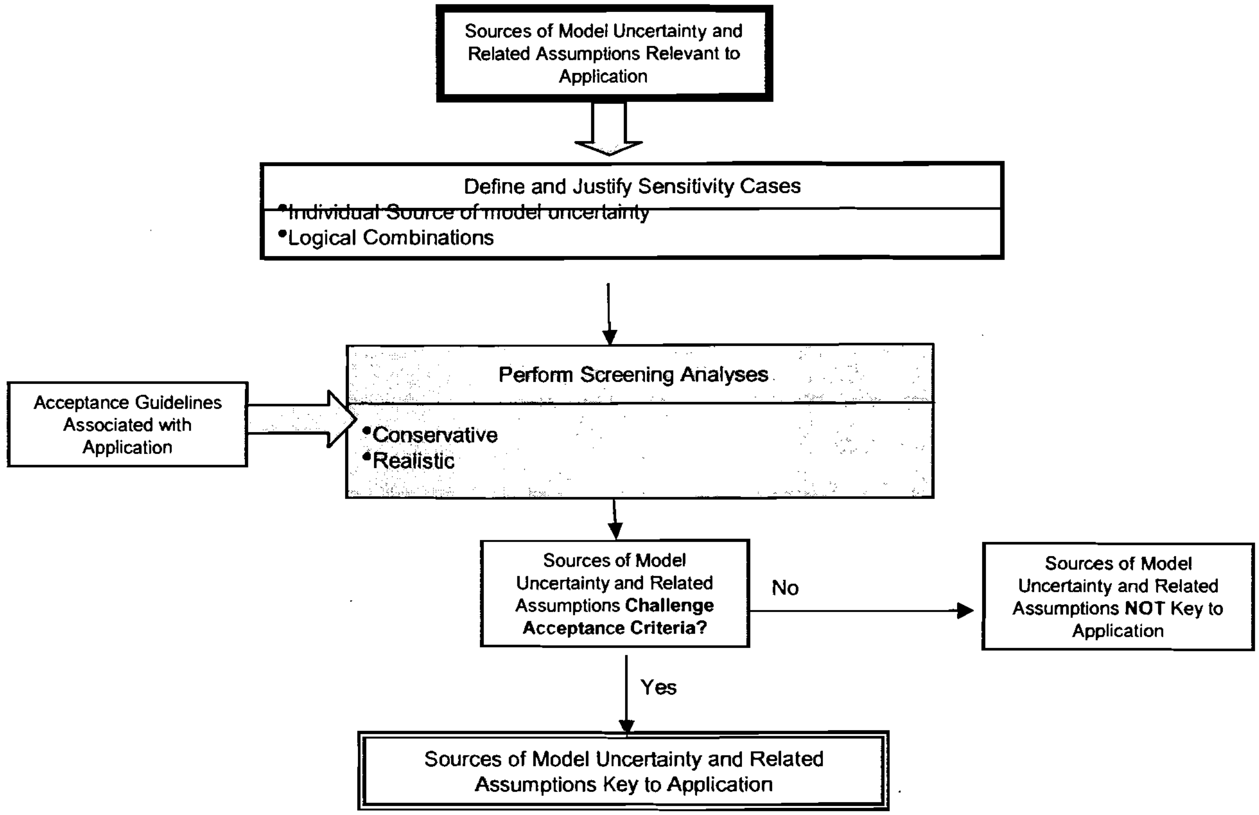
Model Uncertainties – NUREG 1855: Sources of Uncertainty (EPRI Focus)



Model Uncertainties – NUREG 1855: Application Relevant Sources



Model Uncertainties – NUREG 1855 – Key Sources



Model Uncertainties – EPRI

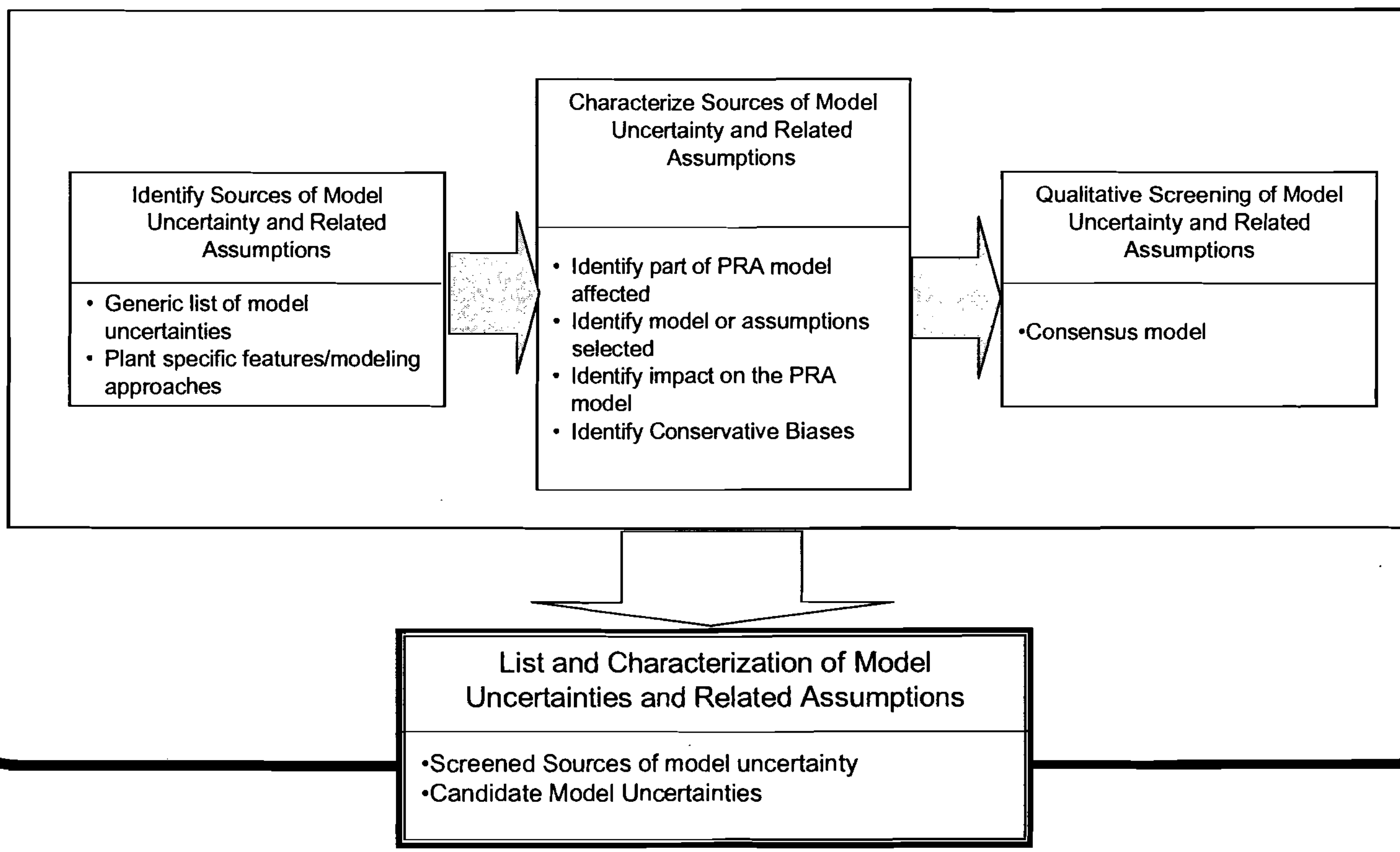
- EPRI addressing the requirements in the ASME/ANS standard regarding the identification and characterization of sources of model uncertainty (QU-E1, QU-E2, QU-E4, QU-F4), and the related elemental SRs
- Many “source of uncertainty” items in original EPRI list from the Technical Basis Document are related to scope or level of detail rather than “model” uncertainty

Model Uncertainties – EPRI

- Candidate Source of Model Uncertainty
  - The phenomena or nature of the event or failure mode is not completely understood,
  - Significant interpretations to infer behavior are required to develop a model (this is the case where some information is available, but is not sufficient to derive a definitive model or value), or
  - There is a general agreement that the issue represents a potential source of modeling uncertainty.

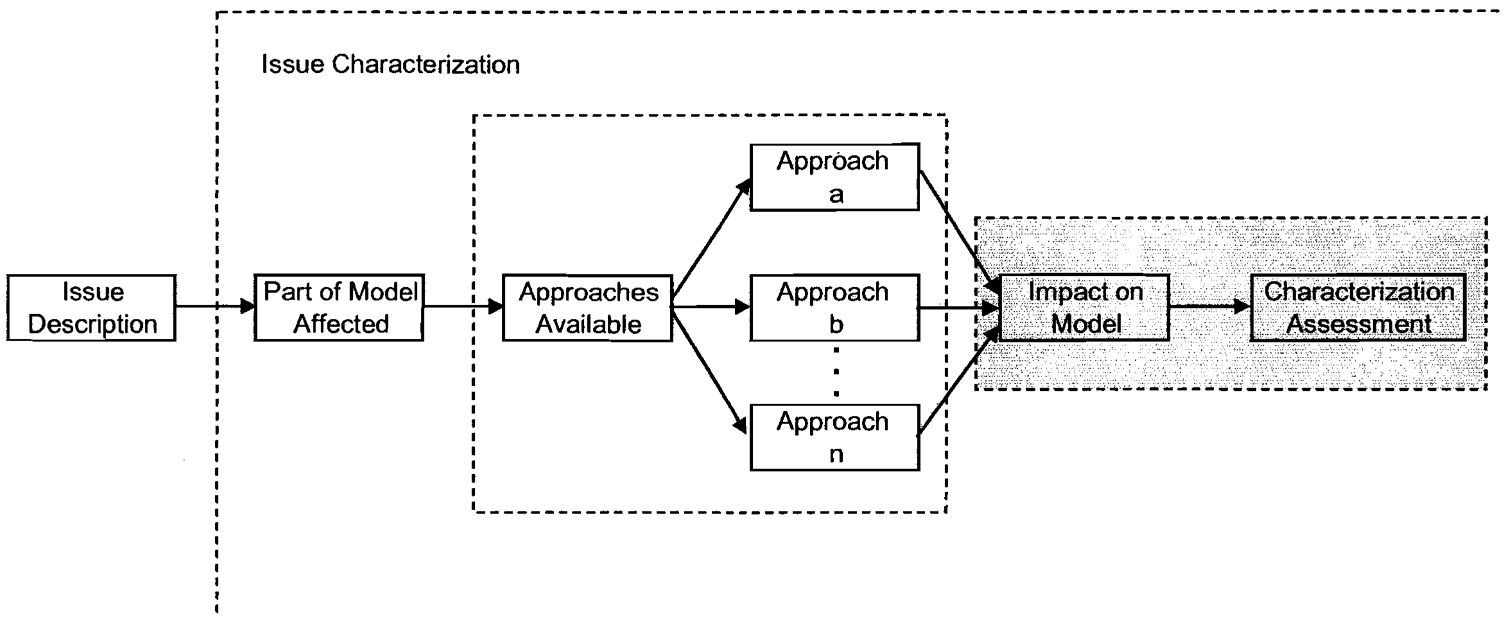
Model Uncertainties - EPRI

- Model Uncertainty Identification, Characterization, and Screening



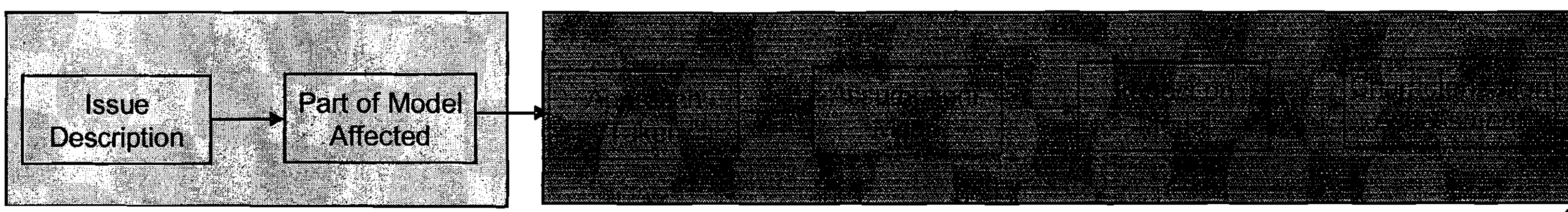
Model Uncertainties - EPRI

- Template for Model Uncertainty Issue Characterization



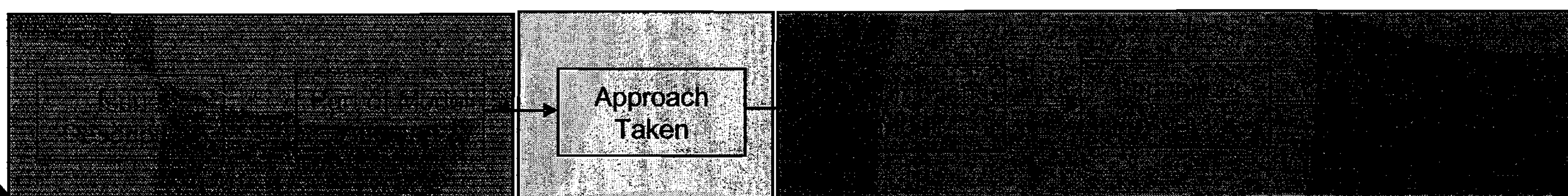
Model Uncertainties - EPRI

- Example Model Uncertainty Issue Characterization Template
  - **Issue:** Impact of containment venting on core cooling system NPSH
  - **Part of Model Affected:** Loss of containment heat removal scenarios with containment venting successful



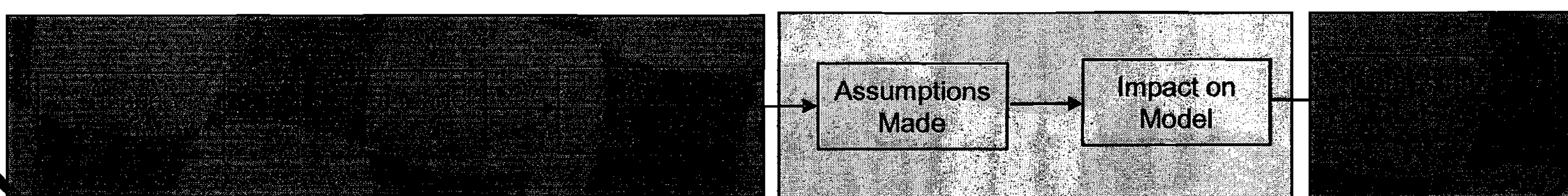
Model Uncertainties - EPRI

- Example Template (cont'd)
  - **Possible Approaches (Not Exhaustive):**
    - No credit for injection from suppression pool following venting
    - Human failure event defined and incorporated into PRA for control of containment pressure in order to assure adequate NPSH
    - Analysis developed to demonstrate continued injection, despite reduction in NPSH
    - Injection from suppression pool assumed to be unaffected by venting



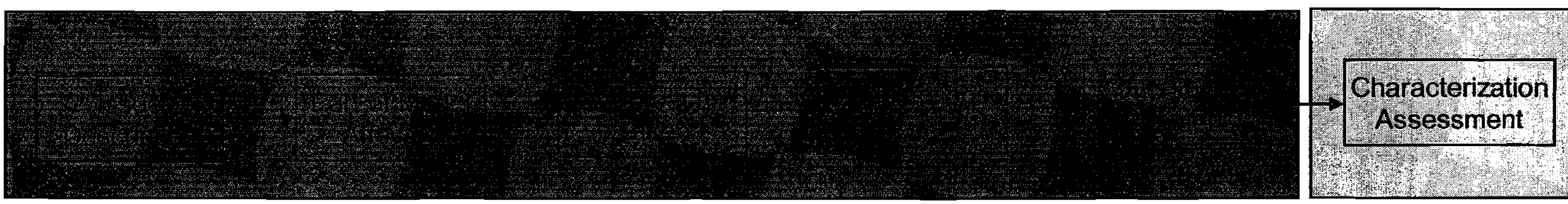
Model Uncertainties - EPRI

- Example Plant-Specific Characterization
  - **Assumptions Made:** Upon successful initiation of containment venting, it is assumed that NPSH is lost for all systems taking suction from the suppression pool (i.e., HPCI, RCIC, and LP ECCS – CS and LPCI)
  - **Impact on Model:** HPCI, RCIC, LPCI and Core Spray are not credited for success after containment venting

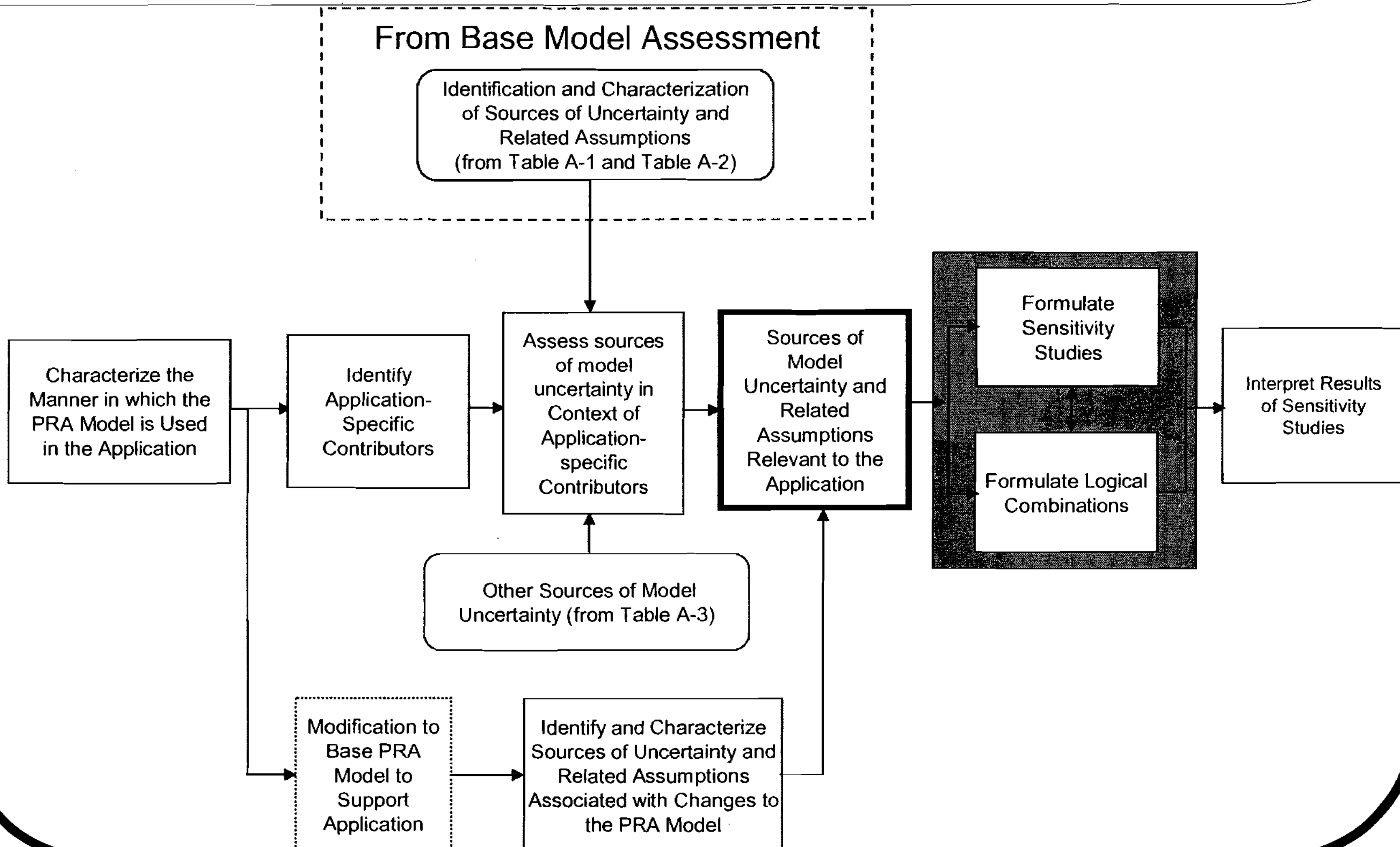


Model Uncertainties - EPRI

- Example Plant-Specific Characterization
  - **Assessment:** No credit for these systems after containment venting represents a slight conservative bias treatment. This should not be a source of model uncertainty in most applications.



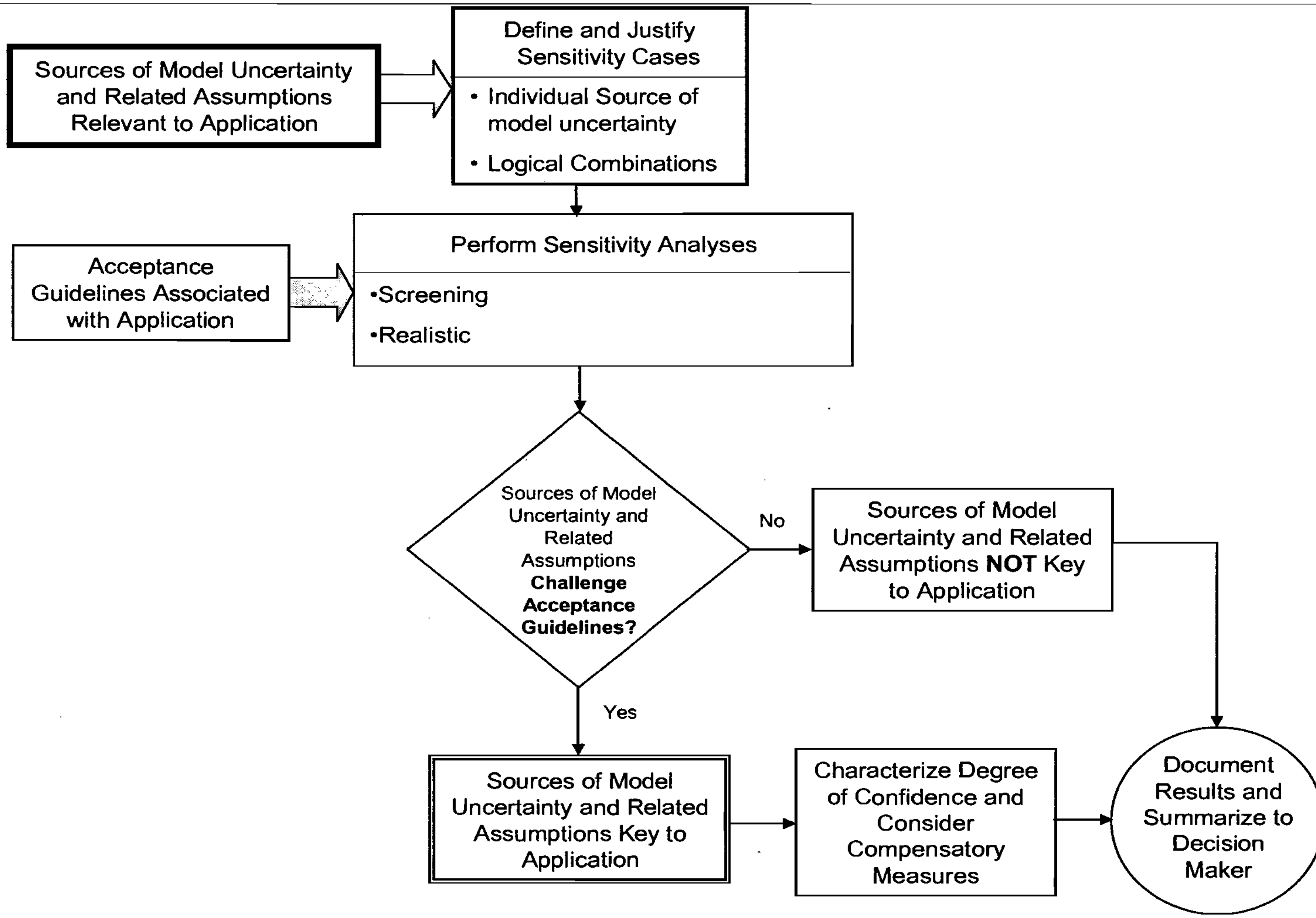
Dealing with Uncertainty – EPRI



Dealing with Uncertainty – EPRI

- Structured sensitivities are used as the primary decision tool.
  - Recognize cases where multiple models may exist to represent the same phenomena or physical process
  - Perform a sensitivity analysis to assess the impact of choosing the alternates as defined above
  - Identify items that should be coupled to perform a combined sensitivity calculation
  - Interpret the results and provide the results to the decision maker in an understandable format

Dealing with Uncertainty - EPRI



Dealing with Uncertainty - EPRI

- For KEY Sources of Uncertainty and Assumptions
  - Justify that the base case results are indeed reflective of the best estimate response of the plant:
    - Provide a detailed explanation of the reason for the variation
    - Provide a characterization (qualitative) of the degree of confidence in the base case results
    - List compensatory measures that may be used to either reduce the uncertainty or reduce the resulting risk metrics

Uncertainty Not Addressed in the ASME/ANS Standard

- Standard does note that if an item is not included in the PRA, "other alternatives" (e.g., bounding analyses) can be used, but when used, is outside the scope of the standard
- NUREG provides guidance in this area

Completeness Uncertainty – NUREG 1855

- Provide guidance on one aspect of completeness uncertainty (i.e., incomplete PRA scope or level of detail) in risk-informed applications
- Guidance involves the performance of screening (qualitative and quantitative) and conservative/bounding analyses

Completeness Uncertainty – NUREG 1855

- NRC addressing . . .
  - Determining the required scope and level of detail required to support an application
  - Defining the types of screening and conservative/bounding analyses
  - Selecting and using screening and conservative/bounding approaches
- EPRI report does not address completeness uncertainty
- Major issues . . .
  - What constitutes a conservative/bounding analysis
  - What makes a conservative/bounding analysis acceptable

Completeness Uncertainty – NUREG 1855

- Examples of screening analyses
  - Qualitative – missing item can not impact risk or is not important to change in risk associated with proposed plant modification
    - At-power tech spec change would not impact risk during LPSD
    - Plant change would not impact SSCs relied upon to mitigate a specific hazard (e.g., seismic)
    - Plant change would not impact risk potential from hazards (e.g., fire or flood) in specific areas

Completeness Uncertainty – NUREG 1855

- Examples of screening analyses
  - Quantitative – missing item has a small impact on change in risk associated with proposed plant modification
    - Thermal-hydraulic analysis shows missing event can not result in plant damage (e.g., loss of HVAC or pressurized thermal shock)
    - Conservative/bounding assessment indicates frequency of a hazard is less than 10^{-7}/yr
    - Conservative/bounding assessment indicates frequency of a hazard is less than 10^{-5}/yr and conditional CDF (CCDF) is less than 0.1
    - Conservative/bounding assessment indicates CDF from missing event is less than 10^{-6}/yr and LERF is less than 10^{-7}/yr

Completeness Uncertainty

- Examples of conservative/bounding analyses
  - Simplified or detailed risk assessment using conservative/bounding hazard frequencies, structures, systems, and components (SSCs) failure probabilities, and consequences (e.g., all SSCs could be assumed to fail from an airplane crash leading to core damage)
  - Conservative/bounding deterministic analyses (e.g., determining the ultimate strength of the containment)

How to Use the Results

- Given the various uncertainties have been addressed, how should the results be presented and how should they be factored into the decision making?

Risk-Informed Decision Making: Dealing with Uncertainty

- NRC giving guidance on . . .
  - Description of the supporting risk assessment
  - Comparison of results with acceptance guidelines
  - Addressing uncertainty in SSC categorization
  - Using qualitative approaches to address uncertainty in integrated decision making
  - Presentation of results to decision makers

Comparison with Acceptance Guidelines - Issues Addressed

- Need to understand the risk contributors
  - Level of resolution due to approximations
  - Scope assumptions
- Decomposition of results
  - Hazard group
  - Significant accident sequences or cut-sets
  - Significant basic events
- Identification of relevant sources of model uncertainty

Comparison with Acceptance Guidelines - Issues Addressed (cont'd)

- Parameter uncertainty
  - Statistical measure specified in formulation of acceptance guidelines
- Model uncertainty
  - Choice of alternate hypotheses
  - Logical combinations
- Incompleteness
  - Phased approach requires significant contributors be modeled in a PRA
  - Use screening and bounding approaches

Qualitative Approaches

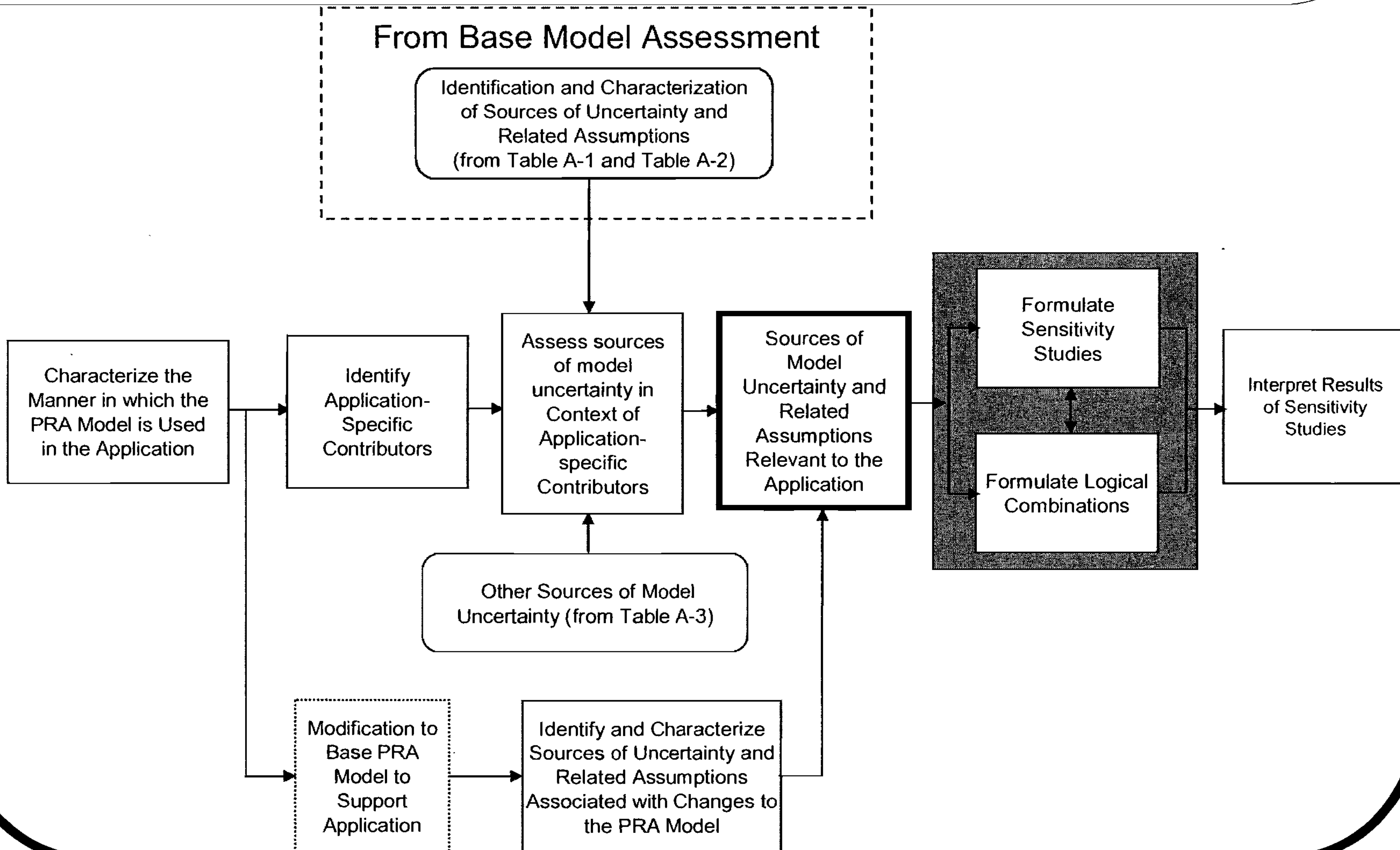
- Used when contributors cannot or are not quantified
  - Performance monitoring (e.g., to confirm an assumption made in the analysis)
  - Limiting scope of implementation of plant change (e.g., to compensate for missing scope)
  - Use of compensatory measures

Presentation of Results to Decision Makers

- Include:
  - Summary of analysis
  - Identification of contributors to results, focusing on those that drive the conclusions
  - Qualitative statement of confidence in recommendation (address uncertainty)
  - If PRA results exceed guidelines or are incomplete justification of acceptability, e.g.:
    - Evaluation is demonstrably conservative, and compensatory measures are defendable
    - Incompleteness addressed, e.g., implementation restrictions, performance monitoring

Example of the Process

Dealing with Uncertainty – Example

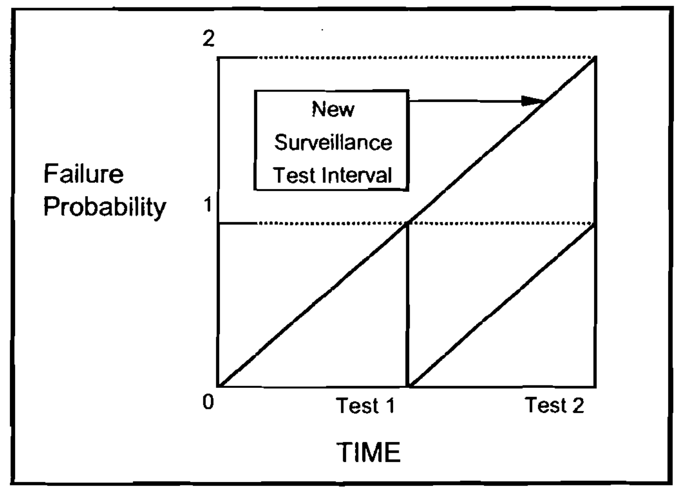


Dealing with Uncertainty – Example

- Characterize the manner in which the PRA model is used
  - Hypothetical Surveillance Test Interval (STI) assessment involving the High Pressure Coolant Injection (HPCI) Pump, Valve and Flow Test per the NEI 04-10 methodology
  - Total demand probability can be assumed to be time related

Dealing with Uncertainty – Example

- Characterize any modifications to the PRA model
  - No model logic changes
  - Increased the HPCI fail-to-start term for assessing a change in the test interval from quarterly to semi-annually



Dealing with Uncertainty – Example

- Identify application-specific contributors
  - Cutset review determined that the results depend on a large number of cutsets with diverse types of contributors
  - Use of point estimate for comparison to acceptance guidelines OK

Dealing with Uncertainty – Example

- Identify application-specific contributors
  - The standby failure rate values utilized for the assessment
  - Operator fails to depressurize HEP values
  - RCIC fails to start probability
  - Turbine trip frequency, loss of feedwater, and loss of condenser vacuum initiating event frequencies
  - Medium LOCA initiating event frequency
  - LOOP initiating event frequency
  - LOOP recovery terms at various time intervals
  - Diesel generator common cause failure probabilities
  - Crediting RHRSW cross-tie to ESW

Dealing with Uncertainty – Example

- Assess sources of model uncertainty
- From application-specific contributors (previous slide) and base model assessment (below)
  - Credit for battery life out to 4 hours without explicit representation of load shedding
  - Percentage of time that two DG HVAC fans required
  - Credit for core melt arrest in-vessel at high pressure
  - Ex-vessel core melt progression overwhelms vapor suppression capabilities

Dealing with Uncertainty – Example

- Selected Sensitivity Studies (Individual)
  - Standby failure rate model
  - Fail to depressurize human error probabilities (HEPs)
  - RCIC fails to start probability
  - Ex-vessel core melt progression overwhelms vapor suppression capabilities

Dealing with Uncertainty – Example

- Selected Sensitivity Studies (Logical Combinations)
  - RCIC FTS, EDG CCF
  - RCIC FTS, LOOP Fail to Recover Probabilities
  - RCIC FTS, EDG CCF, and LOOP Fail to Recover
  - RCIC FTS and Fail to Depressurize HEPs

Dealing with Uncertainty – Example

- The following two items are identified as KEY sources of uncertainty for this application of the PRA model:
  - HPCI standby failure rate model
  - Failure to depressurize RPV Human Error Probability values
- Need to provide confidence to decision maker that these sources of model uncertainty would not change decision

Status of Reports

- NRC NUREG –
  - Finalizing the NUREG end of calendar year
- EPRI Report –
  - Final draft issued for comment to industry
  - Final version to be published by the end of the calendar year

Future Work

- Develop and hold workshop for both NRC and public on utilizing and applying the NRC and EPRI reports
- Gather insights and lessons learned as the documents are used
- Determine whether either an update/revision is needed or other related/supporting guidance is needed