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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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RELIABILITY AND PRA SUBCOMMITTEE

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FRIDAY

OCTOBER 19, 2012

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 1:00 p.m., John W. Stetkar, Chairman, presiding.

SUBCOMMITTEE MEMBERS:

JOHN W. STETKAR, Chairman

DENNIS C. BLEY, Member

JOY REMPE, Member

WILLIAM J. SHACK, Member

ACRS CONSULTANT:

MARIO BONACA

NRC STAFF PRESENT:

JOHN LAI, Designated Federal Official

MARY DROUIN, RES

ANDERS GILBERTSON, RES

MARK RUSSO, NRO

ALSO PRESENT:

JEFF LaCHANCE, Sandia National Laboratories

GARETH PARRY, ERIN Engineering

MARY PRESLEY, EPRI

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P R O C E E D I N G S

1:01 p.m.

CHAIR STETKAR: The meeting will now come to order. This is a meeting of the Reliability and PRA Subcommittee. I'm John Stetkar, Chairman of the Subcommittee meeting. ACRS Members in attendance are Dennis Bley, Bill Shack, and Joy Rempe. Our consultant, Mario Bonaca, is also in attendance. John Lai of the ACRS staff is a Designated Federal Official for this meeting.

The Subcommittee will hear discussion of EPRI Draft Report 1026511, practical guidance on the use of PRA in risk-informed applications with focus on the treatment of uncertainties. We'll also hear the staff's discussion of the revised draft NUREG-1855, Revision 1, guidance on the treatment of uncertainties associated with PRAs and risk-informed decision-making.

We've received no written comments or requests for time to make oral statements from members of the public regarding today's meeting. The entire meeting will be open to public opinions. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full

committee.

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. A transcript of the meeting is being kept and will be made available, as stated in the Federal Register Notice. Therefore, we request that participants in the meeting use the microphones located throughout the meeting room when addressing the Subcommittee. The participants should first identify themselves and speak with sufficient clarity and volume so they may be readily heard.

We'll now proceed with the meeting. And, Mary, I don't know if you want to say anything first. Mary Drouin.

MS. DROUIN: Mary Drouin with Office of Research. Well, we're just glad to be back, and we're continuing to move forward. We think this is a very important document and supporting risk-informed regulation. You know, how to deal with uncertainties just is one of the key pieces.

CHAIR STETKAR: Mary, just for the benefit of the Subcommittee members that are here, could you just briefly tell us what your plans are for the NUREG anyway, in terms of the near-term --

MS. DROUIN: Right now, we have just issued, before we can send something out for publication, we need to give a two-week advanced notice to our program offices. So the two-week advanced notice letter is being issued right now as we speak, so I would anticipate that this will be out in the next two to three weeks. For public review and comment, we'll go out for 60 days, so we expect to have the public comments in January and then to issue this final in February.

CHAIR STETKAR: Great. Thank you. With that, I guess we'll turn over the meeting to EPRI. Mary?

MS. PRESLEY: Hi. I'm Mary Presley from EPRI, and I'm here with Gareth Parry from ERIN Engineering. Let's just jump right in. So the first couple of slides you've seen at the last meeting we had, so I'll go through them fairly quickly so we can spend some time on the actual technical details. Quick overview of the project history and our points of collaboration with Mary Drouin's team and then an overview of what's in the new guidance, and we'll actually step through some of those sections and then discuss our next steps.

So the EPRI report is complimentary

guidance to the Revision 1 of 1855 that's coming out. And, previously, the Revision 0 of 1855 had a complimentary document, EPRI 1016737, that came out together. And that document --

MEMBER SHACK: The telltale heart.

CHAIR STETKAR: Ignore it.

MS. PRESLEY: Okay. Oh, there we go.

CHAIR STETKAR: Just as long as our recorder can hear okay, that's the important thing.

MS. PRESLEY: So that previous document focused on providing some guidance on the state of knowledge correlation, particularly using experiences to describe when it's important, how to look for it, and how to assess it. And, also, there was some sections on characterizing model uncertainty.

The guidance on state of knowledge correlation is untouched. We're leaving that in 1016737. And in this new document, we're going to update some of the model uncertainty discussion, which we'll discuss later.

CHAIR STETKAR: Mary, why, you know -- I can understand documents, but why didn't you simply update 1016737? Right now, there's some separate information in 1016737, there's some separate information in whatever the new one is; I've forgotten

the number already --

MS. PRESLEY: 10267 --

CHAIR STETKAR: -- and there's some overlap, and some of the overlap is the same and some of the overlap is morphed a little bit. Does it not create confusion for users, especially in the overlap and morphing areas?

MS. PRESLEY: We tried to map it out in the front of our new document. I think it was a matter of convenience more than anything to have this new document be an update because people are already --

CHAIR STETKAR: Or why didn't you bring the state of knowledge correlation stuff into the new document and just surplus the other one?

MS. PRESLEY: We could have.

CHAIR STETKAR: I mean, you would have had, you know, the state of knowledge correlation in one place, you would have had the new thoughts of model uncertainty, the tables in terms of the internal events model uncertainty issues. I mean, you know, that's just copy and paste. That's production stuff. It just seemed confusing to me to have the two of them, especially with overlap and disjoint things.

MS. PRESLEY: I understand. That's a fair

comment. We kind of went back and forth on that. We didn't want, we wanted people to read the new guidance and be aware of what the new stuff was.

CHAIR STETKAR: Yes.

MS. PRESLEY: And we were a little bit worried that if we poured all the old stuff in, the new stuff would get lost. It was kind of six of one, half dozen of the other, but we'll consider that comment again, only --

CHAIR STETKAR: I mean, I just think of people having to work from two documents. If they were absolutely mutually exclusive, you know, I could rationalize that. But given overlap and some additional elaboration, especially in the area of modeling uncertainty compared to the older one, it just, you might want to think about that.

MS. PRESLEY: It may make sense to port that over. That was also a public comment we got.

CHAIR STETKAR: Oh, was it?

MS. PRESLEY: So we'll consider that. I'm not sure, at this point --

MR. PARRY: I'm not sure whether we can do it and meet the schedule, but maybe we could consider doing that at a later date, EPRI could consider doing that at a later date just to combine them.

MEMBER BLEY: It just seems for the poor folks out in the field trying to use this --

MR. PARRY: I know.

MS. PRESLEY: Yes.

MEMBER BLEY: -- it's going to be tough for them.

CHAIR STETKAR: It's also a lot easier going forward, one would think, that if there's any, I hate to say this with the staff present, but if there are any future revisions to things, and you want to point to updates of methods or something like that, trying to keep two documents coordinated that are referred to from a NUREG or guidance or whatever, this is prone to problems.

MS. PRESLEY: Right. Originally, they were mutually exclusive. They were two separate documents. And then we decided, oh, this chapter four seems to be really applicable and we need to update parts of it, so we ported it over. That's where the lines started blurring, but it's a fair comment.

MR. PARRY: I think there's another comment that you could also make as to why we have an NRC document and an EPRI document when they're dealing with the same thing and cross reference --

CHAIR STETKAR: Well, I was going to ask

Mary that, but since you brought it up . . .

MR. PARRY: No, I mean, like the fire --

CHAIR STETKAR: Yes, why not?

MR. PARRY: -- PRA project, for example.

CHAIR STETKAR: Why not? And there have been a few NUREGs issued. I mean, the fire isn't the only one. There have been others issued.

MR. PARRY: Right.

CHAIR STETKAR: I'll ask the staff. Mary can answer that because I'm sure that decision was made somewhere.

MS. PRESLEY: So the previous work also, as you know, has a list in the appendices of generic model uncertainty for internal events --

CHAIR STETKAR: At-power.

MS. PRESLEY: At-power, yes.

CHAIR STETKAR: As opposed to internal events at shutdown, which isn't a new one.

MS. PRESLEY: Yes. So internal events at-power. And that, of course, built on prior EPRI work, which is 1013491.

CHAIR STETKAR: Or internal events contribution to Level 2, which isn't a new one.

MS. PRESLEY: So we've been working with the NRC under an MOU, and there's two particular

points of cooperation in this project. One was to take the stages, the steps that 1855 Revision 1 defines and really provide some concrete guidance on how to apply those steps and where the iteration points are, some of the nuance of how you use those steps in an iterative process to put together a license application and perform that analysis. And the second part was, to produce the appendices, we worked with the NRC, we had a joint workshop where we brought experts in on fire, seismic, low-power shutdown, and Level 2. So those were the two main points of collaboration and, obviously, we were involved in reviewing each other's documents and making sure that there was one coherent story.

CHAIR STETKAR: Is it fair to now characterize, since Appendix A has been deleted from 1855 and subsumed in Appendix A now of the new report, is it, from a user's perspective, is it fair to kind of characterize 1855 as what ought to be done and the EPRI documents as guidance for how to do it?

MS. PRESLEY: It's kind of a user's --

CHAIR STETKAR: Or is it not that --

MS. PRESLEY: -- guide.

MR. PARRY: Yes, it's kind of like that, I think.

CHAIR STETKAR: Okay.

MR. PARRY: I mean, that was the intent was to not necessarily reproduce all the techniques and stuff that's in 1855 but to show how they fit into a license --

CHAIR STETKAR: So if I'm a user, I basically pick up the EPRI documents and I have confidence that if I follow the template that's there, if I can call it that, I'll satisfy the NRC's need to quantify uncertainties?

MR. PARRY: One would hope so.

CHAIR STETKAR: Okay.

MS. PRESLEY: And we have --

CHAIR STETKAR: I'm just trying to --

MR. PARRY: Yes. I mean, that would be the intent.

CHAIR STETKAR: I'm trying to get down to real practical things. I'm not trying to be --

MR. PARRY: No, no, no, that was --

CHAIR STETKAR: -- as simple as I'm sounding. I want to understand how somebody out in the field, a PRA practitioner, will understand how this process works. Will they have confidence when they pick up this document that that, indeed, will satisfy the regulatory needs of the NRC in terms of

what they need to do to develop a, you know, a risk-informed application with appropriate treatment of uncertainty, and they don't need to go to other guidance.

MR. PARRY: Right.

CHAIR STETKAR: They don't even need to read the NUREG in principle.

MR. PARRY: Right. I think that's correct. But I think the only caveat I would have is that there's no guarantee that an application would be successful because there could be disagreements, the sources of uncertainty for example, on their characterization.

CHAIR STETKAR: Yes, but those are technical --

MR. PARRY: Those are technical things, right.

CHAIR STETKAR: Those are specific technical issues, like you didn't model this valve or something like that.

MR. PARRY: Right.

CHAIR STETKAR: But in terms of the basic process and the methods that are used --

MS. PRESLEY: I would say that, with the caveat that there's a lot of good detail in 1855 that

we don't replicate. We've mapped, we give an overarching framework of how to do the assessment, how to use those steps. And then we refer to specific sections that give detail on how to specifically do parts of the analysis. So we don't replicate. It's really, they're really complimentary. They're supposed to be used, I think, more or less, together.

MS. DROUIN: Both NRC reports, well, the NRC report and the EPRI report are supposed to be, as Mary said, complimentary. There was very little duplicate effort in the reports, so you really need both of them. We had, you know, at one point, was going to put the detailed example in 1855. After a lot of discussions with EPRI, it did make more sense that it belonged better in the EPRI report because that's really where the examples are really given and the detailed guidance that supports the high-level guidance of what the staff expectations are that's in 1855.

MS. PRESLEY: And I'll give you just an example of what I mean by we give a broader framework and they provide the details. In our document, we talk about how you need to make sure you have the right hooks in your PRA model to model the change that your -- but then we referred to 1855 where they

provide a rather lengthy list and discussion of what those hooks are, internal events, basic events, like where you look to find those hooks.

So this is really the process and the framework, and we map it against the steps in 1855. And then 1855 flushes out some of the technical details.

CHAIR STETKAR: Okay. I'll have to think about that.

MS. PRESLEY: So, hopefully, that will be more clear when you see the flowchart.

CHAIR STETKAR: Okay. I'll let you continue.

MS. PRESLEY: So the new guidance really is intended as the nuts to soup --

MR. PARRY: Backwards.

MS. PRESLEY: Soup to nuts?

MR. PARRY: Soup to nuts, yes.

MS. PRESLEY: Thank you.

CHAIR STETKAR: It's okay. Either way works.

MS. PRESLEY: I eat desert first. Yes, soup to nuts approach of --

CHAIR STETKAR: You can start making fun of the way he talks, too.

MS. PRESLEY: Thank you. I'm just surprised he didn't point it out to me earlier because it was written on my sheet and he saw it. Okay. Anyways, starting with the PRA that you have and incorporating the changes that you need and doing the screening and pulling out the key risk drivers and key sources of uncertainty and then how do you decompose and interpret your results to find out what those key things are, how do you do sensitivity analyses, where do you look, that sort of thing. And then we provide the graded approach on now you have your uncertainties, you've assessed it against these regimes that are defined in 1855, well, how do you really determine which regime you're in and then what do you do once you figure that out?

And then, once you've done all that and you have your quantitative assessment complete, how do you package that together to produce a story that really describes that you have a wholistic understanding of what the risk is and what the uncertainties are? And part of that is dealing with large uncertainties.

So that's what the core of the document is about, and then we provide an example implementation, which is Appendix A, which, as you know, was what was

planning to be in 1855 prior. We've moved it over here because we referenced it so heavily, it made more sense to put it in this document. And then we added four appendices for the expanded tables on generic modeling uncertainties for seismic, fire, low-power shutdown, and Level 2.

So where we are with the document, I'll talk about this a little bit further in next steps, but we've sent out our document for public comments for users' group and also to Mary's group and have received those comments back. And the majority of the comments were in areas of clarification where we were being a little vague or at least not entirely clear. And then you'll see some of -- we've tweaked the document a little bit. That flowchart is one of the areas where we've tweaked it, and you'll see some of those things as we go through the slides. And I think Gareth will point out areas where we've made some changes in response to those public comments because you got the draft that went out for public comment. So that's the -- okay.

So I'll go ahead and hand it over to Gareth Parry from ERIN Engineering.

MR. PARRY: Okay. Thank you, Mary. Yes, one of the things that I think we hadn't really made

clear when we put the document together what our ingoing assumptions were. So the next couple of slides make that a little clearer, and you'll see, as Mary said, that we changed the process diagram to reflect the comments that we had from the commenters that said but what about this situation?

So what we wrote this for was for guidance for licensees who want to make a risk-informed submittal in accordance with guidance documents, such as Reg Guide 1.174, not necessarily that one specifically. But as you know, all the risk-informed application documents tend to rely on that, at least in terms of the philosophy of the integrated decision making and the principles. So that's one going-in position.

And, in general, most of those submittals, when you read the guidance documents, they require consideration of all the contributors to risk with a few exceptions. Sabotage is typically excluded. But, significantly, they generally require that you look at all hazards and all POS's, except, of course, for very specific things, like NFP 805 where you're looking specifically at fires.

Now, we recognize that, currently, there are very few, if any, licensees that have full-scope

PRA. I mean, there may be a couple that have, but, generally, they do not. So we developed the process to facilitate the screening or bounding of the missing scope items from, the items that are missing from the scope of the PRA. So the process is designed to do that, and it compliments to what the discussions in 1855, which also has a whole chapter on bounding and screening of hazards.

Clearly, this, I think, was the part that perhaps was missing from the original document that you can bypass these steps if you have a full-scope PRA or if the PRA that you have is adequate for the application. The application only requires that scope. The other thing we wanted to put in here in the document, it's a little separated from the process itself, is we wanted to explore a little bit of the interplay of the principles of risk-informed regulation, particularly the principle that talked about the limit, the size of the change that's allowed in terms of the change in risk, and the defense-in-depth principle because that has been a little problematic in terms of the way it's been interpreted.

So, in general, we would expect to be starting out with a PRA that, as a minimum, addresses internal events and internal flooding as hazard

groups. We also expect that the base PRA will have been peer reviewed against the ASME standard and Reg Guide 1.200 Rev 2, so that the technical adequacy of the base PRA is understood, we know if there are any problems associated with it. And the only comment to make about that is that really only addresses the base PRA. Clearly, you'd have to come back to look at the technical adequacy of certain aspects of the PRA that might be specific to an application.

So there's an iterative approach here, but the document doesn't really get into that. That's, if you like, parallel activity that you'd expect the licensee to be doing to ensure the technical adequacy. We didn't think this was the right place for looking at that.

Okay. So now if we look at the figure, you'll notice that this is different from the figure that appeared in the draft document in which you had. And the difference is in the first little diamond on the left-hand side that says PRA model adequate, instead of going to step three, now it clicks up and asks the scope question. So this is a bypass of the screening and bounding part of the process if you know that the PRA model you have going in is of sufficient scope to deal with the specific application. And this

could happen if it's a full-scope PRA or, say if you're only dealing with fires, that it's a fire PRA.

So those are the only, that's the only difference in the figure, except also that these nice little bubbles on here which indicate which steps of the 1855 process are addressed by these particular steps. So rather than talk through the figure at this point, I'll go through the steps one by one, if that's okay.

Okay. Steps one and two. These are, essentially -- there's absolutely nothing new here. This is the standard stuff that everybody should be doing if they're doing risk-informed application. They've got to understand what guidance documents they're using, which means that they have to have understood the acceptance guidelines; which risk metrics are being used and how they're to be used; which hazards and plant operational states have to be considered. That's the overall scope. There's the comment again that some applications can be hazard specific; and, therefore, that's very clear in that case. And in some cases, the cause/effect relationship is also specified in the guidance documents. In some of those documents, it tells you what it is you need to do to model the impact of the

change. It may not always be the case for things like Reg Guide 1.174. If it's not one of the standard applications, you may have to search for the way to model the change.

And step two is, effectively, it's an assumption that you're staffing with the PRA that you have, whatever the scope is, and you're looking at that model to see that it has the right hooks to model the cause/effect relationship. So it has to have the right elements for you to be able to model the change that you're assessing from a risk perspective. And this is NUREG-1855 Stage B. So this is just to remind people that that's where you have to start.

Okay. Step three we put in as -- and you'll see this in the way that the example in Appendix A of our document is developed. You have a PRA, so you're going to do an initial comparison of the PRA results for the acceptance guidelines. This is essential if the scope of the PRA doesn't address all the risk contributors required by the acceptance guidelines. If the scope is, in fact, adequate, then you really don't need to do this, although you might do this as part of step five.

The advantage that you get out of doing this is that the -- there's two things really. One is

that the quantitative results you get from that give you an indication of the margin that you have to the acceptance guidelines, so it's a good place to start to see if you've got a hope of meeting the guidelines. But perhaps the more important thing, well, definitely the more important thing is that when you look at the results and you analyze them, you'll get an indication of which initiating events, which accident sequences, which functions, systems, components are important for determining the risk metrics that you're going to be using to make the decision. So it's a detailed qualitative understanding of what's driving the risk metrics, and you need this to be able to do the screening and bounding analysis in step five. You need it in any case in the end when you do step four, the screening and bounding. You'll need it also in step five.

So one of the things that we put in the document, and it's in chapter three of this document, is, and I'll come back to it a little later on, is a description of the hierarchical process for analyzing the results of the PRA, to dig deep and understand where the contributors are coming from, and also to understand the level of detail, if there's any conservatism or anything associated with it. We can

come back to that a little later.

Okay. Step four. The purpose of step four is to give guidance on how you can assess the adequacy of the scope of the PRA you have. So the idea is to look at the missing scope items and investigate, given that you have understood from step three what are the important initiating event sequences, functions, etcetera, whether you can explore whether, based on that knowledge, you can either screen the hazard group, the missing hazard group of PRS out or whether you can bound its contribution to the risk metrics in some ways.

Because there's no universal way of doing this, things are going to be different, depending on the application and the plant and the PRA. We can only give general guidance at this point. What Appendix A does, it gives specific examples of approaches that were used for the particular plant for which Appendix A was developed. So you'll see, for example, in that appendix there's what we call a bounding analysis for the seismic. It's bounding in the sense of the path of the earthquakes on the plant is bounded, not necessarily frequency. So you can't argue that it's bounding overall. The frequency of the earthquakes is considered to be that which

everybody agrees on, more or less, given that there's a lot of uncertainty on it. But at least there's an accepted frequency of the earthquakes, so the bounding in that case is bounding on the impact.

Now, if neither of these can be demonstrated, i.e. that you can't screen or you can't bound, then you have a problem, at least a short-term problem. Either you can construct a PRA model which could be fairly time consuming and probably resource intensive or, if possible, you could also change the way the change you're proposing is to be implemented at the plant and restricted in such a way that the contributions for the missing scope items become negligible.

Okay. Now, step five. Once you're satisfied that the PRA you have has a sufficient scope and/or the missing scope items have been effectively bounded by some calculations and demonstrated to be bounded, then what you do is you do the final comparison with the acceptance guidelines. And this really hasn't changed very much, but it's described in chapter four of this report. It follows, largely, the guidance in the previous EPRI document.

What is different, though, is in the latest version of NUREG-1855 NRC has introduced these

regimes where they effectively represent a graded approach to the review and the level of detail of the argument you'd have to make to demonstrate that you've met the guidelines. So what we've included in this is a sort of graded approach to addressing uncertainty, depending on where the point estimate lies.

CHAIR STETKAR: Let me ask you about that because I was going to, dependent on who came up first.

MR. PARRY: Okay.

CHAIR STETKAR: You came up first so . . .

MR. PARRY: We got the short straw.

CHAIR STETKAR: Why is it that I should care more about uncertainty only because I'm in regime three? Why shouldn't I care about uncertainties that I've not evaluated that could give me a measurable probability of being in regime three when I thought I was in regime one and a half because of very large uncertainties?

MR. PARRY: Yes, I don't think we've precluded that.

CHAIR STETKAR: Certainly, you've not -- well, you don't preclude anything. You're very careful about not precluding. I'll come back to my

original comments now. If I'm out in the field as a practitioner and I read this guidance, I read this guidance to say I don't need to worry about uncertainty unless I'm in regime three.

MR. PARRY: No.

CHAIR STETKAR: I'll tell you, that's the way I read it.

MR. PARRY: Okay, okay.

CHAIR STETKAR: So if you don't want it to be read that way, you ought to rewrite it.

MR. PARRY: I'm sure we will. I think what we say is --

CHAIR STETKAR: Now, I get the same impression, by the way, from the NUREG, so Mary is going to have to answer that one, also.

MR. PARRY: Well, I think what we say is that, as far as parametric uncertainty, we don't really care when they're in regime one and probably not in regime two because we're low enough. But we do say in the document that you really have to look at the model uncertainties even in regime one because they could shift you into regime four. We never take model uncertainties out of the equation. If we don't, if it's not --

CHAIR STETKAR: I'll give you, I'll give

you that. Indeed, it does say you need to look at model uncertainties throughout. But this notion of parametric uncertainty, though, is a slippery slope because what is a model uncertainty and what is a parametric uncertainty? Suppose I'm using a fire model to evaluate a flame height, and within that fire model, whether it's an algebraic empirical correlation or, you know, a zonal model or, in principle, a CFD model, there are a number of parameters that are input to that model, all of which have uncertainties. But I don't quantify those uncertainties in that model. I simply put in a nominal value, and I crank out a result. Is that parameter uncertainty? Is it model -- you know, my result from that model doesn't have uncertainty on it.

MR. PARRY: No, I would argue that, in those circumstances, if you were using different approximations to calculating that value, that turns out to be more of a model uncertainty than a parameter uncertainty. And I --

CHAIR STETKAR: So, for example, the use of the EPRI5 empirical correlation versus a different correlation that might be in whatever the NRC empirical correlation, certainly that is a --

MR. PARRY: That's a model --

CHAIR STETKAR: -- a source of model, too.

MR. PARRY: Yes, yes. And --

CHAIR STETKAR: MELCOR versus MAP, for example.

MR. PARRY: Right.

CHAIR STETKAR: Which you don't address.

MR. PARRY: Okay. We'll skip over that one.

CHAIR STETKAR: But I'm just trying to understand, honestly, I'm trying to understand this subtle difference between where do we transition from model uncertainty to parameter uncertainty because I've got a wonderful example that I'm going to bring up once I try to understand your --

MR. PARRY: Okay. I think, I think what you're saying is correct. You have to be very careful about the way this is defined. And the parameter you think we're talking about are really the probability distribution to put on basic events.

CHAIR STETKAR: Yes, okay. And that's important because. Here's my example. I think it's NUREG -- John, help me out -- 1934, the fire? Thank you. NUREG-1934, fire modeling. We had a meeting on it. They, indeed, address model uncertainty and they also address parameter uncertainty within the context

of a model.

MR. PARRY: Right.

CHAIR STETKAR: There's a wonderful example in there where, if you put mean values through an algebraic equation, you conclude that a flame height does not impinge upon your cables of interest. If you actually quantify the uncertainty distributions on the heat release rates through that same correlation, you conclude that there's something -- don't hold me to the exact percentages -- there's a 30-percent probability, because of the large uncertainties, that, indeed, the flame height does hit the cable, which has a tremendous impact on then how you model that whole process.

MR. PARRY: Yes.

CHAIR STETKAR: I'm not sure where that fits into regimes one, two, and three in this context, but without -- now, you can say, well, that's parameter uncertainty, but it's not in the context of what you just told me because it's not a basic event that you're quantifying state of knowledge correlation through. It's not a model uncertainty in the sense of looking at correlation A versus correlation B. It's looking at the uncertainty and the results from that model and how it would affect your conclusion.

MR. PARRY: Yes.

CHAIR STETKAR: And I didn't see any of that coming through in this guidance.

MR. PARRY: That's probably true. But I think where we would have to deal with that, and this is something that we'll take into account, would be in the appendices because I think that's where we would need to be clear about sources of model uncertainty --

CHAIR STETKAR: Because part of that, actually, is changing the, it could change the format of the logic model and, you know --

MR. PARRY: It surely could, yes. Yes, yes.

CHAIR STETKAR: -- I mean, you know, how you implement that point three or whatever is mechanics in a sense. But identifying the fact, the only way you do it is actually propagating those uncertainties through it.

MR. PARRY: Yes, and those are --

CHAIR STETKAR: You know, I don't want to get hung up on the semantics of is it that model or is it parameter because it's a parameter propagated through a model.

MR. PARRY: Yes, yes.

MS. PRESLEY: But is that something you

would perform a sensitivity study on?

CHAIR STETKAR: I don't believe in sensitivity studies, so we'll talk about that later. I believe -- no. And the reason for this is I don't know what a sensitivity study on that mean value means, and I don't know how people use it. Suppose I come up with -- I don't remember what the mean value was. Let's call it two with no units on it. Now, if I did an uncertainty analysis, which I did, I found out that the uncertainty about that parameter gave me a 30-percent probability that, indeed, a flame height would impinge on a cable. If I do a sensitivity study on that value of two, what do I do? Do I increase it plus or minus a factor of two? Well, if I increase it by a factor of two, maybe by doing that it does hit the cable, but maybe it doesn't if the uncertainty is really broad. So do I increase it a factor of ten or a hundred? And then I say, well, gee, that's unrealistic because I had a mean value and what does it mean to increase a mean by a factor of a hundred?

So that's why I don't like this notion of uncertainty distributions or sensitivity studies on the mean because it's the mean of an uncertainty distribution. You already have the information. I had that information because I calculated a mean. I

calculated the mean from the uncertainties. I knew the likelihood that, indeed, it would exceed a certain threshold.

MR. PARRY: I think I would craft sensitivity studies differently then because I think if, in the one case, you could, by using the mean you've demonstrated that there's no impact. And if you did the uncertainty propagation and you found there was an impact --

CHAIR STETKAR: Yes, which is this example.

MR. PARRY: -- which is this example, in that case, I would say, well, okay, it does -- if that makes a difference to your application, then you better rethink whether you're doing the right thing when you do the full propagation. And I think that would tend to lead you to do the more detailed analysis for the actual application. If it could affect it, I think you would do the more detailed case, and you wouldn't -- because one is a shortcut of the other, right? Substituting the mean values is a shortcut to doing the --

CHAIR STETKAR: Right.

MR. PARRY: -- full propagation --

CHAIR STETKAR: Well, but I mean this

notion of if I substitute the mean values and I win, the notion is, to address some of the concerns, you say, well, do a sensitivity study on the mean.

MR. PARRY: I wouldn't say that, though. That's not what -- I think your situation is a little different, that you wouldn't necessarily do the sensitivity study on the mean. I think you would --

CHAIR STETKAR: If you had the full uncertainty distribution, there's no reason to do the uncertainty on the mean. You may be saying the same thing.

MR. PARRY: Well, that's where we may be saying the same thing, yes.

CHAIR STETKAR: Because you, I mean, it doesn't make sense.

MR. PARRY: Yes. But even that, you could say, I mean you'd have to have some notion that the mean that you were getting by substituting mean values, I think you'd have to have some idea of whether that was going to be realistic or not if you were going to use it. And maybe the only way to do it is to do the full propagation. I think, I mean, you're bringing up a good point, but I don't know that we can, we can't address all these situations. That's the problem. But I think --

CHAIR STETKAR: Well, granted --

MR. PARRY: -- is a good one.

CHAIR STETKAR: No. Granted, you can't address all the situations. Again, I'll step back to the person, the practitioner who's going to be picking up these documents and saying what do I need to do tick off my box that I can satisfy the regulator that, when they, you know, when a reviewer has to tick off their box, did they adequately address uncertainties, the answer will be yes, verily, they followed this guidance and did it. And some of the messages, you know, that you convey either through examples -- examples are good, but examples that are focused, you know, only on one experience set sometimes narrow people down a little bit to where they shouldn't. This one from the fire, I mean, it's kind of a classic.

MR. PARRY: Yes, yes.

MEMBER BLEY: But you see the same thing in other places.

CHAIR STETKAR: Oh, yes, you do. I mean --

MEMBER BLEY: At least to me, you know, when you sit around this table with the people who are here, I think you kind of know what these things are.

But if you're picking up this book, these two books to tell you how to do it and the books kind of say parameter uncertainty is not important --

MEMBER SHACK: Well, but in John's example, what worries me more is the fact that the uncertainty is something that you add to an existing PRA. It seemed to me if I had the PRA and I'm dealing with the uncertainty, John's thing sort of has to be built into the PRA as he's developing the model. I'm not sure how, you know, here we are with a given PRA and we're somehow trying to divine the uncertainty, whereas in his model the guy that's done the mean value has already set up the model, he hasn't included it, and he's set up his success criteria and everything and he's often, now, somehow, he's missed things.

CHAIR STETKAR: Well, he's missed things, but, I mean, part of this guidance says that, for particular applications, you may have to go back and change the structure of your model, you know. And this is a piece of information, without doing that, you wouldn't know that you'd need to change it.

MEMBER SHACK: Maybe that's when you go back and you look at the model for that application that you find that out.

MR. PARRY: I think one of the things that's coming through, to me anyway, is that we need to have a statement in there about the distinction between parameter and model uncertainty because I think, I mean, I can see where you're -- in fire, in particular, and maybe in other places, too, some of the probabilities that we put in the logic models are derived from models that are not simple. I mean, all the stuff, like failure rates and things like that, those are statistical things that you get from it, and that's really, in a sense, what we were talking about here.

CHAIR STETKAR: And that's why I was trying to, you know, through provoking, is trying to understand because there are a couple of different notions of model uncertainty. One is comparing MAP versus MELCOR or, you know, CFAST versus MAGIC or whatever. The other is the results of a modeling process, the uncertainty in those results because of treatment of input parameters, you know, or correlations, whatever. And that's sort of missing. That's between the two notions.

MR. PARRY: I think that's a good thing that we probably ought to add something in there to clarify that, and I think that would --

CHAIR STETKAR: And a simple example. I mean, I'd go look in that NUREG. It's --

MR. PARRY: Okay. What's the NUREG again?

CHAIR STETKAR: 1934.

MS. DROUIN: I would like to offer that I do think some of this is in a 1055 where we have a chapter where we go into quite some detail, you know, describing parameter uncertainties and model uncertainties. So I would really suggest that we revisit some of this stuff that is there, you know. The problem is is that, as you move along in the process, you know, you will have explained something earlier in a chapter or two chapters earlier and then you forget about some of these things that were already there.

CHAIR STETKAR: Well, and that's another reason, Mary, is that, again, as a practical user, the person out there developing the fault trees and event trees and stuff, if the guidance or the public interactions or, you know, if there are workshops or whatever, focuses primarily on the EPRI document as how to do it. At that final point, the process needs to be very, very sensitive to how the user will interpret both the words and the examples and make sure that they capture the broader stuff from the top

because the typical user isn't going to go back and read every page in 1855.

MS. DROUIN: But I would like to think, because of the way the NUREG is structured and the way the EPRI document is structured, I personally don't see how that can really happen. If I was a licensee and I saw a NUREG that has a chapter written by the NRC that says here's the strategy you should be using and here's how the NRC is going to review what you've put in, I think I would pay close attention to that.

CHAIR STETKAR: Well, let me say --

MS. DROUIN: And I would view that --

CHAIR STETKAR: -- let me just tell you --

MS. DROUIN: -- along with reading the EPRI document, which has given me some examples.

CHAIR STETKAR: Well, but some examples carry a message. What those examples are carries a distinct message.

MR. PARRY: Yes, we need to look at, re-look at the NUREG-1855 and make the appropriate references. But it's a point well taken because I think it could be misunderstood, and I think people do tend to think they understand stuff without actually understanding the subtleties of what's going on very often.

MEMBER SHACK: Well, I think the whole notion of a consensus model kind of leads to that kind of attitude that, if I'm using a consensus model --

CHAIR STETKAR: I'm using a consensus model. A consensus model -- we've had V&V on all five of those fire models, whatever they are. There's reports saying yea, verily, within the constraints of, you know, use these models, they're good. But that V&V didn't talk anything about uncertainty analysis. In fact, the NUREG that talked about the models didn't talk about anything on uncertainty analysis, you know, until they were pressed, for example. So that everybody who knows now that it's the right model and you go to this place and you look up the parameter values and you take a mean value and means are good, you don't use medians, you know, it's excessively conservative to use the 98th percentile and all of that kind of stuff.

MEMBER BLEY: I just went back and peeked. I didn't peek at the whole document, I couldn't, but where parameter uncertainty and model uncertainty are defined. And John's example is a nice one, and there's a distinction that I'm not sure is made between parameter uncertainties on things like valve failure rates where we have extensive data and they're

actually reasonably narrow to parameters of physics models where it's really, you could argue whether that parameter uncertainty you described is parameter or if it's hiding some aspects of modeling --

MR. PARRY: Right.

MEMBER BLEY: -- or it's just, it's quite broad because it's a physics parameter under conditions that aren't narrowly enough defined that you have to cover a wider range. And I'm not sure that jumps out. There's great discussions, but it's a neat example because of that.

MR. PARRY: It's a good example.

CHAIR STETKAR: I mean, when you think about convolution of full-sized hazard crews with the real uncertainty on the fragilities rather than some surrogate mean curve or something like that is another -- I mean, you know how to do it mechanically but people don't do it.

MEMBER BLEY: In a physics parameter, you get that kind of thing.

CHAIR STETKAR: Yes, any kind of natural or physics. You're right.

MEMBER BLEY: Or chemical. A natural parameter.

CHAIR STETKAR: Yes.

MS. DROUIN: But I would really put it to the committee, and I'm not trying to discount what you're saying, I'm truly not. I'm coming from a purview of practicality, trying to get something out the door with not a lot of resources and we're running out of time. Is this a fatal flaw to this document? You know, we can continually improve, improve, improve, and I certainly, you know, understand that. But is this something that makes this document difficult and has a high potential for misuse? I would say, no, it doesn't. Now, that's my personal opinion, you know. I recognize these things, but I've got to come back and look at this from a practical perspective.

MEMBER BLEY: We'll have to think about that a little bit. Actually, over all possible applications, is there a high chance of misuse? Probably not. Over cases where you're focusing on the kind of problem that was described here, yes, maybe it is. We'd have to think about that some more.

MR. PARRY: I certainly think we can add something into this document to clarify what we mean when we make these statements.

MEMBER BLEY: And if you had examples of

this kind of thing over in the EPRI document, I think that would go a long way.

CHAIR STETKAR: It doesn't take, it doesn't take many examples. It takes, like, one that you say, hey, think about this kind of thing.

MEMBER BLEY: And a story with it that generalizes that one example.

MR. PARRY: We might, as Mary pointed out, we may have some examples in the Appendices B through E, not A.

CHAIR STETKAR: Well, those are just tables, though. And that's --

MR. PARRY: Well, I know, but there is issues and they describe what --

CHAIR STETKAR: Yes, that's right. I mean, you're right.

MR. PARRY: So we'll check to see what --

CHAIR STETKAR: Check to see.

MEMBER REMPE: Maybe elaborate kind of the descriptions of the tables. I'm thinking of, like, the one --

CHAIR STETKAR: Well, but, I mean, the whole purpose of those tables, though, isn't to try to get too specific.

MEMBER REMPE: Yes, but if they spurred it

a little bit more with a little more detail, maybe it would cover it.

CHAIR STETKAR: Okay. We've probably spent -- I think you hear it.

MR. PARRY: Yes, yes. No, no, it's good.

CHAIR STETKAR: Back to this thing, though. I mean, honestly, you may want to think about some of this because I did get the impression that one should pay, you know -- you even have the approximately two times little multiplier on this thing here, that as long as my mean value is about a factor of two below my acceptance criteria I don't really need to pay much attention to uncertainty analysis.

MR. PARRY: That's not what it says.

CHAIR STETKAR: You may want to read that --

MR. PARRY: That's not what it says.

CHAIR STETKAR: Okay.

MR. PARRY: What it says is that's really related to parameter uncertainty and whether you need to do the full propagation of the state of knowledge correlation. That's the only thing that relates to that.

CHAIR STETKAR: Okay.

MR. PARRY: And even that factor of two is sort of fuzzy because, in some cases, it's pretty obvious that you have to do it because you've got a lot of problems. You know, a lot of your cut sets have these correlated things. So it's not intended as that at all. It's purely for the propagation of --

CHAIR STETKAR: You know, let me give you an example.

MS. PRESLEY: Is there a specific thing that gave you that impression?

CHAIR STETKAR: Yes. Step, you know, on page 27, step five, final comparison with acceptance guidelines. There's a statement that says, "The rigor with which the uncertainty analysis is performed is a function of the closeness to the acceptance guidelines. For example, if the analysis of model uncertainty does not result in a challenge to the acceptance guidelines, a rigorous acceptance of the parameter uncertainty may not be needed." I don't know what that last sentence means, but the first sentence seems to give me --

MR. PARRY: No, that's purely referring to the propagation of uncertainty. It's only the parameter, that's only the statement knowledge correlation stuff. That's the only thing that's

intended to reflect.

MS. DROUIN: The reason this figure was created is we sat down with NRR and NRO with quite a bit of time for them to explain to us the actual ways they do the review, how they attack it, how they approach it.

CHAIR STETKAR: I understand that, but, quite honestly, they don't know and they don't care about uncertainty. That's one of the problems we have in this agency, and it's got to stop, Mary. You know, I realize that they want a simple-minded way out.

MS. DROUIN: Yes, they do.

CHAIR STETKAR: And we can say that. So I understand the feedback you're getting from NRR and NRO. I understand that.

MS. DROUIN: And I don't think that they discount uncertainties. I think what we're trying to do is find a practical way to deal with them and to try and illustrate that it is going to be, you know, commiserate with where are they in terms of the acceptance guidelines. And that's a philosophy that this agency has had, you know, since we started bringing risk insights into play that, you know, the closer you are to your acceptance guidelines the more justification you're going to need. And so this is,

all this is trying to communicate is that, you know, when you're in regime one and you have taken into account your uncertainties and you're in regime one, you're not going to need to provide as much justification. But as you approach, you know, regime three, we're going to take a very close look, we want to have a very good understand about your uncertainties.

CHAIR STETKAR: But, I mean, we're living, we need to stop thinking about error factors of, like, three for pump failure rates and X to the fourth, you know, for pumps for state of knowledge correlation because we're entering a time in risk assessment and use of risk-informed applications that are addressing, and we'll eventually get to your work on large uncertainties --

MS. DROUIN: Well, I don't know where that 2X came from.

CHAIR STETKAR: -- we're dealing with a lot of things like fires, flooding, seismic events, those types of things that, by definition, have large uncertainties associated with them. And when you say, well, I'm in regime one because I've accounted for my uncertainty, if I've accounted for my uncertainty in the mean sense and I'm in regime one, but my

uncertainty is so large that there's still a 10-percent chance that I might exceed my acceptance guideline, that might be okay for a decision-maker to have that information. The decision might be that's fine, but the decision-maker ought to have that information that there's a 10-percent probability that I might exceed the acceptance guideline, despite the fact that I've got large margin on the mean. And that's the kind of thing that I'm talking about, the message that this sends, that's being derived from level one and internal events only core damage frequency world of PRA to something that's going to be applied going forward, you know, maybe over the next decade or so, and be pointed to as guidance for how to think about things that way. Now, I always use the financial stuff. If my financial advisor had told me in 2006 that there was a five-percent probability that I would lose 40 percent of my net worth, I might have made different --

MS. DROUIN: Absolutely.

CHAIR STETKAR: -- investment decisions, even though their best estimate was that I would gain money, right?

MR. PARRY: I think there's two things that I'd like to point out here. First of all, that

statement in 2.7, on page 2.7, I think we can link forward to section 4.2 because I think it's explained better there, and that's the intent of it. But the other point that I see you straying towards is really looking at whether we should be even changing the acceptance guidelines because you're now worried about how much --

CHAIR STETKAR: No, no, I don't want to muddy that. No, no, no.

MR. PARRY: Okay. Well, it sounded like, to me, that you were because really, in a sense, even if we have a tail that crosses the acceptance guidelines, that's not the way --

CHAIR STETKAR: We're talking about risk-informed decisions here, and, indeed, you know, both the NUREG and the EPRI document do a very good job about the notion that that's not just based on a number out of the PRA. It's based on five principles, and it's integrated. And in that sense, I'm not talking about changing the acceptance guidelines. I'm talking about developing risk information for that decision that appropriately represents both an expected value, mean value if you want to call it that, and information about if the uncertainty is broad and it might give you some probability that you

do not meet the acceptance guideline, that information, so the decision-maker can look at that and say, well, I still feel confident we have the ability to make a reasonable assessment that, for a variety of reasons, the decision is okay, despite the fact there's a small probability that it might be exceeded. And that's the whole notion of this, you know, the gray area there anyway. So, no, I'm not --

MS. PRESLEY: I think that's exactly why we have chapter five, and maybe some of these discussions will be more --

CHAIR STETKAR: Chapter five is --

MS. PRESLEY: -- directed because that's really, you're in those areas when you have large uncertainties and when you're dealing with things important to defense-in-depth. So in terms of coming up with an application and a story that holistically represents your real risk profile and what you're worried about, I think that's what we strive to explain in chapter five. So maybe some of this discussion will come up again when we --

CHAIR STETKAR: Yes, let's --

MS. PRESLEY: -- go forward, if that's okay.

MR. PARRY: Yes, that's fine. But I do

think, though, that, you know, we've thought about this back in the day when we were developing Reg Guide 1.174 is what should the metrics be and should we have a guideline that said that you've got to be less than this with X percent confidence. That is really, really difficult when we're dealing with very small numbers.

CHAIR STETKAR: Sure.

MR. PARRY: So it was decided back then that we shouldn't, that we wouldn't do that. So I'm not sure what you do with that information or what anybody would do with that information.

CHAIR STETKAR: I'm not sure what you do with that information. Now, I'm not trying to make that -- I think that's beyond what we're talking about.

MR. PARRY: Okay.

CHAIR STETKAR: I would like people to have the information, though, so that they can think about it.

MR. PARRY: Okay.

MS. PRESLEY: And I think that's within the guidance, though, chapter five.

MR. PARRY: Yes, we do have the percentiles and stuff on that.

MS. PRESLEY: Well, and also the quality, I mean, the qualitative stuff that you do for large uncertainties.

CHAIR STETKAR: Chapter five, we'll get to chapter five. Chapter five, by and large, I think is actually really good. It's just the other parts that, again, if I'm picking up this document as a user, PRA group leader out at a utility instructing, you know, the people who work for me or myself, what message is this telling me?

MS. PRESLEY: We'll take another look at it for the tenor of, I mean I think we have a good idea of what the issues are, and make sure that we're conveying what we actually intend to convey.

MR. PARRY: Right. Could I ask for a short break?

CHAIR STETKAR: You can. We were going to break later, but you can do that. Let's take a -- until 2:25 we're recessed.

(Whereupon, the foregoing matter went off the record at 2:07 p.m. and went back on the record at 2:22 p.m.)

CHAIR STETKAR: We're back in session.

MR. PARRY: Okay. So we were, we showed the diagram of the regimes and sort of talked a little

bit about how we were going to use that. Okay. So we're on this slide now, which is slide 14. And, actually, this just repeats what I said earlier is that, basically, when the results are far from the acceptance guidelines, parameter uncertainty, in the sense that we talked about it, like valves and pumps and all that sort of stuff, is generally unimportant, except in some cases where it's obvious that it is important. So maybe that's an obvious statement, but this is just based on the experience that we have with doing PRAs for various applications. So in that case, just the substitution of mean values in the cut set equation is probably adequate to get the mean.

But we also think that, if you're getting close -- and the reason we set this factor of two is that the way the NUREG was written it said things like from below an order of magnitude to slightly below or slightly above the acceptance guideline as defining regime two, so we wanted to put some more specificity on slightly. And we figured that a factor of two was a good place to start, even though it's not a definitive criterion. But, certainly, if you are within a factor of two, it would be wise to do the full propagation, if you could.

CHAIR STETKAR: Again, I'd caution you,

when I read this, I read it with a very cynical view, obviously. And I look for things where people will point to something and say I don't need to do it because I am 2.5, and they said it's only important if I'm within 2 or 3. Now, again, I'd just caution you to read it with that -- you can't read it, because you wrote it, with that degree of cynicism, but someone can somehow. The problem is a lot of the public comments you get might not do that either.

MR. PARRY: Right.

MS. PRESLEY: If we link it back to where we got the guidance from, because a lot of that is from 1016737, of how much, where you're looking and where it's important and how much of an impact it's made in those cases, I think if we link it more closely to that, maybe porting that section back into this document --

CHAIR STETKAR: Some of those examples in the appendix on 1016737 are good examples.

MS. PRESLEY: Yes. But I agree. We'll go back and look at it and make sure we're not --

MR. PARRY: You know, and I agree, you know, anything you write can be misused, misinterpreted because nobody reads the small print, typically --

CHAIR STETKAR: Well, they read the small print, but they read it if it's in their best interest.

MR. PARRY: Yes, yes, okay. That's a good point. I think we just need to make sure that that isn't used inappropriately as much as we can. But the next point that's important is that, since the model uncertainties may be large, and these are usually the big things, so they've got to be assessed for all regimes, basically. And what we've done is to provide, we've done in this document, in chapter four, is to reproduce the guidance that we had in the old EPRI document, which is what you were saying that maybe we shouldn't have done --

CHAIR STETKAR: Let's say there was substantial overlap there.

MR. PARRY: Yes. So we haven't changed the process any, but it's the way in which we refer to the different appendices that is a little different. And I don't know if you want me to walk through the next three slides because you've seen these before in the previous version. There's not a lot new here, and there's not a lot that's not, in fact, totally consistent with what's in NUREG-1855. It just talks about, you know -- well, let me not deal with it. Let

me go on to the next one.

In this case, what we're really saying is that we've identified the owner of the PRA should have identified the sources of model uncertainty because he has to do that to meet the standard in the base PRA model. There are other things that you have to do, though. The things that are important are those that affect the risk metrics. So it's the uncertainties that can affect the contributors to the risk metrics that are really what we're trying to focus on here. And they can come from two places. They can come from the base PRA model, but they can also come from the way that the cause/effect relationship is developed, from the way that you model the impact. So you've got to consider all these sources of uncertainty, and it's on that set that can affect the risk metrics that we then formulate sensitivity studies to see if they're going to be significant. And the whole of the formulation of the sensitivity studies and the logical combinations, etcetera, is no different from what was in the previous document and what's also in NUREG-1855.

And the next figure is, essentially, just sorting out, using the sensitivity studies to sort out which are the key sources of uncertainty. So we're

really looking for those that can impact the decision and, in particular, those that can change the decision because those are the ones that we need to focus on.

CHAIR STETKAR: Now, let me ask kind of a question here. Does this whole process presume that I have numbers for which I have no measure of uncertainty? I don't want to call them parameters because of -- I mean, in other words, why do I do sensitivity studies? Because I have no notion of what the real uncertainties are?

MR. PARRY: No, no. Well, one thing you can do sensitivity studies on, if you have a different model to evaluate a specific parameter --

CHAIR STETKAR: That's true.

MR. PARRY: -- you can do a sensitivity study on that. Now, there are other things you can do, though. For example, human error probabilities that we know we have no certainty on those --

CHAIR STETKAR: But we have quantified uncertainties.

MR. PARRY: Yes, but do we really believe that those quantified uncertainties are significant in any way?

CHAIR STETKAR: You know, I'd argue that if you don't believe that you're not doing what you

ought to do.

MR. PARRY: Well, I'm not --

CHAIR STETKAR: If you quantified your uncertainties, you ought to live or die by them. They mean as much as that seventh significant figure mean value.

MR. PARRY: But in many cases, understand that I think that a lot of the methods, the uncertainties are just, they're mandated, right? If the number is X, then the error factor is three. If the number is 2X, maybe the error factor is five. There's no real assessment of the uncertainty, if you'd like. It's almost paying lip service to it. But what I'm saying is that there are things you can do with HEP that one thing you could say is, well, okay, let's see if I calculated all the HEPs with model X I'll get one set of values and I'd get their uncertainties. If I did them with model Y, I'd get a different set. We realize this is, we meaning I think a lot of people involved in the development of the guidance documents, for example the guidance documents for 5069, we realized back then it's pretty impractical to get people to do two sets of HRA models to make any sense.

So what you can do is you play with the

values as a set to see whether by increasing the human error probabilities you're going to get different insights than you would with a base and, similarly, if you lower them you might get different insights. And I think it's done, it's a slightly different sort of way of using the sensitivity analysis. You're not using it to say this is the result. You're using it to generate --

CHAIR STETKAR: You wouldn't do that with pump failure rates, though or valve failure rates.

MR. PARRY: No, probably wouldn't do that with pump failure rates and valve failure rates because I think we feel we have enough information on those statistically to characterize the uncertainty, and that's already addressed by using the mean values.

MS. PRESLEY: I think the key word on that slide is the related assumptions. I mean, those are really, the assumption, I mean . . .

MR. PARRY: Yes. Of course, the example I gave is a little bit different because, in that case, we're not really looking to calculate numbers, per se. We're looking to characterize whether something is risk significant or not. And the way it's done for 5069 is you take the inclusive set, rather than the one particular value of the HEPs. All

right. We'll move on.

So in step six then, that's the part of the integrated decision making. That's really where everything comes together, and you're presenting the results to the decision maker. So the topics that we address in chapter five are comparison of the results to the guidelines, a characterization of the results to the decision-maker, and this includes, I think -- you can look there, John. I think it actually includes the 50th and 95th percentile of the risk metrics, as well as the mean value. So it's included in there.

CHAIR STETKAR: It says parametric uncertainty.

MR. PARRY: I'm sure it does, yes. It does because I think the model uncertainties are going to be characterized largely through the presentation of the sensitivity cases for the various sources of model uncertainty, and the reason we're doing it that way is you can find out which of these sources of uncertainty are going to help, are going to challenge the guidelines. And given that, then you have to justify whether the particular model uncertainty or the particular sensitivity study that challenges the guidelines, you have to first position it in some way,

either by saying, well, okay, this is not really credible but we put it in there to see how bad it could get. That's one way, okay? Another way is to say, well, okay, I'm not sure about this, but I think if I put something in place, like a compensatory measure, I can combat that source of uncertainty. I can change the way I implement the proposed change to effectively negate that source of uncertainty. Oh, and the other thing is that, depending on what that source of uncertainty is, I might be able to do performance monitoring to make sure that the changes that actually occur don't exceed a pre-defined level that, well, that don't exceed a pre-defined level. And that really hasn't changed. I mean, that's always been the case, I think, with all this stuff.

So the other things we address in that chapter are, first of all, integration of the PRA results with the other percentiles of risk-informed regulation, and particularly defense-in-depth. We put something in on defense-in-depth, and we put in a section on dealing with large uncertainties, as well.

CHAIR STETKAR: Are you going to talk more about those three things?

MR. PARRY: I'm not going to talk much about the comparison of the results of the guidelines

because I think that's been covered pretty much elsewhere. I will talk more about the, specifically about defense-in-depth and a little bit about large uncertainties.

So in this slide, it's just a recap of what the five principles are and, clearly, where uncertainty really rears its ugly head, if you'd like, where it's dealt with is in two. It's also dealt with in three, although we don't say very much about that. Safety margins are clearly a way of dealing with uncertainty, but we don't really deal with that one in this document. We'll talk more about defense-in-depth. Really, the principle thought is what we've been talking about anyway, and then the other one on the performance monitoring. I'm not going to talk about that now, but that's also addressed in there. And you know the classic example, again, of that is 5069 where you're lessening the special treatments. You don't really know how to model the impact on equipment reliability, but if you set a limit such that, if you set a limit on the increase of equipment unreliability that is consistent with principle four, proposed changes being small, if you do your performance measurement to demonstrate that you can maintain it within that value, then that's an approach

to dealing with that source of uncertainty.

Okay. Next one. So the proposed approach that we've included in this report for addressing defense-in-depth, I have to note that this is not something that NRC has adopted or endorsed but we think it's a fairly pragmatic approach. And I should say that, although it's not written on this slide, I think one of the assumptions going in here is that, given that the plant has been designed and operated in accordance with the regulations, it is assumed that the defense-in-depth is, in fact, achieved to the extent that we know about it. And Fukushima maybe throws a little bit of a monkeywrench into that in some ways, but that's, you know, that's something we can't do very much about. We're going to change the state of the plant as it is. So to the extent that defense-in-depth is adequate according to our state of knowledge at this moment, we can assume that it's there.

So what we did was to develop a guidance recognizing that defense-in-depth is essentially hierarchical, by which I mean is that I think most of the documents that you look at will accept, will agree that defense-in-depth is established by having a set of barriers, whether they're physical barriers or

administrative barriers. But there are things that you need to have in place that prevent bad things from happening. And the way that the plant achieves that is by implementing certain strategies, like having redundant or diverse systems, having training, all these things that help to ensure that the barriers are, in fact, effective.

So the focus of the approach that we've presented in here is to make sure that, when the license amendment request comes in, it doesn't affect the presumed balance of levels of protection through physical changes to the plant or changes to the way it operates. And the -- if we can move on to the next one, I think.

So what we've done is to say that what they should do is identify and assess changes that may adversely affect achieving a required safety function, particularly when the level of redundancy or diversity is limited or where significant uncertainty exists. Identify and assess the impact of defense-in-depth crosscutting changes, and these could be things like administrative changes, maintenance changes, that will affect multiple safety functions or cut across levels of protection. And then we'll also use things that can't be addressed directly by the PRA, such as late

containment failures. We don't really have a good metric for that in the current regulatory framework.

CHAIR STETKAR: You mean in the current level of PRAs that people have developed?

MR. PARRY: No, I mean in the current set of metrics, like CDF and LERF, which are the ones that we use for Reg Guide 1.174.

CHAIR STETKAR: Okay.

MR. PARRY: If we had acceptance guidelines placed on large release or other things, then, yes, we would have some way of looking at it. Okay. I should actually say that if you look at SRP 19.2, which used to be SRP Chapter 19 a long time back, a lot of these thoughts are actually in there. I think the thing that wasn't explicit in there was that the assumption that the plant does start out with an adequate level of defense-in-depth. And I think that, in a sense, is what makes this process logical. If you can't start with that position, I think you're on a bit more shaky ground.

But what we concluded is that if you meet the acceptance guidelines of principle four, you've demonstrated to some extent, at least at an integral level, defense-in-depth is maintained for those issues that relate to CDF and LERF. You haven't changed them

very much. Therefore, you cannot change the defense-in-depth very much. But that's really just an overall look.

The thing that we're proposing is that what you should do, though, is understand where the changes are being made. And the example here is a, I think it's quite a good one in the sense that it shows how this can affect things differently.

So let's look at a couple of cut sets. They're both low frequency, but one of them may also be low order. If you look at, think about propose to change the surveillance frequency on, say, the reactor pressure vessel on the LPCS system for boiler, the pressure vessel appears in a single element cut set. The LPCS appears in cut sets of very high order typically because we have so many systems in a boiler to put injection in. And, also, if you look at the impact of the frequency of surveillance on the RPV failure probability and that on the LPCS system, you probably have a lot more uncertainty.

So while you could argue from the point of view, perhaps, of a probabilistic argument that you could justify a change for the reactor pressure vessel surveillance frequency, you'd have to make a much stronger case than you would for LPCS because for LPCS

it probably doesn't matter. You can probably take LPCS out of the model and you wouldn't change the CDF very much at all.

CHAIR STETKAR: Risk achievement would be pretty small.

MR. PARRY: Yes, yes. So this is just an example, I think, of how you need to understand the role of the thing that you're doing and relate it to the level of redundancy, the role it plays in preventing, in performing that function.

CHAIR STETKAR: Now, before you -- I'll ask Mary. You had that nice qualifier on the bottom of page 20. It says this approach has not been endorsed by NRC. Is that in the report?

MS. PRESLEY: It will be. That was one of the comments, our comments.

CHAIR STETKAR: I was going -- since there's a lot of discussion these days about defense-in-depth, one of the questions that I wrote to myself was, you know, does the staff agree with this, regardless of my own personal opinion.

MS. PRESLEY: That was one of the comments, and we're going to add --

MR. PARRY: We're going to add a caveat.

CHAIR STETKAR: Okay.

MR. PARRY: Okay.

MS. DROUIN: We don't endorse it, but it's not meant to say that there's not good thoughts or anything. It's just a recognition, as you well know, that we have ongoing work on defense-in-depth with, you know, going forward with the development of the policy statement. So that's all going to be worked out in the end, and we're not going to get ahead on this EPRI document and start endorsing things in a very narrow scope.

MR. PARRY: Yes. Because I think what you're dealing with is a much bigger issue than this particular case, which is to do with license amendment requests.

MS. DROUIN: I mean, and it will all trickle down because, you know, we're in the midst of revising Reg Guide 1.174, and that's been put on hold to after the larger effort so that, you know, it's all done in a consistent coherent manner.

MEMBER BLEY: What a concept.

MS. DROUIN: I know. What a concept.

MR. PARRY: What is it? Consistency is the hobgoblin of small minds. Is that what someone said?

MEMBER SHACK: Foolish consistency.

MR. PARRY: Oh, okay, thank you. Okay. We've also got a discussion here on addressing large uncertainties. This is really triggered by some of the more recent events.

CHAIR STETKAR: Gareth, first, before we go into this, how large does my uncertainty have to be before it's large?

MR. PARRY: You know, I was pondering that question when I was re-reading this section in preparation for this meeting.

CHAIR STETKAR: No, I mean, seriously, because it's sort of this section --

MR. PARRY: I know.

CHAIR STETKAR: -- you know, we're going to talk about this section but --

MR. PARRY: Okay. I --

MEMBER BLEY: Your example comes to mind.

CHAIR STETKAR: Yes. And, indeed, that uncertainty really wasn't all that large, like it wasn't an error factor of a hundred. You know, it's not the kind of uncertainties that you see in seismic hazard that are quantified. It was a fairly modest uncertainty and, yet, without considering it, you would make the wrong decision, for example. So I think it is important to say you have this now section

on ways to think about and address large uncertainties.

MR. PARRY: Yes. I actually think, though, what we've done is we've commingled a couple of things in here because you could argue that a large uncertainty is one that changes the decision perhaps. Okay. It's large enough to worry about.

CHAIR STETKAR: Okay. But that certainly doesn't come through here.

MR. PARRY: No, no, no, it doesn't. It doesn't. And that wasn't the original intent of the section.

MEMBER BLEY: You've hit on something kind of interesting, though. Your example turned out important. If you look at seismic, if you run median values, you get the same kind of confusion. But if you run mean values, usually you're okay. The uncertainty there is so big, the mean is driven way up in the high end of the distribution, which kind of makes it okay. So if the uncertainty is large enough, mean values kind of cover --

CHAIR STETKAR: The 96th percentile anyway.

MR. PARRY: But I think what this was triggered by was really things like external flooding

where we really do not have good models for calculating the frequency of the events. And, therefore, you can have very, very large differences between the frequencies, particularly if you're trying to do any extrapolation from the historical data, which may or may not be relevant. But it also means that you don't necessarily have a nice little distribution because what Dennis said is true. If you've assumed a lot of normal distribution or one of those skewed distributions, then, yes, the mean gets driven way up as the uncertainty goes up, and it will be ahead of the 99th percentile in some cases.

CHAIR STETKAR: Eventually, yes.

MR. PARRY: But in this case, maybe you don't even have a distribution, you just have assessments that are over a very large range. And what it really means is that you really don't know what the frequency is. It's not useful to do the standard Reg Guide 1.174 calculation because you don't know whether you've got the mean.

CHAIR STETKAR: There is some, and this is philosophy, and I don't, you know, we have to be careful about philosophy, but, see, my philosophy is you do know. As a risk assessor, it is incumbent upon you to examine all of the available information and

express your current state of knowledge with your uncertainty. That is the best we can do. That is what we understand. We understand that there's a five percent probability that I'll lose 40 percent of my net worth. That's really broad uncertainty, but that's the best we can do today. And we assess our risk and our margins to safety based on our current state of knowledge, and if our state of knowledge ignores the fact that we might have a 14 meter tsunami hit my nuclear power plant sometime in my measurable lifetime, you know, we've not done our job right. If we'd evaluated our uncertainty for that and said, yes, there's a measurable uncertainty that this could happen, I still might make a decision that's wrong, but at least you've done that.

So this notion that I can't evaluate the frequency of large flooding because I can't evaluate the uncertainty, I don't subscribe to that. Yes, you can. It might be very broad, but if it's the best you can do, if you've done a good job doing that, the best you can do, that's what it is.

MS. PRESLEY: The question is is it, I mean, how meaningful is it to do that if there are other things that you can do to get you a better understanding of the situation? And that's where --

CHAIR STETKAR: What's a better understanding, though? Give me an example of what's a better understanding than that.

MS. PRESLEY: I think this idea of trying to figure out if there are cliff edges. That's a good -- I mean, the risk insights of what the large uncertainty, where do you actually have to start worrying about it, and then back-calculating, well, what would my frequencies have to be and then what realm does that put me in? Does that -- okay. The frequencies have to be slow that that puts me in the realm of worrying about whether climate change or not is driving my models, and maybe that's where I can be a little bit more comfortable in saying that. But if that cliff edge is driven by a different type of model uncertainty, maybe the river shifts because there's a seismic event or something, and that's more graspable. Then maybe that changes our decision. I mean, the numerics aren't important. It's the drivers behind those numerics and trying to get at those when the uncertainties are so long and everything is mushed into a really broad distribution. You have to have some tools to parse that out.

MR. PARRY: I tend to agree with Mary. At some point, the numbers do sort of become, I wouldn't

say necessarily irrelevant but they're certainly not anything you can hang your hat on. Therefore, you should be looking to other approaches to dealing with this, and part of that is to understand what the impact of these uncertainties is and is there anything you might be able to do about it, or do you have to live with it?

But this would get into more -- this, though, is also in, it's in the context of making risk-informed changes to the plant, so the plant exists, as opposed to changing the design of the plant to accommodate these large uncertainties. And that's a definite thing, and I think we have to be a little clearer about that in the document.

CHAIR STETKAR: It might help.

MR. PARRY: Yes, because I think, you know, we have to say, okay, there is a very large uncertainty. We really don't know what's happening with the external. But does, it might be --

CHAIR STETKAR: Let's say I wanted to install FLEX stuff at my plant and want to know how high a pedestal I need to put it on so it doesn't get washed away in the flood that I'm trying to protect it against.

MR. PARRY: That's a design problem.

That's a design problem.

CHAIR STETKAR: Well, should I need to know how high that flood might be and how often --

MR. PARRY: I think it would be helpful.

CHAIR STETKAR: Okay.

MR. PARRY: But I --

CHAIR STETKAR: That's a change to my plant. I mean, it's a relevant thing we're talking about.

MR. PARRY: Okay. It's a change to your plant, but it's not -- yes. But that's a design change. That wasn't what we were, it wasn't -- it's not going to be -- okay, all right. Hold on, hold on. I've got the answer. I've got the answer. That's a change the plant was designed to make the plant safe for sure, right? What we're talking about is changes to other things in the plant and would they be affected by this particular hazard event.

CHAIR STETKAR: One of the things, you know, we can toss examples back and forth a lot, something you said going in is that you might need to better define the boundaries about what -- you said this is in the context of a risk-informed change in the license.

MR. PARRY: Right.

CHAIR STETKAR: But my sense is it might be a little bit more narrowly defined even than that.

MR. PARRY: It's possible. Yes, I think any change that you're going to make that can be demonstrated to make the plant safer should be acceptable without going through much --

CHAIR STETKAR: But, I mean, some of these same principles could, as long as you're going to make a change to make the plant safer, small changes that have a large potential benefit, you ought to be aware of that.

MR. PARRY: Yes.

CHAIR STETKAR: I mean, the fact, you know, you put two meters of nominal grade versus three meters above nominal grade, it might not be all that much expense if you're making a change, given the fact that even two meters will help you. Just something to think about. It doesn't answer how big does it have to be before it's big enough.

MR. PARRY: No, it doesn't. It doesn't.

MS. PRESLEY: But to address that, this process is, and one of the public comments that we got was that this process is fundamentally no different than how you would assess any other model uncertainty with one exception where you may not go that far in

the cliff-added effects, but, fundamentally, this is the same --

CHAIR STETKAR: Well, but even the cliff edge effects, I'll come back to the 5 percent losing 40 percent of my net worth. I didn't lose it all.

MR. PARRY: You sound somewhat bitter about that.

CHAIR STETKAR: That's why I'm somewhat bitter. But even that, you know, it's uncertainty about the degree of the hazard, the frequency and the consequences. Go on. You know, we're going to run over time here if we're not careful.

MR. PARRY: So, basically -- yes, we'll go on to the next one. Yes. Basically, we just outlined a process for doing this.

CHAIR STETKAR: Actually, back up to the last one because there were a couple of things. I mean, one is the philosophy of this whole thing, but, apparently, flooding can't be addressed but seismic is no problem because we know how to do that and have been doing it, despite the fact that the uncertainty is not real big.

MR. PARRY: No, no, no, that's not, that's also not taken out of the equation because there are things in modeling that's seismic, and we give the

example of the correlation effect, for example, that can have an impact, and that can be big because, basically, you're saying you fail one and you fail them all. That can make a big difference to the frequencies.

CHAIR STETKAR: But in terms of the seismic hazard, you feel pretty comfortable that we've expressed our uncertainties in that okay, despite the fact that they're really large. You have other examples about --

MR. PARRY: Yes.

CHAIR STETKAR: -- doing sensitivities on the mean of the seismic hazard, which you'll eventually get to.

MR. PARRY: I think the thing with the seismic hazard is we know the uncertainties are large, but we also have, to some degree, a consensus approach to calculating those. So it's a frequency, but there's a consensus approach to representing the uncertainty.

CHAIR STETKAR: So if we had that consensus approach for flooding, we'd be okay with flooding.

MR. PARRY: We'd be in better shape.

CHAIR STETKAR: Okay.

MR. PARRY: Right.

CHAIR STETKAR: Okay.

MR. PARRY: Okay. So the process is really, it's not very different from what you would do. You would understand if this source of uncertainty, what is its role in the decision making, how does it affect things, and then we have some ideas on how you address that and how you might integrate it with the other principles but particularly defense-in-depth. Performance monitoring for some things really is not going to help you too much. You can't monitor the impact of a large flood, for example. If it happens, it happens.

So the types of things that we do is, in recognizing that the large uncertainties, one of the things they can do is they can potentially overestimate computed risk. In some cases, that overestimation is known to exist. In some cases, it's not known whether it's an overestimation or not. It depends on the type of uncertainty we're talking about.

One of the things that's critical is that, if you put conservative assumptions into a model, and one of the examples is this complete correlation of seismic failures, you can mask the effect of the

change on the risk because you could take a diesel out for maintenance. If you assume that when the earthquake hits that all the diesels fail, then it has no impact on the risk by taking that out. It's a rather extreme example, but it's a case of where making a conservative assumption can mask the change in risk. But you can see whether that's significant by relaxing that particular assumption in that case, so maybe you don't put the correlation in and you put it in as random and see whether that changes things. So that's one way of looking at it.

CHAIR STETKAR: Some of that, though, there is guidance in NUREG, and I can't recall --

MR. PARRY: Yes, I think there probably is.

CHAIR STETKAR: -- about subdividing contributors by hazard groups. So, for example, if you looked at, you wouldn't see a change in your example for the seismic hazard group, but you might see a measurable change for the internal events hazard group. That's a different set of -- and when you combine the two, if your risk was dominated by seismic, that's a third piece of information. But the decision-maker would have that comparative information.

MR. PARRY: Yes. And we --

CHAIR STETKAR: You're saying prompt the computer about the whole listed pie.

MR. PARRY: Well, not necessarily because this would be a portion of that pie that could mask everything by --

CHAIR STETKAR: Sure, sure.

MR. PARRY: So I don't think it's any different. I think you always have to understand where this -- that would come into understanding the role in the decision making and the potential to affect the decision. So I think, yes, no, a part of what we describe in this report is, in fact, that you do have to decompose the results and understand where they come from. Potentially underestimating the computed risk, while I'm not quite sure what -- to be honest, I can't remember what we were thinking about here. But if you've got large uncertainties, the certainty is the possibility that you can underestimate risk. But it escapes my mind now what we precisely had in mind with that.

But as far as the cliff edge goes, one of the ways you can look at it, at least in the decision making context, is say, you know, reverse engineering, if you'd like, figure out what likelihood for this

cliff edge would you have to have to make it significant to the decision and then work on that basis.

CHAIR STETKAR: Okay. Let's think about that because Mary brought it up. Let's think about the floods and say, okay, I need to have a 14-meter flood to come over my cliff edge effect. How do you address that? What is the likelihood that you would get that and how you divine a likelihood that gives you confidence that you can make a decision that it's not a problem?

MR. PARRY: I think what you'd have to do is you'd say, okay, I'm going to say I've got my decision, this is an element in the decision, how high does that frequency, and let's say the consequences of this cliff edge is that you have core damage. CCDP is one. What you would be looking at to see is at what frequency is that assumption likely to change my decision, if it can?

CHAIR STETKAR: Okay.

MR. PARRY: That gives you a piece of information. What you do with that information, it's like any of the other assumptions that we're going to deal with because none of these assumptions can be proved. So you have to come up with an argument of

why you think that frequency is low enough that you can live with it. And that may be a specialist argument. I mean, we can't give the guidance on how you do that, but that gives you a path for at least trying to address that situation. But it's like any other assumption. If we have two assumptions, and one of them kills the decision and the other one doesn't, you still have to make, if you want to go with the decision, you still have to explain why that assumption that kills it is not believable.

CHAIR STETKAR: Have some confidence that the frequency is low enough that --

MR. PARRY: Not the frequencies because this isn't the frequency. This is is this assumption correct or is that assumption correct. You have to have confidence that that assumption is not a credible assumption.

CHAIR STETKAR: I think I lost you. Walk me through the example of the cliff edge effect on the flood because I lost something about an assumption. There is a flood high enough that's going to flood the whole thing.

MR. PARRY: There is, and you know what it is.

CHAIR STETKAR: And you know what it is

because you know what elevation --

MR. PARRY: Because you've calculated the elevations. What this is saying is, okay, I want to do -- what I need to know is what is the likelihood that that cliff edge occurs that could change my decision? If that likelihood was a 10 to the minus 2, I'd say I've got a problem.

CHAIR STETKAR: Well, when you say likelihood, I think frequency, so maybe we're not communicating.

MR. PARRY: It's the frequency of the flood that --

CHAIR STETKAR: That is big enough.

MR. PARRY: -- is big enough to give you the cliff edge, right.

CHAIR STETKAR: Okay. So we're talking about the same notion --

MR. PARRY: Yes, we are.

CHAIR STETKAR: Okay.

MR. PARRY: Okay. So all the reverse engineering does is it tells you what that frequency has to be to change the decision. Now what you have to do is you have to look at all the evidence to decide whether that frequency is believable.

CHAIR STETKAR: So you have to assess your

confidence in --

MR. PARRY: You have to do some assessment, yes. And I think it's a little different from producing a hazard effect because now you can start piling on extreme things to come up with it to see whether you can get that frequency.

CHAIR STETKAR: So I don't see a difference in the two processes --

MEMBER BLEY: That's where I'm kind of sitting here and --

CHAIR STETKAR: There's some subtlety here that I think I'm missing but . . .

MR. PARRY: Well, I think that's because you guys come from the Caplan school of putting probabilities on everything, right?

CHAIR STETKAR: Well, because there probably is probabilities on everything. Sometimes they're really small, and sometimes the range is fairly large.

MR. PARRY: I'm being a little facetious, but I think there is a difference with trying to make a case that a likelihood that you've come up with is bounding or not likely to be achieved than there is to try and do an analysis that gives you a whole range of frequencies because you can look it from a more

bounding approach this way. And if you can show that you think that likelihood, that frequency is, the way you'd have to get to that --

CHAIR STETKAR: I mean, I see what you're saying, honestly, Gareth. But I'll take your 10 to the minus 2 number. If I say there's a half of one percent probability, 0.005 probability that, indeed, the frequency would be 10 to the minus 2, is that good enough? I mean, is that sufficiently incredible, or does it have to be a one billionth of one percent probability that it could be that high?

MR. PARRY: Well, I don't see how --

CHAIR STETKAR: For a decision-maker. Now, this is a decision-maker because a decision-maker is going to make a decision, you know. And depending on how risk adverse that decision-maker is, a half of one percent might be good enough or a one billionth of one percent might not be good enough, depending on the particular decision-maker.

MR. PARRY: No, I don't think we can do that. I also don't think that I, I mean, this is what I meant by saying you were following the Caplan school of thought that you can actually put a probability on that. I'm not sure you can because I don't know how you would do it, to be honest. So I'm not even

suggesting you can come up with these numbers, like I am, you know, 0.02 percent confidence that this is bounding. To me, that doesn't mean --

CHAIR STETKAR: Well, but if I'm a decision-maker and you say, well, look, the frequency, to make a difference, the frequency has to be whatever, 10 to the minus 2, once in a hundred years. If it's less than that, it isn't going to make any difference.

MR. PARRY: Right.

CHAIR STETKAR: If it's more than that, I've got a real problem. How do you convince me that, indeed, I am so confident that I'm not even close to that 10 to the minus 2 that I don't need to worry about it? How do you develop that convincing argument? Do you just say, well, obviously, these things are incredible?

MS. PRESLEY: So if you have a --

CHAIR STETKAR: You know, it's much less than the frequency of a meteorite hitting the plant that, that --

MEMBER BLEY: The decision-maker is going to say how sure are you of that.

CHAIR STETKAR: How sure are you of that.

MR. PARRY: I agree. And I think maybe

the things you have to do to look at all the things that could happen, that would have to happen to generate that and come up with some frequency, but I'm guessing here because I'm not an expert in hydrology, right? So I can't tell you how to do that. All I'm saying is that this is one way of looking at it, and then somebody would have to come up with the argument that this frequency is believed to be negligent. And I think it's not that we're saying it's, I wouldn't want to say it's 0.02 percent because the decision-maker wouldn't know what to do with that anyway. These decision-makers are not, they're not sitting there with a, you know, calculator saying --

MEMBER BLEY: But, see, you were real close, you were real close to the non-quantified way is when you can say I've considered this list of all the things that could contribute and I can't think of anything else and I can't find anything in the literature beyond this set, this is a complete set. Then you're pretty far along in the game, whether you do what John wants or not.

MS. PRESLEY: Or if you can winnow it down to a couple of things that are so uncertain and so little data is available. I mean --

MEMBER BLEY: Then I'm going to want to

hire a wall.

MS. PRESLEY: Then you're going to -- yes. But at least that tells you something.

MEMBER BLEY: Or bigger pumps inside or something.

MR. PARRY: No, we're not claiming that we have all the answers to this. We've --

CHAIR STETKAR: I mean, it's help. I understand, you know, sort of the rational that you're using and the approach. I'm not convinced personally that the amount of effort is different, whether you approach it from building to hazard or whether you look at how big does the hazard have to be to give me confidence, but I at least understand.

MR. PARRY: And perhaps what we need to do is to maybe have some examples of how this is done and try to --

CHAIR STETKAR: You know, examples really help.

MR. PARRY: Yes.

CHAIR STETKAR: But go on.

MR. PARRY: So, really, that's all I think we wanted to say about this particular issue. I mean, if you have specific comments, obviously we'd like to hear them. But just on the next slide --

CHAIR STETKAR: The only comments I had reading through this, and I actually thought that this discussion of large uncertainties, I liked it.

MR. PARRY: Okay, good.

CHAIR STETKAR: I really did. Some of the specifics I didn't like so much.

MR. PARRY: Yes.

CHAIR STETKAR: This whole notion of when you say that you can do an uncertainty, a sensitivity study on the mean unreliability value, and there's several statements. And when you talk about sensitivity studies, you talk about them in terms of sensitivity studies on the mean unreliability values for operator reliability, organizational effectiveness. There's several things where you talk about that phrase. As soon as I --

MR. PARRY: In chapter five?

CHAIR STETKAR: Table 5-1.

MR. PARRY: Okay, okay.

CHAIR STETKAR: Okay. As soon as you say mean value, I think I already have an uncertainty distribution because I have a mean value. And once I have an uncertainty distribution doing a sensitivity study doesn't make any sense to me because I already have all of the information I need.

MR. PARRY: Okay.

CHAIR STETKAR: That's why I asked earlier, if I have a guess, I guessed it was 10 to the minus 3 without doing any real analysis, then, yes, doing a sensitivity study on what happens if it's 10 to the minus 2, what happens if it's 10 to the minus 1, in some sense, makes some sense.

MR. PARRY: Yes, okay.

CHAIR STETKAR: Because people will look at that and say, well, okay, I have a mean value, I have a mean frequency of a seismic acceleration of one g. I had that mean value, and if I vary it plus or minus five that's okay. Well, I have the uncertainty distribution. Just use it.

MR. PARRY: Your point is taken. I think we need to look at that to make sure that we're not using the terms inappropriately, using the term "mean" inappropriately because I don't think that's what we meant. Yes, you're right. If you have a distribution, why --

CHAIR STETKAR: Why not use it?

MR. PARRY: -- sensitivity. Yes, I agree. So I think we just need to --

CHAIR STETKAR: This notion of where you do -- that's a lot of what I hung up on this because

it might be just misinterpretation of terminology or something. In many cases, I got the notion that you're recommending that we do sensitivity studies on things for which we already have some quantitative estimate of the uncertainty. And as I said, when I read mean value, that's what I think.

MR. PARRY: I think in some of the literature related to this in the past, that is, in fact, what's done, like with common cause failures, right? Some of the common cause failure things are all shifted to the 95th percentile just to see if it makes any difference because, actually, if you -- but that's in the case of looking for insights as to what's significant, as opposed --

CHAIR STETKAR: Yes. But, I mean, people have criticized that approach also --

MR. PARRY: I know they've criticized that approach, but, you know, you need to do something because the impact there is that if you overload the common cause failure stuff, you're going to mask stuff.

CHAIR STETKAR: Sure.

MR. PARRY: If you under-load it --

CHAIR STETKAR: Sure. But, see, the point is if you've done a decent job of evaluating the

available data and assessing your uncertainty about that, saying how bad could it be if your beta factor was one, I mean, it doesn't make any sense. Make it seven.

MR. PARRY: That would be interesting.

CHAIR STETKAR: Do you follow what I'm saying?

MR. PARRY: Oh, yes --

CHAIR STETKAR: Some of that notion of just doing sensitivity studies for the notion of kind of playing numbers games is not what we ought to be telling people to do.

MR. PARRY: No, except what you're really doing is you're saying, well, okay, what happened, I'm going to look, I know that my common cause failure methodology isn't that great and the data is pretty sparse. What happens if we were way off on CCF either one way or the other? Does it change the way, does it change the way the risk profile looks sufficiently to give me different insights? And it's done for that reason alone. It's not --

CHAIR STETKAR: But if we were way off, the data would have told us that. We would have seen either no common cause failures or we'd be seeing them everyday.

MR. PARRY: But you know that the way that the common cause failure database is. There's an awful lot of judgment that goes into calculating those numbers.

CHAIR STETKAR: You know, but there's a judgment -- if this valve failed, is it a failure or not?

MR. PARRY: Yes, I know, I know, I know.

CHAIR STETKAR: So there's uncertainty in everything that we do.

MR. PARRY: Right.

CHAIR STETKAR: Go on. We're getting short on time.

MR. PARRY: Yes. This is just a reminder. This is just a summary of what's in chapter three, and that's just some explanation of how you might decompose results to get an understanding. That's the intent of it. It's a bit of an orphan in this presentation, but I just put it in there. I don't think there's too much controversial about that, hopefully. That's all I wanted to say. Well, I mean, again, it's not changed from what was in chapter seven of the old NUREG-1855.

MS. PRESLEY: So then the last piece is, obviously, we have the appendix, the appendices.

Appendix A illustrates how we applied our process. B, C, D, E provide tables. There's an excerpt of the headings for the tables for fire, seismic, low-power shutdown, and Level 2.

CHAIR STETKAR: Let me ask you about Appendix A. The NUREG report solved many of our questions back in June about the example by excising the example from the NUREG report. So the NUREG solved all of our issues regarding the example in the NUREG. The example, I did a text compare side by side and, other than references to specific section numbers, it's verbatim from what the example was in the NUREG.

MS. PRESLEY: I thought we put in a couple more caveats.

MR. PARRY: I thought there were a few more caveats put in --

CHAIR STETKAR: Well, not in the text compare I did, and I looked at the June version of the NUREG and I looked at the version of the example in at least the incarnation of your report that we got, the one that went out, I guess, for public comments you said. And I challenge you to find differences. Certainly --

MS. PRESLEY: It would have been in

footnotes, but they were there.

CHAIR STETKAR: I think I even checked the footnotes.

MS. PRESLEY: Okay.

MS. DROUIN: I can tell you that, and maybe it's in an earlier version, and this was before you were on the committee, when the committee first saw it --

MEMBER BLEY: I think John was here when we first saw it. I don't know.

MS. DROUIN: I don't think he was.

MS. PRESLEY: Well, we definitely discussed the changes. Whether or not those changes made it in the August draft, I'll have to double check.

CHAIR STETKAR: All I'm doing -- okay. I don't care when I joined the committee.

MS. DROUIN: I just don't know if we're talking about the same changes.

CHAIR STETKAR: I compared -- here's what I did. I took the version of NUREG-1855 Rev 1 that we reviewed in June of this year that had the appendix in it. I compared that text side by side with Appendix A in the version of the EPRI report that we received for this meeting. Now --

MS. DROUIN: Okay. You would not have seen changes between those two.

CHAIR STETKAR: Boy, oh, boy, I'm glad to hear that because I didn't. So there's a newer version of the EPRI report that we haven't seen?

MS. DROUIN: No, no, there's obviously a miscommunication of changes that you wanted to see that we have not done.

CHAIR STETKAR: Yes. I mean, that was my -- okay.

MS. DROUIN: And I think that's where there's a disconnect because, if we go back a couple of years, the criticism that we had gotten on the appendix is that we didn't have enough caveats and that it could be misused. And I know that we systematically went through and added those caveats. That would have been over the version you saw. So I guess what I'm not understanding is what are the things you were looking for that we haven't done?

MR. LAI: You're talking about 209 of the NUREG, Rev 0?

MS. DROUIN: I think that's what it was is that we really had not done something that you're looking for because I can tell you the differences between the two, there really, except perhaps in

tweaks that they did in moving it into their document, there weren't full-scale changes made.

MS. PRESLEY: No, there were a couple. I do remember there were a couple of comments from John, actually, I think most of them came from John from the last meeting, and they were, I think the flooding, the way we positioned the flooding or the seismic, one of those --

CHAIR STETKAR: I have my notes here, and it's because we're running long --

MS. PRESLEY: We definitely discussed them. I --

CHAIR STETKAR: The concern I had is the notes I had written to myself after the last discussion is that my sense was that, I mean, the notes says, yes, the staff is going to look into this, the implication being that something might be --

MS. PRESLEY: Yes, yes, they did change.

CHAIR STETKAR: -- changed.

MS. PRESLEY: We have the changes. I'm not sure, like, for instance, in Table A-3, the note at the bottom has changed. In the June version that went to you for the last meeting, the note said analysis supporting these conclusions would typically be --

CHAIR STETKAR: That one, that one did -- you're right. Yes, that footnote did, indeed, change. That one I stand corrected. I was wrong. That one did change, that one footnote about other -- I've forgotten what it is, but it's the one you cited. I was talking more about details of the examples itself, themselves, that we had some comments on in June --

MS. PRESLEY: Yes, I think we ended up adding just a couple more caveats instead of changing the examples because we didn't have the resources at that time. Are there specific ones that really give you heartache that we should really need to go back and look at?

CHAIR STETKAR: You know, it's because of time -- I'd go back to our comments from the June meeting. The ones -- what I don't like to do here is, I had raised some questions in June about specific items. I've got 15 pages of things, but it's not fair to raise new ones at this point that I didn't raise in June. I had my shot back in June. In the interest of time, though, it's not clear to me that that's the most effective use of our time today --

MS. PRESLEY: Okay. Well, if --

CHAIR STETKAR: -- because I still have about a half a dozen things that I raised in June that

weren't changed.

MS. PRESLEY: Okay.

CHAIR STETKAR: It's not our report.

MS. PRESLEY: Well, I mean, we can take a look through the -- I know some of those comments are intermingled with other comments on examples that were in 1855 because that's when those discussions came up. You were talking about examples generally and the use of examples in the document, and you bounced back and forth between stuff that was in Appendix A and stuff that was elsewhere. So we could have very well missed some of those comments. We can take a look back at the notes from the last meeting and try to do a scrub, unless you'd like to send --

CHAIR STETKAR: A lot of the comments in the examples, quite honestly, are not, they're items that would benefit, in my mind, from more caveats or better elaboration because I still believe that someone will pick up this document and use it as a template for the bare minimum that needs to be done to check off the box that I've satisfied things. And, therefore, what's in the example is, in many cases, okay within the context of that particular example. What's not in the example might be inferred as something I don't need to do.

MS. PRESLEY: Right. And other than dealing with that in the introduction to the appendices, I mean, when we footnoted that caveat a couple of places, I mean, you can caveat until you're blue in the face. I don't know how much is useful. So if there's, again, some specific parts, I'll go back and look at the notes, if there's some specific things that you think will lead people down a rabbit hole, I think it's important to caveat those. But I'm wary of caveating everything because we do have the general caveat up-front. That's a lot of use of the word caveat.

MS. DROUIN: Well, you need to balance it because you don't want to give so many caveats that you discount the whole piece of work there.

CHAIR STETKAR: See, part of the thing is one approach is to have very, very detailed examples, which you run the risk of people focusing on that as saying this is necessary and sufficient to achieve. The other is to have perhaps less detailed examples but more that will say, hey, here's an example of something you ought to think about and a real practical example. So rather than going through -- what this is is a detailed evaluation of a particular, very-focused change and saying this is the right way

to do it. The other approach is to highlight things, you know, like my fire example of, hey, here's something that has a practical implication. It's not a nuts to soup, beginning to end -- no, nuts to soup is, indeed, beginning to end because you start with things and you grind them up and make a roux and create a soup -- beginning to end template for how to do an analysis. It's rather other examples to say, well, here's an issue and here's one way to address it and here's a different issue and here's an example of another way to address it. So it's broader this way rather than deep this way.

MS. PRESLEY: Right. And I think this appendix specifically we were trying to get the deep to show --

CHAIR STETKAR: Absolutely.

MS. PRESLEY: -- the process.

CHAIR STETKAR: That's what it does.

MS. PRESLEY: And we'll put the broad where they're needed. I just wanted to point out the caveat, and I think we added or at least tweaked this sentence in the introduction. It should not be construed to imply that this is the only approach or that the specifics of the illustrative example would be sufficient in all cases.

CHAIR STETKAR: No, that's -- and I think that was in the old one, also.

MS. PRESLEY: Oh, okay.

CHAIR STETKAR: But then, again, somebody is going to read that and --

MS. PRESLEY: No, we understand but --

CHAIR STETKAR: You can't make it perfect.

MR. PARRY: Right.

MS. PRESLEY: The other reason it's in the EPRI document and not the NUREG.

CHAIR STETKAR: I just, a lot of the detailed examples I brought up in June were meant to sort of illustrate this point. And whether you want to address it by caveats -- I don't know the best way to address it, quite honestly. But it comes back to kind of reading the document with a very cynical skeptical approach to how someone might construe it as being the absolute minimum necessary and sufficient to satisfy the perceived regulatory requirement. I mean, the last thing I think anybody wants to have done is somebody follow, perhaps naively, the guidance in this, come in with an application, and have the staff say, well, this isn't adequate.

MEMBER BLEY: Well, that might not be the last thing we'd want to see but . . .

MS. PRESLEY: No, that's a training issue.

MEMBER BLEY: One thing we haven't talked about are the Tables B, C, D, and E. And I don't know if you're going to -- you don't have another slide?

MS. PRESLEY: No, this is it.

MR. PARRY: No, we didn't intend to go through --

MEMBER BLEY: There's a lot of stuff in those tables. Now, John's analyst who he's so worried about won't look at those, but, if I'm going to look at those, this sure gives me a lot of hints about things to think about.

MS. PRESLEY: John's analyst should look at that. This is the --

MR. PARRY: Well, no, that's the intent of having them in there, though, is that they look at them.

MEMBER BLEY: Okay. But you can't cookbook these things. These aren't cookbooks.

MR. PARRY: No, no, you can't.

MEMBER BLEY: This is a pretty broad set of --

CHAIR STETKAR: It is.

MEMBER BLEY: -- ideas. They're more ideas.

CHAIR STETKAR: It is. And, see, I see those tables useful --

MEMBER BLEY: I like that.

CHAIR STETKAR: -- more useful than the specific detailed example.

MEMBER BLEY: Well, you can't, I mean, are you recommending that we get rid of all the examples? I don't think so.

CHAIR STETKAR: No, no, not those tables.

MEMBER BLEY: No, no --

CHAIR STETKAR: Appendix A.

MS. DROUIN: There is two different purposes, and 1855, in numerous places, sends the licensee to those appendices, saying, okay, go to EPRI document, you know, appendix blah, blah, blah, for a generic list of model uncertainties that you need to consider.

MEMBER BLEY: Consider. And that's a whole set of information we haven't been talking about all day.

CHAIR STETKAR: No, that's absolutely true.

MEMBER BLEY: And I guess I'm, I don't know what corner I get backed into listening to my colleague here, but we can't have enough detailed

examples in Appendix A to cover everything. But having some is pretty darn useful to help people deal with it. Maybe one wants a warning on every page don't cookbook this, go see the other tables, you know. There's a lot of issues to be considered, but I think that's a really useful set of information.

I haven't quite completely come to grips with how not the person I'd like to see doing these analyses but the person who's coming at it kind of cold, how they learn to use those. That's a bit of a trick. What I haven't thought about before is do our examples in Appendix A send us back to those for ideas?

CHAIR STETKAR: No, no, no, that's the problem. That's the problem.

MEMBER BLEY: And I think that could be a useful thing.

MS. PRESLEY: Yes. So that was one of the public comments that we got, actually, from the user review is you haven't used the tables that you gave us in your appendix. And it was because that example was developed, obviously, way, way before those tables existed.

MEMBER BLEY: Maybe John was daisy-chaining toward this all day.

MS. PRESLEY: But that's one of the revisions that we're going to make in Appendix A. We're either going to find a way to incorporate them or put in that this was developed before those. Ideally, you would use --

MS. DROUIN: That's not an accurate statement.

MEMBER BLEY: Which one?

MS. DROUIN: That it doesn't use the tables. Remember these are the new tables. There's also the tables in the other EPRI report on internal events, internal flood, and it does refer back to those because, at the time, this example is just meant to illustrate the process. So it does look at how to use these generic sources. It's just for internal events as the example it uses.

CHAIR STETKAR: What I wanted to ask is, and that's absolutely true, Mary, but what I wanted to ask is you got comments from the public on EPRI 1026511 --

MS. PRESLEY: Yes.

CHAIR STETKAR: -- that report that has these appendices in it. Now, the RHR example in Appendix A of this report used to live as Appendix A of the NUREG. In EPRI 1016737, there were the

companion tables for internal events and flooding that listed these similar types of things, but it didn't have the example. Did you get any comments -- I mean, you don't -- the example that used to live in the NUREG that is now Appendix A of this report doesn't very well talk to Appendices B, C, D, and E. I don't recall, honestly, whether the example in Appendix A of this report talks very well to what are the companion tables in that other report. Follow me?

MR. PARRY: I think it does. I think it does.

CHAIR STETKAR: Does it? I don't recall that.

MR. PARRY: Well, that's the way it was developed because, in fact, both that table and the example were developed at the same meeting so --

MEMBER BLEY: Let me ask you a question. Once all this comes out and it's published, is EPRI planning some courses on use of this?

MS. PRESLEY: Not specifically now, unless there's a need for it. We're kind of --

MEMBER BLEY: I'm telling you there's a need for it if anybody is going to use it. You have courses on a lot of other things.

MS. PRESLEY: We do.

MEMBER BLEY: This isn't the easiest thing to go do if you haven't, if you're not with a group. You know, those of us who have done a lot of this, we've been in a group where there's a bunch of people working on it and you trade ideas and work it out. So if you're the person doing the uncertainty analysis, you don't have that. It's real hard to learn to do this stuff strictly from a report.

MS. PRESLEY: We can certainly approach our users and see if they would like the training.

MEMBER BLEY: Or maybe your consultants are already planning such a course.

MS. PRESLEY: Or maybe it's already -- I don't know. But training is definitely a component of how guidance is used.

MEMBER BLEY: NRC will probably have its own course, I assume.

MS. DROUIN: On this document?

MEMBER BLEY: Or work it into the PRA course or something like that.

MS. DROUIN: There are no plans for right now.

MS. PRESLEY: Not currently, but we haven't thought that far ahead, frankly. And it's not that we're opposed to it either. So we can bring that

up --

MEMBER BLEY: It's worth thinking about.

MS. PRESLEY: Yes.

MEMBER BLEY: Because it's --

MS. PRESLEY: I think, particularly, because I don't think in this go-around we're going to have the time or necessarily the ability to explicitly link Appendix A example to the tables and the uncertainty in those tables. I think what we're going to do is give a more general statement about how it needs to be done and maybe, if we have thoughts on how it could be done, put that in. But if we did do training --

MEMBER BLEY: I think that seems reasonable at this point.

MS. PRESLEY: Yes. If we did do training, maybe that's something we could look at is actually, well, no kidding, how do you really use these tables?

MR. PARRY: I think the other aspect to put in here is that one of the big contributors here would be fire, right? That's the one we'd have to think about.

MS. PRESLEY: And that's the one that the public comment was --

MR. PARRY: Yes. And that's pretty fluid

right now --

CHAIR STETKAR: Well, and some of the comments, some of the comments that we'd had -- I don't think it got into our letter. I don't remember, John. On 1934, the fire modeling, NUREG, was that the staff ought to look at -- I think it was in our letter -- development of case studies to show how all of the uncertainties would be integrated because that was strictly in the model: uncertainties in the initiating event, uncertainties in, you know, other parameters, HRA, things that are in fire models. That's a particular element, you know. It kind of goes toward Appendix B in this EPRI report, but it's along those lines of either developing case studies or courses or something like that.

MR. LAI: Yes, the comment is in the letter, the staff saying when they have --

CHAIR STETKAR: Right, right.

MS. PRESLEY: And there have been some users who have been very vocal on how much they're struggling with this.

CHAIR STETKAR: Oh, sure.

MS. PRESLEY: So we definitely know there's at least some sort of need out there. Whether it's just those few vocal or more widespread, I'm not

sure. So the last -- are there any other specific comments on the appendices?

CHAIR STETKAR: No, I read through dutifully all of the appendices, and I thought the examples were quite good. You can come up -- I don't think it's ACRS's role to come up with details of, gee, this ought to be different --

MS. PRESLEY: We did get substantial public comments on Appendix E, so that one is the one that's likely to get some updating.

CHAIR STETKAR: Now, Appendix E, my only comment on Appendix E -- I did have a comment on Appendix E. Thank you for the help. And I already actually made it in a snide remark as an aside. Appendix E is, there are examples in there that say, and I'm not going to take the time to go find it right now, but example saying, well, I did this analysis using, for example, MELCOR or MAP. The biggest source of uncertainty might be comparing MELCOR versus MAP, you know. And that whole notion of model uncertainty is absent in Appendix E. It's looking at, primarily, variations in, I mean, it's phenomenologically uncertainty, it's got all of the bells and whistles in there. It looks at variations in parameters within the context of a particular consensus model that

you've selected, but it does not address this notion that if you selected the other consensus model you might get different results.

MR. PARRY: And that, actually, might be more relevant because I think the trouble with Level 2, as you know, is that it's all epistemic uncertainty.

CHAIR STETKAR: Sure.

MR. PARRY: So a lot of those things are already in the containment event trees or development of those scenarios. So it's a little tricky one to develop I think.

CHAIR STETKAR: It is. That's the only comment I had sort of on Appendix E, generically.

MS. PRESLEY: Okay. And the last slide are next steps. As we've mentioned, it's already been sent out for review, and that was sent to the EPRI PRA scope and quality users group, and it was sent to Mary Drouin's group. And like we had mentioned, there were no fundamental issues, just mostly clarification, and you've seen the changes reflected int his presentation.

So, initially, we were in sync schedule-wise with 1855. Best laid plans of mice and men. We are still on track for publishing in December 2012,

and that will be before the anticipated release of NUREG-1855 Revision 1. So we are now out of sync.

We have in our document a lot of references to sections, but they're fairly high-level section references, and we don't anticipate those section references to change. From our perspective, as long as the draft guidance is published prior to December 2012, and, as Mary had indicated, they are already going through the widgets to get it out, that's sufficient for our purposes. And that also solves, I think, your problem that you need ours published before you can publish yours because you need to reference our full document. So we're okay with that, I think. We're absorbing the risk of public comments completely disrupting 1855, so we don't anticipate that happening. So that's the plan forward.

MR. PARRY: Okay.

MS. PRESLEY: Okay. Thank you very much.

CHAIR STETKAR: Anybody have anymore comments or questions for EPRI?

DR. BONACA: One question that was raised but not answered was why two documents? I think that it seems to me there would be a better beneficial effect if they were combined.

CHAIR STETKAR: You know, we can't -- I fully agree. I mean, I don't know whether it's --

DR. BONACA: We all agree probably.

CHAIR STETKAR: No, that's what I mean, the EPRI document. We can address the other issue, but the EPRI documents, it would hang together so much better, especially because now Appendix A example in the current document is more relevant to the table of sources of model uncertainty in that other one. The whole state of knowledge correlation stuff, I mean, that comes over directly. And you would only have one section, whatever they are, three and four --

MS. PRESLEY: Right. I think we can look at that and look at that probably pretty carefully to see how logistically difficult it would be. But the way it evolved, initially, they were two completely separate sets of guidance. And once we ported over chapter four, things got fuzzy.

CHAIR STETKAR: But you ported over chapter four and what's now the example in Appendix A.

MS. PRESLEY: Yes.

CHAIR STETKAR: In terms of what Dennis was talking about, you know, it's relationship to sources of modeling uncertainty. Well, the most relevant ones are over in that other report.

MS. PRESLEY: Yes, yes.

CHAIR STETKAR: Regardless of whether you want to put links into some of the other, you know, A, B, C, D, E.

MS. DROUIN: Well, you know, it is not an easy thing for NRC EPRI to write a combined report, and I can give you all the nightmares that happen on 6850 on the fire.

CHAIR STETKAR: At this level, I'm not talking about integrating 1855 and EPRI report. I'm strictly talking about 1026511 and 1016737, making it a single report.

MS. DROUIN: We agree with that.

MEMBER BLEY: Without disagreeing, almost the same stuff.

MS. PRESLEY: So we're going to, we're going to -- it hinges on whether or not we can actually do the clean-up of the references and everything to smush it into one document before we need it published. And we may consider publishing what we have now as an interim, and then smushing them together. But comment well taken. Yes, definitely comment well taken.

CHAIR STETKAR: Anything else for EPRI?

MS. PRESLEY: I do have a comment towards

why NRC versus EPRI document.

CHAIR STETKAR: Okay.

MS. PRESLEY: I think there are some benefits of having EPRI document a little bit separately because it gave us the chance to provide some of the guidance that the NRC wouldn't have necessarily felt comfortable putting in and endorsing, like the defense-in-depth stuff.

MS. DROUIN: I can tell you I think it was, we've got a better product by not having a combined effort, a much better product.

CHAIR STETKAR: I'd like to address some of that when Mary gets in the --

MS. PRESLEY: Maybe that was a con for you. Okay.

CHAIR STETKAR: We've had some internal discussions about confusion.

MEMBER BLEY: If they could disavow hunks of the other one --

CHAIR STETKAR: Yes, I mean, that's, I wanted to hear -- I understand how your document hangs together and why. There must be a rational of why it's not issued as a joint, you know, NUREG.

MS. PRESLEY: I can blame it on my predecessor.

CHAIR STETKAR: It sounds like it's probably a staff decision, not an EPRI decision. Maybe not.

MS. PRESLEY: I don't know the history well enough. I'm sorry.

MS. DROUIN: Are you going to, can we take a break?

CHAIR STETKAR: We can, yes. If we want to take a break -- in the interest, I know Bill has to leave fairly close to 5, so can we keep it until 5 after 4, 12 minutes?

MS. DROUIN: We don't have a full hour presentation.

CHAIR STETKAR: You don't think. So we'll recess until 5 after 4.

(Whereupon, the foregoing matter went off the record at 3:51 p.m. and went back on the record at 4:02 p.m.)

CHAIR STETKAR: Let's get restarted and hear from the staff on 1855. Mary?

MS. DROUIN: Okay. At the table with me is Anders Gilbertston from the staff and Jeff LaChance from Sandia. I just want to acknowledge two other major members of the project team is John Lehner from Brookhaven and Tim Wheeler from Sandia. They couldn't

be with us today. So we're going to very quickly just go through the objectives and the background, re-educate ourselves on how the document was restructured from the original version, do a summary of the feedback we got at the last subcommittee, how we changed the NUREG, and then what are our steps forward.

Okay. On the, you know, objectives, it had a very narrow focus. This could have been written to deal with uncertainties across all risk-informed decision making. But it was to provide guidance with regard to identifying and characterizing the uncertainties associated with PRA, performing uncertainty analyses to understand the impact of the uncertainties on the results of the PRA. And this one was more in line to support the PRA standard where the PRA standard was requiring you to identify and characterize, and this was giving the means of how to do that. And how do you factor the results of your uncertainty analyses associated with the PRA into your decision making?

We started this project, and we found out at the time that EPRI had a similar project going on for some months. So under our MOU, we got together, and it was decided to do a collaboration of our two

projects and to trade information and to, hopefully, you know, issue reports that were complimentary. And it turned out at the time that there was a good division of the labor, so we kept with that. And I think that the documents have served well and worked well together and done in a very efficient manner.

CHAIR STETKAR: Now it's probably time to ask you, given that and given kind of the character and nature, I'll use NUREG/CR-6850 as an example of a combined EPRI/NRC report, obviously there was an active decision to keep them separate. It's not entirely clear to me why, given, you know, if I read 1855 now, because it liberally cites, as you mentioned, specific sections of the EPRI report, it lists both of those EPRI reports for examples to go look at these reports. Initially, I thought, well, there was, for some reason, that Dennis mentioned that it gives the staff the opportunity to essentially not endorse specific sections of those reports, but I haven't found any places where they're not endorsed.

MEMBER BLEY: Or cited.

CHAIR STETKAR: Or cited. And the NUREG, I guess, doesn't endorse something but . . .

MS. DROUIN: Well, we don't have a blanket endorsement of their document anywhere. We do refer

to specific places in the document where we say go look at this, this has good information in it. And those were -- excuse me. I'm getting over a cold. Those were the, you know, appendices that give the list of sources of model uncertainty. And the staff was heavily involved in the first one in doing a lot of review of it. The second one in this most recent, we were heavily involved because that came out of a joint workshop. And we produced the technical report, all those tables, which EPRI used extensively. So for that part of it, you know, we were involved.

But if this had been a combined report, I don't think we would be along where we are today because it would have constituted a much deeper involvement of the staff, you know, because now we would have to read it, you know, agree to the actual language, how something is worded, make sure it doesn't have an implication on a staff position we can't live with. So in this way, you know, we haven't given a regulatory endorsement of the document in that sense.

CHAIR STETKAR: What I was going to ask, though, and I need help on this because Reg Guide 1.174 does, indeed, refer to NUREG-1855 in several places for guidance on treatment of uncertainties.

MS. DROUIN: Yes.

CHAIR STETKAR: NUREG-1855 now refers to an EPRI report for examples let's call them. This notion of, is there a danger that someone will say, well, I followed, I used the EPRI report; therefore, by implications, I met the guidance in Reg Guide 1.174? Because 1.174 doesn't say anything about the EPRI report. It doesn't say it endorses the EPRI report, except for, you know, I'll use, since somebody else brought it up, the section on defense-in-depth. It doesn't say that. NUREG-1855 doesn't say this is all good except for the section on defense-in-depth. So there seems to be a danger that nobody disavows anything anywhere. Now, perhaps you look at it and the fact, you know, a very narrow sense that the specific things that are cited in NUREG-1855 are the things that you like. And if you're silent about everything else, by implication, you're silent and, therefore, there's some question. I just can't follow the string.

MS. DROUIN: The NRC historically has referenced industry documents. There's a difference between referencing an industry document and endorsing an industry document.

CHAIR STETKAR: Right.

MS. DROUIN: And we have historically referenced a lot of industry documents that go out, we say go out there, that's good information there. So there's always that danger --

CHAIR STETKAR: Okay.

MS. DROUIN: -- you know, that's always in there. But there is a difference between, because if we say we endorse it, then that means we have, yes, you follow that, we don't have a problem.

CHAIR STETKAR: And you don't see a danger with this just because the way the daisy chain is --

MS. DROUIN: No.

CHAIR STETKAR: Okay, okay.

MS. DROUIN: No. So, you know, as you're aware, the major change we made was a restructuring of the document that gives a much better explicit process on the guidance, and the scope was expanded, which really primarily affected EPRI and not us, to address low-power shutdown, internal fire, seismic, and Level 2. We met with the Subcommittee back in June to present the version. You all gave us some feedback, and we have systematically, hopefully, addressed your concerns, which we're going to go through.

CHAIR STETKAR: Mary, when you turn your page, be careful on the microphone. When you hit it,

it explodes in her ears, and it's --

MS. DROUIN: Sorry about that. This is just a diagram that just shows how the document was restructured and how it's now organized. And it starts off at a high level with stage A telling you whether or not the risk-informed application has to follow this guidance. And we did take into account and we had said it a couple of places that's generic, and we elaborated more in this next version on that. And then stage B through stage F is the guidance for the licensee to follow in how to address the uncertainties as he's pulling together his application. And then the right-hand side is the stage G, and that's the NRC risk-informed review process. And then supporting both of these is the risk-informed decision-making process and the ASME and ANC PRA standard because the standard does require you to deal with uncertainties, and this document is answering those requirements of providing the how-to because, if you remember, the standard is a what to do.

MEMBER BLEY: Just enlighten me a bit on how we get from a NUREG to guidance. So we use a reg guide then to point to the NUREG to essentially say this is good guidance to follow.

MS. DROUIN: A NUREG can be a guidance document.

MEMBER BLEY: And it doesn't need a reg guide to point to it?

MS. DROUIN: No, we have NUREGs that are guidance documents themselves that could -- usually, the NUREG or the reg guide will point back to something.

MEMBER BLEY: Yes.

MS. DROUIN: You know, so we do have reg guides that do reference 1855 in other documents.

MEMBER BLEY: That's what I was thinking. You had to have that to make the link, but you don't need that. You just say that guidance is okay --

MS. DROUIN: Right.

MEMBER BLEY: -- if it's in the NUREG?

MS. DROUIN: Yes.

MEMBER BLEY: Okay.

MS. DROUIN: So on this sheet, we tried to summarize the feedback that we thought we received from the ACRS Subcommittee. We had taken some notes, and we sent them to get feedback, and we really appreciated your feedback on it. So we've tried to summarize it here into one graph. One was to go through and re-evaluate the use of subjective terms,

and I'll come back to these, each of them individually, and my two colleagues will jump in and save me when I don't say it correctly.

Address issues regarding the sources of the model uncertainty, particularly the definition of consensus model; clarify the relationship of uncertainty in PRA and deterministic analyses with defense-in-depth and safety margin. And this gets into the risk-informed decision, the integrated risk-informed decision making process.

Consider inclusion of a more generic global process for the application of the NUREG; expand the discussion on bounding conservative and realistic analyses; re-evaluate the discussion on the process of truncation, particularly with regard to its importance on the state of knowledge correlation; and then revisit the discussion of a reasonable alternative for a sensitivity analysis. So, in my mind, these were the seven big ticket items that you all had asked us to go look at.

So we actually did do a, I'm not saying that we didn't miss something but --

CHAIR STETKAR: I don't think you missed this one.

MS. DROUIN: I'm sorry?

CHAIR STETKAR: I don't think you did miss any on this one.

MS. DROUIN: We tried to go and do, literally, a line-by-line search for subjective terms, and pretty much the thing we found was reasonable and credible. And I can't promise that we caught them all, but we did try and replace -- we thought, after a long discussion, that credible was the better term to use than reasonable.

CHAIR STETKAR: Regardless of the word, credible is now defined.

MS. DROUIN: And we defined it.

CHAIR STETKAR: You defined it. So at least, you know, people may argue with that definition, but you've at least stated what that thing means.

MS. DROUIN: Right. And there were places where we thought the term wasn't needed so --

CHAIR STETKAR: Right. In some places just --

MS. DROUIN: -- in some places, we just got rid of it.

CHAIR STETKAR: That's right.

MS. DROUIN: But in some places, it really was, and so when it was we went with the term credible

--

CHAIR STETKAR: Honestly, Mary, I read through this thing with kind of a fine-tooth comb, and I think you've done a really good job in terms of removing what we raised as a concern about this kind of vague notion of what is reasonable.

MS. DROUIN: Right. And then there was the term "broad acceptance" that was used in the definition, and we had a lot of discussion on that, and we finally came to the conclusion it didn't add anything. So we removed it from the definition. But, you know, in terms of subjective terms, that's all we could really find, and we really did take the time and effort to do a thorough scrubbing. So if there are other subjective terms you think we missed, we'd like to hear about them.

Okay. Changes to the NUREG, and this is to deal with the definition of sources of model uncertainty. And when you go in on page 18, you'll see there may be cases of more than one consensus model. And I'm trying to remember exactly what we did here.

MR. LACHANCE: Let me help you. I think the general comment -- this is Jeff Lachance, by the way. The general comment or one of the general

comments we got was what do we do about the case of consensus model if there's really more than one. And we tried to address that with this language that's shown on the slide, and we recognize that there could be multiple consensus models but the definition of that, if there are, they essentially have to give you similar results. If they don't, then how could they really be, you know, two different consensus models that give you --

CHAIR STETKAR: Kind of like MAP and MELCOR.

MR. LACHANCE: Yes. We give you orders of magnitude difference, okay? And so we put that into the document, and we also recognize the fact that EPRI, as a document, is listed in the second paragraph. That was the first step in establishing a process for compiling them, okay? It hasn't gone any further than that EPRI document. The NRC hasn't endorsed the models that were identified, but some of them probably have been endorsed in particular applications. And so we added that language.

MS. DROUIN: So the other thing is that we don't know, if the time is available, whether it's worth to take the time to start with the list that's in the EPRI document and to try and identify are any

of those consensus models. I don't know if we can come to that kind of agreement in the time frame that's available and whether that would be worthwhile.

CHAIR STETKAR: You know, quite honestly, this is my own perspective, I thought this was really good. You didn't point to EPRI as examples, but I kind of agree with you that trying to define what are the officially-sanctioned consensus models might be a rabbit hole that you don't necessarily want to run down right at this time, given the general --

MS. DROUIN: It sounded like a good idea when --

CHAIR STETKAR: -- resources might be spent much more effectively in other ways. I'd rather see a training. Take those resources and do some training courses on, you know, realistic examples or something. I thought this was really good.

MS. DROUIN: And exactly what you said is why we didn't progress further.

CHAIR STETKAR: One of the things regarding consensus models -- maybe it's addressed on the next page. Go the next page.

MR. LACHANCE: So this part addresses, you know, the definition of source of model uncertainty, and there were some slight changes made to the

definition that was in the previous version. Basically, it sort of indicates the change was made to reflect the fact that a credible assumption could be submitted by a single expert. And what it didn't have to do is it didn't have to receive broad acceptance. That's where we made the major change here. In step one, we removed broad acceptance, and this is the area where we did it because we didn't think that was necessary. A single expert may come up with a very good and credible alternative method. That could be the source of a model, a sensitivity study to address model uncertainty. I think that's the major change that was made here.

MS. DROUIN: And we've seen a lot of examples of that in the past, particularly in the seismic area where you have a single expert, you know, that does not have the broad, but it's a source of model uncertainty even though it has not received broad acceptance.

CHAIR STETKAR: One of the things, a note that I made to myself as I was going through this, I think the previous slide did a very good job of kind of clarifying this notion of having two nominal credible consensus models, and what does that really mean, and I guess this addresses it. I've been really

sensitive to the thing that I brought up earlier regarding suppose I have one, every consensus model, everybody agrees that this is the best available consensus model, how do I treat the fact that I still have uncertainties in the results from using that model? I'm propagating uncertainties in the parameters that that has --

MEMBER SHACK: It should also be noted that the adoption of a consensus model would not negate the need to model any parameter uncertainty.

CHAIR STETKAR: Yes, yes. And I think this does it. I think this handles that.

MS. DROUIN: It doesn't get rid of the uncertainty. It's just that everybody agrees as to what that uncertainty is, and I think that's what the subtle difference is. Okay. On the third one, we just added some more language to better tie in the different principles of your integrated decision to the PRA and to risk and that they weren't always isolated. You know, they were integrated, so we just brought that clear into the picture. And then we did delete the one picture that you didn't like, and trying to add verbiage to better explain it, it got difficult. And then we stood back and we said, well, you know, the real thing here is the integrated

decision making with the different principles and not this other figure. So we thought it was better off just to --

CHAIR STETKAR: Oh, yes, yes, yes, yes.

MS. DROUIN: -- keep that figure, which is what we did.

CHAIR STETKAR: Yes.

MS. DROUIN: When you look at the NUREG, we did say in the scope that, you know, this is limited to this, but the process is generic and is applicable. And then we had the first stage, which goes to where you apply it. And we still acknowledge there that it has a generic process. So what we did is we added a new subsection so that -- and it got into the three main things you have to deal with so that if you got into the block that didn't send you, that this NUREG, that you had to go through the rest and follow it explicitly, we do now have a subsection in there saying, okay, here's how you apply it generically at a higher level.

CHAIR STETKAR: One of the questions I had on this, though, Mary, first of all, you may want to read through that section because I had a really difficult time. I sort of saw what you were trying to say, but it didn't flow very well. One of the

comments that we made, and this wasn't changed in the NUREG, there's a statement that says, "Internal NRC activities may use risk results and insights. However, the treatment of the associated risk uncertainties are not subject to the process in this NUREG. While the risk analyses associated with NRC activities do have uncertainties, the treatment of these uncertainties is addressed by a different process that is outside the scope of this NUREG," and now there's a parenthetical "see section 3.4." And there are several -- I mean, when you talk about the Reactor Oversight Process, everything points to this new section which is now a very broad sense of, oh, yeah, you have to think about uncertainties in a systematic way. But I still have a problem of why, internally, the NRC staff doesn't have to go through the same type of systematic assessment of uncertainties that's laid out in this NUREG and now, by implication, in the EPRI report.

So, for example, if I'm using a SPAR model to make a decision about the relative risk of something, why don't I, as a staff member, need to also quantify my uncertainties through that SPAR model? Isn't that a PRA?

MS. DROUIN: I'm not going to get into

some of those issues. What we are trying to say when you don't have to file a -- 1855 gets very specific of the things you have to think about. But the process itself, you would have to think about that any time you're dealing with uncertainties. So I think what you read is not, we did not word that well enough because it makes it sound like there's something totally different.

CHAIR STETKAR: You may want to go back and --

MS. DROUIN: And that was not the intent --

CHAIR STETKAR: -- read those things because I was trying to be very sensitive to this. And places that I flagged back in June where I thought that the NUREG was promoting this approach, let's say for the industry, and, yet, a different approach ill-defined at that time for internal NRC decision making, every place that I had flagged back in June now has a parenthesis that says "see section 3.4."

MS. DROUIN: Right. And what we were trying --

CHAIR STETKAR: And 3.4, quite honestly, leaves me a bit empty because 3.4 is just very high level and qualitative and it gives me the impression

that staff decisions, I'll come back to using a SPAR model, that staff input to the decision-making process that's derived from something like using SPAR models for two or three different plants to draw generic conclusions, which is done, are not subject to quantitative evaluation of uncertainty or this systematic process that is, indeed, laid out really well in 1855.

MS. DROUIN: Well, the thing that, you know, we have to be careful with in 1855 and why, you know, we may not make you happy is, you know, because we haven't gone through, and I didn't have a problem with writing 3.4 and keeping it high level. Now, we may have erred in keeping it too high level, but it can't get real detailed because we haven't gone through and vetted, you know, is this really, you know, can I just take all the details that are in 1855 and say, yes, this is exactly what you would do for SPAR models or for ROP. I know at a high level that you're going to have to understand the activity, you're going to have to understand the sources, you're going to have to address the uncertainty, you know, so that high-level process is certainly applicable.

CHAIR STETKAR: Let me ask it a different way is in 1855 and, in particular, the guidance, the

more detailed guidance in the EPRI report, there are many instances that says, well, you need to think about these things but there may be alternative ways to address them. You know, we had this discussion about what does it mean to do a sensitivity analysis or, if you can't estimate the frequency of a cliff edge effect, how you might address that. That's a way to address that uncertainty. Why shouldn't the NRC staff, why shouldn't the guidance just say follow the process in 1855, period? Whether you're NRC staff, whether you're a consultant, whether you're an applicant, what's wrong with that? Why can't the NRC staff do that? Because the process in 1855 and the EPRI reports says, in some cases, you may need to develop alternative arguments rather than a rigorous treatment of uncertainty.

MS. DROUIN: I would be hesitant to do that at this point on programs that are well established and, all of a sudden, coming in and telling them, okay, now when you're in your decision making, you need to explicitly do these things that are in 1855. I'm not ready to retire yet.

CHAIR STETKAR: It's just -- okay. I hear you. I understand the constraints. But at some level, you know, we pride ourselves as an agency of

using risk information and uncertainty as part of that risk information, and it doesn't quite seem fair in the sense of trying to develop a lot of guidance from what we expect people to deliver to us and not hold ourselves to that same standard, if you will.

MS. DROUIN: Right. And I appreciate that. But I guess, from a personal perspective, I also come back to when we wrote 1855 we really had blinders on. We really were thinking, you know, very narrow applications.

CHAIR STETKAR: Risk-informed applications. I understand that.

MS. DROUIN: And that's where we came from.

CHAIR STETKAR: Yes.

MS. DROUIN: And so then after doing it we thought, well, you know, this process at a high level, it's pretty generic. So we wanted to communicate that, but we haven't systematically gone through and said, okay, and tried it out in these other applications to say would I want, would I go and change something in one of these chapters for it to fit? And that's what, you know, I would be hesitant about. Mark, do you want to --

MR. RUSSO: Perhaps I can add some value

and perhaps not.

CHAIR STETKAR: Mark, just for the record, can you --

MR. RUSSO: Oh, Mark Russo, NRO. I think, first, I think the point about why shouldn't the NRC live up to the same standards that other organizations do when they do analytical work, everybody in the room agrees that, to the extent that it's appropriate, you know, you should. You know, I think we went through this with QA of the SPAR models and QA of other stuff where, you know, we have strong QA standards, but ten years ago or something we weren't QAing our own things. We were running calculations and making decisions. So I think we agree there.

The point I would make is I think perhaps that it's probably more appropriate in whatever guidance exists for the particular application, be it the STP process or be it a calculation of a change in risk or a risk associated with an event, whatever guidance we have for staff in those programs, that that's where they should be looking at, you know, how would one apply this and to what extent should they apply it, if it's, you know, something very, very simple, a risk-informed scoping kind of tool, maybe you don't need to do all this. So I guess what I'm

saying is maybe it's better for this to be the kind of thing that's addressed in the methodology of guidance for a particular application.

CHAIR STETKAR: You know, I understand that, but in 1855 there's not, maybe I'm misinterpreting it, but 1855 does not contain that level of specificity. It doesn't say if you're doing a risk-informed submittal for a change in the surveillance interval for a diesel generator of how you should address uncertainty within that, which is what I'm hearing you say that the specific guidance for each application needs to reflect details of the process. This is a much higher document. It says, you know, you have to systematically address uncertainties. Here are the types of uncertainties that you need to consider. You need to consider parameter uncertainties. You need to consider modeling uncertainties, regardless of your own opinion about whether you're closer or far away from a threshold uncertainties may be more or less important to your ultimate decision. And I don't understand why, at that level, it doesn't apply universally. Why, if I'm close to making a decision on STP, of whether I'm green to white or white to yellow or whatever, why it might not be more important to assess

uncertainties. You see numbers coming in that says, well, condition to core damage frequency or probability was 1.23 times 10 to the minus 3, so it's, you know, whatever color it is, without any expression of uncertainty that there's a 90-percent probability that it might still be green. That still might be enough to make the decision that you trip over it to the next level, but it's kind of inconsistent of what we're asking people to do coming in from the outside and submitting things. How you do it, whether it's a significance determination process or other types of application that the agency gets involved in, is more detailed-focused guidance, but I just don't understand why we need the statements in here saying that internal NRC needs some different process of thinking about this stuff at this level, at the level of the guidance in the NUREG. I'll just leave it, you know.

MEMBER BLEY: It's not so much saying use it everywhere as not saying don't use it.

CHAIR STETKAR: That's right. That's right.

MEMBER BLEY: And you can still keep your job.

MS. DROUIN: I was being facetious there.

MEMBER BLEY: Can I ask a specific

question?

MS. DROUIN: Sure.

MEMBER BLEY: This new section I don't think got reflected up into the abstract.

MS. DROUIN: You know, you're probably right.

MEMBER BLEY: And I think right at the end of the first paragraph of the abstract another sentence or two would do it because you'll be talking to the rest of staff, and getting it out in front I think is useful.

MS. DROUIN: You're correct. I did not catch the abstract.

MEMBER BLEY: And the way that first paragraph is written, it almost invites the next sentence that says and, therefore, it could be used more generally.

MS. DROUIN: Okay. The next one on bounding analyses.

MR. LACHANCE: Yes, Jeff LaChance. This one is we just sort of added an extra paragraph there to try to provide a little bit more explanation. That extra paragraph sort of addresses the fact that, you know, in reality, when you do a bounding analysis, it might represent, on a probabilistic level, you know,

some high percentage on distribution. But I also recognize that's not practical to do that, okay, specify a percentile in the definition of a bounding assessment, even though it may turn out to be closed to one. But it also leaves open the option that, well, for specific parameters, you could use a 95th percentile and say, well, that's close to my bounding assessment. And so it just adds a little bit more guidance on what to do here.

CHAIR STETKAR: I thought this --

MS. DROUIN: Well, also --

CHAIR STETKAR: We kicked around a couple of different ideas but I . . .

MS. DROUIN: And we thought it was important to, in this section, to keep separate and have a definition for your bounding analysis versus a conservative analysis versus a realistic, but those are three distinct things and we needed good definitions for them. So we did get rid of the frequency side, but I think we incorporated it a little bit differently.

MR. LACHANCE: Well, actually, where it says we removed that text, that one sentence, because it was redundant.

CHAIR STETKAR: That one was, yes. But

the definition now gets it very much closer to this notion of the worst credible outcome and so forth, which I think was in there but not as succinctly.

MS. DROUIN: So we can go on to six then.

CHAIR STETKAR: Mary?

MS. PRESLEY: Sorry. We had a question on the last slide. So, for example, a bounding scenario may be defined utilizing a bounding frequency assumed failure of available mitigating systems, so that sentence, that last sentence, second to last sentence. That may be a little bit inconsistent with what we've been calling them, and I don't know if we used the word bounding but we would use a bounding consequence and a realistic or conservative frequency, and we would call that a bounding scenario, as well. So I just wanted to make sure we're not being inconsistent or if we need to tweak our terminology.

CHAIR STETKAR: That's something you can probably work out between you.

MS. DROUIN: Right. We'll take a note and we'll work that out with you.

CHAIR STETKAR: You don't need to struggle. You did good here.

MS. DROUIN: Okay. I'm sorry. I'm not my --

CHAIR STETKAR: That's okay. This was the whole notion about at least instilling the sensitivity to the notion that looking at the cut sets that you can examine might not be sufficient to examine the effects of the state of knowledge correlation, that your truncation frequency might have suppressed those cut sets, and the revised words at least instill that notion. It does it. It was adequate.

MR. LACHANCE: But to be fair, in the previous version, we actually did have some wording in there along these lines, but we just amplified it a little bit more.

MEMBER BLEY: If only you didn't have to use the SOKC acronym. I hate it.

CHAIR STETKAR: You probably coined the phrase. We've already talked about this, that . . .

MR. LACHANCE: Yes, on seven, really in the first part we mention, actually for number one, that we already replaced reasonable with credible. But the real question that we're trying to address here --

MS. DROUIN: It's not reflected correctly on the slide.

MR. LACHANCE: -- was that, you know, revisit the discussion on the reasonable alternative

for a sensitivity analysis. We had some discussion with EPRI, and I think we came to the conclusion that the EPRI guidance was pretty good with regard to this. And so we just simply referred to the EPRI documents for that.

MEMBER SHACK: You're consistent that way.

CHAIR STETKAR: I know what you did.

MS. DROUIN: Okay. Where are we now? As I started off, we're in the midst. Hopefully, it will go out any day now with two-week notification to the program offices. Once we hit that two weeks, then it goes into the process to go to publications, and that's anywhere from three to five days to get through that. So looking at, you know, two to three weeks before this actually comes out. So we go out for a two-month public period ending at the end of December, and then we would come back in January, address at that time both NRR and NRO comments. We've gotten a few NRR comments --

CHAIR STETKAR: What we've seen has not yet incorporated the NRR or NRO comments?

MS. DROUIN: NRR and NRO have been heavily involved in this, but we send it to them formally for their comments. I mean, over the time frames, we've had numerous meetings, numerous discussions, showing

them what we've done, gotten their feedback in realtime, but now it goes to them for formal and it was sent to them for formal --

CHAIR STETKAR: So, in principle, there shouldn't be any surprises --

MS. DROUIN: No, there should not be any surprises, any surprises.

CHAIR STETKAR: We can never say never. Okay.

MS. DROUIN: So I would anticipate not receiving any comments from them formally, but if there are any they'll be addressed during, you know, with the public review and comment. So we're looking for this to be published in early 2013.

MR. GILBERTSON: I would just mildly qualify that. I mean, our publications branch has expressed that they have a fair queue of documents to review, so we'll be getting it to them as soon as we can.

CHAIR STETKAR: Nothing that's within the realm of your control, I understand.

MR. GILBERTSON: They have assured to a certain degree that we would probably have a November or December publication date for the draft.

MS. DROUIN: And what they do is that they

go through and they make sure the table of contents, those page numbers, that's really the right page number. So, I mean, they don't read the document. You know, they're looking at it at that high level, you know, has it been assembled correctly --

CHAIR STETKAR: Okay. Offline, I caught a couple of editorial things that I'll share with you offline.

MS. DROUIN: Okay.

CHAIR STETKAR: We don't need to do it in this forum.

MS. DROUIN: So that's where we're at.

CHAIR STETKAR: Great. Any questions for the staff? If not, thank you very much.

MS. DROUIN: Thank you.

CHAIR STETKAR: Appreciate that. And as we usually do for the Subcommittee, what I'd like to do is go around the table and see if any of the members have any comments and questions. But, first, since we have a consultant here, I'll put him on the spot and ask him first. So Mario?

DR. BONACA: No, I thought your argument at the end of this project, but I thought that it was well organized and the presentation was usable. And I think that it will be a big help in the industry

with the PRA. So I have no other comments.

CHAIR STETKAR: Thank you. Dennis?

MEMBER BLEY: Yes, I just want to thank everybody. It's been an interesting day, and this has come a long way. I really like it. I think with respect to the examples and things, we aren't ever going to be perfect. But a few more caveats in, as we've talked, I think that will help. I'll only express my disappointment that very few people from the staff were at this meeting all day, and somehow the word on what has to get spread pretty far because it does have broad applicability. And there's lots of people who still come and talk to us and say, oh, there's no way to even think about those things, and you've given them a pretty good framework for thinking. Thanks.

CHAIR STETKAR: Bill?

MEMBER SHACK: I'll just echo what Dennis said. I think it's come a long way. I hope it gets put to use.

CHAIR STETKAR: And me, too. It's one of the reasons why I've been as animated as I am about those excerpting those phrases about NRC staff using other processes because I thought that that example that I've cited a couple of times from the fire

modeling stuff, had it not been for a lot of prodding, that example would not have existed because there was no sense of the fact that we need to account for uncertainties at that level. The document at another level accounted for uncertainties in modeling.

So I'd echo Dennis' notion that I think this is really good, and it does have broad applicability and people ought not to be given a free out on --

MS. DROUIN: I have a question. You know, it was actually the ACRS that started this program way back when. You all sent us a letter. I don't know if you were planning on writing a letter on this --

CHAIR STETKAR: I think that's -- okay. We have a December full committee meeting scheduled on this topic. Don't look at me as if you're surprised. It's on the schedule.

MS. DROUIN: No, I didn't know that.

CHAIR STETKAR: Talk among yourselves. You're actually on our agenda for the December full committee.

MR. LAI: I've actually sent you several emails talking about it.

MS. DROUIN: You know, I will tell you, I'm dealing with so many things right now, it's very

easy for an email to slip. And I know you're very good about keeping informed. I'm sure it's there.

CHAIR STETKAR: You're on the agenda. Now, whether we write a letter is something we need to discuss internally, and I can't give you, you know, a notion on that right now, quite honestly. I mean, I think even if it were a short letter just saying it's really good it might benefit a lot of people, but that's my own opinion. I can't give you a statement on it. By the way, just simply, if you come before the full committee, it doesn't necessarily mean we'll write a letter either.

MS. DROUIN: I recognize that. That's why I was . . .

CHAIR STETKAR: But you are on the agenda, and if that's going to change we need to know about it. And right now I'm personally open. I don't know whether we'll write one or not. One last thing I'd like to say is just to reiterate if there's any way that EPRI can re-read your report with a really cynical set of goggles on and try to see where people might misinterpret it as the bare minimum that's necessary and sufficient. And I recognize you can't put enough caveats in there, in practice, to resolve that problem. You can't have enough examples. You

know, you just can't. But there might be a few ways that you can recast a few things without too much work to at least better thwart off that sort of mind set. It might help.

With that, thank you again. I appreciate it, especially on a Friday afternoon. And we are adjourned.

(Whereupon, the foregoing matter was concluded at 4:54 p.m.)

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Practical Guidance on the Use of PRA in Risk-Informed Submittals with a Focus on the Treatment of Uncertainties [1026511]

Mary Presley EPRI

Gareth Parry, Doug True, Don Vanover ERIN Engineering

Advisory Committee on Reactor Safeguards Reliability and PRA Subcommittee Meeting

October 19, 2012

Overview

- Project History
- Ongoing Collaboration with the NRC
- New EPRI Guidance
- Next Steps

Project History

- Complementary documents addressing uncertainty analysis in risk-informed decision making using PRAs were prepared under a memorandum of understanding between EPRI and the Office of Research of NRC
  - NUREG-1855, Revision 0, *Guidelines on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making,* March 2009
  - EPRI 1016737, *Treatment of Parameter and Model Uncertainty for Probabilistic Risk Assessments,* 2008
    - Guidance on SOKC and characterizing model uncertainty
    - Lists generic sources of model uncertainty in internal events
- Prior work by EPRI provided significant technical information
  - EPRI 1013491,*Guideline for the Treatment of Uncertainty in Risk-Informed Applications: Applications Guide,* 2006

Ongoing Collaboration with NRC

- NRC decided, based on comments from NRR and NRO to produce Revision 1 to NUREG-1855.
  - Revision 1 is a reorganization of Revision 0
  - EPRI document is intended as a companion to the revision; it takes the stages defined in NUREG-1855, Revision 1 and demonstrates how and when to apply them
- Expansion of list of generic sources of model uncertainty needed to expand scope
  - NRC/EPRI sponsored a workshop (February 28 – March 1) to solicit input to identification of sources of uncertainty in PRAs for fires, seismic, low power and shutdown and Level 2

New EPRI Guidance

- A pragmatic approach to developing a risk-informed proposal factoring in the uncertainties in the PRA results for the purpose of risk-informed decision making
  - Decomposition and interpretation of PRA results
  - A graded approach to dealing with parameter & model uncertainty based on Regimes (NUREG 1855, Rev 1)
  - Interaction between principles of risk-informed decision-making
    - Dealing with large uncertainties
- Example Implementation (Appendix A)
- Expanded tables on sources of model uncertainty for:
  - Seismic hazard group (Appendix B)
  - Fire hazard group (Appendix C)
  - LPSD operational states (Appendix D)
  - Level 2 (Appendix E)

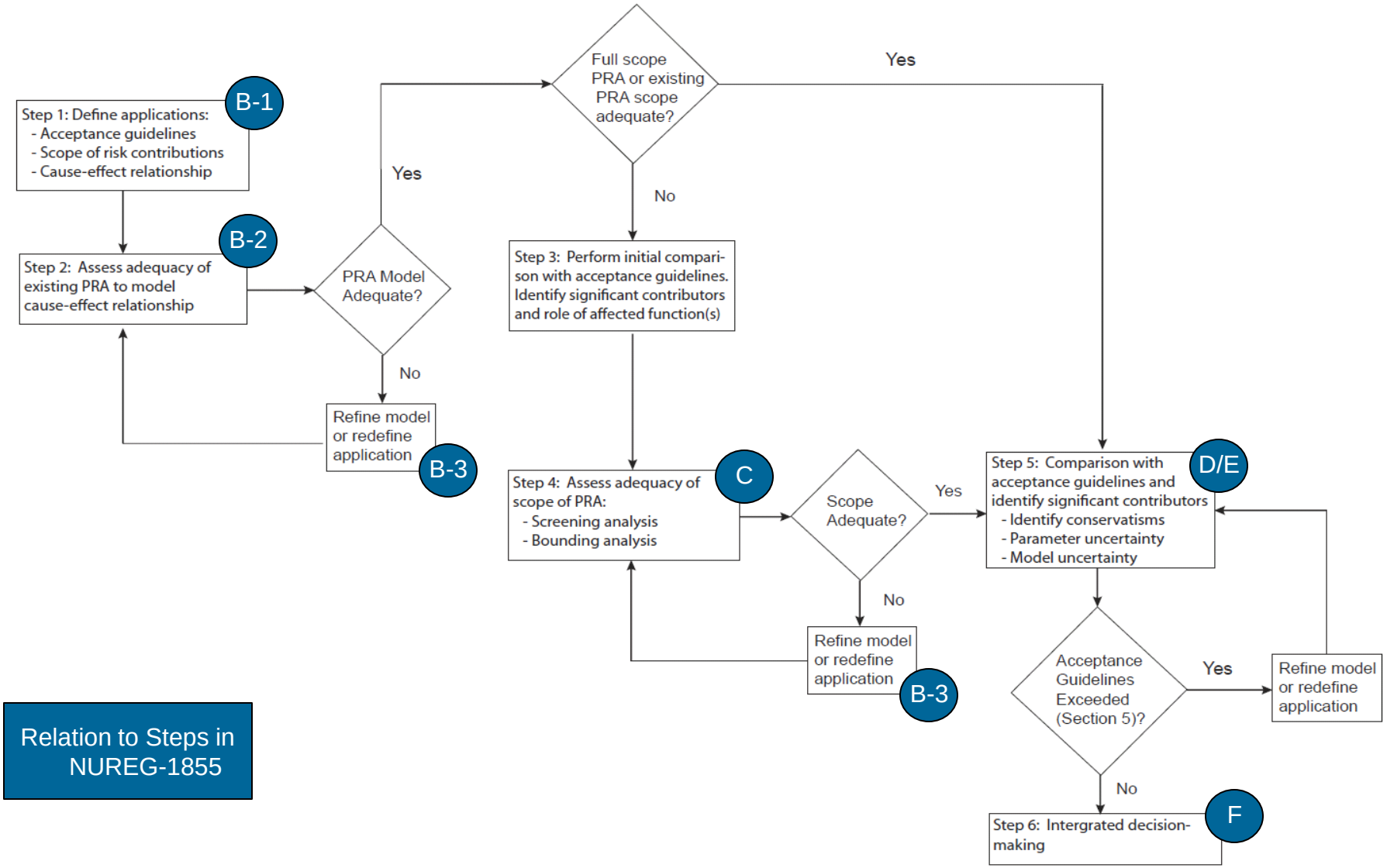
Assumptions

- Risk-informed submittal is developed in accordance with guidance documents such as RG 1.174
- Generally such submittals require considerations of all contributors to risk (e.g., all hazards and POSs)
- Currently very few licensees have a full scope (all hazards, all POSs) PRA
  - Process developed to facilitate screening or bounding of missing scope items
  - These steps can be bypassed for a full scope PRA or a PRA of sufficient scope for the application
- Guidance needed on interplay of principles of risk-informed regulation, particularly the DID principle

Assumptions (Cont'd)

- The starting point will be a PRA that *as a minimum* addresses internal events and internal flooding hazard groups AND
- The base PRA will have been peer reviewed against the ASME/ANS standard and RG 1.200, Rev 2
- Some iteration on technical adequacy can be expected
  - The technical adequacy of the PRA model for the application is assessed taking into account the significance of the elements of the model to the risk metrics required for the application

Process for Assessment of PRA Results for the Purpose of Risk-Informed Decision Making



Relation to Steps in NUREG-1855

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Steps 1 and 2: Define Application and Assess Capability of PRA to Model the Cause-effect Relationship*

- Step 1: Identify appropriate guidance documents for the application to determine:
  - Acceptance guidelines (risk metrics)
  - Hazards/POSs to be considered
    - Some applications can be hazard specific (e.g., NFPA 805)
  - Cause-effect relationship (modeling the impact of the change)
- Step 2: Check to see the PRA model has the right “hooks”

* (NUREG-1855 Stage B)

Step 3: Initial Comparison of PRA Results with Acceptance Guidelines*

- Necessary when the scope of the PRA does not address all the risk contributors required by the acceptance guidelines
- Quantitative results give an indication of the margin to the acceptance guidelines
- An analysis of the results identifies the initiating events, accident sequences, and functions and systems whose unavailabilities have an impact on the risk metrics for use in the screening and bounding analyses conducted in Step 4

* This step and step 4 are skipped when the PRA is full scope or is of sufficient scope for the application

Step 4: Assess Adequacy of the Scope of the PRA*

- The purpose of this step is to assess whether the missing scope (hazard groups or POSs) items can be screened or their contributions to the risk metrics bounded so that they are not significant contributors
- Approach varies with application and hazard: *examples* are given in Appendix A for a particular application and plant but are not intended as definitive guidance
- If neither cannot be demonstrated, then either a PRA model is constructed, or, if possible, the implementation of the proposed change is restricted so that the contributions from the missing scope items can be neglected

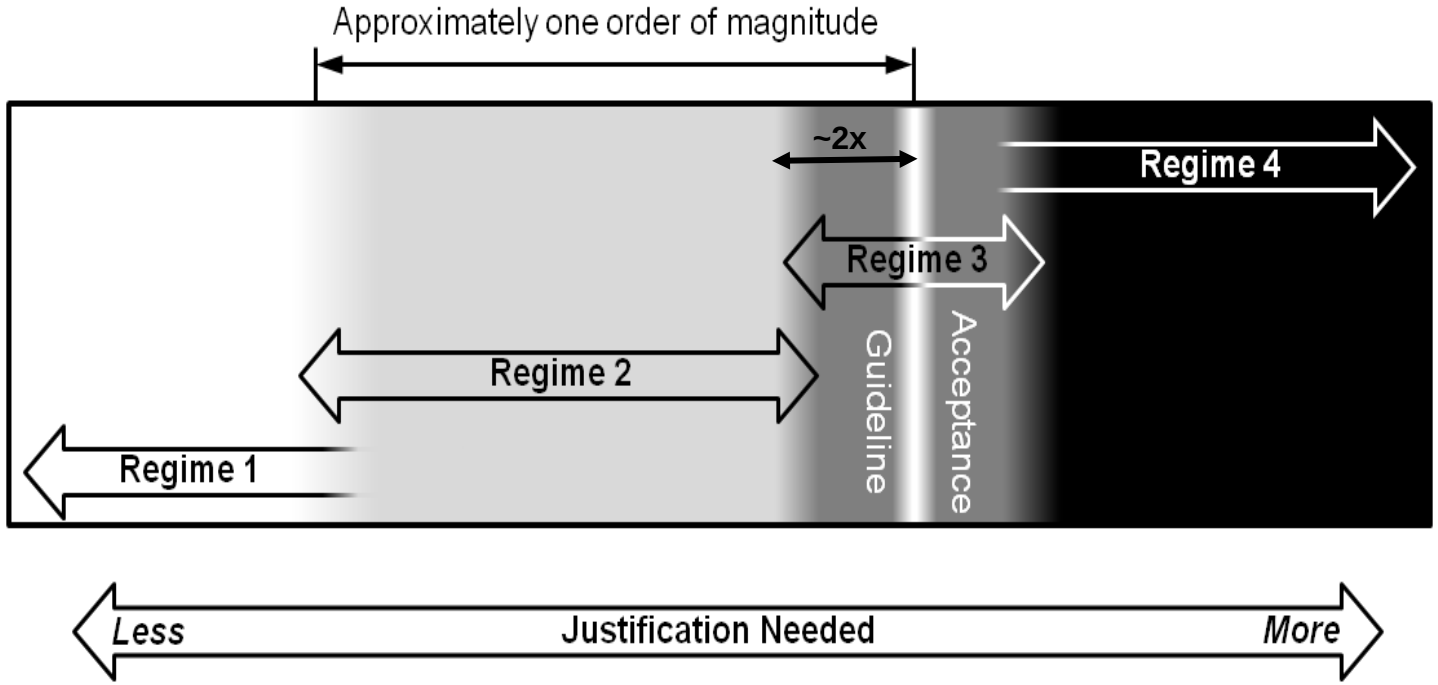
* (NUREG 1855 Stage B-3, C)

Step 5: Final Comparison with the Acceptance Guidelines

- Described in Chapter 4 of the report following largely the guidance in EPRI 1016737 addressing both parameter and model uncertainty
- Includes a graded approach to addressing uncertainty depending on where the point estimate results lie with respect to the Regimes defined in NUREG-1855, Rev 1 Chapter 9

A Graded Approach to Dealing with Uncertainty

- Initial assessment (steps 3 and 4) and comparison against acceptance guidelines (step 5) using point estimates
  - Assignment based on conservative results if sensitivity studies show decision at "boundary" between regimes.



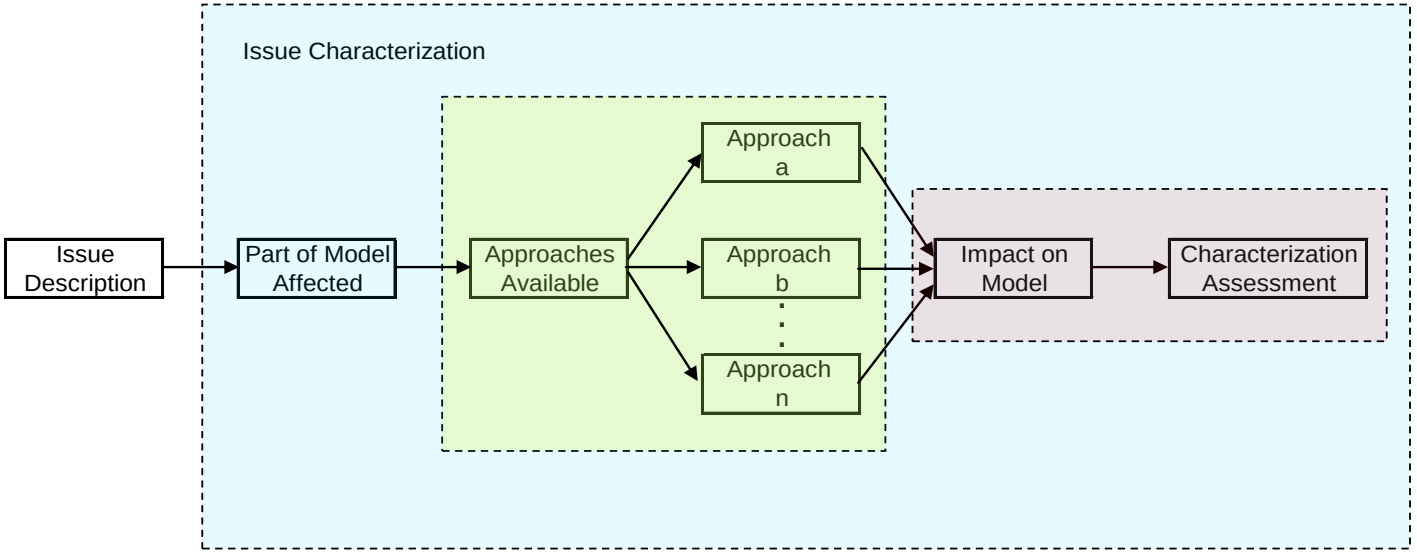
A Graded Approach to Dealing with Uncertainty (2)

- In Step 5 address uncertainties:
  - When results are far from the acceptance guidelines, parameter uncertainty is generally unimportant (except where it obviously is (e.g., ISLOCA))
    - Propagate mean values, perform qualitative assessment of SOKC
  - Within a factor of two assess how to address the SOKC using guidance in the EPRI documents (e.g., 1016737)
    - If SOKC appears to be important according to the EPRI guidance, perform a quantitative assessment of parameter uncertainty
  - As model uncertainties may be large, they must be assessed in all regimes
    - Guidance on this assessment provided in Ch. 4 (next slides)
    - Generic sources of model uncertainty to consider provided in EPRI 1016737 as well as this document.

* (NUREG 1855 Stage D, E)

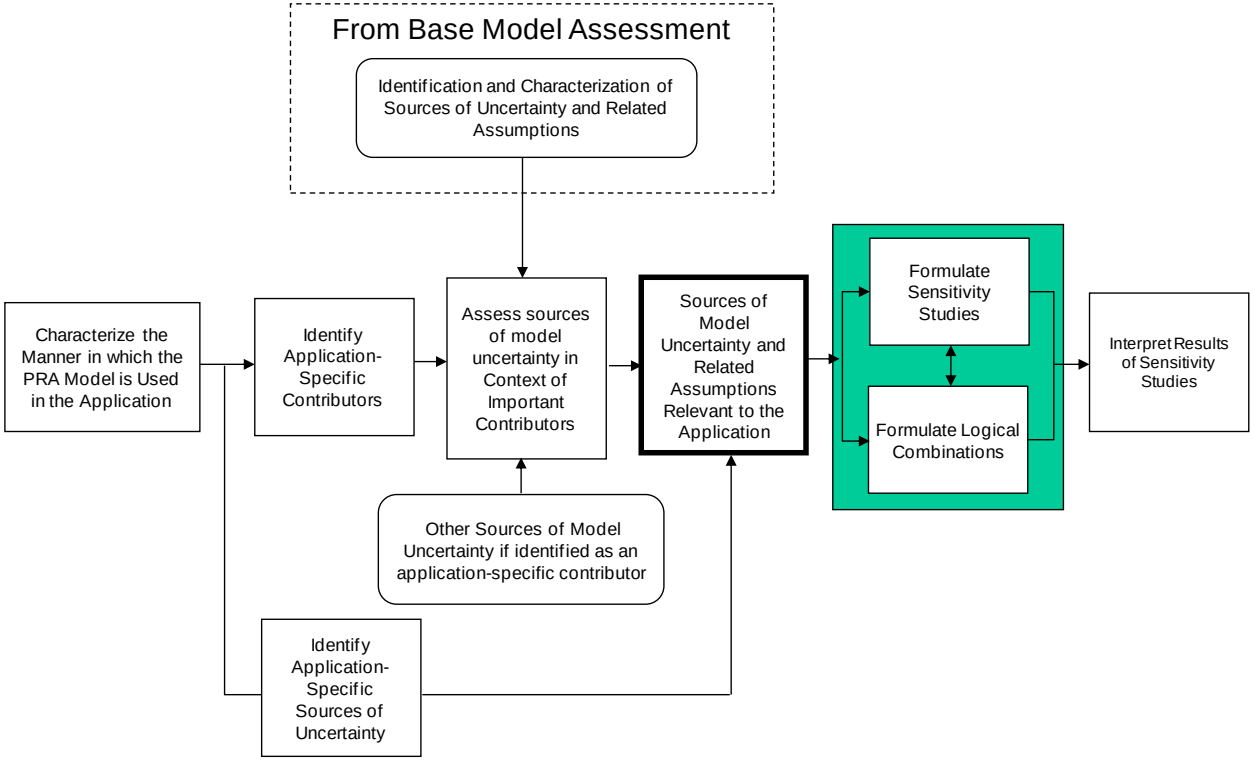
Approach for Characterizing Model Uncertainty

- Similar to approach in EPRI 1016737, but expanded to encompass fire, seismic, LPSD, and Level 2 (as applicable)
- Base Model Assessment



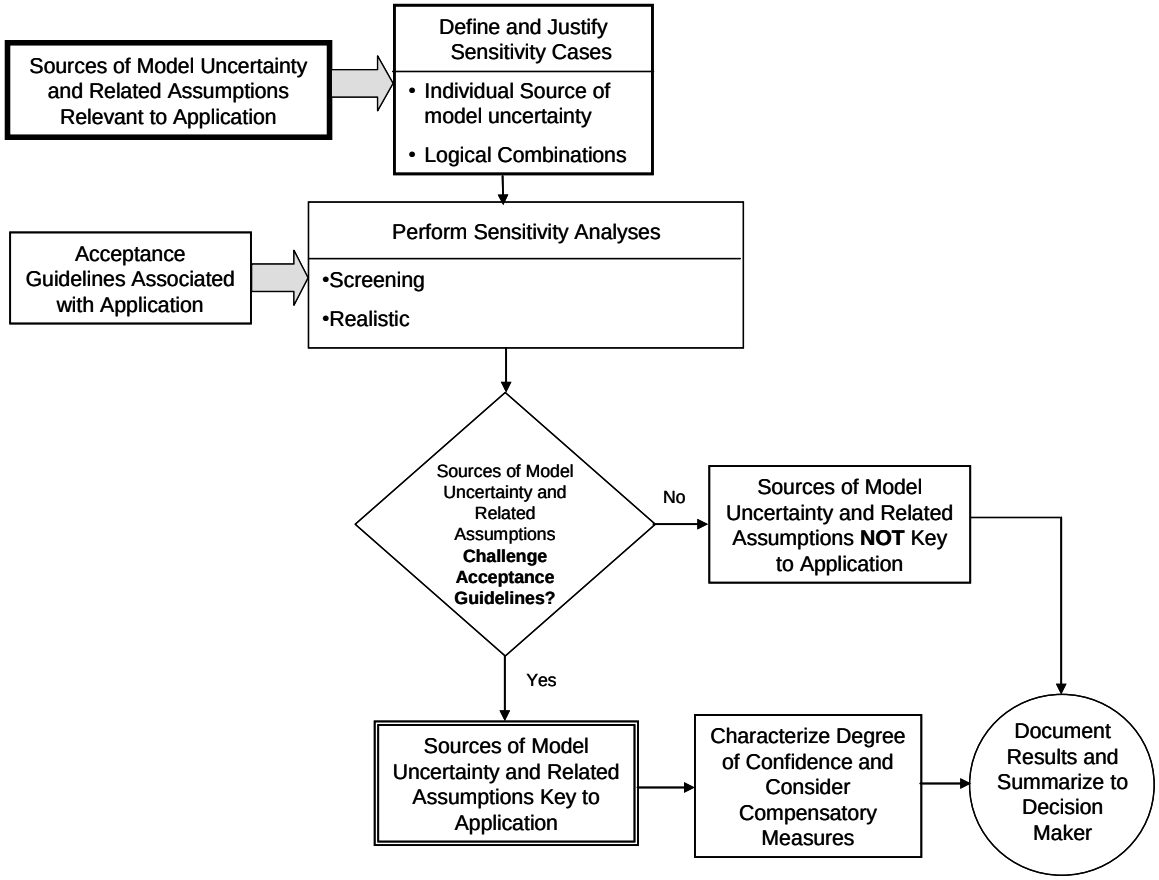
Approach for Dealing with Model Uncertainty

- Process for identifying potential key sources of uncertainty in applications



Approach for Dealing with Model Uncertainty

- Process for identifying potential key sources of uncertainty in applications (cont'd)



Step 6: Integrated Decision-making

- Discussed in Chapter 5 of the report
- Topics addressed include:
  - Comparison of the results to the guidelines
  - Characterization of results for the decision-maker, and options for when the guidelines are challenged
  - Integration of the PRA results with the other principles of risk-informed regulation (RG 1.174)
    - Defense-in-depth
  - Dealing with large uncertainties

* (NUREG 1855 Stage F)

Integrated Assessment

- Integrated assessment based on the five principles of risk-informed decision-making (RG 1.174):

1. The proposed change meets the current regulations unless it is explicitly related to a requested exemption (i.e., a “specific exemption” under 10CFR 50.12, “Specific Exemptions”).
2. The proposed change is consistent with a **defense-in-depth** philosophy.
3. The proposed change maintains sufficient safety margins.
4. **When proposed changes result in an increase in core damage frequency or risk, the increases should be small and consistent with the intent of the Commission’s Safety Goal Policy Statement.**
5. The impact of the proposed change should be monitored using **performance measurement** strategies.

- Specific topics addressed are DID and large uncertainties since they are potentially the most contentious

Proposed Approach for addressing DID*

- Develop guidance that recognizes the hierarchical aspect of DID
- Recognize its role in addressing unknown factors
- Focus on the way the LAR affects the presumed balance between the levels of protection:
  - Physical changes to the plant
  - Changes to operating practices
- Provide guidance on the integration of DID concerns with the other principles
  - Dealing with the unknown

** This approach has not been endorsed by NRC*

The Role of DID in an Integrated Decision

- Identify and assess changes that may adversely affect achieving a required safety function when the level of redundancy or diversity is limited or where significant uncertainty exists,
- Identify and assess the impact on DID of cross-cutting changes (e.g., administrative changes, maintenance practices) that affect multiple safety functions or cut across levels of protection
- Use for things that can not be addressed directly by the PRA, e.g., late containment failures

Interaction with other Principles – Principle 4 _ Change in Risk is Small

- Meeting the acceptance guidelines of Principle 4 demonstrates that, at an integral level, DID is maintained for issues related to CDF and LERF, and that are represented in the PRA
- However, if the change affects only low frequency and low order cut sets, DID is still a relevant consideration
  - Contrast proposals for a change to surveillance frequency on RPV with change to surveillance frequency on LPCS system (BWR)
    - Former appears in single element cut sets, the latter in cut sets of high order, i.e., other systems perform the same function
    - Furthermore, there is much more uncertainty about the RPV failure probability than that of the LPCI system
    - Therefore, while the change for the RPV might be allowed, the case would need to be much stronger

Addressing Large Uncertainties

- Problem statement – results from:
  - Paucity of data
  - Need for extrapolation (e.g., flooding) and/or use of models (e.g., seismic)
- Manifestation in PRA models
  - Hazard characterization
  - Characterization of impact
  - Characterization of response to hazard (e.g., HRA)
- Special case – cliff edge effects
  - A small change in hazard results in a large change in impact (e.g., CCDP)

Large Uncertainties (Cont'd)

- Process for addressing large uncertainties
  - Step 1: Understand role in decision-making
  - Step 2: Understand potential to affect decision
  - Step 3: Disposition
  - Step 4: Integration with other principles
    - Defense-in-depth
    - Safety margins
    - Performance monitoring

Large Uncertainties – Steps 2 & 3

	Potential for Large Uncertainties	Disposition
1	Potential Over-estimation of Computed Risk	See 2 & 3
2	Known Over-estimation of Risk Impact	Describe impact of conservatism in application
3	Masking of Change in Risk	Sensitivity study that removes the conservative treatment
4	Potential Under-estimation of Computed Risk	Sensitivity of the risk metrics to changes in the mean estimate – is it reasonable to assume that these sources of large uncertainty do not present a threat to the decision?
5	Cliff-Edge	"Reverse Engineer" hazard likelihood

Results Decomposition (Chapter 3)

- The contributors to the risk metrics are identified
  - Hazard groups
  - Initiating events
  - Accident sequences/classes
  - Functions/systems
  - Cut sets
- Required for
  - Step 3 to identify risk drivers during screening
  - Step 4 to construct the bounding analyses
  - Step 5 to identify:
    - Sources of uncertainty that could influence the result (key sources)
    - Portions of the PRA model treated conservatively and possibly distorting the conclusions
    - Assessment of significance of SOKC

Appendices

- Appendix A: Example Implementation in a Risk-Informed Regulatory Application [RHR example]
- Appendix B: Generic Sources of Fire PRA Modeling Uncertainty
- Appendix C: Generic Sources of Seismic PRA Modeling Uncertainty
- Appendix D: Generic Sources of LPSD PRA Modeling Uncertainty
- Appendix E: Generic Sources of Level 2 PRA Modeling Uncertainty

Issue Description		**Issue Characterization**	
Topic	**Discussion of Issue**	**Part of Model Affected**	**Possible Approaches for Model Uncertainty Issues (Not Exhaustive)**
Plant Operational State Definitions (LPOS)			
1. Omission of POSs needed to complete evolutions resulting from safe stable states from at-power scenarios	Some level 1 scenarios end in a safe-stable state, such as successful feed and bleed, successful shutdown to terminate SG tube leak, or sump recirculation following a LOCA. These may lead to prolonged shutdown to allow for repair. While they are low frequency scenarios, the complete cycle to restoration of power is not generally modeled.	This is associated with the characterization of shutdown POSs, and represents a level of detail or completeness issue.	N/A – Level of Detail

Next Steps

- EPRI document 1026511 was sent out for review by the EPRI scope and quality working group and to NRC
- No fundamental issues were raised, but the comments received were helpful in identifying where the document lacked clarity, and will be addressed before publication.
- Publication is planned for December, 2012 (prior to anticipated release of NUREG-1855, Rev. 1)
  - *NRC needs to publish draft prior to December 2012.*

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Revision 1 to NUREG-1855, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking"

Presented to ACRS Subcommittee on PRA

October 19, 2012

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United States Nuclear Regulatory Commission
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OUTLINE

- Objectives
- Background
- NUREG Restructure
- ACRS Feedback
- Changes to NUREG
- Steps Forward

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OBJECTIVES

- Objectives – provide guidance with regard to:
  - identifying and characterizing the uncertainties associated with PRA
  - performing uncertainty analyses to understand the impact of the uncertainties on the results of the PRA
  - factoring the results of the uncertainty analyses into the decisionmaking

- NRC and EPRI, under an MOU, have developed companion guidance documents which are meant to complement each other and are intended to be used as such when assessing the treatment of uncertainties in PRAs used in risk-informed decisionmaking.

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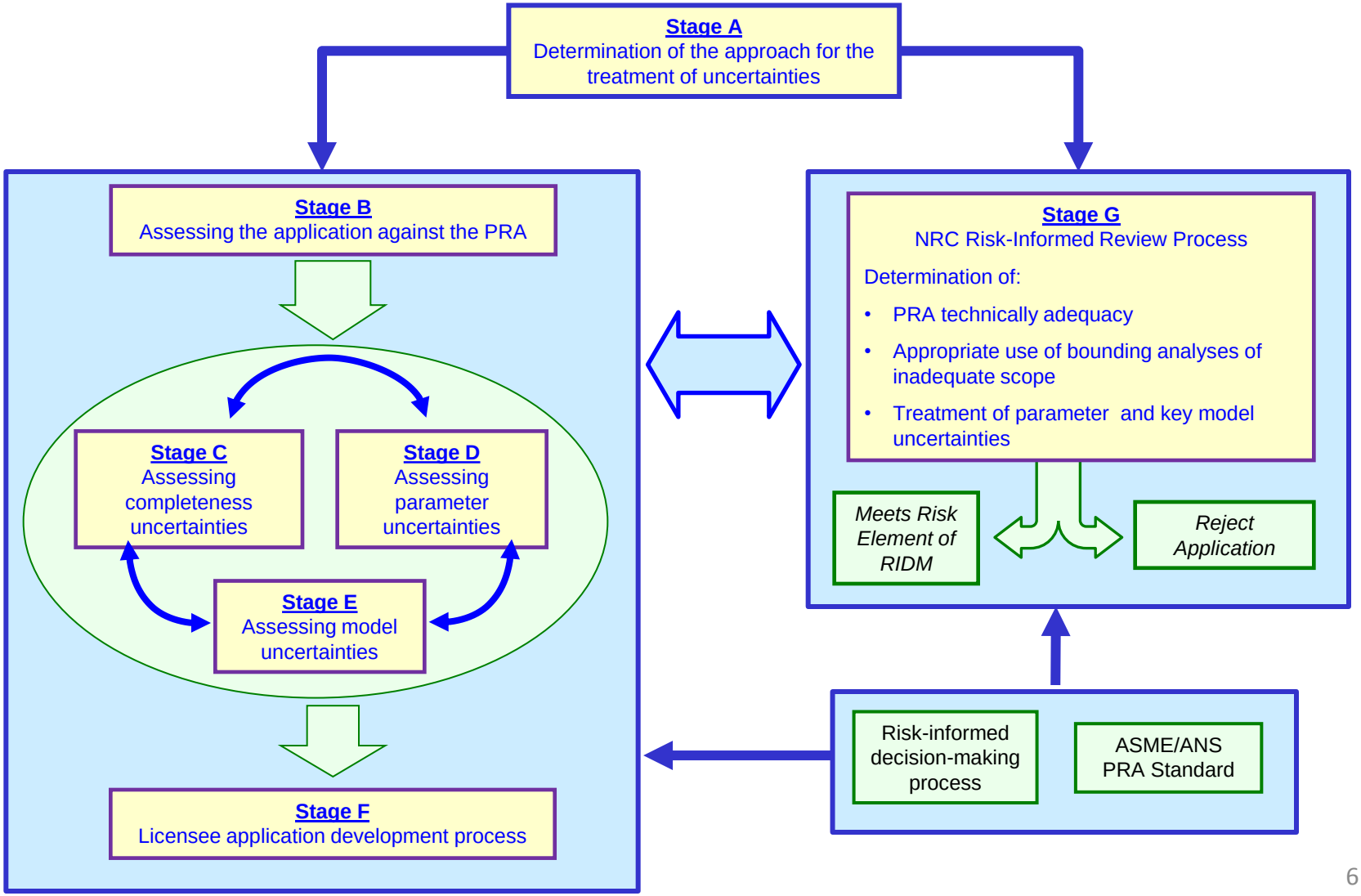
BACKGROUND

- Major changes involved a restructuring of the document and development of an explicit process which describes the guidance for the treatment of the uncertainties.
- The scope was expanded to include sources of uncertainties associated with low power and shutdown, internal fire, seismic, and Level 2 PRA
  - The expanded scope primarily affected the EPRI report.
- Met with subcommittee on June 19, 2012 to present progress.
- ACRS provided feedback and NUREG was revised.

NUREG RESTRUCTURE



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Summary of Feedback From ACRS Subcommittee

1. Re-evaluate use of subjective terms
2. Address issues regarding sources of model uncertainty (i.e., definition thereof, consensus models)
3. Clarify the relationship of uncertainty in PRA and deterministic analyses with defense-in-depth and safety margins
4. Consider inclusion of a more generic and global process that is applicable to all risk-informed decisions/activities including those performed by the NRC
5. Expand discussion of bounding, conservative, and realistic analyses (i.e., definitions, examples used)
6. Re-evaluate discussion on the process of truncating and subsequently determining the importance of the SOKC
7. Revisit the discussion of a “reasonable alternative” for a sensitivity analysis

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CHANGES TO THE NUREG

1. NUREG was reviewed for subjective terms and revised.
   - The term “reasonable” was replaced with “credible” and a definition for credible was provided
   - The term “broad acceptance” was removed from the definition of source of model uncertainty (see page 86).

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CHANGES TO THE NUREG

2. Revisions made to address issues with the definition of sources of model uncertainty and consensus models as well as the treatment of model uncertainties for consensus models.

   - *From page 18:* There may be cases where there may be more than one consensus model for addressing a specific issue. An example is the Multiple Greek Letter and the Alpha methods for quantifying common cause failures. In such a case, any one of the consensus models can be used. Multiple consensus models should provide similar results. If they do not, then they do not meet the requirement for being a consensus model and an evaluation of the associated model uncertainty should be made utilizing the guidance in Section 7.

     Currently there is no agreed-on list of consensus models nor is there a formal process to establish such a list. However, as a first step in establishing such a process, EPRI has compiled a list of candidate consensus models [EPRI, 2006a]. This list includes common approaches, models, and sources of data used in PRAs. At this time, the NRC has not reviewed this list although specific models, approaches and data may have been approved for specific risk-informed applications.

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CHANGES TO THE NUREG

2. (*Con't*) Revisions made to address issues with the definition of sources of model uncertainty and consensus models as well as the treatment of model uncertainties for consensus models.

   - *From page 86:* A ***source of model uncertainty*** exists when (1) a credible assumption (decision or judgment) is made regarding the choice of the data, approach, or model used to address an issue because there is no consensus and (2) the choice of alternative data, approaches or models is known to have an impact on the PRA model and results. An impact on the PRA model could include the introduction of a new basic event, changes to basic event probabilities, change in success criteria, or introduction of a new initiating event. A credible assumption is one submitted by relevant experts and which has a sound technical basis. Relevant experts includes those individuals with explicit knowledge and experience for the given issue. An example of an assumption related to a source of model uncertainty is battery depletion time. In calculating the depletion time, the analyst may not have any data on the time required to shed loads and thus may assume (based on analyses) that the operator is able to shed certain electrical loads in a specified time.

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CHANGES TO THE NUREG

3. Revisions made to clarify the relationship of uncertainty in PRA and deterministic analyses with defense-in-depth and safety margins

   - *From pages 20-21:* Appropriate consideration of the uncertainty in both deterministic and probabilistic assessments is required to properly interpret the results. Both the deterministic and probabilistic components implement Principles 2 and 3, which take into account the impact on defense-in-depth and on safety margins. The probabilistic component implements Principle 4, acceptable risk impact. A treatment of the uncertainties in the probabilistic analysis is implicitly required to implement Principles 2, 3, and 4 of risk-informed decisionmaking. Treatment of probabilistic analysis uncertainties is the focus of this report. Although uncertainties in a deterministic analysis are not explicitly addressed in this report, the types of uncertainties and the methods for evaluating them are the same for a deterministic assessment.

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CHANGES TO THE NUREG

4. A new subsection describing the generic application of the treatment of uncertainties was added to Section 3, which includes the following three parts:
   - Understanding the risk-informed activity
   - Understanding the sources of uncertainty
   - Addressing the uncertainties in the decision making

CHANGES TO THE NUREG

5. Expanded the discussion of bounding analyses.

   - *From pages 54-55:* In the context of a specific PRA scope or level-of-detail item, a bounding analysis provides an upper limit of the risk metrics and includes the worst credible outcome of all known possible outcomes that result from the risk assessment of that item.

     The following text was removed from pages 54:
     Consequently, a bounding analysis must consider both the frequency of the event and the outcome of the event.

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CHANGES TO THE NUREG

5. (*Con't*) Expanded the discussion of bounding analyses.

- *From page 53-54*: Performance of a bounding analysis utilizes available knowledge to set an upper limit on where the answer may realistically lie. When compared to a best estimate probabilistic evaluation, a bounding value may represent a 95%, 98%, or some other percentile of the best estimate value. However, it is not practical to establish a specified percentile in the definition of a bounding analysis since one could only meet that definition by performing a best estimate analysis. Instead, a bounding analysis can only provide a point estimate of the risk metric associated with a missing scope or level-of-detail item. To accomplish this, a bounding analysis can be broken down into individual constituent parts with bounding values, assumptions, and models utilized in each piece of the evaluation. For example, a bounding scenario may be defined utilizing a bounding initiator frequency, assumed failure of available mitigating systems, and a maximum possible release of hazardous material. If the uncertainty distribution is available for one of the parameters such as the initiator frequency, a value representing a high percentile (e.g., 95th percentile) could be selected as a bounding value.

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CHANGES TO THE NUREG

6. Revised discussion on the process of truncating and subsequently determining the importance of the SOKC.

   - *From page* 71: …When the basic event mean values and uncertainty distributions are propagated in the PRA model without accounting for the SOKC, the calculated mean value of the relevant risk metric and the uncertainty about this mean value will be underestimated. The values can be underestimated due to the effect of the SOKC directly, as well as due to incorrect screening out of cutsets in truncation due to neglect of the SOKC in calculating cutset frequencies. Appendix 6-A of this section discusses both these potential effects of the SOKC in more detail…

     From page 75: …It should be noted here that, due to the large number of cutsets in a PRA model, it is common to screen out cutsets with frequencies below a certain truncation value at this point in the analysis. Caution needs to be exercised to avoid incorrect screening out of cutsets in truncation due to neglect of the SOKC in calculating their frequencies. Appendix 6-A of this section discusses this possible effect of the SOKC in more detail, along with other potential SOKC effects…

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CHANGES TO THE NUREG

6. Revised discussion on the process of truncating and subsequently determining the importance of the SOKC.
   - *From page 83*: … If the frequencies of the MCSs are calculated using a point estimate that does not account for the SOKC, and the point estimate frequencies of some of the MCSs containing correlated basic events are smaller than this truncation value, a subset of these MCSs may be incorrectly discarded because the correlated frequency (that accounts for the SOKC) of each MCS in this subset is actually larger than this truncation value…

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CHANGES TO THE NUREG

7. The term “reasonable” was replaced with “credible.” The discussion was amended with the following paragraph. No impact was identified on Stage F.
   - *From page 99*: …Section 4.3.1 of EPRI report 1016737 [EPRI, 2008] and Section 4.4.1 of EPRI 1026511 [EPRI, 2012] provide guidance on determining a reasonable range over which a sensitivity analysis should investigate model uncertainty.

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STATUS AND NEXT STEPS

- NRR and NRO are being provided with the two-week notification of impending publication of the draft NUREG for public review and comment
- Will address NRR and NRO comments simultaneously with public comments
- Revision 1 to NUREG-1855 is scheduled for publication in early 2013