UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

November 8, 2012

MEMORANDUM TO: ACRS Members

FROM: John Lai, Senior Staff Engineer /RA/
Technical Support Branch
Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFIED MINUTES OF THE ACRS RELIABILITY AND PRA SUBCOMMITTEE MEETING ON NUREG-1855, REV.1, "GUIDANCE ON THE TREATMENT OF UNCERTAINTIES ASSOCIATED WITH PRAS IN RISK-INFORMED DECISIONMAKING", ON JUNE 19, 2012

The minutes of the subject meeting were certified on November 1, 2012, as the official record of the proceedings of that meeting. Copies of the certification letter and minutes are attached.

Attachments: As stated

cc H. Gonzalez

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November 8, 2012

MEMORANDUM TO: John Lai, Senior Staff Engineer
Technical Support Branch
Advisory Committee on Reactor Safeguards

FROM: John W. Stetkar, Chairman /RA/
Reliability and PRA Subcommittee

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS RELIABILITY AND PRA SUBCOMMITTEE ON NUREG-1855, REV.1, "GUIDANCE ON THE TREATMENT OF UNCERTAINTIES ASSOCIATED WITH PRAS IN RISK-INFORMED DECISIONMAKING", ON JUNE 19, 2012

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting are an accurate record of the proceedings for that meeting.

/RA/ Date 11/1/2012
John W. Stetkar, Chairman
Reliability and PRA Subcommittee

Certified By: John W. Stetkar
Certified on November 1, 2012

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
MINUTES OF THE ACRS RELIABILITY AND PRA SUBCOMMITTEE MEETING
JUNE 19, 2012

The ACRS Reliability and PRA Subcommittee held a meeting on June 19, 2012 in Room T-2B1, 11545 Rockville Pike, Rockville, Maryland. The meeting convened at 12:59am and adjourned at 5:27pm. The entire meeting was open to the public. No written comments or requests for time to make oral statements were received from members of the public related to this meeting.

ATTENDEES

ACRS Members
John Stetkar, Subcommittee Chairman
Dennis Bley, Member
Michael Ryan, Member
William Shack, Member
Steve Schultz, Member

ACRS Staff
John Lai, Designated Federal Official

NRC Staff
Gary DeMoss, RES/DRA
Mary Drouin, RES/DRA
Stephen Dinsmore, NRR/DRA
Anders Gilbertson, RES/DRA
See Meng Wong, NRR/DRA
Hahn Phan, NRO/DRA

Other Attendees
Mary Presley, EPRI
Tim Wheeler, SNL
Jeff LaChance, SNL
John Lehner, BNL
Stanley Levinson, AREVA

SUMMARY

The purpose of the meeting is to hear staff's discussion of the treatment of uncertainties associated with PRAs in risk-informed decisionmaking, NUREG-1855, Revision 1. The meeting transcripts are attached and contain an accurate description of each matter discussed during the meeting. The presentation slides and handouts used during the meeting are attached to these transcripts.

Major Issues discussed during the meeting are described in the following Table.

Table 1. Major Issues Discussed During the Meeting

Major Issues Discussed	
Issue	Reference Pages in Transcript
Chairman Stetkar asked why there are two separate reports (i.e., one from NRC and one from EPRI) for this subject. Mary Drouin of RES replied that the staff thinks it is more efficient to do this way.	10-11
Chairman Stetkar asked how the applicants will use the NUREG as referenced in the regulatory guide while the NUREG itself references an EPRI report. How does the staff handle the updates if these two documents are not updated at the same time? Staff responded that they will make it clear when time comes.	11-15
Chairman Stetkar stated that the definition of “credible” should be defined clearly in the NUREG.	25
Chairman Stetkar stated that the figure on slide 16 shows a clean dotted line to separate the uncertainties treated in PRA from deterministic analysis. It was not shown that way in RG 1.174. Assessment of uncertainties in deterministic analyses can provide information about confidence in the available margins. That idea is not supported by the NUREG distinction between PRA and deterministic analysis.	28-30
Member Bley stated that the uncertainties could be applied to qualitative analysis as well as quantitative analysis.	31
Chairman Stetkar stated that the NUREG focuses on a very prescriptive process and on a set of narrowly defined quantitative licensing issues. Mary stated that the staff will look into this.	35
Chairman Stetkar stated that if one only considers the most important contributors to the results, because the belief is that all PRA assumptions are conservative, one may miss possible sources of optimism in contributors that appear less important until their uncertainties are accounted for.	44-46
Chairman Stetkar asked if there is any plan to pilot this NUREG. The staff replied that they will explore the possibility.	54-57
Chairman Stetkar stated that some examples given in the NUREG may need to be clarified to not mislead users on applying the guide. For example, “an application to change an at power technical specification would not impact low-power shutdown risk and thus a lack of a low-power shutdown PRA would not be an issue regarding the necessary PRA scope to address the application." This may not	59-60

be true for shared systems in a multi-unit site. If one takes out a system or component for maintenance while one unit is at power, that condition may affect the risk for another unit that is in shutdown.	
Members, staff, and presenter discussed the definition of the word "bounding" used in the NUREG.	63-69
Chairman Stetkar asked how one determines the significant contributors. Does one need to quantify the results using various truncation values, generate different sets of cutsets, and see what the sensitivity does when propagating the uncertainties through each set? The NUREG does not alert analysts that the truncation process may delete cutsets that could be affected significantly by state-of-knowledge correlation uncertainties. Member Bley stated that the error factors (EFs) could be used to address this issue.	78-84
Chairman Stetkar asked what the definition of consensus models is. Presenter and staff stated that the consensus models are those widely utilized by users and accepted by NRC.	91-94
Chairman Stetkar and presenter discussed how to apply the treatment of realistic sensitivity analysis.	99-105
Chairman Stetkar stated that the guidance in this NUREG emphasizes scrutiny only when the analysis results are close to the acceptance criteria with small margins. Members noted that the staff also needs to know the quality of analyses that justify very large margins to the acceptance criteria.	119-120
Members and staff discussed the application of RG 1.174 regarding the use of mean values and uncertainties.	123-125
Member Schultz and staff discussed the requirements of document quality and quantity for staff reviews.	131-132
Chairman Stetkar gave suggestions to add some descriptions/clarifications to examples shown in Appendix A.	139-154
Mary Presley of EPRI stated that the sources of model uncertainties and additional guidance for treating uncertainties in risk-informed applications will be included in a new EPRI report.	166
Members Bley and Shack stated that it is hard to see why one does not need to address model uncertainty if one uses the "consensus model".	176-177

Table 2. Action Items

ACTION ITEMS

Action Item	Reference Pages in Transcript
None	

Documents provided to the Subcommittee

1. Draft NUREG-1855, Rev. 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking", NRC-RES, May 17, 2012 (ML121310509)
2. EPRI Report, "Treatment of Parameter and Model Uncertainty for Probabilistic Risk Assessments", EPRI-1016737, December, 2008.
3. ACRS Letter Report, „Draft Final NUREG-1855,"Guidance on the treatment of Uncertainties Associated with PRAs in Risk-informed Decisionmaking" and Draft Appendix A', February 23, 2009 (ML090490652)
4. Memo and Summary of "Public Workshop on Treatment of Probabilistic Risk Assessment (PRA) Uncertainties", April 12, 2012 (ML121030572).

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards Reliability and PRA Subcommittee

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Tuesday, June 19, 2012

Work Order No.: NRC-1693 Pages 1-183

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UNITED STATES OF AMERICA

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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TUESDAY

JUNE 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 T2B1, 11545 Rockville Pike, at 1:00 a.m., John Stetkar, Chairman, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

JOHN W. STETKAR, Chairman

DENNIS C. BLEY

MICHAEL T. RYAN

STEPHEN P. SCHULTZ

WILLIAM J. SHACK

NRC STAFF PRESENT:

JOHN LAI, Designated Federal Official

GARY DEMOSS

MARY DROUIN

STEPHEN DINSMORE

ANDERS GILBERTSON

ALSO PRESENT:

JOHN LEHNER

JEFF LaCHANCE

TIM WHEELER

MARY PRESLEY

C-O-N-T-E-N-T-S

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

(12:59 a.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 member in attendance are, Steve Schultz, Dennis Bley will join us, Bill Shack and Mike Ryan. John Lai of the ACRS Staff is the designated federal official for this meeting.

The Subcommittee will hear the staff's discussion of the revised NUREG-1855 Guidance on the Treatment of Uncertainties Associated with PRAs and Risk-Informed Decision Making. We'll hear presentations from the NRC staff, their contractors and a representative from EPRI. There will be a phone bridge line. To preclude interruption of the meeting the phone will be placed in a listen-in mode during the presentations and Committee discussion.

We have 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 attendance.

The Subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions, as appropriate, for

bill 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. The transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice.

Therefore, we request the participants in this 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 that they may be readily heard.

We will now proceed with the meeting. And I call upon Gary DeMoss of Research to begin.

MR. DEMOSS: Hello. I'm Gary DeMoss, the Performance and Reliability Branch Chief in the Division of Risk Assessment and Office of Research. I want to thank this team for pulling together NUREG-1855, this revision of it, and the presentation today. I think they've done an outstanding job and I the ACRS should have little trouble wearing them down because this hard-working group did a two-hour public meeting on another topic this morning.

The document's an important revisions to

NUREG-1855, I characterize the initial revision as a lot great information not structured in a fully useable manner. Well they've restructured this information and expanded the scope. And I think they'll present you an outstanding piece of work. Mary.

MS. DROUIN: Thank you, Gary. Okay, before we get started I would like to acknowledge the team, because the team really has worked, of course very hard on the first revision. But, as you will see as we go through, we have really done a major restructure of this document. And I think done a vast improvement in terms of its usability to the stakeholders, both internal and external to the NRC.

So sitting over on the table there is Anders Gilbertson from Research. Steve Dinsmore is somewhere around here, there he is. Steven Dinsmore and others from NRR, we had quite a few interactions with them to the best way to restructure the document. So Andy Howe, who is now retired, was a major player. And Donnie Harrison, who apologizes that he couldn't be here today.

John Lehner, to my right, from Los Alamos and Jeff -- Sorry. That was my big mistake for the day. From Brookhaven. And Jeff LaChance and Tim

Wheeler from Sandia National Lab.

Okay. So today we're going to try and concentrate on the changes but we felt that it had been such a long time since we'd been here to visit the Committee that we thought it was important to go through, briefly, the background, the objective, the scope. We're really focusing on what the NUREG structure is, the overall approach and the detailed guidance. Appendix A, which is the test case, and then let you know where we plan to go forward.

Okay, how did this project come to be? Well it really was a result from two letters that were from the ACRS asking the staff to look into the treatment of uncertainties. How to define bounding analysis and just what do you do with uncertainties in your risk decision making process.

So we came up with the document. And when we came back to the ACRS, back in February, they did support publication of the NUREG but at the time --

CHAIR STETKAR: February of 2009, for the record.

MS. DROUIN: Yes. But they did not believe that publication of Appendix A should occur. And the reason for that is, though they liked Appendix A, they felt like it didn't have enough cautionary

statements in it. That it would be very easy for a licensee to adopt it as something absolute versus an illustration. So we had agreed that we would add those cautionary statements.

It was first issued for a draft in 2007 for public review and comment. And then for use in 2009. And, as I said, Appendix A has actually never been formally published. We met again with ACRS in March of 2009 and we did go through the changes to the Appendix and they agreed with them. But they wanted us to come back after our public workshop and share what we had learned. And that meeting, which is actually today's meeting, has been deferred each year. And I think other events have now overtaken it.

But the public workshop was very important. It was a two and a half day workshop and we got a lot of tremendous insights from it. And Appendix A was made public. It wasn't published as part of the NUREG, but it was made public and so we did get a lot of good information on the usefulness of the Appendix.

And the major comment that we got, from both our stakeholders and internal, was that this was a great document. It had a lot of interesting information in there. But it was written more kind of

like an intellectual document and not so much as guidance. You know, what do I do with this information, you know, you've given me cautions. And you need to consider this and you need to consider that, but how do I actually, you know, what do I really do with all this information.

So based on that we spent quite a bit of time on trying to figure out how to restructure the document to make it useful and not just an academic type of exercise. At the same time that was happening we did receive some user need requests from NRR and NRO saying please expand the scope to include internal fire, seismic Level 2 and low-power shutdown.

Now, expanding that part really did not effect our document, because our document is more the process and the process was already kind of generic. So it really effected what EPRI was doing. And this was, well here, let's go to the next slide.

We've been working with EPRI under an MOU. When the work first started it was discovered that both NRC and EPRI was doing something in this area. So we thought it would be much more efficient if we worked together and in some sense divvy up the work. So there's the NRC Report, which is an NRC NUREG, and then there is the EPRI Report. And they compliment

each other, they do not overlap in the sense that they aren't redundant.

MEMBER BLEY: They haven't updated that since 2008 version, have they?

MS. DROUIN: No, but you're going to hear from Mary on what's happening with the EPRI document.

MEMBER BLEY: Okay, good.

CHAIR STETKAR: Mary, although you characterize them as complimenting one another the NUREG refers directly to table numbers, to section numbers, to analyses in that EPRI report. I'm curious because they're so intertwined, or at last reading the NUREG looking toward the EPRI document. Why wasn't this NUREG issued as a joint EPRI staff NUREG as other NUREGs have been done under kind of similar close cooperation?

MS. DROUIN: Well because we felt we could really divvy it up. And that we weren't going to be held to each other. We had our report and industry had their report. And we felt like we could define pieces of work where we could each go off and do our piece. Now that doesn't mean that we worked independent of each other. EPRI was very much involved in reviewing what we did and gave us comments. We would look at what they did and gave

them comments. But we really felt that this was a much more efficient way to go.

CHAIR STETKAR: Let me then ask you, since this is only a NUREG, it's not a regulatory guide or the SRP. It does mention at least three ISGs that are in progress. I think I counted three, I'm not sure if there's --

MS. DROUIN: Yes, I think that might be right.

CHAIR STETKAR: I don't know if they're three separate ones, since they're just refereed to as an ISG in progress. When they are issued or regulatory guides or part of the standard review plan is updated how will you address potential deviations between this NUREG and the EPRI report? Will there be separate endorsements for each report.

I'm concerned about making references to Table A point something or other in the EPRI report as a basis for an analysis that was done, that's used now in this NUREG, which maybe endorsed in a Regulatory Guide and then the EPRI report deviating at some time in the future from this NUREG and somehow being endorsed as NRC accepted methods. So have you thought how will that all work itself out if it's not a single joint report?

MS. DROUIN: Because that's part of the MOU process. I mean, this is work we're doing together.

CHAIR STETKAR: No, I understand that. But in a regulatory sense when the staff now reviews a license application that makes use of the guidance and methods in this NUREG, or according to some Regulatory Guide. When the staff does that review how do they treat these references to an EPRI report, as examples of kind of how to do it? Not the overriding what ought to be done, but how it's done.

MS. DROUIN: Well their report is endorsed, our report. Now we have just tried to help out the reader and point them to particular places in the EPRI report.

CHAIR STETKAR: I understand that.

MS. DROUIN: But, you know, we have in essence endorsed their report in our report.

CHAIR STETKAR: So will that endorsement of both reports, I mean, it doesn't say anywhere this report endorses the analyses in the EPRI Report --

MS. DROUIN: And we can clarify that.

CHAIR STETKAR: -- to support regulatory decision making.

MS. DROUIN: We can clarify that.

CHAIR STETKAR: I mean what I'm concerned about is they may be completely dovetailed right at the moment because you've been working closely together. The NUREG, you know, NUREGs take on a life of their own. They're updated at some periodicity approaching geologic timeframes in some sense.

But there will be guidance to staff reviewers on how to assess a submittal in terms of the scope and the quality of uncertainty analyses that are provided in that submittal.

And in fact the NUREG, Stage G, as you get to it talks about a bit of that process. But if EPRI updates their document in a year and a half after running through some more actual licensee submittals and decides that oh, gee, this particular approach doesn't seem to work. We'll change our guidance. How does that work into a regulatory review process?

MS. DROUIN: Well we would have to make a decision. Now if they decide to update their report that report's not endorsed. I mean there is a report that has a certain number and date within --

CHAIR STETKAR: It doesn't yet.

MS. DROUIN: Well, now if they go and update their report we will have to make the decision of do we modify the NUREG or do we issue perhaps an

ISG that, you know, there's many different ways to handle it.

CHAIR STETKAR: Okay, well.

MEMBER SCHULTZ: So you have in mind a particular configuration control for the documentation. But as John says, the process going forward could become complex.

CHAIR STETKAR: It could.

MEMBER SCHULTZ: And that's why I mean you have to --

CHAIR STETKAR: I mean other NUREGs have been issued as a joint report to sort of freeze, you know essentially freeze that endorsement.

MS. DROUIN: Well it is frozen in the sense that it is a specific report we endorse. I mean it's no different than any other industry document out there. We endorse documents all the time. And then they go and change over time and we have to decide whether or not we're going to update to endorse their changed document.

MEMBER BLEY: So what we've seen elsewhere, in a case like this, is you endorse a specific version of their report?

MS. DROUIN: Yes. Yes.

MEMBER BLEY: And then if there's a new

one and you want to endorse that you have to update your NUREG?

MS. DROUIN: I mean we might update the NUREG or there may be another way that we do it. I mean, we do have options of how we would address a new or a revised version.

CHAIR STETKAR: I'm assuming the NUREG, this is being issued for public comment now or this is being issued final? Rev 1?

MS. DROUIN: No, right now it's been issued for internal review.

CHAIR STETKAR: Internal review. Okay, that helps a little bit because there's still some uncertainty about which version of the still in progress update to the EPRI Report. In some places it referred to the 2008 version of the report but that's obviously going to change, I would think, sometime in the near future.

MS. DROUIN: Right. And that's where we have to coordinate closely, because we can't legally reference something that hasn't been published yet.

CHAIR STETKAR: That's right.

MS. DROUIN: We can footnote it but we can't do a legal reference.

CHAIR STETKAR: Right.

MS. DROUIN: So right now it's footnoted and our timeframe is such that, you know, they'll have their document out before we go final on ours.

CHAIR STETKAR: Okay, thanks. That helps.

MS. DROUIN: Okay. Along with that, this is how the two documents, is that ours is providing the process for how you treat the uncertainties. And the EPRI report is primarily two things. It's giving the guidance on how to do the state-of-knowledge correlation and then it's identifying two things. A generic source of model uncertainties and how you go about identifying unique ones. And Mary will talk to you about the EPRI report.

Okay. So now let's get into how this document was restructured. It was organized around three parts. And these three parts were divvied up into seven stages. And the first part was determining whether or not your risk-informed decision, or your risk-informed activity or application is, when you're dealing with the uncertainties do you use the process in this document? Because this document doesn't care how you treat uncertainties everywhere.

And then Stages B through F is giving the guidance for the licensee. This is what we expect the licensee to do. And then Stage G is discussing,

describing the process used by the staff to see if what they did was appropriate. So we're going to go through --

CHAIR STETKAR: Okay, who's hitting the microphone?

(Simultaneous speaking.)

MS. DROUIN: Okay, I'm just going to quickly describe each of these stages and then we're going to go through in detail and explain to you the stages. But basically when you look at Stage A that is to determine whether the NUREG is applicable to the decision. There's --

CHAIR STETKAR: Mary, before we get into the stages, I'm sorry, I was writing things. And I think it's appropriate to ask now. As I read this, and I probably missed it in an earlier vision of the NUREG. The NUREG, I think, specifically says it applies to licensee submittals in support of risk-informed applications.

And it also seems to explicitly exclude the NRC staff from doing any of these types of uncertainty analyses in any of the decisions they make. For example, in terms of -- I can pull up the section with the quote in it. In terms of significance-determination process and reactor

oversight. In terms of notice of enforcement discretion and other applications. And I was curious why the industry is held to a different standard than the staff in terms of assessments or --

MS. DROUIN: Hopefully when we go through Stage A we will make that clear.

CHAIR STETKAR: Okay. All right, I'll let you go through Stage A.

MS. DROUIN: We did have criteria for where this is applied and where it isn't. You know I truly apologize, I thought I had turned it off.

CHAIR STETKAR: If you'll address that in Stage A, I'll wait.

MS. DROUIN: Yes, we're going to go through each of these.

CHAIR STETKAR: Okay.

MS. DROUIN: So in Stage A we recognize that you always have to deal with your uncertainties. But do you apply this process? And there are situations where this would not be the process. And we tried to identify what circumstances would this not work with.

Then Part 2, which is Stages B through F is that's guidance for the licensee or the applicant. Now you're going to hear us say licensee all the time

but when we say licensee we always mean the applicant, which is a new reactor, because they're not a licensee yet, they're an applicant.

So for Stage B that is making the decision whether or not given the decision you have underhand, whether the PRA that you're using has the right scope and level of detail. So it's giving the guidance and the criteria for making that determination.

And then Stage C is that, coming out of Stage B you're going to end up having three answers. Either the PRA is of sufficient scope. It's not of sufficient scope but you're going to refine your application to make it of sufficient scope. Or maybe you might try and do some kind of bounding analysis or some kind of sensitivity to show you don't have to consider that.

Well that's part of the completeness. So the criteria and the steps you have to go through is what is in Stage D, sorry Stage C. And then Stage D is that okay, now you have your PRA and you have the results and you're looking at the parameters, so you're looking at your values out of your PRA against your acceptance guidelines. And what are the uncertainties associated with that in determining whether or not you challenge or you meet or exceed

your acceptance guidelines.

And then Stage E is then looking at the model uncertainties. You know, how do you go about identifying the key model uncertainties and what you do with them in your decision making.

And then Stage F, now all of these stages so far, B, C, D and E were in there, but we cut and pasted them in a more logical fashion. Now Stage F is actually a new chapter. And this is coming in, we recognize that this is really an iterative process, you don't do these things sequentially.

And so the licensee is always going to be thinking, you know, what is his strategy. You know, does he update the PRA. Does he do some kind of bounding? What does he do when he starts challenging the acceptance guidelines, should he do compensatory measures? Should he do monitoring.

So Stage F is to provide some guidance to the licensee in helping them develop their strategy for what they're going to put in their submittal. And you'll see a lot of parallel between Stage F and Stage G because that's giving the staff process. So there should be a lot of parallel between those two chapters.

So then Stage G is providing the process

the staff uses. This one's a little bit different in that it's not written, you know, we don't say this provides guidance to the staff. This is telling the licensee what the staff does. So it's explaining the process versus giving the guidance thing to the staff, because that's in standard review plans and elsewhere.

Okay. This is just a figure, you'll see it in the NUREG. That's just trying to show all of these stages and to communicate that this is a very iterative process. And that we will get into, when you get into Stage G, whether or not you meet the risk element of your risk-informed decision making process or whether the application would be rejected.

Also feeding into there, and we'll get into that in a little bit, is you have to have an understanding of the risk-informed decision making process to truly understand the NUREG.

And you need to understand the ASME/ANS standard, because this document is also providing you how you meet certain requirement in the standard, at least from an NRC perspective. You know, how we expect those, because the standard just tells you you need to identify your uncertainties and you need to characterize them. It doesn't tell you how you go about doing that. So this document is providing that

how-to part.

Okay. So getting into this overall approach, the licensee needs to have a clear understanding of several things. The application and the risk contributors, the uncertainties, particularly in the context of the decision under consideration. And what is the impact of these uncertainties relative to your acceptance guidelines. And then what are the requirements in the standard as endorsed by the NRC.

And this is where you'll see some of the ISGs, because right now we're not revising Reg Guide 1.200 but we have some problems with some of the stuff in the standard that would impact this document. So in order to complete this document and to give licensees an understanding of our position there are some ISGs that are being written.

CHAIR STETKAR: What's the schedule for those ISGs?

MS. DROUIN: Those are going to be done this year.

CHAIR STETKAR: This year?

MS. DROUIN: This year.

CHAIR STETKAR: We should see that.

MR. LAI: Okay.

MS. DROUIN: So I don't think we have to

spend a lot of time. There's the three types of uncertainties. The completeness, the parameter uncertainties and the model uncertainties. I think we've spent a lot of time with that in the past.

Okay. The PRA standards requirement. When you're looking at the parameter uncertainties the standard, as endorsed by the NRC, and this will be reflected in the ISG, is that depending on the significance of the basic event mean values or point estimates are acceptable with characterizing uncertainty either qualitatively or with a probabilistic representation.

And then depending on the significance of the sequences and the significance of the state-of-knowledge correlation, mean values or point estimates of the risk metrics are acceptable with an estimate of the uncertainty interval or with propagating the uncertainty distribution.

MEMBER SHACK: Now this notion of the significance on the Category 2 thing, I couldn't find that in the standard. That seemed to me something that you put into the NUREG as your interpretation of the way --

MS. DROUIN: No, it's very clear and I'll send you an email showing you where that is in the

standard.

MEMBER SHACK: Okay. I looked and I couldn't find it.

MR. LEHNER: I'll talk a little bit about that in my stage.

MS. DROUIN: Oh that's right. It's QU-E3, QU-A1. But he does get into it in his presentation.

MEMBER SHACK: Okay, I looked and I didn't find it, but I'll wait.

MS. DROUIN: Well we can point you directly to which supporting requirements it is.

MR. LEHNER: Although the reporting requirements in the current version of the standard may not read exactly like --

MS. DROUIN: But that's okay, it hasn't changed from the current.

MR. LEHNER: Okay.

MS. DROUIN: Then for mono uncertainties the standard as endorsed by the NRC is that you need to identify your sources of uncertainty and characterize them. You know, understanding what their impact would be. Are they going to introduce a new initiating event? Are they going to change the success criteria? Do you get a new accident sequence?

Now this is the definition that is used in

the standard that we have adopted in the NUREG. And I will have to say every time I read it I personally have problems with it. So this is going to come as a surprise to my colleagues. But it finally dawned on me what I had problems with and it is when it says, "A source of model uncertainty exists when a credible assumption is made." And it's the word credible because un-credible assumptions. Does that mean if it's un-credible it's not a source of uncertainty?

CHAIR STETKAR: I hope in your wonderful NUREG on definitions of terms you're going to have a clear definition of what credible is?

MS. DROUIN: That's a very good comment.

CHAIR STETKAR: No, honest that's not a snide remark. People throw that word around just wildly and --

MS. DROUIN: But I know that we have --

CHAIR STETKAR: Just because something is rare doesn't mean it's incredible, it's just rare.

MEMBER SHACK: There is a sentence there that defines a credible assumption.

MS. DROUIN: See and I wonder, that makes it seem --

CHAIR STETKAR: Okay, what is broad then? I'm a broad person, but it doesn't necessarily mean

that --

MEMBER SHACK: In a relevant technical community?

CHAIR STETKAR: There are a lot of terms in the standard, as you're well aware of, as you've mentioned, that leave a lot to be desired.

MS. DROUIN: Yes. But I come back to when we think of a source of model uncertainty, you know, when a credible assumption, and even though it has sound technical basis, it may not have sound technical basis and it's still a source of model uncertainty. So I think that this definition still needs some work, personally. And I would love to see the ACRS weigh in on this.

CHAIR STETKAR: Well unfortunately we, well I guess we can weigh in on it in terms of how it's used in this NUREG.

MS. DROUIN: Yes.

CHAIR STETKAR: We can't say anything about the standard.

MS. DROUIN: No, no, no. Here. Okay. I won't spend really hardly any time on this risk-informed decision making process. In creating the NUREG and knowing how it all fits together you need to understand what is this process and it has these

principles that are defined but the principles in and of themselves do not explain the decision making process.

So in looking at the NUREG and the guidance we're centered around Principle 4. But some of these others come in to play when you create your strategy for dealing with the uncertainties. And that's reflected here. And when you go through and we talk about Stage A is determining whether it's applicable. B is looking at whether the scope or level of detail match up, et cetera.

It does follow this process that the NRC came up with when it first published Reg Guide 1.174 in defining the decision, identifying your applicable requirements, et cetera.

CHAIR STETKAR: One of the things, Mary, and this is kind of, for me anyway, a fairly important philosophical issue. This drawing in the NUREG draws a nice, clean dotted line around what the NUREG addresses. And it shows that little excerpt from deterministic analyses as assessing the impact on defense-in-depth and safety margins.

If you read the words in the NUREG, and maybe I'm misinterpreting them, it seems to say, well we aren't interested in uncertainty analysis to

address safety margins, because that's strictly a deterministic evaluation. And that's reinforced by this picture here, it's outside the dotted line.

There's a drawing that's similar to this in Reg Guide 1.174 that doesn't show this crisp dotted line, and indeed it shows direct crosstalk between deterministic analyses for safety margins and PRA analyses. So the NUREG has separated that out. And that's different. And that's an important difference for me.

I use the example of if I go to my financial advisor with the $10.63 that I have left in my IRA and say, gee, financial advisor, what's going on in the world of investments this year? And the financial advisor, as they always do, says oh the rate of growth is going to be a little bit slower than we expected it to be last year. Well that gives me one piece of information.

If the financial advisor tells me, gee, the chance of you losing 40 percent of your net worth has increased from three percent to 15 percent, that tells me a little bit different information about my margin and I might make a much different decision about my investment portfolio with that than his expectation that the rate of growth might be a little

bit slower than it was last year.

So this notion of assessing the probabilities and looking at where our uncertainty brings us with respect to the margins, I think is an important part of this decision process. And in fact there's an example in, I lose track of whether it's in the appendix or in the text. It says well the 95th percentile of the analysis might show that we could be in Region II, let's say, rather than Region I but we don't care about because the mean value is in Region I.

And that bothers me a little bit. Is that consistent with NRC understanding of the use of uncertainties in Decision making and to understand where you are relative to acceptance margins?

MS. DROUIN: Yes.

CHAIR STETKAR: It is? All right.

MS. DROUIN: Because when you go back and use 1.174 as an example here the staff made it very clear that we're looking at the main value against quantitative acceptance guidelines. And you've treated your parameter uncertainties by using a mean value. Now you have to show, you have to factor in this state-of-knowledge correlation. But that's completely within keeping of the NRC position on

1.174. Now whether or not, you know, revise 1.174, that's totally different. Rather than keeping 1.174 --

CHAIR STETKAR: I've read 1.174 and it certainly talks about mean values. It also talks about assessments of uncertainties and having confidence about where you are relative to margins. It doesn't do it quantitatively, but it's --

MS. DROUIN: That's right.

CHAIR STETKAR: -- but it seems to be part of the philosophy of it. And this, as I said, this particular drawing draws a very clear distinction that isn't drawn in 1.174. You know, it just isn't.

MS. DROUIN: Okay. Stage A. As we said earlier, not every risk-informed decision that is made should or can implement the process described in this NUREG. And the approach to address uncertainties can certainly vary depending on the nature of the risk-informed activity under consideration.

So the way that we went about trying to give guidance on whether or not to use this process is divvied on two steps, is looking at the type of risk results used in the application and are the results PRA or non-PRA in nature. Because sometimes the risk results might have been derived qualitatively. And if

the results are from a PRA are the results being used to support the decision. Sometimes they're a minor factor in the decision so they aren't playing a big role in the decision that's being made.

So in looking at --

MEMBER BLEY: I haven't thought about this a lot, but there's a lot of very good guidance in how to think about uncertainty, how to categorize it, that to me applies no matter what kind of an approach you're using. And to suggest a hard and fast rule that it only applies to cases that are kind of fully quantitative seems unfortunate. Because other people could gain a lot from using this even in a qualitative analysis.

MS. DROUIN: And, I agree with you and I thought about that the other day when we were working on our viewgraphs and everything, is that there is a lot to be learned and that could be extrapolated.

MEMBER BLEY: And even, once you go through that process of identifying and categorizing the uncertainties then qualitatively it gives you a different picture of the concept you're dealing with, whatever the analysis is.

MS. DROUIN: So I don't know how, I mean we'd have to give it some thought about how we would

fix the text to let people know this. It wasn't meant to be this hard and fast rule. And I mean if we just, let's go here to the example to show. You know for example the risk, if we look at the Maintenance Rule (a)(2). It's utilizing a risk monitor, so you're constantly evaluating the risk.

That would make it very hard to use this kind of process. Now it's not some things in here you wouldn't want to think about. You know, the risk is constantly being evaluated. And it's not evaluated to support an initiative. It's not evaluated as the result of an event.

Whereas, when you look at the tech specs it's utilizing a PRA, it's not continuous evaluated, it's not as a result of an event. So it clearly is subject to 1855. When we say it's not subject to 1855 we are not trying to say that there's not value in you understanding what's in this document. But you're not going to go through this prescriptive guidance that we've sort of gone to now in this revision.

MEMBER BLEY: Yes, I see the place we've worked ourselves into with having this kind of guidance. It doesn't come out hard and fast, it's like you don't have to think about this at all if you're on the right side of your chart.

MS. DROUIN: And there's probably some stuff we could do in this chapter to soften that up quite a bit.

MEMBER BLEY: It just seems a shame to me to, it then demands another document that talks about these other things. So if there was a way to deal with that I think it would be really useful. Because to me we're real close to having something here, not the step-by-step what you do, but the general process. Having something here that every decision going throughout the agency ought to be thinking about these concepts as it comes up. And right now there is nothing like that to point to.

MS. DROUIN: I agree in that when you look at across the Agency, when I mean that all the different kinds of decisions that we do is part of our regulatory job. And you going to always have to think about uncertainties that, at a global level, these are the kinds of things you need to be considering and dealing with. But now, how do you take that global process and apply it on these very specific types of applications, which is what this NUREG is.

So I'd have to think about how difficult would it be to maybe include a write-up of what this global process would be. It may not be that

difficult, I don't know. But it's something that we could certainly looking into.

MEMBER BLEY: It's worthwhile.

CHAIR STETKAR: And now I'll bring up, I found the quote in my notes here.

MEMBER BLEY: Well go ahead.

CHAIR STETKAR: And it sort of dovetails with what you were saying, Dennis, in terms of a broad applicability of this process. And the quote is, and it's in Stage A, it 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."

MEMBER BLEY: Well I guess it's just subject to that's generally, to me you'd evaluate the same.

MS. DROUIN: Where are you reading?

CHAIR STETKAR: I don't know, it's section, I don't have the page number here, it's in Section 3 where it's --

MS. DROUIN: Page 25?

CHAIR STETKAR: So this notion that this NUREG is now focusing on a very, very prescriptive process that applies to only a very narrowly focused set of PRA quantitative license issues has, as Dennis said, walked us into a corner that begs something else to dig us out of that corner.

MS. DROUIN: And that was our original mandate. But again, I think we can look into how would we modify this to bring in this global process.

MEMBER BLEY: I think that's a good idea. It's something that's desperately needed. And I think you're real close to it. So maybe it's a different document, I mean this is focused on PRAs and reviews of PRAs. But the way it focuses on them it says, don't use this for anything else, which is --

CHAIR STETKAR: I think if the goal of this NUREG is indeed to provide kind of crisp guidance for how to address issues of uncertainties in the context of what we just said, that's fine. But it shouldn't imply that that's the only place you need to consider uncertainties.

MS. DROUIN: It was never meant to imply that. It was never meant to imply that. And I know that that language we could easily clean up.

MEMBER BLEY: I think that's a good idea

because I can easily see somebody saying look, it says right here, I don't have to think about this stuff.

MS. DROUIN: Okay, so now we're going to move to Stage B and Jeff is going to walk us through Stage B and C.

MR. LACHANCE: So are you in control of the slides, Mary?

MS. DROUIN: Yes.

MR. LACHANCE: Okay. All right, so coming out of Stage A, whether we change it or not, it's going to be a determination that the treatment of uncertainty for a risk informed activity being considered fits within the scope of this document.

So the goal of Stage B is to determine if the PRA has the required scope and level of detail needed to essentially made a decision or mull and it make a decision on the application. The required PRA scope and level of detail can vary, substantially, for different risk-informed activities.

But it's important that the PRA address all the important contributors to risk. Whether it be external hazards, low-power shutdown and what we traditionally look at now is the risk during at-power considerations.

So the guidance in Stage B has three

steps. The first one is you have to understand the risk-informed application and the decision that you're trying to make. And we'll talk about that a little bit more. And then you identify, well does my PRA have the scope and level of detail to essentially model what you're changing in the plant. Essentially does it have the hooks that you need to evaluate, all the hooks.

And then Stage B-3 addresses how do you deal with the fact that I may not have all the PRA scope and level of detail. What can we do about it? So just briefly this is a new section that essentially consolidates guidance from the previous NUREG. It was primarily in the old Section 6.2, that talked about completeness uncertainty. But there's little pieces here and there that address this. Next slide, Mary.

So Stage B-1 involves two things, understanding the risk-informed application, what we're changing in the plant, and then essentially what is the decision or the results that we're going to need to make our decision. So I think it's pretty straight-forward to understand what plant changes are going to be made or operational changes are going to be made as a result of the application. That's pretty straight-forward.

The second part is understanding, we essentially have the risk metrics that we're going to be looking at. What results were we looking at to make the decision. And for awhile the key applications that we see now ISI, Tech Specs, I mean there are regulatory guides that identify what are the acceptance guidelines that you need to meet. But there are always maybe unique applications where those will have to be formulated.

And the typical ones that you see, for example Reg Guide 1.174 is CDF, LERF, delta CDF, delta LERF, you know, importance measures. And there's a variety of other measures that I'm sure you're all aware of.

The next bullet says the acceptance guideline should also include guidance on how the metrics is to be calculated. Particularly with regard to addressing uncertainty. And an example of that obviously is the one Mary cited earlier in Reg Guide 174, is we're going to calculate the mean value, taking into account state-of-knowledge correlation. So that's the type of guidance I'm talking about here.

So all the impacts of the proposed application need to be looked at. Can include effect on prevention features, things that can cause an

initiating event. Mitigation features can be hardware, procedural, tech spec type of things. Next slide, Mary.

So Stage B-2, the purpose of it is to determine if the PRA scope and level of detail needed to support a risk-informed application, does it have that scope of detail. So just to go over this real briefly here I think you're aware of the three aspects on the PRA scope.

And the first one is the metrics used to evaluate risk. Well you want to ask how does that impact scope. Well obviously if you're just doing CDF and LERF you can do just abbreviated Level 2.

But if your metric goes all the way up to the qualitative health objectives then you need a Level 3 PRA. So it essentially addresses the level of PRA that you need.

MEMBER BLEY: Jeff?

MR. LACHANCE: Yes.

MEMBER BLEY: Let me ask you a question, because my memory is not 100 percent clear on this. The PRA standard, now I'm remembering the original Level 1 PRA Standard, had a process for doing the same thing. My two questions are in the unified standard, has that been expanded to cover the kind of things

you're just talking about now? The Level 2 issues and that sort of thing. And in what areas are we not being redundant with the standard? What are we bringing in here that's new, in this Step B?

MR. LACHANCE: The first question is, I mean that logic sort of remains the same but there are examples that have been expanded to address, well actually Level 2 hasn't been brought into it yet. Okay, so it really hasn't --

MEMBER BLEY: Okay. It hasn't, I couldn't remember if it had or not.

MR. LACHANCE: But is has brought in external hazards, decisions upon that. But you know, as low-power shutdown and Level 2 and Level 3 are incorporated and will hopefully be revisited in the standard in that one section to address what level of PRA do you need for an application.

Now the second one is, is this redundant or consistent with --

MEMBER BLEY: And if it's not redundant what are the things you're introducing here that are aren't available in the standard?

MR. LACHANCE: Well I think it just parallels it, you know, the logic in there --

MEMBER BLEY: I'm not objecting to having

it here. I think it's a coherent picture now.

MS. DROUIN: It's very consistent. The difference is is that you have to remember the standard gets more at a what to do, and what this does it goes a step further and gives you a little bit of how to do it.

MEMBER BLEY: How to do it, okay. Okay, fair enough. Thanks.

MR. LACHANCE: All right. Now, with regard to plant operating states and the type of hazard groups. Okay, that you include. I think that's pretty obvious, you know, if you changed your plant it is going to impact a mitigating system that can affect the risk in low-power shutdown or from an earthquake. And obviously you need to consider that as part of your PRA scope.

Now level of detail is the other thing. We're all PRA practitioners and we know even in the current Level 1 at-power PRAs we do include some coarseness in the modeling that addresses level of detail. You know, we break up LOCAs into three groups. And that's usually pretty good. And we may not include all mitigating systems. But potentially it could be utilized when we make those decisions for the sake of making modeling easier.

So there may be some things missing from your PRA model. It can be sequences, initiating events or component failure modes. Typically in PRAs we don't include spurious valve opening, for example. That all addresses level of detail. Next slide, Mary.

So the key is I don't know how to make it any more harder, or it just seems simple to me, is that once you identify what your plant change is is essentially use a cause and effect relationship. Say, okay, this change is going to modify these components or this failure mode. It's going to cause a new initiating event. And essentially you translate that into well, I got to go change my PRA model to essentially have those hooks for the plant change.

There's some examples that are listed there on how your plant change could impact the logic structure. New initiating event, a component failure mode, et cetera. I'll let you look at those. Next slide, Mary.

So essentially Step 3 is you've done the evaluation and what you're going to find out is that well either my PRA has necessary scope of level detail, and if it doesn't I've got to do something about it. And we'll talk about that a little bit more on the next slide.

But what I want to continue to talk about on this slide is the fact that Stage B I think may be the only place in the NUREG that talks a little bit about aggregation. It talks about the conservative bias that you can potentially have, and a lot of people discuss with regard to, well, we don't model external hazards as well as we do internal hazards. We have a lot of conservatisms, more conservatisms, bias, you know, in how we do that. There's been a lot of discussion about with regard to internal fires. And to some extent that's true.

And so the problem is is when you're putting all the scope together and aggregating the results, then what do you do about it with regard to uncertainty.

CHAIR STETKAR: Jeff, one of the, I guess, gnawing concerns I have with the NUREG, and you just sort of mentioned something that was a good hook into that, it that the NUREG implicitly, if not more strongly, states that everything in a PRA must be conservative. And because of that, implicitly remember, I didn't say explicitly. And because of that you only need to look at the most important contributors to a set of results because everything is really conservative.

Uncertainty has taught us that you might have been optimistic. It might be optimistic bias. If I make a decision, you know, I try to be conservative. I've made several decisions in my life in PRAs, I've discovered, as I've aged, that some of those indeed were optimistic and some of them were grossly optimistic. I didn't do a word search, the word optimism might be in the NUREG, but I didn't do a word search.

There's no sense in here, it says conservative bias. We need to account for conservative bias because that might be pushing the numbers too high. What about the optimistic bias that's pushing the numbers too low?

What about the sources of uncertainty that affect cutsets, that are driven down because their values are too low so that we never see them as significant or important or whatever words you want to use? That notion really isn't in this NUREG anywhere either.

MR. LACHANCE: You're correct. I don't think we really have talked about that and I think that's a valid point. And it can cut both ways.

MS. DROUIN: It can certainly cut both ways. And when you look at the standard there's been

this misinterpretation by numerous people that as you go from capability category 1, to 2 to 3, that you go from conservative to less conservatism. And that's absolutely not true. What you're doing is you're going from a simple PRA to a more complex PRA and the simple PRA may not be conservative.

CHAIR STETKAR: That's right. Not only simple to more complex, but hopefully a PRA that has broader uncertainties because you've had to make some really wild guesses about things.

MS. DROUIN: Exactly.

CHAIR STETKAR: To something that's supposedly more realistic because you have better data, you've done more analysis, you have a better technical support for the underlying basis for that PRA.

MS. DROUIN: Exactly. So when you think about your uncertainties in that light and we probably should go back through and try and see if we can change that flavor, because we aren't trying to say that you're just looking at the stuff that's conservatism, you're looking at what are those sources of uncertainty and what are their impact. And their impact could be good or bad in that way.

CHAIR STETKAR: I just, you know, because

as I read through the thing, and I read through the whole thing again because I hadn't looked at it in a couple of years. You just keep getting this flavor of conservative bias. Of you need to look at the numerically significant contributors and assess your uncertainties about those. And the whole notion that whatever is done is either realistic or conservative and therefore you can then afford to look at what you can see.

MEMBER BLEY: I think maybe what happens is you go from the conceptual description, where it is identify all your sources of uncertainty, to proceduralizing it. But that's where it just kind of naturally went. But I think if you just read it straight through again you'd feel this thing that John's talking about. Even if you just search for conservative and read around every place it says that.

MS. DROUIN: This is very good input because I can tell you we did not have any discussions that was our intent to put that flavor in there. That was not our intent, so if that flavor is coming out --

CHAIR STETKAR: It came across to me anyway, but I'll firmly admit I'm very sensitive to that issue.

MEMBER SCHULTZ: And therefore it's coming

across that way in the slides. But the way you spoke it in response to John's question I thought was appropriate. But that's the focus that I believe the goal of the document is trying to capture is that as you look at biases you're not only looking at the conservative biases. You're looking at where the uncertainties lie that have been treated by bias and trying to extract those as you go to another level of sophistication with respect to the modeling and representation of uncertainty.

MEMBER BLEY: Yes, I agree with both of them. And I'd go back to the thing you two were talking about earlier. In principle, if you did a Level 1 PRA the way, at least I would envision it, if you fully thought about and characterized the uncertainty in that Level 1 PRA your result probably would be conservative because you've allowed for high extremes as well as low extremes and that would bias the result.

Now, I'm afraid most people who do a Level 1 kind of PRA don't think hard enough about the uncertainties to capture that sense and as you progress the same thing happens. So if this helps people give good thought to the uncertainties both ways it will lead to better characterizations. And in

that sense then I think the final number would probably go down as you went from 1 to 3, but only because you had allowed for really extremes on the uncertainty bounds in the Level 1. Just an aside.

MS. DROUIN: Okay.

MR. LACHANCE: Okay, that's a very good comment and I take that. So this is the last step from Stage B. So just to quickly reiterate, so we've identified what we're going to change in the plant. We identified what scope of the PRA and level detail we need to address all the impacts of the proposed change.

And so here's the conclusions that you can arrive at. Number one is, that a PRA is adequate support to application. And so if that's true then essentially you go to the next stage in the process, actually Stage D, which is to essentially assess the parameter uncertainties, of course you have to modify the PRA to account for those specific changes to the plant.

If it's not adequate and the licensee decides to refine the PRA, so you go up there and you add that external vent you're missing or a low-power shutdown or you add an initiating event. Okay, essentially go back, modify and then again you're back

in Stage D to essentially modify the model and address parameter uncertainties and then later uncertainties.

Or if it's not adequate then the licensee could decide to redefine the application. So maybe it's too hard to generate a seismic PRA so I'm going to redefine the application so that it does not impact seismic risk. So that's another conclusion you could reach. And to do that you go to Stage B. Go back to Stage B and essentially repeat this process a little bit.

And then the last one, if it's not adequate and the licensee can decide to term the significance of the missing scope and here, again, sort of the conservatism here what you're trying to do here is do a screening assessment, okay. We'll talk about that in Stage C, but essentially you're going to assess the significance of the missing scope. And that's done in Stage C, which is the next one we're going to talk about.

All right. So we're going to come in here and essentially what we want to try and do, the guidance is for licensee to address the missing scope or level of detail. And that's generally done by determining where the missing scope, is it a hazard, initiating event, whatever, are significant to the

decision under consideration.

And there's two steps. The first one is we're going to try to do a screening analysis on the missing item, to see if it's important. It can impact the decision. And Step 2 is to determine if the PRA model needs to be updated or if the application needs to be modified to address the missing PRA scope.

So the risk from each significant hazard group's cause, accident sequence needs to be developed in accordance with an NRC-endorsed consensus standard for that hazard group. That's Commission policy. If there's an endorsed PRA standard then you're supposed to generate a full PRA for that particular hazard. And I don't know if policy is the right word, maybe it's guidance, to do that. Next slide.

Okay, so in each of these steps we're trying to identify what's changed from the previous version. So there really hasn't been much change on the completeness uncertainty guidance. Primarily we just moved it up earlier, before the parameter and the model uncertainty and that's because you need to essentially address completeness and uncertainty and include the missing scope before you even get to addressing the model uncertainty and the parameter uncertainty. So that's why we moved it up front.

Process in Step 1 of the old version, determining the required scope level detail, well I just went over that, it's over in Stage B now. And we included a table to identify supporting requirements in the PRA standards that address screening requirements.

We didn't get into any great discussion on what are in those supporting requirements. But again, this is going to be part of an ISG that's being worked on. Not only to have certainty but also screening requirements.

And the last bullet, hopefully we reorganized this so it's in a little bit more concise manner than what the previous version is. I guess you'll let us know all that, right? Okay. Next slide.

Okay, so step C-1, the purpose is to provide guidance for determining whether missing scope or level of detail of the PRA is risk-significant to the decision under consideration. The process to determine risk-significance of a missing scope or level of detail can include performing either qualitative or quantitative.

One thing we need to iterate here is that a lot of these screening criteria and screening

analysis may have gone through some of these in the PRA, the applicant, as part of the IPEEE process, because they did do some screening, for example, on external hazards. Unfortunately most utilities haven't done a low-power shutdown PRA and so there probably hasn't been much done with regard to screening positives.

So the point I want to make here is that you may have done some previous screening, and you may not. And if you've done any previous screening you're probably going to have to revisit that screening for a particular risk-informed application, because the reason you screened it out may have changed. And so you always need to revisit that.

Another factor is in some cases the screening criteria has changed. For example in the IPEEE, there was a screening criteria that if the design basis met the '75 version SRP you could screen it out. And that actually was incorporated into the PRA standard.

But the new version that's come out, Addendum B, has eliminated that. And so if you screened out anything based on that criteria, you know, a peer reviewer may not accept that criteria anymore.

(Off the record comments.)

MEMBER BLEY: So while we're just sitting here, let me ask a question. Since this draft has been available --

MR. LACHANCE: It's predecisional.

MEMBER BLEY: I'm sorry. Have you had the opportunity to give this to somebody who wasn't involved in developing this and have them go through and use it and tell you how it worked for them? You know, somebody that had never seen it before?

MR. LACHANCE: Well we did on the previous draft. I mean, that's Appendix A has an example application. Now, I cant' say that the person hadn't seen it. They were people who worked on that particular example, who were familiar with it. They didn't write it but they had worked over on the EPRI side and so they were familiar with the general content. But somebody who's completely devoid of any knowledge, no we haven't done that yet.

MEMBER BLEY: Interesting. I mean it seems usable but it would be nice to know how it works for people who weren't involved in the developing.

CHAIR STETKAR: Is there any, do you know if EPRI has any plans to pilot this?

MS. DROUIN: I'm sorry, what was your

question?

CHAIR STETKAR: Does EPRI have any plans, we'll ask EPRI later perhaps it would be better, any plans to pilot this?

MS. DROUIN: Well it's piloted through that example.

MR. LACHANCE: A new pilot? I don't think there's any plans, no.

CHAIR STETKAR: Yes, but that's all of us kids getting together an making up the rules for the game that we decide to play. It's, as Dennis mentioned, a pilot would be a real-world example by people who have never seen this documentation before.

MEMBER BLEY: Weren't involved in developing it.

MS. DROUIN: That question would really go to NRR to See Meng. I mean we can take it up with them.

MEMBER BLEY: There were just things about it, reading through it, that, you know, I'm not sure if I were brand new to trying to do this if I'd have said wow this is great guidance, I can go step-by-step through this. Or if I'd have had some trouble getting into it. There's some stuff up front that I thought was a little awkward in trying to understand for how

the whole piece hangs together and what we ought to be doing to it.

MS. DROUIN: Well that is what Appendix A did, it's illustrated but it was a real example. It wasn't a real example that somebody had submitted but we took a real, if somebody wanted to do that, and --

MEMBER BLEY: But it's always different when you give it to somebody who wasn't involved in the development to say, here's your guidance, give this a whirl. You know, read it front to back and apply it to something new for your plant.

CHAIR STETKAR: If you look at the history of NUREG/CR 6850, admittedly much more complex with many, many different things going on. But conceptually here, but in a parallel sense the folks who wrote that thought that they had perfectly wonderful, coherent guidance. For whatever reason a pilot of the guidance in an interim form wasn't done, a complete pilot.

And now that people are developing real-world, under the gun license applications people are saying well, gee, we should have piloted this thing because we don't understand what the guidance means. Or the guidance is conflicting, or the guidance is too conservative. Or the guidance is this or that.

MR. LACHANCE: That's one reason why we give a course on NUREG 6850 twice a year, to explain all that.

CHAIR STETKAR: That's true.

MEMBER BLEY: That's true.

MR. LACHANCE: And we think it helps. And I understand a lot of criticism on 6850, I am involved in that.

MEMBER BLEY: I just think it applies to anything that you're -- And we're tainted as well. I mean we've seen this in the development so it looks great.

MEMBER SCHULTZ: And it's very difficult, you have a public comment period or review of that type and it's generally those that are --

MEMBER BLEY: All of the know how.

MEMBER SCHULTZ: They are know how, they're experts in the field or at least have sufficient experience so they feel comfortable commenting on the guidance. And, as Dennis said, the real test is when someone that has not been involved in developing the guidance needs to use it.

MS. DROUIN: Yes, all I can say is that we can talk to EPRI and NRR and NRO and between all of us see do we feel there's value in doing a pilot.

MEMBER BLEY: Okay.

MR. LACHANCE: All right, so we want to try and address the missing scope using the smart-person approach, and now let's see if we can screen it first, make it disappear before we do anything. And so you can do successive steps in screening.

You can start with qualitative screening, move to quantitative screening after that. And then step C-1.3 is determining the significance of anything you couldn't screen out. That's where you're sort of stuck. So next slide, Mary.

So Step C-1.1 is the first one, qualitative screening. And, as Mary mentioned, the staff is working on a position on acceptable qualitative and quantitative screening that could be used. I don't know if you're that familiar with the PRA standard but if you look at the screening criteria through the different parts they're all over the place and they're inconsistent. And there's an effort going on in the Committee on Nuclear Risk Management to address that.

But in the interim the staff's going to develop this Interim Staff Guidance to address that issue. So I gave a couple of examples there. The first one, does the hazard result in a plant trip.

Well, you may have already done that but again you've got to go revisit and see if the application changes that conclusion.

And the second one, the plant response to the hazard is not affected by the proposed application. That's what you always hope. Again, you could redefine the application so that's the case.

And the third, contributor or hazard can be bounded by another event. So these are just a couple of examples of what you might see eventually in the ISG.

And always leave the out to the applicant to define their own criteria and provide the basis for it. Don't want to be so prescriptive that something you may not have thought about they can come up with a reasonable screening criteria. So next one, Mary.

CHAIR STETKAR: Jeff and Mary, one of the cautions I have, and again, step back and try to read this from the perspective of a potential licensee or applicant. Be really careful about the examples that you choose throughout the document. The document has a large number of examples. Regardless of how you qualify those examples, saying these are only examples and you need to do things right when you do it, they are examples and they are in an NRC document and

people will focus on them.

An example, of an example. In the discussion of qualitative screening it says, "An example of a scope item that is not important to the change in risk is the following; an application to change an at power technical specification would not impact low-power shutdown risk and thus a lack of a low-power shutdown PRA would not be an issue regarding the necessary PRA scope to address the application."

Suppose I have a multi-unit site that shares a lot of support systems. Or even front-line systems. Taking something out of service while Unit 1 is at-power does affect the shutdown risk on Unit 2 when it's shut down.

Be careful about these examples that you put in, because people will read that and think of my old, gee, I have six units at my site. They're all interconnected but I do the PRA only on unit-by-unit basis. And say well, just because I have no low-power shutdown model for any of them I don't need to look at this or an integrated site-level PRA.

MR. LACHANCE: Good point.

CHAIR STETKAR: And just do that. I mean, I have several examples here, but in the interest of time I won't.

MR. LACHANCE: Well we actually made --

MS. DROUIN: I will say in defense of the team is that that was one of the big criticisms we got from the ACRS is that we didn't have examples and to go put examples in.

CHAIR STETKAR: A lot of the examples are really, really good. They are really, really good. I don't have the notes on gee, this is a really good example. But do try to read through those things for sensitivity. And I'll a couple others that I want to get on the record for quantitative, but I wanted to bring this one up in terms of the qualitative screening.

MS. DROUIN: Thank you.

MEMBER SCHULTZ: One other example is that you just covered on the previous slide, the contributor or hazard can be bounded by another event. It's very important to understand what bounded means. A PRA analyst would consider bounded perhaps in the proper context. But a safety analyst would think of an event being bounded in a way that would not necessarily appropriately account for risk.

MR. LACHANCE: Yes, I understand that. That's a good comment.

MS. DROUIN: Now, my question would be,

because I agree with your comment, but I would go on to ask you, because we did try and give guidance of what we meant by bounding and what made it acceptable or not. Was that sufficient to address your concern?

MR. LACHANCE: That is the next slide, we're coming up to that.

CHAIR STETKAR: Yes, I was going to wait for my quote on bounding until we get to quantitative. The simple answer is no.

MR. LACHANCE: Okay. So just subset C-2 is essentially similar to 1 except it's using quantitative type of analysis. And we identify different levels of quantitative analysis that you can use and we defined them here as you can use a bounding conservative analysis. And we defined bounding as really being the sort of the worst credible scenario that can occur and it can be bounding in terms of just frequency or --

MEMBER BLEY: There's that word again.

CHAIR STETKAR: I'm glad you picked up on it. The credible word.

MR. LACHANCE: Okay. You know, I give you an example there and you can back off from that a little bit and use a conservative but not necessarily worst case type of scenario.

CHAIR STETKAR: Now, Jeff, I understand that at one level, and I understand the general philosophy of what you're getting at here. Let's take that example. "For example, assuming that all fires or floods in a specific area (maximum frequency) fails all equipment in that area (maximum consequences) combined with taking no credit for mitigation systems (fire suppression or floor drains).

What is the maximum frequency of a fire in this location? Is it the 95th percentile of the uncertainty distribution? The 99th percentile of the uncertainty distribution? The 100th percentile of the uncertainty distribution? Something that's larger than the 100th percentile of the uncertainty?

What is that maximum, you're going to say credible, so I'll say it, what is the maximum credible frequency of the fire given the underlying uncertainty distribution?

MR. LACHANCE: Using the fire PRA methodology it would be the contribution from all potential ignition sources in the room?

CHAIR STETKAR: Yes.

MR. LACHANCE: Okay, and it would be the mean. Okay.

CHAIR STETKAR: No, no it's not the mean,

because there's a substantial probability that the frequency is higher than the mean. Which may be a 60 percent, well no I'll use maybe a 30 percent probability that I lose 60 percent of my net worth.

MR. LACHANCE: I understand the comment.

CHAIR STETKAR: Well, no but it's a real, this whole notion, Mary asked have you sufficiently defined bounding. No, you have not.

MR. LACHANCE: Okay.

CHAIR STETKAR: A bounding means it can't be any worse, either in frequency or consequences.

MS. DROUIN: Now I agree with that.

CHAIR STETKAR: So if I'm defining a maximum frequency I'd better understand what that means. And it's not the highest, it's the sum of several means. It's not necessarily the 95th percentile of an uncertainty distribution, it's the maximum frequency, whatever that means. I don't know what it is.

MR. LACHANCE: All right, we threw this in --

MS. DROUIN: But this is a case where for practicality sake we may have to just come in and say, for example, and I'm not saying that's what we're going to do, but we might have to just come in and say

it's the 95th.

CHAIR STETKAR: It's two levels. Number one it is really important to understand what bounding means, because when we get to Appendix A and several of the other anecdotal examples in here that word is used quite a bit. And it's not at all clear, to me anyway, in several of the examples that they are indeed bounding assessments.

You know, if you all get together and say that the 95th percentile is a bounding assessment I'll say well, there's five percent probability that it's worse. So it might be conservative compared to the mean, but it's not the worst case assessment.

MEMBER BLEY: But if you went to where John goes, to a real worst case, I've never seen a real worst case I couldn't make worse. This is a tough area to define.

MR. LACHANCE: It is.

MEMBER BLEY: It's kind of you know when you see it but it's real hard to define.

MR. LACHANCE: Let me tell you why bounding shows up here. It's because it shows up in that chapter you're referring to in the standard on addressing missing scope in an application. And they address using bounding type assessments.

Quite frankly I don't know if you can ever, ever convince anybody you're going to be completely bounding, but you'll hopefully be able to convince them it's conservative compared to a realistic. So I think the focus should be on the conservative one rather than the bounding.

But of course then if you can't even do it with the conservative just use the smart-person approach, sharpen your pencil and then you start to get more realistic. Keep getting more realistic until you can make it go away, if you can make it go away. And if you're not, you're sort of stuck. I mean that's the process I always used when I did a PRA.

MS. DROUIN: And I think you know it's just going to have come down to we're going to have to apply some practicality. And yes, in an ideal, pure world there's always going to be something that could be worse. But for this definition this is what we mean by the worst.

MEMBER SHACK: The Standard's definition says the outcome will meet or exceed the maximum severity of all credible outcomes.

MR. LACHANCE: So we're not the only guilty ones here.

MEMBER RYAN: I was thinking the same

thing. I struggle with the, and I'm not a practitioner of PRA so forgive me. But I struggle with where these edges are and you seem to spend an awful lot of time about these edges. And I appreciate John Stetkar's comments.

When is the probability of something happening small enough I don't need to worry about it and I'm okay with the deterministic approach. That's what I'm hearing as what we're trying to figure out, is that it?

CHAIR STETKAR: Yes.

MEMBER RYAN: Okay, so one person's low probability is another person's oh my god I can't stand that. How do we get over that hurdle? I don't mean to ask a hard question, but I'm just trying to struggle with when will we know when we're done? I would often ask that of all regulators when I was a licensee, when am I done? Just tell me when that is and I'll get there.

CHAIR STETKAR: Part of the notion is we throw this word around, bounding. You know, why do we need to use that word?

MEMBER RYAN: That's a good question.

CHAIR STETKAR: Why do we need to use that word?

MS. DROUIN: Because George told us in his letter to the --

CHAIR STETKAR: No, no, I don't care about -- You see George here? Why in 2012 do we need to use something that nobody can understand what it means?

MS. DROUIN: I think that's a good question.

CHAIR STETKAR: Only because the word is used in the standard? Fine. This is we are the NRC, we can define things in our new regs the way we want to define them in our NUREGs the way we want to define them.

MEMBER BLEY: You're going to have to come up with that end point. And just saying don't use one of the common words doesn't help. It doesn't. I mean it's too easy. We use that because it's easy and we think it covers the case but it --

MEMBER SHACK: Yes, but it's sort of like pornography, you know, you can't define it but you know it when you see it.

MS. DROUIN: And I'm not a believer, I'm truly not a believer of those kind of answers, because I think we know it when we see it and that's because we have criteria in our head. And it's just really forcing ourselves, through a systematic, structured

way to pull that information out of our head and put it in paper.

And I think we can do it we just don't like to do it. But I think pushed up against, you can do it. I mean it can be a challenge but I'm a believer that it can be done.

CHAIR STETKAR: For pragmatism, and I'm certainly not necessarily endorsing the notion of a 95th percentile as being bounding, but if one develops that notion and makes it fairly clear at least users of the guidance will understand what they need to think about to establish something that's bounding. Rather than just saying, well I'm doing a bounding analysis. And I think it's bounding.

MS. DROUIN: And also it gives a starting place that if you don't like 95 percent then why don't you like it? And don't tell me I just don't like it. Why don't you like it and what would you find acceptable?

MEMBER SCHULTZ: I think that's a good way to look at it, as a starting point. And I do feel that that type of an approach would make more sense than what is here. Bounding conservative analysis and then stating it as that it includes the worst credible scenario, as Dennis said, I'll think of a worst one.

And so that statement itself really doesn't provide a guidance. Once could say it doesn't make sense. You'll never be able to do that.

MEMBER SHACK: But even in design basis world we sometimes screen a 10^{-4}, sometimes 10^{-6}, sometimes 10^{-7}.

CHAIR STETKAR: Right.

MEMBER SHACK: And so our definitions are, you know, we always have the definition in mind. I'm not sure it's the same definition every time.

MS. DROUIN: Yes.

MR. LACHANCE: All right, Mary, let's move on to the next slide. So Step C-1.3 is, you know, so you've done the screening. Well if you can't screen it out you can still use the conservative assessment if it's low enough as part of your application. But we provide some cautions about that as be careful. The common example is they can really give you wrong results with regard to importance measures and if your application is strongly influenced by importance measures you may get the wrong results.

Now the last one I already talked about, is you need to revisit any assumptions you're using to screen out things regarding the application.

CHAIR STETKAR: Jeff?

MR. LACHANCE: Yes, sir.

CHAIR STETKAR: By the way, and to kind of follow up on Bill's, I was looking for the quote. In C-1.2, under quantitative screening, realistic but limited quantitative screening there are two bullets in that section. And it says a flood area can be screened if the product of; a) the sum of the frequency is of the flood scenarios for that area; and b) the bounding condition or core damage probability is less than 10^{-9} per year.

A fire compartment can be screened if the CDF is less than 10^{-7} per year and LERF is less than 10^{-8} per year. Why do we accept either higher risk from fires than floods? Or why do we hold floods to a more stringent risk screening criterion than fires?

MR. LACHANCE: I don't think we should. These are examples of coming out of the standards and this is --

CHAIR STETKAR: That's fine. This is a NUREG.

MR. LACHANCE: -- part of the inconsistencies that we're going to address, okay?

CHAIR STETKAR: Okay.

MR. LACHANCE: I mean it's, like I said earlier these things are inconsistent throughout the

standard so we really need to fix this.

CHAIR STETKAR: Well the question is --

MR. LACHANCE: We're doing ISGs first.

CHAIR STETKAR: If you're going to fix it in the standard are the ISGs on screening going to address this?

MR. LACHANCE: Yes.

CHAIR STETKAR: I mean I'm thinking about timing. I'd hate to see the NUREG get published and out there with quotes like obvious inconsistent quotes and it's simply because they're in the version of the snapshot of the standard. You know, in the sense of putting examples in, it's good to have examples, but if they're obviously inconsistent you might not want them in there.

MS. DROUIN: Okay. The NUREG, now you may be catching stuff that we had missed. But the NUREG is supposed to be, in a sense, ahead of the standard. It is supposed to represent what the NRC position is. And when we provided formal comments on the standard one of our big complaints was that the screening stuff was inconsistent everywhere, you need to fix it.

So we can't, in our NUREG, reference the standard as the NRC position because it's incorrect. So our intent is to have what's in the NUREG what is

the correct thing that would be reflected in an ISG.

CHAIR STETKAR: Okay. Just then, if I hear you, just then as I said earlier. Judiciously please go back and kind of read those examples and then bullets because you might stumble across things that I've tried to highlight in a couple here. And I won't take up more time with that, if you just do that.

MS. DROUIN: We will do that. It's easy for this to get away from us because we're so close to it. But I appreciate this.

CHAIR STETKAR: Yes. And they're only simple examples, that's the problem.

MR. LACHANCE: Okay, so next slide, Mary, please. Finish up. So Step C-2, the final step, is provide guidance for determining what to do, ways to treat non-modeled scope or level detail items that you have determined could be significant to the decision. And significant is highlighted in there and its inclusion in the application PRA can impact the decision.

We talked about the standard a little bit is that the risk of each significant non-model or level-of-detail should be addressed using a PRA model as developed in accordance with the consensus

standard. Okay, for that, it has been endorsed by the NRC staff.

However, if there is no standard that addresses that missing scope then the licensee can submit the results of his quantitative screening analysis. Something that's not a complete, detailed PRA for that missing scope. So next slide.

Now here's just a summary of Stage C. That's if the missing scope level detail is not significant to the application then essentially you don't have to worry about it. Licensee moves on to Stage D. If it is significant to the application but there is no standard endorsed by the NRC the licensee can submit his conservative analysis and move on.

But if it is significant to the application and there is a standard endorsed by the NRC then licensee has to make that same decision. Does he redefine the application to remove that missing scope item or does he make a decision to upgrade the PRA to address the missing scope and move on to Stage D. So that's the end of Stage C.

MS. DROUIN: Stage D.

MR. LEHNER: All right, I'll talk about Stage D. For the record I'm John Lehner from Brookhaven International Laboratory. So the objective

of Stage D is to provide guidance to the applicant, or licensee, on how to account for the uncertainty in the parameter values in the PRA input when the PRA results are calculated. That's the objective of this stage.

And the guidance involves three steps. First of all, what are acceptable ways to characterize the uncertainty in the parameter values of the inputs. Step D-2, what are acceptable ways of propagating that uncertainty to get to the quantification of the risk metrics, and at the same time accounting for the state-of-knowledge correlation. And then Step D-3, provides guidance on comparison of the results with the acceptance guidelines.

So in this step the licensee determines whether the risk results challenge the acceptance guidelines and how close they are. Next slide, Mary.

Now, before we talk about each one of these steps we have to talk a little bit about the ANS/ASME PRA standard. So the standard has a number of requirements directly related to characterizing and propagating parameter uncertainty. The standard, of course, recognizes that the specificity, the realism and the level of detail can really, in a PRA, depend on what that PRA is being used for. It can vary depending on the applications that you're going to use

it for.

So the standard is written in terms of three capability categories. And in general if you go from Capability Category 1 to Capability Category 3 the level of detail, specificity and realism increases. And this is true of the requirements in the standard that deal with parameter uncertainty as well. So what's acceptable for dealing with parameter uncertainty depends on which Capability Category the PRA is trying to meet.

So in the subsequent discussion, at least for Steps D-1 and D-2, the guidance is provided in a context that also provides the NRC's position on the requirements in the PRA standard that deal with parameter uncertainty. So if you want to go to the next slide.

Okay, so one more item to talk about before we get into the steps. What are the changes in this stage compared to the document that you saw back in March of 2009? Well as you've heard earlier the scope was expanded so now we have to deal with parameter uncertainties associated not just with internal events but also with other plant operating states, external hazards, fire and Level 2 PRA.

And also the second change in scope is

that since then the NRC position for what is acceptable for meeting the requirements on parameter uncertainty in the standard has been further detailed, defined and clarified. So that's really what's new in this version from the previous version. Next slide, Mary.

All right, so the first step is how do you characterize the parameter uncertainty of the PRA inputs. Ultimately what you want to do is you want to get the PRA results the core damage frequency, the LERF. You want to estimate those quantities with a good mean values and an understanding of the uncertainty about them.

But in order to do that you have to first characterize the uncertainty of the inputs to the PRA. And that's especially important for the parameter uncertainty in the significant contributors. So here's where we start talking about significant contributors and you'll see that terminology used in this guidance as well as in the standard.

And the significant contributor is not an arbitrary term that the applicant can decide on what it means. A significant contributor is defined, in the standard, in terms of the context that it's used in. Whether it's internal events, PRA, a external

hazard or a Level 2, or a LERF analysis I believe.

And there's a chain of definitions here that are all important because a significant contributor is defined in terms of a significant basic event. And then as well as in terms of significant sequences or cutsets.

And the standard defines all those terms and, as a matter of fact, gives some quantitative guidelines for what constitutes significant sequences, cutsets, as well as what are significant basic events. So there are some quantitative guidelines in the standards that make the significant contributor term definitive rather than arbitrary.

Okay, so if we could now go on to the next slide. So for Step D-1, what is an acceptable approach for characterizing the uncertainty. Well for the first category, for Capability Category 1, only point estimates are required for the basic event parameters and their uncertainty can be qualitatively characterized by specifying some kind of interval or perhaps even multipliers. But it doesn't have to be a formal quantification.

For Capability Category 2, which is what one would expect most applications to meet, the mean value of the significant contributors, the mean values

of the parameters of the significant contributors have to be provided. And the uncertainty around those mean values should be probabilistic representation of the parameter values. So you need to probability distribution, not just the mean value.

And, for Category 2, this is only done, or only has to be done for the significant contributors. For Category 3 you have to do the same thing, that is mean value and uncertainty distribution for the parameters for all of the inputs. So that's the distinction since --

CHAIR STETKAR: John, since you've obviously studied this quite a bit, how do I determine a significant contributor. I know it's defined. How do I do that? And I know it's defined even in the NUREG as Fussel-Vessley importance greater than 0.005 or risk achievement worth greater than 2.

MR. LEHNER: That's for a basic --

CHAIR STETKAR: That's a nice quantitative, that's a basic event, significant. How do I do that calculation in the real world doing a real PRA? I'll tell you how we do it. I quantify the PRA using some numerical truncation and I throw away a whole bunch of cutsets. I quantify some number, which I'll call a number, from the remaining cutsets

and I push a button and a whole bunch of math gets done and out spews a list of numbers. And that is comparing the basic event to that number that's generated.

The whole point of the state-of-knowledge correlation is that a whole bunch of the cutsets that I threw away, if I actually accounted for that state-of-knowledge correlation, would have contributed, perhaps significantly, to that number, that I'll call the number.

But I cant' test that because I can't see those cutsets because I threw them all away. And by definition all their basic events are not significant. So what am doing playing with the state-of-knowledge correlation with only the things that I can look at? How do I know it's not important to the results?

MR. LACHANCE: Well there is a certain gray area there, I think.

CHAIR STETKAR: I'll tell you from PRAs I've reviewed it's not so gray.

MR. LACHANCE: Well there's requirements in the standard to essentially assess truncation. You know, and being sure that you're not, you need to do sensitivities on the truncations values and essentially verify that the truncation is not --

MEMBER BLEY: But this adds a new wrinkle into it.

MR. LACHANCE: The state-of-knowledge?

MEMBER BLEY: Yes. Those things that were truncate-able for all other criteria might bite you here.

CHAIR STETKAR: Don't think about current operating plants with two, and only two, trains of things where I'll grant you X-squared is not a very big number. Think about new plants with four trains of operating things.

MEMBER BLEY: Or more.

CHAIR STETKAR: Or more. Where X^4th starts to get significant compared to the 4th power of X.

MR. LEHNER: Yes, I think that's why I think it is bit of a --

MR. LACHANCE: So you would vote for doing Capability Category 3, right? That's the only way you're going to make sure?

CHAIR STETKAR: No, pragmatism is important but I didn't read anywhere in this NUREG, anything that sensitizes the user to this notion that, gee, if you're going to investigate state-of-knowledge correlation types of uncertainty you may need to, for

example, test your PRA solution at various truncation values. Generate different sets of cutsets and see what the sensitivity to that overall result is when propagating those uncertainties through.

I didn't read anything that even makes people kind of sensitive to that issue.

MR. LACHANCE: Right. As a matter of fact I think, if I understand you correctly, even Category 3 wouldn't necessarily address it, because you're talking --

CHAIR STETKAR: No it doesn't.

MR. LACHANCE: You're talking about what's been truncated and thrown away.

CHAIR STETKAR: That's right.

MR. LACHANCE: And so Category 3 would not address, no.

CHAIR STETKAR: But I mean if a lot, essentially all of this NUREG, in terms of parameter uncertainty quite honestly, deals with state-of-knowledge correlation uncertainties. And since the NUREG makes such a big deal about it, and it can in rare instances be numerically important --

MEMBER BLEY: But that importance is related, and you could do a level something like this. That importance is related to two things, whether

you're x-squared or x to the fourth or x to the sixth, and what's the error factor on your failure rate.

CHAIR STETKAR: Yes.

MEMBER BLEY: If the error factor is fairly small x-squared doesn't matter much at all. And x to the fourth only begins to. The error factor is pretty big. Man, it jumps up fast. I think some of the examples you cite the old Kaplan and Apostolakis paper, which is the first one on this. They did examples of x-squared and I think x to the fourth and it's really linked to that error factor. So as the error factor goes up this becomes much more important.

So you could almost gin up some little guidelines as to depending on whether you have error factors exceeding a certain amount what you need to do --

(Simultaneous speaking.)

CHAIR STETKAR: The EPRI report actually had that. It had some of that.

MR. LEHNER: It had some of that.

CHAIR STETKAR: Yes, it had some of that in it.

MR. LEHNER: Yes, the EPRI report actually shows error factors versus, I mean, it rates the

importance depending on the --

CHAIR STETKAR: Yes, it does have that notion in it. I can't recall --

MEMBER BLEY: And I can drive an analyst into how to begin to do test cases to see where it's important.

CHAIR STETKAR: I don't recall whether the EPRI report had much in it on kind of testing the numerical truncation to then generate combinations of basic events that you can go back and look at and say, gee, there's a bunch popping up here and they have high error factors so I need to be sensitive to them.

MR. LEHNER: Right. I guess we can go on to the --

MEMBER BLEY: But the next group of reactors that get licensed, if in fact they do, are going to have this in spades.

MR. LEHNER: Yes, that's true with all those trains.

MS. DROUIN: Our original --

CHAIR STETKAR: What's x to the sixth for a squib valve, for example?

MEMBER BLEY: For a new squib valve, never tested. Or only limited testing on it, big uncertainty.

MR. LEHNER: The difference between x to the sixth and the expected value of, the sixth value of the expected value of x, right?

CHAIR STETKAR: It's a big deal.

MS. DROUIN: My original thought was that the standards were making this way too complicated. And that Capability Category 2 and 3 should just be combined, because right now you have software that just automatically does it. And just propagate. Don't just try and figure out this is significant and this isn't.

Just propagate your uncertainties for all of them and make your life easy. Because you have to quantify, initially, to find out what is significant. And then you caught up in all of that, if you had just propagated everything to begin with.

MR. DINSMORE: Yes, hi. This is Steve Dinsmore from the NRR. I'd like to make a comment on this before I get up there and you ask me the same thing. Don't forget there's CCFs as well, so it's not just the x-squared, it's plus stuff with CCF. So the CCFs will mitigate some with this problem. I think.

CHAIR STETKAR: Well, go on.

MR. LEHNER: All right, so the next step then is -- All right. I think I'm being told to move

to Step D-3. Well anyway Step D-3 is the propagation of the uncertainties that are again dependant on the Capability Category. And again there's a distinction between significant for Category 2 and all for Category 3. And also, accounting for the state-of-knowledge correlation, in any case in Category 3, always in Category 2, you can calculate mean values without the state-of-knowledge correlation if you can demonstrate that the state-of-knowledge correlation is not important.

Step D-3 then is comparing the PRA results with the acceptance guidelines and so obviously you need an estimate of the risk metric, which is calculated and hopefully have gotten a good estimate of your mean value. The acceptance guidelines and, in some cases, the uncertainty distribution of the risk metric. And if you go to the next slide, Mary.

In most cases you're comparing the mean value of the risk metric with to an acceptance guideline that's also been formulated in teams of mean values. And the comparison should demonstrate to the decision maker not just whether the guideline has been met or not but also how close the results of the analysis are to those guidelines.

And this sort of touches on a point that

was raised earlier, you know, if I'm just using mean values all the time why do I even bother with the uncertainty distribution? Well, in some cases, I mean obviously if your results are far away from the acceptance guideline you're not going to worry very much about the uncertainty.

But if you're close to the acceptance guidelines then it may influence the decision if you have a better idea of the uncertainty that's associated with that mean value and how it was to spread, et cetera. So then the decision maker may be interested in that.

CHAIR STETKAR: I'm glad you brought that up, John, because in particular in this section of the report that notion does exist.

MR. LEHNER: Yes. That you would be interested in the --

CHAIR STETKAR: Yes, that you might be interested in it. And yet, back in the example it says, well, we're not interested in it. It does. This is the 95th confidence interval shows that you could be in a different region but we don't care.

MS. DROUIN: I know that's in there.

CHAIR STETKAR: It's an example. I get confused about one, two and three but it was the next

worse one.

MR. LEHNER: All right, well actually that's the end of Stage D. There is an appendix associated with Stage D that just gives more information about the state-of-knowledge correlation. Nothing's really changed here from the previous version, so I don't think we really have to go through it. Unless you want me to.

CHAIR STETKAR: No. Thank you.

MS. DROUIN: And Tim's going to bring us back on schedule.

CHAIR STETKAR: Tim's going to bring us back on schedule after we take a break.

MS. DROUIN: Oh, I thought we were going to go through his and then take a break.

CHAIR STETKAR: That's what you thought. No, honestly we're going to start talking about model uncertainty and we probably should take a break. So let's recess until 3:15.

(Whereupon, the meeting in the above-mentioned matter went off the record at 2:57 p.m. and resumed at 3:14 p.m.)

CHAIR STETKAR: All right, let's reconvene and hear about Stage E.

MS. DROUIN: And that's going to be

presented by Tim Wheeler.

MR. WHEELER: Okay. Are we ready?

CHAIR STETKAR: We are.

MR. WHEELER: Okay, well good afternoon everybody, and I am Tim Wheeler from Sandia Labs and I'll be presenting Stage E, the stage that follows Stage D and where we assess model uncertainties.

So the objective of Stage E is to provide guidance to the licensee for addressing sources of model uncertainty and related assumptions in both the base PRA and the what we call the modified or the PRA Developed for the purposes of the application, with the goal to both, number one, make sure we have a comprehensive identification, and understanding of all the model uncertainty.

And then an understanding of the extent and the degree to which those sources of model uncertainty could potentially impact the estimate of the risk metric, and to see if there is a possibility of challenging or even exceeding that quantitative acceptance guidelines.

There's two major steps in Stage E. Step E-1, the step that involves the identification and the characterization of the model uncertainties. Step E-2, is the step where we take the identified model

uncertainties and then analyze them against the acceptance criteria using sensitivity analyses to determine whether or not they are key to the decision.

The methods and guidance have fundamentally not changed from Rev 0 to Rev 1. We hope, and we think, that we've improved some of the discussion and things but the real fundamental content of the methods have not changed.

Step E-1, again, typically summarized, provides guidance to identify and characterize the model uncertainties. We have five steps that we lay out to do this. I'll talk about those in more detail, so we can go on to summarizing Step E-2.

E-2, having identified the source of the model uncertainty that are relevant to the application, this provides the guidance to determine whether or not these model uncertainties are key to application. And we do this, again, by performing uncertainties. We provide guidance both for the licensee to do conservative screening analysis so they can hopefully pick out some low-hanging fruit without doing the more complex analyses associated with realistic sensitivity analyses.

In the original Rev 0 we had some feedback from the industry saying we were a little bit over the

prescriptive in our language and tried to address that. They felt they came across as saying thou shalt do conservative screening and then if necessary do realistic. So we'd just like to readdress that so it was providing guidance on as either an option to do both or either. Okay, next slide.

Step D-1 we'll address in a little bit more detail. We have identified, again this is the process for identifying and characterizing the sources of model uncertainty in the PRA. We've identified five sequential steps. In reality obviously some of these might merge together a little bit.

And Step 1.5 is to do the whole process over again for the PRA associated with the application. But we wanted to set each step out explicitly to bring attention to each and drive home to the licensee the needs to consider each aspect of the step. Next slide.

So in Step E-1.1, this is the step where we identify the model uncertainties in the base PRA. And as you can see you have obvious sources such as your own plant specific sources that you have identified and have incorporated into the PRA model. And then the EPRI report also contains a very useful starting point for an analyst with a list of generic

sources.

I'd like to point out that this step is a requirement in the standard. So this is a step that the licensee should be doing and they should have successfully when they pass muster with their peer review.

CHAIR STETKAR: Tim?

MR. WHEELER: Yes.

CHAIR STETKAR: And I have to admit I didn't get a chance to go back and reread all of the EPRI report. The NUREG talks about uncertainty within the context, let's say, of a selected model. It doesn't seem to talk about uncertainty related to the selection of a model among a number of choices.

For example, MELCORE versus MAPP. For example, CFAST versus MAGIC for fire analysis. For example, Human Cognitive Reliability Model versus THERP for human performance analysis. How are those sorts of uncertainties addressed? Are they addressed through the standard or are they addressed through EPRI guidance?

MR. WHEELER: We do have as examples how one's selection of a HRA methodology can introduce model uncertainty into an analysis. We --

CHAIR STETKAR: It's stated.

MS. DROUIN: The way we do it is that the standard and NUREG 1855 talks about a consensus model. And if a consensus model is being used then it's taken off the table as a source of uncertainty.

CHAIR STETKAR: Okay. Both MAGIC and CFAST are consensus models, they're both endorsed. I suspect they will give you different results if you run fires through them. I haven't used both of them, it's just a suspicion, I would bet heavily that they would. They're both conservative models.

MS. DROUIN: And they would not under our process, good or bad, that's the position that has been, you know, was adopted in the standard and we further adopted it in 1855. Is that if it was a consensus model then we did not disagree with the standard that you would have to identify that as a source of model uncertainty.

CHAIR STETKAR: What's the definition of widely used and widely accepted, because I see those words in here?

MS. DROUIN: That's a real good question. And I don't have --

CHAIR STETKAR: Okay, well that defines what a consensus is --

MS. DROUIN: Yes.

CHAIR STETKAR: -- according to what I've read here.

MS. DROUIN: And as I noted earlier we need --

CHAIR STETKAR: Does that mean if I have five people three of them like it and two don't?

MS. DROUIN: Well that's where we're going to need to provide some additional explanation. Because I personally, you know, was that I wasn't happy with that explanation. The more I've thought about it I feel like we've bought into that definition too quickly. I think it has some subtleties that could really cause some problems.

CHAIR STETKAR: Because I mean in some sense if three people like it and two people don't and they're all experts and they give different results I can weight things 60/40.

MS. DROUIN: Yes.

CHAIR STETKAR: Looking at what the sensitivity of the results or the uncertainty in the results might be. And that's one way to do it.

MR. WHEELER: Mary, I'll defer to you as representing the regulator but I do believe that when we define consensus model in this NUREG we did specify that it has to have been either utilized or accepted

by the NRC.

MS. DROUIN: Yes, that's true.

MR. WHEELER: So we did hook it back to the NRC's opinion on consensus.

CHAIR STETKAR: There might be an or in there, I'm not going to try to find it.

MS. DROUIN: But Tim is right. We did add that on there that it has to be accepted by the NRC.

CHAIR STETKAR: Okay.

MEMBER SCHULTZ: But that provides --

CHAIR STETKAR: But that still --

MEMBER SCHULTZ: You should be comfortable with these definitions.

CHAIR STETKAR: MAGIC and CFAST have both been accepted by the NRC.

MS. DROUIN: But that was just one of the limitations that we put on this NUREG.

CHAIR STETKAR: All right.

MR. WHEELER: Earlier today we had discussions on optimistic bias and I would not be surprised if when this team goes back to address that, in addition to other parts of this NUREG, that we may see some discussion of optimistic bias in this step, because one of the things we did have from Rev 0 was a table and discussion under identifying model

uncertainties that have to do with issues related with when you're dealing with a PRA of a design stage plant or design.

So I, just based on what we heard earlier today in the discussion of optimistic bias, I would not be surprised if we see some new material being added to 1.1 as well, because this is the part, the process and consistent in alignment with the PRA standard where the licensee has to demonstrate that they've studied their models and their assumptions and that they've documented and identified all of them here.

Step 1.2 is identifying those model uncertainties that are relevant to the application within the base PRA. And I have, actually I was going to stay typo but this is really a mistake. I think I got fooled by reading headers and I was referring back to step A-3, I think it's more appropriate to refer back to B-1 where you've identified what part of your PRA model that you're going to be applying to the application process.

And so obviously from your full list of the base PRA model uncertainties that you've identified in 1.1 you don't need to worry about all of them, potentially, depending on the scop of what your

application is going to encompass.

And example being for the diesel generator allowed outage time extension, you would be focusing on loss of off-site power sequences, whereas, as we also see in the other bullet there are risk-informed applications that would, however, require that one consider all of the model uncertainties in the entire base PRA. Next slide.

Step E-1.3, this is where you've taken your set of identified model uncertainties and you are characterizing these model uncertainties as to how they potentially affect and impact the PRA model. Again, this is consistent with the requirements of the PRA standard. I believe this is QU-E4, is where the standard directs licensees to do this.

For example one would be does a particular model uncertainty effect just a single basic event, multiple basic events. Are we potentially affecting the logic structure of an event tree or several event trees or fault trees. Or is it somewhat more complex combination of all the above. Or some of the above.

And I like to invoke a lot of the things that Gareth Parry who, before he retired from the NRC, worked on this extensively. And this is where he always said this is all about understanding your PRA,

both macroscopically and microscopically, knowing why your results are the way they are and why things behave the way they do given different assumptions. And understanding how, for your model uncertainties, what is the basis of the model that you used so that you will better understand what the potential issues associated with that model uncertainty.

And again, this included an understanding of conservative bias to make sure that if your model incorporates say perhaps reflects the deterministic, conservative nature of your license basis, you need to understand how that might be shielding potential importance of other aspects of your model. And we've already noted today that there's at least a tone that we are ignoring optimistic bias. And I think we'll be revisiting that as a team.

Step E-1.4. Qualitative screening of relevant model uncertainties. I call this just a backup to Step 1.1 and Mary brought this up where we have allowed the licensee to take credit for if they have used what is considered a consensus model. They do not have to take the assessment of this model uncertainty further. They have used an approach which has at least received somewhat broad acceptance or acknowledgment within the technical community. And

that includes the NRC and what we said in the NUREG. And example might be the Westinghouse reactor coolant pump seal LOCA model.

Step 1.5, this is really we take the PRA which has been developed for the purposes of the application and we just go back to Steps 1.1 through 1.4. And, again, in reality a licensee might be doing this in parallel but we just explicitly pointed this out as a separate sub-step so that the analyst understand they have to be careful and evaluate their modified model and make sure they are or are not introducing any potential new model uncertainties that they didn't already identify in the first step. And EPRI has examples of this as well.

So at the end of Step E-1 you have a list of what I call candidate potential key model uncertainties. They are, hopefully, as comprehensive a set as possible to get of all the model uncertainties in your base PRA and your modified PRA for the application, which are relevant to the application. As we said you can filter out those that are just not going to be impacting the scope of what the application involves.

And then Step E-2 is where we study these using sensitivity analysis, it's conceptually very

straight forward. You have to look at each model uncertainty, perform a sensitivity analysis and compare the results against the acceptance guidelines and come up with a determination of does the uncertainty associated with the model uncertainty potentially cause the estimate of the risk metric to approach, or even potentially exceed, the quantitative acceptance guidelines.

If the answer is yes you've identified one or more key model uncertainties. If the answer is no then you have great assurances of demonstrating to the NRC that the model uncertainties are not going to impact the decision. In either case the applicant then moves on to Stage F where they develop their strategies for dealing with the results of their uncertainty analysis.

CHAIR STETKAR: These sensitivity analyses, I understand this whole process and it makes a lot of sense. What I struggle with a bit though is if a particular source of modeling uncertainty, if you tested that, could give you a range of results. Whether it's success criteria in terms of flow rates or drain-down times or heat up, you name it.

There's not sense in here that -- There's a sense that, well I can look at the sensitivity to

the worst case if you will. And if I win with that, however I define that worst case, I'm okay. But if there's a spectrum, if I'm now bordering on the acceptance criteria, there's no notion here of any assessment of confidence in any of those possible outcomes.

In other words, either convening a group of experts to say well, you know, in my simple example we'll assign 60 percent confidence to this outcome and 40 percent to this other outcome. Or in a broader sense a more rigorous type of uncertainty evaluation. I'm assuming that was deliberate, is it?

MR. WHEELER: I'm not sure I would say it was deliberate in the sense that I think to a certain extent we didn't want to be over prescriptive in some of the guidance. But I think your comment that I think the team should consider to see if there is some additional guidance that we could put in there as to how one may want to address what we call the various realistic sensitive.

And so I think what you're suggesting in your comment is we may want to think about additional guidance within the context of looking at multiple --

CHAIR STETKAR: It could help, because if you look at the example, and I'm not necessarily

trying to be somewhat practical about this. In some sense, if I look at the example they say well we did this sensitivity analysis on modeling uncertainty, let's say. And, gee, we could exceed our acceptance criteria so we're going to implement some sort of compensatory measures to make up for that.

If there was low confidence in that particular set of sensitivity parameters a different decision might be made by both the applicant and considered in terms of a staff review of that application. But there's not sense of that kind of confidence. It just says well we did a sensitivity analysis on something that we think could be this bad. And look, it pushed us over our acceptance criteria.

So as an applicant I'm going to implement some sort of compensatory measures to account for that possibility.

MR. WHEELER: Well when we talked about the conservative sensitivity analysis that was definitely left out. I think that thinking may have been imbedded in our discussion on realistic sensitivity analysis, where we said things such as alternatives are hypothesis that are considered reasonable or have a broad acceptance in the technical community and a sound technical basis. But that may

--

CHAIR STETKAR: But those are pretty qualitative issues.

MR. WHEELER: Right that may be leaving some threads hanging from your perspective. So we will take that comment within that context and see if we can --

CHAIR STETKAR: It might help a little help a little.

MR. WHEELER: -- tighten that up a little bit.

MS. DROUIN: I think when you go into Stage G, and I think some of it will be alluded to in Stage F, that when, and I don't want to jump in and speak for Steve, but one of the things they do do is look at what is the adequacy, the technical acceptability, of the PRA. And part of that is having confidence in all the different things that you have done. In particular having confidence that what sensitivities you did were sound.

So I know that we've talked about it. Maybe not as much as we needed to. But I do know that we did allude to that as part of the Step review is that they have to have confidence that the things that they did in the PRA, the things they did to assess the

uncertainties, was technically sound.

CHAIR STETKAR: That's true. And it does talk to that, but again I'll come back, you read the words as an outsider and you read the words as practitioners will probably read them. And there are things in there, it says well, typical sensitivity analyses might vary the value of a parameter by a factor of two, five or then.

I've seen reviews where staff has come back and said, you didn't vary it by two, five or ten. That's according to this guidance you have to do that for an acceptable sensitivity analysis. You know, I could set a beta factor to 1.0, that would really make every common cause really, really important but it's kind of silly.

MS. DROUIN: Yes.

CHAIR STETKAR: So just by saying that people typically do these things without instilling a notion that you ought to, as part of that process, at least express some measure of confidence in whether a factor of ten, in that particular example, makes any sense. Or 1.0 for a beta factor for common cause, makes any sense.

MS. DROUIN: I agree, some intelligence has to be put into the process when they're choosing

what they decide to do on their sensitivities.

CHAIR STETKAR: But as we evolve into more, I hate to use the term prescriptive, but kind of tighter guidance about how this is done people naturally tend to just follow the written word and interpret that as necessary and sufficient.

MS. DROUIN: I appreciate your concern.

CHAIR STETKAR: I'm sorry.

MR. DINSMORE: Yes, this is Steve Dinsmore. Just in practice what would happen is if one of these issues comes up, for example human reliability, during an application we'll ask them to do a sensitivity study. If it's less than the acceptance guidelines everybody's fairly happy. If it's above the acceptance guidelines we might not accept the, we might.

So it becomes kind of a decision. It's not well it's a 30 percent it's above and 60 below, it's simply well you're not going to get 14 days you're going to get ten. Because ten will work. And that's kind of where it ends.

CHAIR STETKAR: Except for the fact people then start to game the system.

MR. DINSMORE: Well I guess that's why we're there. They could, but once the process has

started, once the issue has arisen and then the way it ends up is there's a final decision whether to okay or not.

MS. DROUIN: No, I mean there's a fine balance in writing a guidance document that you don't want to become so prescriptive that the people stop thinking and they use it as a checkmark.

CHAIR STETKAR: Right.

MS. DROUIN: And we don't want to do that. And so hopefully we haven't erred on that side where we thought we were so un-prescriptive that people had no idea really how to apply it. So we've tried to add enough clarification without going down that path. And maybe we need to go back and add some more caveats.

CHAIR STETKAR: Again, in the sense of practicality I'm certainly not advocating the fact that every type of model uncertainty you look at. Or any type of range of sensitivity values that you put in an analysis you do a formal Shack type process of expert elicitation. That's obviously inappropriate. But having the people who do that express at least some degree of confidence could help, on both sides.

MS. DROUIN: Absolutely.

MR. WHEELER: Okay. Next slide. I think

this discussion we just had relates to this slide where we point out that we give guidance on both doing conservative screening to give the analyst the option of hopefully picking off some low hanging fruit without having to worry about some of the issues we just discussed. Or using realistic sensitivity analyses where they are directed to develop alternatives or hypothesis that are considered to be reasonable.

And I'll just, again, I think we actually have this sentence in the report somewhere and I'll invoke some more wisdom from Garith Parry, where he said, what is known about the issue itself will likely dictate the possible alternatives that are defined and studied. And I think that relates strongly to the discussion of how much confidence do we have in particular alternatives or hypothesis as to whether they are strong candidates or perhaps lesser so.

MEMBER SCHULTZ: Now here the slide said perform screening and sensitivity analysis. Earlier you mentioned that you wanted that to be an or.

MR. WHEELER: Yes, and thank you. It should be an or here to be consistent with how we present this in the chapter. Thank you very much. Next slide, Mary.

So the guidance in Stage E is presented within the context of what we call two significant different cases for acceptance guidelines. Case one being the single metric case. For example where the acceptance guideline is an acceptable core damage frequency guideline.

And then case two, we call that the multiple risk metric case. For example, where we may interested both in core damage frequency and the change in core damage frequency. And an example of this is Reg Guide 1.174. And then for each of those two cases if you harken back to Step 1.3 where, again consistent with the standard, you are characterizing the model uncertainties we identify four different categories or types of model uncertainties.

Those that affect a single basic event. Those that affect multiple basic events. Those that could potentially impact the structure of the PRA model, either fault trees or event trees. And then logical combinations of any of the above three. And I think we also inherently understand combinations of those but I just -- Next slide, Mary.

I just wanted to quickly discuss logical combinations, and we did this in the NUREG because we wanted to make sure the licensees were clear in what

we meant. There can be multiple, model uncertainties can often interact in a synergistic way when you assemble your model together and this is what we're calling logical combinations.

And an example of this might be what is the importance of the high-pressure coolant injection section in a BWR. AS you can see there are several aspects of that where each one is potentially individually a model uncertainty. And you could model them individually and see how each one of them effects the potential importance of the HPCI system.

But to really get a clear understanding, or a comprehensive understanding of what might be the potential impact of several model uncertainties on the importance of the system you would have to coordinate your sensitivity analyses so that you're looking at them all together, not just individually and ignoring any kind of synergistic effect.

Another example would be diesel generators and failure to restore DGs before the batteries fail, you could do a model that shows that as time goes out you're going to approach the probability of successful recovery of the diesel generators of 1, because given enough time you'll restore those diesel generators. But there's a competing situation going on here with

the batteries.

And you're going to come to a point where, after so much time, you'll no longer have the batteries available to flash the diesels. So that's another example. And the EPRI report has additional examples as well. Next slide.

So in summary the content of Stage E is presented, the guidance that's presented in these eight different cases, four for each case according to the four different categories that we had identified.

And I just want to state here that for all the case one cases you might be doing a calculation, for example for the single base basic event case that lends itself to a risk achievement worth importance measure comparison, you can compare it to some metric that we call, for example, the maximum allowable risk achievement worth.

The others don't lend themselves to risk achievement worth measure but you would be quantifying a new core damage frequency, for example, given the sensitivity analysis that you've identified and developed and comparing that to a maximum allowable core damage frequency metric.

In the second case, where you have the two metrics, you can see down at the bottom we give

guidance to calculating two different pairs of numbers that can be compared against the acceptance guidelines. And example is NUREG 1.174, the second one over shows the potential impact of the proposed change in the application without any regard to the potential impacts of uncertainty.

In the first one you would requantify the base PRA and application PRA within the context of your sensitivity analysis and come up with new metrics for core damage frequency and for the delta core damage frequency. So you're getting two different perspectives against the acceptance criteria 1.174 as to where you might be given the application.

And so just in conclusion. Stage E we have identified any key model uncertainties and we have an understanding of what is the potential impact from the uncertainty associated with these key issues and the extent to which we might be challenging or exceeding the acceptance criteria. And the strategy for what the applicant chooses to do with that is discussed in Stage F.

MS. DROUIN: Okay, so we'll move on to Stage F. And, as we said earlier, this is a whole new chapter that's in the revision. And so Anders Gilbertson is going to walk through this chapter.

MR. GILBERTSON: Thank you, Mary. Good afternoon, everyone. So Stage F is describing the licensee application development process. The primary objective of this stage is to provide guidance to the licensee on the process of developing a risk-informed application submittal as pertains to the treatment of uncertainties.

The purpose of this guidance is to help ensure that the licensee provides adequate justification for the acceptability of the given risk-informed application. Including the physical documentation provided in the submittal. So this stage consists of a set of options that can be used by the licensee to determine whether adequate justification has been provided.

And these stages include defining, or redefining, the application. Refining the PRA analysis or using compensatory measures or performance monitoring requirements. And I'll go into more detail on these in the next slides.

As Mary had mentioned, this is a new section in the NUREG. Revision 0 of 1855 had brief discussions throughout the document regarding the determination of adequate justification for the application submittal. However, it was generally

unclear in many cases whether the guidance was intended for the licensee or the staff.

So for this revision the stage consolidates many of these discussion from the previous revision to help provide clear guidance to the licensee on the staff expectations regarding the licensee's justification of an application. Next slide.

So this figure illustrates the relationship of the licensee application development process, shown here as Stage F, to the overall uncertainty assessment process. Stage F is represented on the right, by the blue box, and it consists of the three options, as had mentioned previously, that the licensee may use to develop their risk-informed application.

During the application development process these three options may be used alone or together and to varying degrees, depending on the needs of the application. Further, as has been mentioned I think a couple of times already this afternoon, the application development process is generally performed in an iterative fashion so as is meant to be expressed here by directional arrow between the assessment of uncertainties and Stage F, there.

So, for example, after either the first two options, the redefine the application or refine the PRA, after either of those two have been performed the licensee should revisit the assessment uncertainty process to reassess the impact of uncertainties following any changes to the application or the PRA model. Next slide, please.

So when an application does not adequately cover significant risk contributors licensee may choose to redefine the application. For example, the scope of the application could be restricted only to those parts that are supported by the risk assessment.

So if the PRA model does not address fire hazards the change to the plant could be limited such that any structures, systems or components used to mitigate the risk from fires would be unaffected. In this way the contribution to the overall risk from the internal fires would be unchanged.

If the application is redefined the licensee should go back to Stage B and determine if the scope and level of detail is sufficient and appropriate for the redefined application. Subsequently the licensee would enter back into the uncertainty assessment process to determine the impact on the uncertainties. Next slide, please.

So the second option, refining the PRA. So if the risk metrics challenge or exceed the application acceptance guidelines the licensee may choose to refine the application PRA so as to reduce the risk. After refining the application PRA the licensee should recalculate the risk metrics by performing, going back through Stage D, and reassess the impact of parameter uncertainties on the refined PRA.

The licensee should also reassess the impact of model uncertainties, via Stage E, to determine the impact of the existing model uncertainties as well as any new model uncertainties that may have been introduced. Next slide, please.

MS. DROUIN: And also I might add that refining the PRA could also come as an outcome where his scope and level of detail is insufficient. And so he may then decide to update his PRA to expand it to include the necessary scope and level of detail. I mean he'd still go through these same steps.

MR. GILBERTSON: Okay. And finally, the licensee may choose to provide justification for any challenge to or exceedance of the application acceptance guidelines via the implementation of compensatory measures and/or performance monitoring

requirements. So by using compensatory measures the licensee essentially tries to eliminate the negative impact of some feature of the plant design or operation on the plant risk.

For example, a fire watch may be established to compensate for some weakness that's been identified in the fire PRA, such as a faulty fire barrier or a temporary removal of a fire barrier.

The performance monitoring is used to show there's no degradation in some aspects of plant performance that is expected to be affected by the application. So for performance monitoring to be effective the affected aspect of plant performance must be measurable in some quantitative fashion. And the guidelines used to assess the acceptability of the performance should be realistically achievable given the quantity of data that might be generated. Next slide, please.

So in preparing the application submittal the licensee is responsible for ensuring that the application is adequately justified and that the conclusions of the risk assessment are communicated clearly and concisely. So the concept illustrated here in the figure, is that the amount of justification needed for a particular application

depends directly on the proximity of the risk metrics to challenge as would be expressed in Regime 3, or an exceedance, such as in Regime 4 of the application acceptance guidelines.

I just wanted to introduce this figure here. Steve Dinsmore will speak more about it in his section on Stage G. Next slide, please.

So in preparing the application submittal, with regard to the licensee's justification of an application the staff expects that the licensee will communicate clear understanding of the risk contributors as well as their impact on the results. Make sure that the model uncertainties have been accounted for using the techniques in Stage E. And the model has sufficient scope and level of detail to support the conclusions of the analysis, using the guidance from Stage C of this report.

Additionally, licensee may need to include additional discussion in the submittal to address aggregation of risk results, depending on the application. Next slide, please.

And, finally, the documentation needed for an application should be commensurate with the proximity of the risk results to the acceptance guidelines. So similar to the relationship between

the justification needed and the proximity to the guidelines documentation should be commensurate with that need.

So that is to say that as the risk metrics come closer to the challenging or exceeding the application acceptance guidelines the greater the justification will be needed as well as the documentation supporting the argument for adequate justification.

And so 1855 includes several elements of the documentation that staff expects to be included in the application submittal, including for example, a description of the acceptance guidelines used for comparison. A discussion of the impact of parameter uncertainty, relevant source of model uncertainty and the impact on the results. And a description of significant modeling conservatisms.

MS. DROUIN: And optimisms.

MR. GILBERTSON: Yes.

CHAIR STETKAR: I'm going to wait for Steve.

MEMBER SCHULTZ: I don't know how much I'd emphasize that first bullet, the amount and quality of the documentation. I just recommend caution there with the selection of those words. Especially the

amount of the documentation. I could certainly see some areas where you'd want to have very good documentation, even if you're not near the acceptance guidelines. It's just going to be case dependant and so giving leeway to less documentation, either in amount or quality, I'm not sure I would go very far in that direction.

MS. DROUIN: Okay.

MR. GILBERTSON: Okay.

MEMBER BLEY: I guess that's worth a little talking about. The general concept that the closer you are to trouble the more convincing the case sort of makes sense. On the other hand, if you're far away because of poor work you don't document well you've missed out. So that's where you're coming from?

MEMBER SCHULTZ: That's where I'm coming from.

MEMBER BLEY: And amount's probably not a crucial thing anyway, it's the quality. But even if you're far away, if the quality if not good maybe you're not so far away.

CHAIR STETKAR: We might as well follow up, because I was going to hit Steve with that. Because the guidance to the staff mirrors this. It

says you need to look really closely at things that are close to the margin. You don't need to look very carefully at things that are way away from the margins.

So if I make up a number and say that a pump fails at 10^{-20} per hour so therefore it can be out of service forever. Well I'm way away from the margin, the staff doesn't need to look at that. And I wrote a report, I had a number in it. I did some sensitivity calculations around that number. I increased it all the way to 10^{-16}.

MR. DINSMORE: Well we've seen numbers like that with some pipe ruptures, but not with pump failures.

CHAIR STETKAR: I've seen valve failures in other countries that have numbers like that. In a sense the point is, regardless of what the guidance to the applicant might be, it would seem that the guidance to the staff should be that you really need to think about the quality of the analysis that justify very large margins just as much as the quality of the analysis that just squeak by.

In fact, in many cases it's more important to worry about the quality of the analyses that show larger margins because applicant naturally is going to

fine tune their numbers and sharpen their pencils and do whatever they can to show that they come in at 9.99 instead of ten.

MR. DINSMORE: Most of the applications that we've dealt with to date, for example risk-informed ISI and those type of things are either we generally kind of agree that the risks are relatively low or it's an AOT extension or something which is fairly well defined so that we can kind of hone in. And if they make an assumption like that, and they're supposed to report that type of assumption, and we would review that and pursue it on a case-by-case basis.

We've had less experience with plant-wide stuff, which probably the fire and stuff is the first time we've had plant-wide --

CHAIR STETKAR: Fire stuff and there's at least one new reactor applicant that's going to come in with a set of risk-informed tech specs.

MR. DINSMORE: We'll like there's on pilot coming in with 50.69 and the tech specs, yes. But we haven't crossed that bridge yet so --

CHAIR STETKAR: Okay, but you know it's coming.

MR. DINSMORE: Yes.

MS. DROUIN: I think that there's two kinds of documentation. And the emphasis here has been on the documentation of your justification of your results versus the documentation to show that you have a technically adequate or technically acceptable analysis. And I think when you're talking about whether or not the analysis they did is technically acceptable they have to prove that whether they're far away, because you want to make sure that they truly are where they are. Or whether they're challenging.

Now, how much justification they have to provide in terms of once you know then that is going to be, from my understanding from NRR, and Steve please correct me, is now going to depend really how close you are. And that's just being pragmatic.

I mean if somebody comes in and they're a good order magnitude away, you know you just aren't going to devote the same resources and the same level of detail into the review as you would with somebody who comes in and they're challenging or exceeding the guidelines. In both cases you want to have good confidence that the analysis was performed correctly.

MEMBER SCHULTZ: Yes, that added clarification helped a lot. I didn't take that from this bullet.

MS. DROUIN: No, you're right. That wasn't explained well enough. And a lot of that is relying on the peer review. And so you may go into more depth on the peer review when you're closer to the guidelines and not go so much into so much depth when you're real far away from the guidelines. Because you're relying on the peer review to have done its job.

MR. DINSMORE: Yes, that's exactly right. That's how we do it.

MEMBER BLEY: This kind of gets us back to where Mr. Stetkar began the day a little bit too. And that's that mean value issue. You know, you've got a location estimate and uncertainty estimate. For the same mean value for a particular decision it's possible in one case that there's essentially zero probability that you exceed whatever the criteria is.

And in a second case, for the same mean value, there might be as much as a 30 percent chance that you exceed that criteria. And to treat those as identical seems not in the spirit of what we're doing here and it bothers me. And John pointed out the language, which I didn't remember in 1.174 that kind of covers that.

In a lot of cases perhaps the error

factors are similar on a lot of things, but in some cases they're quite broad and when that happens you can have a fair chance that you're going to operate outside of where you think you're going to be. That one just bothers me a bit. We'll leave it there for now.

MR. DINSMORE: Yes, 174 says quite clearly that we use the mean value.

MEMBER BLEY: It does. But then, and, John, you remember the words. I forget what the words are but with due consideration of --

MR. DINSMORE: Uncertainty.

MEMBER BLEY: Something like that.

MR. DINSMORE: Well we do that by pursuing the technical adequacy of the PRA with more vigor, as Mary was saying, as we get closer.

MEMBER BLEY: And in most cases you look at your uncertainty bounds are relatively similar. In some cases they're quite extreme. To treat the same doesn't seem in the spirit of 1.174 or in the spirit of what I think we ought to be doing here. In those cases where we've got a 30 or 40 percent chance of being outside of whatever the criteria is, to treat that the same as the chance where we're almost guaranteed not to, doesn't seem to make sense to me.

MR. DINSMORE: Yes. Well if they'd use an odd method, noted by the peer review as being odd, and they came in --

MEMBER BLEY: I'm not talking about methods. I'm talking about a case where you've really got a lot of uncertainty. As opposed to the normal case where your uncertainty isn't so extreme. It's independent of method. It's the real world's out there and we have uncertainty about it. Anyway let's go ahead. But that's, the logic just doesn't seem to work for me. Essentially because I've spent time working in how you address those cases and how you get out of that situation. They're very different cases.

MEMBER SHACK: But that seems like a 1.174 issue. I mean that's how do you make the decision in that case.

MEMBER BLEY: Oh, I think it is.

MEMBER SHACK: You know if you come to this conclusion --

MEMBER BLEY: But I think 1.174 has a softness to it to say --

MEMBER SHACK: But I think 1.174 says that -- Well I mean, mean is what you look at for the delta CDF but that's not the only thing that goes into the decision.

CHAIR STETKAR: Well but if the guidance doesn't capture the notion that you ought to be producing the information. And if the guidance to the reviewer doesn't say that you ought to be looking for that information, then you're left with sort of vague terms in 1.174 and people saying well this NUREG, or the associated ISGs clarified that vagueness and we don't have to look at it.

MS. DROUIN: Okay. Steve, you're on.

MR. DINSMORE: Okay. My name is Steve Dinsmor, I'm a Senior Risk and Reliability Risk Analyst in the NRR, PRA licensing branch. As Mary indicated earlier Donnie Harrison and Andy Howe did most of this work. I only recently got involved so I'll try to do justice to this topic.

The objective of Stage G, which I guess is a new stage in this report. They're all new stages. See I'm going to be learning a lot in here. It's to describe the process used by the staff to determine whether a licensee's risk-informed application demonstrates and acceptable treatment of uncertainties and that the proposed application represents and acceptable risk impact to the plant.

Then that next bullet, that little dark, oh it's green on that. The green is the one that

means something in general, more justification will be needed for a given application when the risk results are closer to challenging or exceeding the acceptance guidelines than when the risk results are farther away. And I'll provide you with specific examples of how that process works later.

In determining whether acceptance guidelines have been met we look at how do the risk results compare to the guidelines. Is the scope and level of detail of the PRA appropriate. Is the PRA model technically adequate. Is the acceptability of the application adequately justified? And then we're going to address through discussing completeness review, parameter review, model uncertainty review, which are the following slides. Next slide.

Changes to the NUREG about the staff review process. This section has been almost completely revised. Previous versions are written by discussing issues that either the licensee or the staff needed to address. It wasn't clear whether the discussion was guidance for the licensee or the staff. The approach that is taken by the staff is laid out in this version. As well as the decision criteria.

Let me answer just quickly the question about how this process described in G compares with

our current review process, which follows the SRP and the Reg Guides. Effectively it just kind of is a collection of best practices that put stuff into the framework. So it just describes what we're currently doing. Next slide.

Completeness review. The staff will assess whether the following criteria are met. The PRA scope and the level of detail and the licensee's use of any screening analyses are appropriate. The base PRA and changes to the PRA that are used to support the application are technically adequate.

Now as Mary indicated earlier the way we do that is we, according to the Reg Guides and the SRP, we use the results peer review. We rely very heavily on those. As is a general measure of technical adequacy. Then if the licensee does not provide adequate justification for the exclusion of the missing PRA scope and level of detailed items, e.g., the licensee provides insufficient justification to show no impact from seismic, the staff will typically reject the licensee's risk-informed application.

This has come up somewhat recently, because fires are now, in Reg Guide Rev 2, which is more than one year old so it's now applicable. So we

have actually started, or have turned back some applications, because they do not have a fire PRA. Because they don't have a fire PRA and they can't demonstrate that the proposed change won't affect the fires. So this has come up mostly with fires.

An example of stuff that you can still do is if you want to move heavy loads and you're doing it for 18 hours and you don't have a seismic PRA and you could say well the likelihood of having a seismic event that exceeds the safe shutdown, the earthquake which I can show, won't drop my heavy load within 18 hours is very small. That's the kind of stuff that we can still accept.

The last one, if the staff determines there is a technical inadequacy we typically reject. Okay. Next slide.

Parameter review. We determine whether acceptable justification is provided for the acceptability of the risk results compared to the acceptance guidelines. There's lot of acceptance in there. The staff looks at the relevant risk measures usually expressed as a mean value or a point estimate. Always expressed as either a mean value or a point estimate. If they don't deliver we don't request. And I don't think, we could request but we don't

normally request uncertainty numbers or distributions.

The acceptance guidelines used for a particular application, there's several of those. The most common are delta CDF and LERF. If inadequate justification the staff will typically reject. Usually, typically what will happen is there will be some back and forth and they will either improve the analyses or change the request.

Model uncertainty review. The staff determines whether there is adequate treatment of the model uncertainties by the licensee. Staff determines if the key sources of uncertainty are appropriately identified or whether they were adequately characterized and their impact evaluated. If they're not appropriately identified or treated, will typically reject the licensee's application.

This is sometimes straight-forward. There was the example earlier about the diesel generator ALT, extending that. The time to recover offsite power is probably a key assumption in that and we'd look at that. Regardless of what the peer review said, we would always look at what the peer review says. But sometimes we will look at stuff that the peer review did not discuss. Although that's --

CHAIR STETKAR: Does that question your

confidence in the peer review, Steve?

MR. DINSMORE: No.

CHAIR STETKAR: Okay. I'm going to question why.

MR. DINSMORE: Well it's we want to be able to demonstrate as well, that we've done our job properly.

CHAIR STETKAR: Absolutely.

MR. DINSMORE: And so that's one of the ways we do that. Modeling uncertainty is becoming a larger issue in fire PRAs and I'm sure you're going to hear a lot about that, I guess next month. It's an issue that we haven't quite figured out how to work our way through the real complicated applications. Next slide.

Steps in the overall review. Well we'll typically begin with a technical adequacy check and comparison of application risk results to the application specific acceptance guidelines. Justification provided by the licensee is dependant on the significance of the risk results. We got regime -- You guys use complicated words. I might slip up and say region occasionally.

Regime 1, if the risk results are well below the acceptance guidelines. 2, they're closer.

3, they're challenged. 4, they're above. If we go to the next page which is this wonderful graph. This graphically illustrates these regimes. And as we move up through the regimes, that's from left to right, the quantitative estimates become more important. So the uncertainties in this estimate also becomes more important.

174 says to use mean values. So the way we use uncertainty is by increased attention to the PRA model. So if you're far enough down there in Regime 1 the conclusion is that you'd have to have pretty severe errors in your model or there would have to be a whole lot of uncertainty to push you up over the acceptance criteria. But as you move on up you pay much more attention to what was modeled in the PRA.

MEMBER SCHULTZ: Just a clarification here. I agree with this pictorial of the way in which justification is needed, but I don't much, to my previous comment on documentation, I don't correlate documentation with justification. The quality and the quantity of documentation doesn't necessarily match up with the justification.

MS. DROUIN: And we agree.

MEMBER SCHULTZ: The documentation quality

and the amount that needs to be provided doesn't necessarily line up with the justification.

MS. DROUIN: We're not trying to imply that if you were, for example in Regime 1, you only had to do a five-page submittal. Whereas if in Regime 4 you had to give a 25-page submittal. No we aren't trying to --

MEMBER SCHULTZ: That's fine. I understand. But that's what I wanted to clarify.

MS. DROUIN: And so we can clarify that.

MR. DINSMORE: Okay, next slide. So now we're going to talk about each regime, one at a time.

Regime 1, a good example of that is risk-informed ISI. The risk results are well below the acceptance guidelines. The staff would review the peer review findings of the licensee's PRA to identify any findings of particular relevance. For example, I'm going to use some terminology here, if you guys want explanation just ask.

We'd probably only request that there was any unresolved findings for supporting requirements that are relevant to the application. The peer review does their thing and they come up with all these findings for these supporting requirements and then the licensee looks at them and they fix them or they

say why it's not important.

So for these type of applications we probably only requested that if there was any of those that are important, that have not been resolved yet. The staff would look for qualitative or quantitative state-of-knowledge correlation showing it does not effect the PRA.

Regime 1 continue on the next page. We'd look to determine whether the validity of the assumptions made in the application PRA will be appropriately monitored and whether degraded performance can be detected in a timely fashion. For example, with one of these type of applications we might just accept that the Maintenance Rule can be relied on to monitor any unexpected increases on availability.

Finally, we would not generally perform an audit of the application PRA.

CHAIR STETKAR: So they could have a bunch of and gates in there instead of or gates and we would never look at that?

MR. DINSMORE: If the PRA peer review --

CHAIR STETKAR: You would rely on the peer review to find that?

MR. DINSMORE: Yes, we would rely on the

peer review to identify those type of difficulties.

CHAIR STETKAR: Okay.

MR. DINSMORE: If the peer review --

CHAIR STETKAR: And you expect to see those in the peer review findings that you need to look at?

MR. DINSMORE: Yes. Because what the peer review would do is they'd say that they found that. And then the licensee would fix it and then they'd say they fixed it. So there would be that trail.

CHAIR STETKAR: So it would be visible. Okay.

MR. DINSMORE: Then Regime 2. These things are kind of the same. Regime 2, the risk results are close by an order of magnitude the staff would examine the peer review findings with a higher degree of scrutiny. That's the difference. For example we might request all unresolved findings. And any resolved findings for important supporting requirements.

We'd also look for quantitative assessment of the state-of-knowledge correlation. The staff would examine the application to ensure that the proposed performance monitoring is appropriate. For example, we might request a description of the program

and how it includes appropriate feedback in this case. Where in Regime 1 we might have relied more on the Maintenance Rule.

In general the staff is unlikely to perform an audit of an PRA application which fall into this regime. Unless there's a lot of problems. Unless the peer review found a lot of problems and the licensee says well, we fixed them all. But if there were a lot sometimes we go audit anyway. And a good example of this regime are AOT extensions for individual SSCs. That's what we've seen a lot in this area. They might be up to the 10^{-5}.

Regime 3. This is the one that's more challenging. Can be right up to the guidelines or maybe even over. These would be risk-informed surveillance frequency changes. For example 4-B, which goes to a plant-wide risk-informed AOTs. Or NFPA 805, so these are much more challenging. So the risk result's challenged but do not significantly exceed.

In this case the staff would examine the peer review finding with an even higher degree of scrutiny. For example, for the fire stuff we're requesting findings on all supporting requirements and which supporting requirements for Capability Category

1 and so on and so forth. So we get a lot more information about the quality of the PRA. We would look for quantitative assessment of the state-of-knowledge correlations which shows that it does not impact the results.

The staff would examine the application to ensure that the proposed performance monitoring is appropriate and adequate. In this case we might request a detailed description of the monitoring program, including how guideline values are selected and used and the procedures which they're going to use and so and so forth.

Then a new one would be applications in this regime would likely identify compensatory measures. Especially if they're going to bump up over the acceptance guidelines. We'd probably want them to give us some information about how they'd deal in that situation.

In general it is likely the staff would perform an audit of the application. So we'd take all the peer review results and we'd go through them and then we'd go down and we'd look at that PRA.

Regime 4, results clearly exceed the acceptance guidelines. You might wonder why this is even here. Actually it's the fourth bullet that this

pops up. If it's part of a combined change request one aspect exceeds the guidelines while another aspect makes the overall risk results acceptable. So part of it's regime is above and they're offsetting it.

The best example of that is we had somebody came in and wanted a diesel generator AOT extension. They couldn't meet the guidelines unless they credited black start of an off-site gas turbine. So they proposed both changes at the same time. And then what we do is we determine the appropriateness of being combined. So these are both electrical stuff so they're fairly consistent, the appropriateness of the compensatory measures and we'd perform a more in-depth audit of the application PRA.

This also pops up in fires. There's also a lot of off-setting risk calculations in fires. And actually that's pretty much it. If accepted by the staff the risk-informed application is considered to have an acceptable treatment of uncertainties, reflected by our more detailed or appropriate review of the technical adequacy of their PRA.

And to meet the fourth risk-informed decision making principle, mainly just by comparing the acceptance guidelines with the results. Conversely if the staff rejects the application it's

considered unacceptable.

We actually, to reject and application we have to demonstrate that it's unacceptable. Or we have to describe exactly why.

MEMBER SHACK: But you're always right in either case.

MR. DINSMORE: We have the final say.

MS. DROUIN: Okay. And I don't know if we're -- I'm sorry.

CHAIR STETKAR: Mary, we're almost definitely going to run over time. Mary, do you have any problems with your travel schedule or anything?

MS. DROUIN: No.

CHAIR STETKAR: All right, I just wanted to check.

MS. DROUIN: I didn't know if you, the next part of the presentation is going through Appendix A. You know, now nothing has changed in Appendix A. So we had just put together a couple of slides and John was going to walk through, but if you want us to skip it we have no problem with skipping that part of the presentation.

CHAIR STETKAR: I don't want to skip discussion of Appendix A. It depends on what the other members prefer, whether they want to go through

the slides. I had several comments on the example, on specific examples from Appendix A that I wanted to raise kind of questions about. You know, they don't address anything that's in the slides, but they're examples. So should we go through the slides or should we just -- Let me just --

MEMBER RYAN: Just jump right to the question.

CHAIR STETKAR: Let me do that. And most of the examples that I'd like to address, and I'll try to be judicious about selecting these things here. My concern is that it's a well presented example that sort of walks through the whole thought process. It's really useful.

The problems that I have is that people reading this document will look at that example and read what people have done in that particular example. Regardless of the little footnotes that you have throughout the document that says, warning, warning, warning, this is a very specific, plant specific, example. It may not apply anywhere else. They will still read what was done and say, ah, the NRC will accept this type of thought process. And let me give you a few examples.

With regard to the scope of the risk

assessment in Table A-3, it's essentially concluded that external floods are not relevant to the AOT analyses because "they are a slow developing event which would allow restoration of out of service RHR loops prior to presenting a significant challenge." That's the justification.

Now there are a bunch of things in that simple quote that presumes that people will always be successful in doing whatever needs to be done within whatever available time window is presented by any possible external flood from any possible source. That's what that says.

Well, I don't know about this particular plant. Maybe it's not downstream from a dam. Maybe it's not on a coast that's susceptible to tsunamis. I don't know anything about this plant, it's a made up plant. It's actually a made up plant, it's Boiling Water Reactor. A two-loop Boiling Water Reactor. Or two safety train Boiling Water Reactor.

More troubling is that the reason that the folks are proposing to do this particular extension of the AOT is to perform preventive maintenance during power operation, instead of during shut-down. A lot of times when people do that kind of preventive maintenance you, for example, disassemble pumps and

valves and power supplies.

So they're lying around on the floor all apart in pieces. Getting all of the pieces back together again into something that might work might take an awful lot longer than whatever you're presuming is the normal maintenance on the RHR loop. That you're taking credit for people getting back into service before the flood hits your site.

So the question is well, as an applicant can I make these kind of glib statements about, well there's always enough time for me to do whatever I need to get done without doing any type of an assessment. I didn't see any assessment in there that says we're not susceptible to rapidly developing floods because A, B, C, D. We have enough time at our site even to build a new pump and machine new little parts for that pump, given whatever warning we have.

We have in place warning systems so that everybody who runs the lakes or the rivers or whatever they run will tell us that indeed the flood is coming. Some plants do. Some plants don't. I don't see any of that justification there. And that kind of goes back to Steve's notion of is it adequate to simply put a box on the table and say we had enough time so we don't need to do this?

MS. DROUIN: So you would feel better if we added some more explanation there, not providing all of the justifications because this then would just impede. But at least acknowledge that there was adequate justification or analyses done to support this.

MEMBER SHACK: You have a Note 1 now that says that there was analysis supporting these conclusion and Tier 2 information.

CHAIR STETKAR: Yes, for the baseline PRA though.

MEMBER SHACK: Well it's Table A-3 note.

CHAIR STETKAR: Yes.

MEMBER SHACK: So I assumed that they're talking about the basis, I mean that was my assumption when I read it. But --

CHAIR STETKAR: Okay. If that's what that means I'd certainly bring that up front, because it's --

MEMBER SHACK: Obviously you can have all the analysis there, but that's sort of what I interpreted it to mean.

CHAIR STETKAR: Okay. If that's the case, I mean if that's the interpretation of that.

MEMBER SHACK: Maybe typically it's not

the words you want to use. That will be included in terms of, you know, and address the application specific.

MS. DROUIN: Yes.

CHAIR STETKAR: Because just saying that in the baseline PRA they did an analysis that says, well under typical maintenance configurations we could rack a breaker back in and open a few valves, that's one thing. Reassembling a pump, in the context of this particular application, might be much different. So sort of reenforcing that notion that that level of justification needs to be provided before you just qualitatively toss things away.

Another example, and again if it's inferred that the documentation is there. But this one's a little bit different. When they talk about accidents at nearby facilities or transportation accidents or releases of chemicals on-site. They justify saying RHR is not a significant system in mitigating accidents from nearby facilities. The potential increase in risk impact is dominated by potential effects of toxic gases on the operators.

You're looking at the change in risk here from an allowed outage time on an RHR train. You're not looking at the change in risk due to a toxic gas

release. Now toxic gas release was in the baseline PRA. Now toxic gas release, in most plants, look like a transient. RHR has been shown to be important in terms of transients.

So just saying that, and I have a little calculation, that the delta risk from having the RHR train out of service, the conditional change in risk is exactly the same whether you have a toxic gas release that kills the operators at point one. Or whether you have some other transient with the operators not available at point one.

Delta risk is exactly the same from having that train out of service. I don't know what the frequency of the toxic gas release is, but this argument isn't made like some of the other ones that say gee, I can't get an avalanche in the middle of the desert. This one just says toxic gas release will affect the operators. Well that's true, but it affected the operators in the baseline PRA.

MEMBER SHACK: I mean that might need clarification.

CHAIR STETKAR: That is not a logically relevant justification for screening out those types of issues. Because the delta risk doesn't depend on the effect of toxic gas on the operators. We're not

looking at delta risk toxic gas versus no toxic gas. And those affect the screening of nearby facility accidents, toxic chemical releases from transportation and on-site types of toxic gas releases. So I'd urge you to kind of look at that one.

MS. DROUIN: I mean we will go through and try and do a real good scrubbing. Now this is one where we'll do it with EPRI, because they were the main authors behind those.

CHAIR STETKAR: Yes, that's a bit of my concern. Kind of cycles back to is this a joint EPRI/NRC or is this an NRC report. Or does the NRC own these examples and this justification in this appendix?

MS. DROUIN: Well we certainly listened to EPRI on our report. And they do very detailed reviews and we have lots of discussion. But ultimately we make the final decision. And the same thing with their report. But we have always been able to work out everything to our mutual satisfaction.

CHAIR STETKAR: Okay. Let me ask, I guess Anders or Steve, who's hidden behind the post again. Wherever you are. One of the justifications, this is on low power and shutdown. It says, "As will be shown in Section A-5, the final at-power delta CDF and delta

LERF results from Table A-7 for this application are such that the results like in Region III of the Reg Guide 1.174 acceptance guidelines and therefore it is unnecessary to evaluate the low-power and shutdown contribution to the base CDF and LERF."

Now the way I interpreted that is you are in Region III meaning the delta CDF and delta LERF on the vertical scale fall below that Region III line. But Reg Guide 1.174 also has an absolute CDF and LERF measure on the horizontal line. If the, for example, CDF from low-power and shutdown were two times 10^{-4} let's say, Reg Guide 1.174 would indicate that you should not accept anything that increases the risk at all.

Or let me put it way in the black or the red or whatever color it is, 1.0 times 10^{-3}. So I'm not sure why you don't have to make some sort of an assessment of what the absolute core damage frequency and large early release frequency from low-power and shutdown might be to satisfy where you are on the horizontal scale in that decision criteria.

MR. LEHNER: I'm trying to understand what the question is. I mean you agree that moving the maintenance, I mean the argument here is moving the maintenance of the RHR from low-power shutdown to at-

power, meaning that you're actually reducing the risk at low-power shutdown.

CHAIR STETKAR: I don't know how much it's reduced because I have no measure of what it was.

MR. LEHNER: Okay. So you're saying that, as you've pointed out, that when you find that place on the delta versus absolute CDF you should include that low-power shutdown CDF --

CHAIR STETKAR: But this says I don't need to estimate, this statement says I don't need to estimate my, call it a baseline, core damage frequency to low-power and shutdown because I'm in Region III on the delta.

MR. LEHNER: Okay. You're saying that --

CHAIR STETKAR: I'm saying that if that absolute core damage frequency were high enough, I don't, you know, according to Reg Guide 1.174, I don't care whether the delta CDF is 10^{-30} it's --

MR. DINSMORE: Yes, this is Steve. I think actually, I'm assuming that Region III is less than 10^{-6} delta CDF increase, in which case we don't normally as them for the total, which is what that sentence says which --

CHAIR STETKAR: Which is what that sentence says, but that's not what Reg Guide 1.174

says, Steve.

MR. DINSMORE: Well, it says that would normally be acceptable unless we believe that the total risk greatly exceeds 10^{-4}, is kind of how we've interpreted it. And so if the risk, in general we believe that the risks aren't real high. If the risks were real high we would have known about it either through the PRAs which have been done.

CHAIR STETKAR: These guys haven't done a low-power and shutdown PRA. So they don't have a low-power and shutdown PRA.

MR. DINSMORE: That's true.

CHAIR STETKAR: Their risk is anywhere between 0 and 1.

MR. DINSMORE: Well the information that we have available is that the risk from low-power and shutdown added to the risk of the current operation is, we don't believe that that's real high. We don't believe it's high enough so that they should go and make changes to their plant to reduce risk. So they'd always have to reduce risk. If we did we'd get them to make those changes. I think there's a certain belief that the risks are, you know, they might around 10-4 and so on, but they're probably not a whole lot higher. Even with the low-power and shutdown risk.

And so when the total change in risk being requested is less than 10^{-6} we normally don't as them for a estimate of their total, because we believe that that answer would not change our review process.

CHAIR STETKAR: Okay. I'm not going to belabor it anymore. I think I've made the point.

MS. DROUIN: And all I can promise is that we will re-look at it and discuss it among ourselves, but.

CHAIR STETKAR: Yes. There are a few places and, where this term bounding assessment is used. Most of the places where that term is used I can easily show that it's not a bounding assessment.

MS. DROUIN: Okay. We will --

CHAIR STETKAR: Seismic in particular, seismic with justification that taking out the main condenser seismically induced transients and the same basically applies for seismic loss of offsite power. Basically says that we'll take the main condenser away, but it presumes that all of the safety related equipment still works, is never affected by a seismic event.

It says well, we looked at the frequency of these things and most of the frequency comes from seismic events that are less then 0.3 g, I'll give you

that. And a CLPF capacities for, I've forgotten, the vast majority of seismically induced transient frequency is less then that. High confidence for at least one success path, high confidence of low probability of seismic failure for at least one success path of the events is greater then 0.3 g.

Well, suppose that's the RHR system, suppose that the CLPF capacities of HPCI and RCIC on this plant or any of there support systems are down in the, I don't know pick a number, 0.4 g range. What kind of risk do I get now from about 0.5 g earthquakes, what's the frequency of those and how sensitive are the results to increased on unavailability of RHR?

Presuming of course that RHR isn't completely failed by that earthquake, you know, so there's a range of earthquakes where you where you might be susceptible. This argument doesn't address that at all. But it's called a bounding argument, it can't be any worse then this, my god it can be a lot worse then this.

MS. DROUIN: We'll do a word search on the word bounding, everywhere in the appendix --

CHAIR STETKAR: Yes, just do that, that might solve. Oh and one last question, and I don't

know the plant, but some of these things and again in particular, in terms of seismic events and to a somewhat lesser extent LOCAs, I'm a bit confused about what the conditional probability of early containment failure is given the damage scenarios. Because as I look at the analysis there seems to be some disconnect. Either some failures of containment heat removal are being assigned to something called a late large containment failure, which obviously isn't addressed here or I'm missing something.

Again, in particular for example, I know they take credit for CRD injection from the condensate storage tank, decent sized earthquake condensate storage tank isn't going to look like a puddle on the ground. They take credit I think, for firewater makeup, not sure that the firewater system at this plant is seismically qualified in a decent size seismic event, it might look like a puddle on the ground.

So a seismic failure within failure of RHR leads me to absolutely no containment heat removal and no core heat removal. It's not clear why the conditional likelihood of a large early release isn't fairly close to the core damage frequency in that condition. And of course the example doesn't talk

about large early release, it only talks about core damage.

MR. LEHNER: Yes.

CHAIR STETKAR: So, so I'm kind of left hanging on that metric, which is also considered in the decision making process.

MS. DROUIN: Right.

CHAIR STETKAR: I mean the argument is kind of made that says, well we sort of believe that large early release frequency will scale with core damage frequency the same way that it has done for everything we looked at. But we didn't look at large early release frequency for fires and we didn't look at large early release frequency or core damage for seismic.

MR. LEHNER: Right.

CHAIR STETKAR: So, so kind of try to be sensitive to some of those things, because as I said, the outside reader will read this as, oh okay, I can use these types of arguments and the NRC well accept them because these are the NRC's staff's examples.

MS. DROUIN: Right.

CHAIR STETKAR: There not EPRI's examples, that's a different, that's a much different --

MS. DROUIN: Well we'll do another very

good scrubbing of this.

CHAIR STETKAR: Much different dynamic.

MR. LEHNER: Yes.

CHAIR STETKAR: Okay.

MR. LEHNER: Yes, it's true the entire fire LERF is dismissed because it's not available, so it's treated --

CHAIR STETKAR: Well some of this, some of the strange things about the fires, John, is that the, there's actually a reasonable discussion on core damage back in that appendix on the fires. And it starts to explain, if you look at the conditional core damage probability for fires, you know given a train of RHR out versus transient, you know, the amalgam of transients, the other transients, all the other transients.

CHAIR STETKAR: It's clear the risk profile is very different. Given that, it's not at all clear to me why LERF would necessarily behave the same way as inferred that LERF applies for the amalgam of other transients and yet that whole issues is just not addressed --

MR. LEHNER: To small.

CHAIR STETKAR: -- it's just basically inferred that it's small enough to not make a

difference without any other justifications. So either, you know, as you work through the examples either address it or make sure that it's really clear that, you know, we didn't take up pages in this document but somebody should --

MS. DROUIN: Yes.

CHAIR STETKAR: -- address these particular issues somewhere. Without just, you know, qualitative arguments to get rid of them. And I won't take up anymore time. Anybody else have anything on the appendix?

MS. DROUIN: Okay, then we just have on final slid. Right now the NUREG is going through internal staff review and that's a two month review. So they've already, it went to them the same time it came to the ACRS, so we've already done 30 days and we have another 30 days for them to look at it and then we will get their comments and as we address and resolve theirs we will, you know, try and address and resolve what we've heard from today's meeting.

So that when we release it for public review hopefully, you know, we have, I mean we aren't going to come back to you with our resolution before we go public, but hopefully we understood you know, all the points you've brought up. I mean I think we

have, and I think the bulk of them are easily addressed.

So that's going to happen in mid-August for 60 days and then the review and comment closes in mid October and we plan to have it published by the end of November this calendar year.

CHAIR STETKAR: Now just, and I want to make sure we leave enough time for EPRI, but --

MS. DROUIN: And that's, that's all I have.

CHAIR STETKAR: Yes. Right at the moment we have a Full Committee meeting scheduled on this NUREG in October.

MR. LAI: September.

CHAIR STETKAR: Or September, some month not July.

MR. LEHNER: Right.

MS. DROUIN: Yes the only thing, we just have to coordinate is that, and I don't think it's a problem, but I just want to double check.

(Off the record comments)

CHAIR STETKAR: This is our Full Committee meeting --

MS. DROUIN: Right.

CHAIR STETKAR: -- so it will be --

MS. DROUIN: So you're the first of September.

MR. LEHNER: Before that probably.

CHAIR STETKAR: It will be way before, it's probably the second calender week in September of this year, I guess.

MS. DROUIN: Though we would be able to come to the Full Committee and at least give you a sense of what we did.

CHAIR STETKAR: At least to address some of the comments that we've brought up here, you will not have public comments folded in at that time.

MS. DROUIN: No, unless you want you us to come back --

CHAIR STETKAR: But that's what, maybe we should discuss it going forward to see, I don't want to have multiple meetings on it. I'd rather see something that looks like the final document including, however you might respond to some of the comments you've have from the subcommittee and public comments.

MS. DROUIN: I'm coming back in either November or December.

CHAIR STETKAR: Yes, well let's, you can work offline with John, but that's --

MS. DROUIN: Okay.

CHAIR STETKAR: That's how I think it would make a lot more sense rather then, if you're going to try to address some of our comments in an interim phase and then fold in whatever other things might come in from public comments. Having us look at something that's between those two, as a Full Committee, doesn't seem to awfully productive.

MS. DROUIN: Now --

CHAIR STETKAR: Especially if we decide to write a letter, I mean the letter probably wouldn't be fair and having two Full Committee meetings is not worthwhile either.

MS. DROUIN: Well if you're going to expect this 30 days in advance, then December would be --

CHAIR STETKAR: Okay.

MS. DROUIN: -- the better timeframe.

CHAIR STETKAR: Well we'll work on the timing offline, but it's starting to sound like the September Full Committee meeting is not too productive.

MS. DROUIN: Yes.

CHAIR STETKAR: And I tend to agree with you, I don't think we need another Subcommittee

meeting, but we should just make sure we schedule that correctly. Anything else from any other --

MS. DROUIN: Well I just had one more question, if you don't mind.

CHAIR STETKAR: Oh I'm sorry.

MS. DROUIN: You know it's been awhile since I've been to the ACRS and I know the protocols and everything changed, but I would love to be able to send to John a list of, here were the key issues that we heard, if we could get confirmation back just to make sure we have good communication going on?

CHAIR STETKAR: Absolutely, please do that.

MS. DROUIN: Okay.

CHAIR STETKAR: Anything that we can do to help clarify things, we will absolutely do that and just, as you said, pass it through John and if there's nay question we will try to clarify.

MEMBER SHACK: They're only comments from the Subcommittee so these are, so they're open?

CHAIR STETKAR: Yes, I mean this is the Subcommittee, that's right, thanks Bill.

MS. DROUIN: Correct, but we've heard --

CHAIR STETKAR: This is not the ACRS.

MEMBER SHACK: This is not the ACRS, it's

you know.

MS. DROUIN: This is what we heard from you gentlemen here today.

MEMBER SHACK: That's correct.

CHAIR STETKAR: Five guys sitting around a table.

MS. DROUIN: But the five best guys.

CHAIR STETKAR: Five guys, no five guys sitting around a table. I have to be careful these days that indeed it's only the five guys.

MS. DROUIN: So where's the hamburger and fries?

CHAIR STETKAR: Yes there you go. Anything else?

MS. DROUIN: No thank you very much, it was a pleasure meeting --

CHAIR STETKAR: Any of the other members have any questions? With that, thank you very, very much.

MS. DROUIN: Thank you.

CHAIR STETKAR: I think it was good, good presentation and --

MEMBER SHACK: Learned a lot.

CHAIR STETKAR: Good discussion and I believe that we have some material from EPRI.

MS. PRESLEY: My presentation is only two slides long so.

CHAIR STETKAR: Your presentation is only two slides, but I count six. So either someone slipped --

MS. PRESLEY: We have two backup slides.

CHAIR STETKAR: Did someone --

MEMBER SHACK: Two black up slides. Okay and a opening and closing right, so there is only two.

CHAIR STETKAR: Okay.

MS. PRESLEY: There you go.

MS. DROUIN: I have them loaded up for you.

MS. PRESLEY: Okay.

CHAIR STETKAR: And we have a low budget operation here, so you have to run everything yourself.

MS. PRESLEY: Oh okay, thanks I got it.

MS. PRESLEY: So my name is Mary Presley, I'm from EPRI. One of the newer project managers in the Risk and Safety Management Group. Just handed over, got this work handed over so hopefully I'll be able to answer all of your questions, but there may be a couple that I might have to defer.

So just the quick background is, we

published 1016737, which was treatment of parameter and model uncertainty for PRA in 2008 as a companion report to the first, to the 1855. And that included a section on parameter uncertainty and a section on model uncertainty and then the bulk of the document was an appendix which provided potential sources of model uncertainty for internal events.

And the sections that had to do with model, sorry, parameter uncertainty we included additional guidance on state-of-knowledge correlation, so some of the questions that had been asked about what happens when you vary your important contributors to --

MEMBER SHACK: Significant.

MS. PRESLEY: Significant contributors, or potentially significant because of the state-of-knowledge correlation, but they get truncated out. There is some specific items in 1016737, not about truncation, but about where to look for things that are important state-of-knowledge correlations importance.

So where you have a lots of ands, and it gives some guidance on fractional contribution to risk metrics based on error factor size and such. So that gives the analyst some guidance of where to look and

where they may have been truncated out.

CHAIR STETKAR: But the lots of ands still depends on the generation of the cutsets so that somebody could look at that, right?

MS. PRESLEY: Yes, or I mean.

CHAIR STETKAR: Which gets into the truncation?

MS. PRESLEY: Yes.

CHAIR STETKAR: Okay.

MS. PRESLEY: But also knowledge of the model, I mean.

CHAIR STETKAR: Yes, yes. But it does, I thought I remembered that, it does address this notion of look in places where you do have larger error factors or uncertainties.

MS. PRESLEY: Yes.

CHAIR STETKAR: Okay.

MS. PRESLEY: And then in terms of, okay, so in terms of -- I want to make sure I address all of the questions that you guys have been asking. Model uncertainty it also does speak a little bit to sensitivity studies and how you should ensure you have confidence in the sensitivity, how much confidence you have in those sensitivity studies and the justification that goes into that. There is a brief

section on that and I think we're going to expand a little bit on that in the next document.

So the original 1016737 will be retained as it is and then the update that we're doing to go with the revision of 1855 will be a new document. Question on version control, this document is set, that will be a fixed report number.

CHAIR STETKAR: Yes.

MS. PRESLEY: When they're updated it gets a new report number, so when Mary cites something in 1855 with that number, she doesn't have to worry about us changing stuff on her.

CHAIR STETKAR: Okay, good.

MS. PRESLEY: So the new report, we are expecting initial draft by the end of July. We'd like to put out our draft for comment, it will go to our Technical Advisory Committee and it'll go to the NRC. This is the closest thing we are doing to a pilot, is getting review from our members. We can ask specifically for them to look at its usefulness, if there's suggestion for that we're open.

CHAIR STETKAR: I just, you know the, certain, even the full ACRS can't speak about these types of things. My own personal opinion knowing what the industry has gone through with the fire stuff and

NUREG/CR-6850, although in some sense this not as convolved as all of those analyses, it still treads in the area of unease and sort of philosophy of how to actually implement this guidance that I suspect a lot of people don't have any experience with at all.

And because of that, you know, despite what comments you might get back from people who haven't ever really thought about doing this, until someone actually sits down and tries to go through the process once and sort of follow the guidance and struggle with what some of these terms might mean.

The first application that cites the fact that it's being used, might have real difficulty. So there might be, you know, a fairly strong benefit from having somebody pilot this before, you know the part of the problem is, to my knowledge, and I will learn more about this in July. For example the, at least the two pilot plants on NFPA 805 did not address uncertainty, period.

And I know that to be a fact. I don't know if the ones that are being submitted now are addressing uncertainty, we'll learn a bit about that in about a month. I have no idea whether the folks were putting together the risk-informed technical specifications for one of the new reactor designs have

thought about addressing uncertainty. My suspicion is they probably haven't.

Both of those are rather, certainly the fires are pretty pervasive and visible throughout the industry and certainly, from the perspective of the one COL applicant, it's going to be a fairly important licensing submittal for them.

MEMBER BLEY: Although we haven't reviewed those completed analyses, from meetings it seems, at least to me it seems pretty clear that some, at least some of the unhappiness with conservatism has to do with not actually doing uncertainty analysis but assuming worst cases.

CHAIR STETKAR: In the fires I'm pretty --

MEMBER BLEY: In the fires, yes. That's what I'm talking about, the fires yes.

MS. DROUIN: Can I jump in and say something here?

CHAIR STETKAR: Yes.

MS. DROUIN: In support of the EPRI work, one of the things that Mary hasn't talked about is that they have a very systematic process that they've described in their document for how they go about identifying the sources of uncertainty.

And so that process which was used to

identify for internal events and internal flood, in the current document that process is still being used on this new one, but in addition, and I know she's going to talk to you a little, what this has in addition to make the sources even more robust, for lack of a better word, is that we did have this workshop that we co-sponsored with EPRI where we brought together quite a few experts in the field to help us not only identify the sources but to understand them and why they were sources et cetera.

So this new document that EPRI will be coming out, has the benefit of this very successful workshop that was held.

CHAIR STETKAR: Yes.

MS. PRESLEY: So as Mary mentioned we, this new supplement will have the tables of generic sources of uncertainty for the internal fires, seismic, low-power shutdown at Level 2 based on this workshop that we had. I have backup slides showing participants and how the workshop was structured if you're interested. And it was a joint effort with NRC.

And then there will also be some additional guidance in the update on preparing risk informed applications. And a lot of that's going to

be geared towards kind of a more practitioner level, how to, there's the steps that are presented in 1855 and there's a lot of good detail in there. This is going to be more focused that we're at the key iteration points.

From a practical level how do you actually exercise those steps and then on the other side how do you, once you have the results, really what are some practical ways of dissecting them so you understand and build that picture of how your plant operates and where your uncertainties really are. And then put those into words when you're preparing a submittal. So those are the guidance that's going to accompany this new revision. Well that's it.

CHAIR STETKAR: Because of the time, I think I understand what you did in the workshop and I think that's really, really useful. And I think Dennis mentioned this earlier, the only problem of these types of workshops is that they're all the experts in the field. They're the people who know, and all of these folks have their own knowledge and experience about what may be important and how they address those things.

They're not the PRA practitioner out at Plant X who suddenly has the charter to go and you are

the lead to develop a risk-informed submittal for and AOT extension in this framework.

MS. PRESLEY: Right.

CHAIR STETKAR: And that's, I think, a bit of the problem that the fire stuff suffered under. And I recognize several of the names on here from example, the fire stuff. And everybody got together and knew exactly what needed to be done and thought that they expressed it in the clearest, best possible way. And you hear people who are trying to use it complain bitterly that it's not detailed enough or it's too conservative or there's a misinterpretations and there's finger pointing. And that's the problem.

MS. PRESLEY: There is some specific guidance in the old, as Mary mentioned, it kind of gives a four-step process for basically how you use the tables and then tailor that to your plant. So there is a little guidance, hand-holding, on how to go from the, like thoughts, to something they can actually use in a submittal. But a pilot would probably, certainly gathering lessons learned once it's been applied would be very beneficial.

MEMBER SHACK: Well this has been around since 2008, have you had experience with people actually using it?

MS. PRESLEY: Yes. I know people have used because I know I've gotten requests for Word versions of the table. But I personally don't have the history with the project to tell you in detail what those are.

CHAIR STETKAR: Does the staff, is Steve still here? Have you had any submittals that refer to uncertainty analyses done according to this sort of guidance?

MR. DINSMORE: No, sir.

CHAIR STETKAR: Thank you.

MS. DROUIN: Well it may not be reflected explicitly in a submittal because 1855 is called out as to be used in the standard. And it's called out to be used in 1.200, like other specific documents. So I would not be surprised that they would just say I met 1.200. And they wouldn't come in and say well I've met all of these other related documents.

CHAIR STETKAR: Okay. I was just curious. Because in a lot of cases people will refer to EPRI documents saying I followed this guidance.

MR. DINSMORE: Let me agree with Mary. She gave a much better answer, but mine was shorter.

CHAIR STETKAR: Okay, thanks.

MEMBER SHACK: Well have you seen any

evidence that reflects use of this document, even if it's cited 1.200?

MR. DINSMORE: I personally don't know. I would have to go look. We can do that though.

CHAIR STETKAR: I mean in some sense it sounds like the scope of the document is certainly being increased, if not just to address the other hazards. And I'm sure there are a lot of other changes in there that would --

MS. PRESLEY: And this is not an update in that it changes anything in the original document, it just adds additional guidance and additional tables.

CHAIR STETKAR: It hasn't changed the basic philosophy of what was there. It just expands. Okay.

MS. DROUIN: And for what it's worth we have received, informally, you know, we're talking with licensees that they are using it. And I think how many public comments we get back, to me, is indicative. Because if you aren't going to use it people aren't going to waste their time giving comments.

CHAIR STETKAR: Right.

MS. DROUIN: So when we first published it and we had that public workshop we had a huge

attendance at the workshop. And quite a few formal comments submitted, which again, to me, why would you spend the time to come to the workshop or provide the comments if you weren't going to use it?

CHAIR STETKAR: Okay.

MEMBER SCHULTZ: So this is going to the NRC for review as well as to the Technical Advisory Committees?

MS. PRESLEY: Yes, and the MOU.

MEMBER SCHULTZ: And therefore, Mary, there'll be some overlap with the internal review of --

MS. DROUIN: Yes. And we're trying --

MEMBER SCHULTZ: -- the NUREG as well as the EPRI guidance?

MS. DROUIN: Right. And we're trying to closely coordinate our schedules.

MS. PRESLEY: Yes.

MS. DROUIN: So that we hit the publisher at the same time.

MS. PRESLEY: And the intention is for us to send our document out for review about the same time that you all do yours, so we can let our reviewers know to review them together.

CHAIR STETKAR: I guess one thing I

struggled with a little bit, we did see the 2008 version of the EPRI report, I know we did because I have notes on it. I don't recall whether we actually discussed it in a Subcommittee meeting.

MEMBER BLEY: I think we did.

CHAIR STETKAR: I think we did. And I guess the question to the other subcommittee members is should we look at this one? You know we talked earlier about going forward on 1855 and probably not having another Subcommittee meeting on it, just bring it to the Full Committee whenever the comments are included. But there might be an incentive to have another Subcommittee meeting to look, to a lesser degree, on whatever interim changes you've thought ab out for 1855. But more focus on the EPRI report.

MS. DROUIN: You know, I do know that in the current published version of 1855, in the EPRI document, that EPRI did come to the Subcommittee with us and had a very detailed presentation on their document. And they came in with their entire team, didn't throw poor Mary out there by her lonesome. And did a very detailed presentation. But that's up to you guys whether you all want that or not, and whether EPRI is willing to come.

CHAIR STETKAR: Well, I mean that's one

thing. But I mean if there's essentially no interest among the Subcommittee it's a moot point. If there is it still might be a moot point.

MEMBER SCHULTZ: But are you thinking of a meeting then that would be coordinated for perhaps the September Subcommittee?

CHAIR STETKAR: It would probably be in the September timeframe because that would, you know, just the practicality of things, we're already full for July and full for the August, I think, Subcommittee meeting.

MS. PRESLEY: You'd like to see it before they come back? After the public comments have been addressed, because it --

CHAIR STETKAR: That's the big question.

MS. DROUIN: See the difficulty, John, is you all's 30 day requirement of getting something 30 days in advance. I mean I can't speak for Mary, I don't know if their schedule has that factored in. We factor that into ours. But they may not have that in there.

CHAIR STETKAR: I don't want to, you know, belabor this because of the time today, but is there, of the members that who are present --

MEMBER SHACK: Well, I think it would

interesting you know, I think September is probably too early.

MEMBER SHULTZ: Yes, I am looking more carefully here, mid October --

CHAIR STETKAR: Dennis?

MEMBER BLEY: I think it's a good idea.

CHAIR STETKAR: Let's just pencil, we can work out the logistics of the timing based on when the reports, how you all are coordinating things going out and things coming in, but let's try to do that then. Let's pencil in another subcommittee meeting on, you know, this general topic where we're in particular we have an opportunity to focus more on the EPRI report and what's in there and at the same time any changes, wherever they are, in the mill for the NUREG.

MS. DROUIN: Okay.

MS. PRESLEY: For clarification you've already been briefed on the older report, it's just the new, the update that you want?

CHAIR STETKAR: Yes.

MS. PRESLEY: Okay.

CHAIR STETKAR: But in the same sense that we're briefed on the older version, the previous version of 1855 and obviously, you know, had some exchange on this revision. There may be similar

exchange on the newer --

MS. PRESLEY: All right.

CHAIR STETKAR: -- version of your report. Any other questions or comments for Mary, if not thank you very much. You absolutely held to your timeframe. And we were good. Before we close out --

MR. LAI: The line is open.

CHAIR STETKAR: I am not seeing a lot of public in the room but I have to ask, is anybody, any members of the public, anybody want to make any other comments?

If not I think the bridge line is open, if there is someone out there could you just make a noise or at least acknowledge your existence so we can confirm that the line is open, say something?

Okay that either means it's not open or there's no one there. I'm assuming it's open.

MEMBER BLEY: Did we go around?

CHAIR STETKAR: We haven't yet, I just wanted to ask for comments first. Okay, hearing no public comments then, as we usually do, let's go around the table and get some final comments, questions, observations by the subcommittee members and we'll go with Steve first.

MEMBER SHULTZ: I have no additional

comments, except to again thank the staff and EPRI for the presentations. I thought they were very thorough and presented the information with the status of the project very well. I do feel that it would be worthwhile, given the importance of this work and what we expect it to be in terms of its usage, to revisit it and follow this carefully until its finally up.

CHAIR STETKAR: Thank you, Dennis?

MEMBER BLEY: Yes I would say ditto to the presentations, the discussion and all the work that went on between the last time we saw everyone and now. We've raised a number of issues that I guess still concern me. There's just one I want to revisit in closing remarks, and that has to do with the decision that if one uses a consensus model you don't have to deal with model uncertainty.

I guess I don't really understand that, I do know that the standard says the same thing. It's kind of, I guess we're really saying 1855 does not require addressing the model uncertainty. What would seem more reasonable to me, with a consensus approach, would be that if that approach includes a full treatment of uncertainty then the use of that uncertainty from the consensus model would be perfectly adequate.

But if it doesn't address its uncertainty, I don't see how we dodge looking at the model uncertainty. It just doesn't hang together. That's all.

CHAIR STETKAR: Thank you, Bill?

MEMBER SHACK: Well I just wanted to say, I think you know, comparing the two versions, the Rev 0 and the Rev 1, having never done a PRA I really can't tell, but it certainly seems to me we now have a process that really wasn't in the original. The original one as you said is more discussion, but this really does seem like a process and I'll be very interested to see some products that come out, you know, maybe we will see risk-informed presentations that reflect this process.

I kind of agree with Dennis that you know, that there is that hanging problem with the consensus model. I did sort of somehow get an implicit kind of or an assumption that somehow the parameter of uncertainty with a consensus model kind of addressed the uncertainty associated with the model, but that really is kind of iffy to, but you know.

But again, it's hard to see how you can really not address the model uncertainty even if it's a consensus model, its impact you know, and whether

it's done with, somehow demonstrate that the parameter uncertainty really does cover it or you've done enough insensitivity studies that somehow it really does seem that it has addressed.

CHAIR STETKAR: What was the, we saw one recently where they looked at model and uncertainty, and I thought did a pretty decent job on it. Not a risk-informed.

MEMBER SHACK: You mean SOARCA?

CHAIR STETKAR: No not SOARCA. It was, I think it was the XLPR. Was that the pipe-rupture?

MEMBER SHACK: The pipe-rupture people.

MEMBER BLEY: Oh yes.

CHAIR STETKAR: They had a kind of a neat way of looking at that if I recall. I don't remember any of the details, but I mean that, it struck me as --

MEMBER SHACK: Well they did a very formalistic kind of uncertainty analysis. I think that it would be tough to duplicate here, because they're dealing with a very narrow topic.

CHAIR STETKAR: That's true.

MEMBER SHACK: But it just seems to me that, that does seem to be a problem with, as I say, it seems to me as a process it goes a long way towards

addressing issues at the, that ACRS has complained about for years as far as uncertainty associated.

And Steve might actually even being to expect to find things other then the mean value. If he you know, if people really did follow this and I think that's one other comment I would make, is that if NRR doesn't look at the uncertainty analysis it's not going to get used and so I think there has to be an expectation here that the NRC now expects these uncertainty analysis to accompany risk-informed applications.

MS. DROUIN: See and I believe that's a true fundamental change from NRC's position and I'm not disagreeing with you, I'm just saying if that expectation now changes where it's not only considering the mean value, but also you know, what is the size of the uncertainty.

MEMBER SHACK: Yes, I mean agree with the 1.174 that the mean value is the, you know, if you've satisfied the criteria and you satisfied the criteria from the mean value, but I think as far as the over all decision in a 1.174 process, knowing the uncertainty is important, goes along with mean value.

MS. DROUIN: Yes, all I'm saying is that, that's not their position right now and I think if you

wanted to move over to that and I'm not disagreeing that it should go there, but I think you're making a fundamental change in a policy somewhat that would probably have to go all the way to the Commission. That's just my personal view there.

MEMBER SHACK: Well then if we get around to writing the letter on this, that might well be one of the issues.

CHAIR STETKAR: That's not new ground.

MS. DROUIN: Yes, I am just saying I think if I went to NRR and NRO right now and said you know, we want to now do I think I would get whoa, whoa.

CHAIR STETKAR: Against policy, yes.

MS. DROUIN: No, no this is how we do it.

MEMBER SHACK: Okay, I mean I see it as a policy change, because it seemed to me that the decision process in 1.174 would include this.

MS. DROUIN: I'm just saying that has not been the interpretation.

CHAIR STETKAR: That certainly does not preclude it.

MEMBER SHULTZ: Doesn't preclude it.

MS. DROUIN: Right.

CHAIR STETKAR: And at least qualitatively seems to endorse them.

MR. LACHANCE: This is Jeff LaChance, just want you know to point out one thing with regard to that when Reg Guide 1.174, the guidance criteria was established, they did you know, they wrote some SECYs on this with regard to, you know, should they use the mean, the 95th percentile or use the uncertainty, and so I mean that's all ground that was considered, you know, years and years ago. Doesn't mean it can't be revisited but I just want to point out to you, that there was consideration to this.

CHAIR STETKAR: Well certainly, I think you know from our perspective we've sort of raised some concerns here at the Subcommittee level, it's not the ACRS it's the Subcommittee. I think we'd be interested to see, you know, if and how those concerns are addressed in the final version of 1855.

MS. DROUIN: Well trust me I'm going to re-raise it, from a personal perspective, I don't know how you cannot consider the size of the uncertainty and say you've adequately treated uncertainty, but you know, that's not my call.

CHAIR STETKAR: That's right. But I was going to say, in terms of process I think that yes, any decision on the Committee's part certainly, if we're going to write a letter on this issue, we'd

certainly look at the old SECYs and what ground was plowed.

(Simultaneous speaking.)

MEMBER BLEY: In the beginning before we have a Full Committee meeting, maybe John could track that down for us and get --

MS. DROUIN: Because in this revision we had it in there, We actually had as part of the --

MEMBER BLEY: Oh you did?

MS. DROUIN: Yes we did, and we took it out.

MEMBER BLEY: Ah.

MS. DROUIN: Because it was not the way we do business. That was, this is how it's been interpreted.

CHAIR STETKAR: Okay, good. Thank you.

MEMBER BLEY: Thanks that helps me a little.

CHAIR STETKAR: Anything more Bill?

MEMBER SHACK: No.

CHAIR STETKAR: And I don't have anything. I echo Dennis's and Bill's concerns about the model uncertainty and particular the overall use of uncertainty in the decision making process. Certainly and I have made a lot of other you know, specific

comments. I do by the way, all of the negativity and my comments, that's just the kind of person I am.

The NUREG is an awful lot better than it was three years ago, an awful lot better. And I think that it's, I think we're really close to having a process and kind of an understanding that, as you said Mary, can kind of push the whole agency in the direction that I think both needs to be pushed, in some cases pushed, and in other cases kind of bring together a little bit of diverse opinions about how things should be addressed. So I do think this was an important effort, it's just not a run of the mill NUREG.

And I think you folks have done a really good job you know, getting to where you are on it.

MS. DROUIN: Thank you. I mean I am such a believer in risk-informed regulation, but I think that you cannot go forward, truly forward, and fully embrace it without having a good understanding of your uncertainties.

CHAIR STETKAR: Amen. Anything else from anyone, if not thank you all we are adjourned.

(Whereupon, the meeting in the above-mentioned matter was concluded at 5:27 p.m.)

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EPRI 1016737 - *Treatment of Parameter and Model Uncertainty for Probabilistic Risk Assessments*

Presented By:

Mary R. Presley

Electric Power Research Institute

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June 19, 2012

EPRI Treatment of Uncertainty

- EPRI 1016737 - *Treatment of Parameter and Model Uncertainty for Probabilistic Risk Assessments* (Final Report, December 2008)
  - Developed as complement to NUREG-1855
  - Includes guidance for dealing with parameter and model uncertainty
  - Includes guidance for dealing with SOKC
  - Includes list of potential sources of model uncertainty for internal events
  - To be retained (i.e., new EPRI document will not be an updated version of this report)

EPRI Treatment of Uncertainty

- New EPRI Report
  - Initial draft expected by end of July 2012
  - Supplement to guidance provided in EPRI 1016737
    - Include potential sources of model uncertainty related to:
      - internal fires
      - seismic
      - low power shutdown
      - level 2
    - Includes input from 2012 uncertainty workshop with industry experts
  - Complement to NUREG-1855, Revision 1
    - Provides additional guidance to licensees for preparing risk-informed applications

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Backup

2012 Uncertainty Workshop Presenters

- **Workshop Format**
  - Presenters chosen to present sources of uncertainty to break-out session
  - Break-out session moderated discussion
  - Summary presentation/discussion
- **Fire**
  - Moderator: Jeff LaChance (SNL)
  - Presenters:
    - Ray Gallucci (NRC)
    - Brian Metzger (NRC)
    - Paul Guymer (Jacobson Analytics)
    - Mike Wright (Jacobson Analytics)
    - Mardy Kazarians (Kazarians and Associates)
    - Dennis Henneke (GE – Hitachi)
- **Seismic**
  - Moderator: John Lehner (BNL)
  - Presenters:
    - Annie Kammerer (NRC)
    - Jim Xu (NRC)
    - M. K. Ravindra (MKRavindra Consulting)
    - Greg Hardy (Simpson Gumpertz & Heger)
- **LPSD**
  - Moderators:
    - Gareth Parry (ERIN Engineering)
    - Matt Dennis (SNL)
  - Presenters:
    - Ken Kiper (NextEra Energy)
    - Don Wakefield (ABS Consulting)
    - Marie Pohida (NRC)
    - Steve Eide (Scientech)
- **Level 2**
  - Moderators:
    - Don Vanover (ERIN Engineering)
    - Tim Wheeler (SNL)
  - Presenters:
    - Don Helton (NRC)
    - Dr. Richard Denning (OSU)
    - Mark Leonard (dycoda LLC)
    - Jeff Gabor (ERIN Engineering)
    - Ray Schneider (Westinghouse Electric Co.)

Example Table from 1016737

Table A-1
Issue Characterization for Sources of Model Uncertainty

Issue Description		Issue Characterization	
Topic	Discussion of Issue	Part of Model Affected	Possible Approaches (Not Exhaustive)
Initiating Event Analysis (IE)			
1. Grid stability	The LOOP frequency is a function of several factors including switchyard design, the number and independence of offsite power feeds, the local power production and consumption environment and the degree of plant control of the local grid and grid maintenance. Three different aspects relate to this issue: 1a. LOOP initiating event frequency values and recovery probabilities 1b. Conditional LOOP probability 1c. Availability of dc power to perform restoration actions	LOOP sequences	1. LOOP frequencies for the different categories and recovery probabilities based on data from NUREG/CR-6890 [11]. Each LOOP category uniquely represented in the model.
			2. Different categories merged into single LOOP frequency with weighted average recovery probabilities.
			3. Update of data for recent experience and use separate analysis to account for plant-specific or regional grid stability issues.
		Consequential LOOP sequences	4. Conditional LOOP frequencies based on NRC recommended values [12, 20].
			5. Conditional LOOP frequencies based on EPRI expert elicitation values [13] or Owners Group assessments.
		LOOP or consequential LOOP sequences with offsite power recovered	6. Plant-specific features and dependencies accounted for in system modeling of LOOP restoration after ac power recovery occurs.
			7. Use of generic data assumed to adequately account for availability of dc power to perform restoration actions.

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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

June 19, 2012

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OUTLINE

- Background
- Objective
- Scope
- NUREG Structure
- Overall Approach
- Detailed Guidance
- Appendix
- Steps Forward

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BACKGROUND

- In letters dated April 21, 2003, and May 16, 2003, ACRS recommended guidance be developed on how to perform sensitivity and uncertainty analyses.
  - More specifically, guidance on both how to treat the uncertainties but also guidance on the acceptable characterization of other methods, such as bounding analyses, to ensure that reasonable approaches are used
- In a letter dated February 23, 2009, ACRS supported publication of the NUREG but did not believe Appendix A (an example test case) should be published until it was revised.
- NUREG-1855 was first issued for draft in November 2007 and then for use in March 2009; Appendix A has never been published.
- The staff met with the subcommittee on March 27, 2009, the Committee supported the proposed staff changes.
  - Staff agreed to meet with ACRS to go over final revisions to Appendix A; however, ACRS deferred the meeting

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BACKGROUND (CONT'D)

- A major public workshop was held (May 5 and 6, 2009) and a test case using the guidance in the NUREG to assess the effectiveness of this guidance was provided (Appendix A).
  - Insights from the public, the test case, and risk-informed activities identified numerous areas for improvement to the guidance and scope of this NUREG.
  - Most significant insight was the difficulty to discern guidance for the licensee versus guidance for the staff.
- Major change involved a restructuring of the document and development of explicit process in describing the guidance for the treatment of the uncertainties.
- Scope was expanded to include sources of uncertainties associated with low power shutdown, internal fire, seismic, and Level 2 PRA
  - This expanded scope primarily affected the EPRI report.

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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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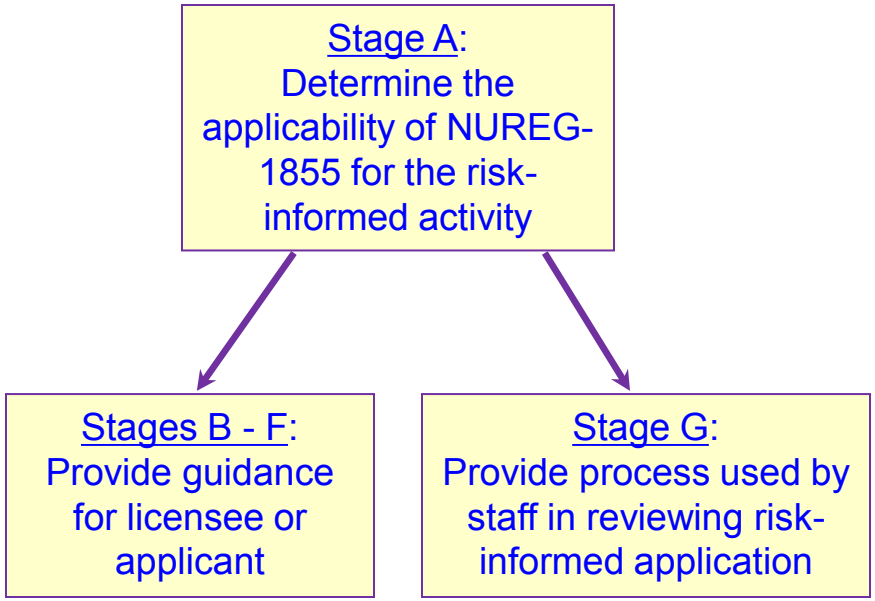
SCOPE

- Scope (NUREG) – guidance on the uncertainty identification and characterization process and on the process of factoring the results into the decisionmaking is generic and independent of the specific source of uncertainty.
  - Consequently, the guidance is applicable for sources of uncertainty in PRAs that address at-power and low power and shutdown operating conditions, and both internal and external hazards.
- Scope (EPRI report) –
  - SOKC correlation
  - List of generic sources of uncertainties for Level 1 and Level 2 for internal hazards and seismic and all plant operating modes

NUREG Restructure

- Guidance organized into three parts around seven stages:
  - Stage A: Determine if application subject to NUREG-1855
  - Stages B-F: Guidance for licensee or applicant
  - Stage G: Process used by staff



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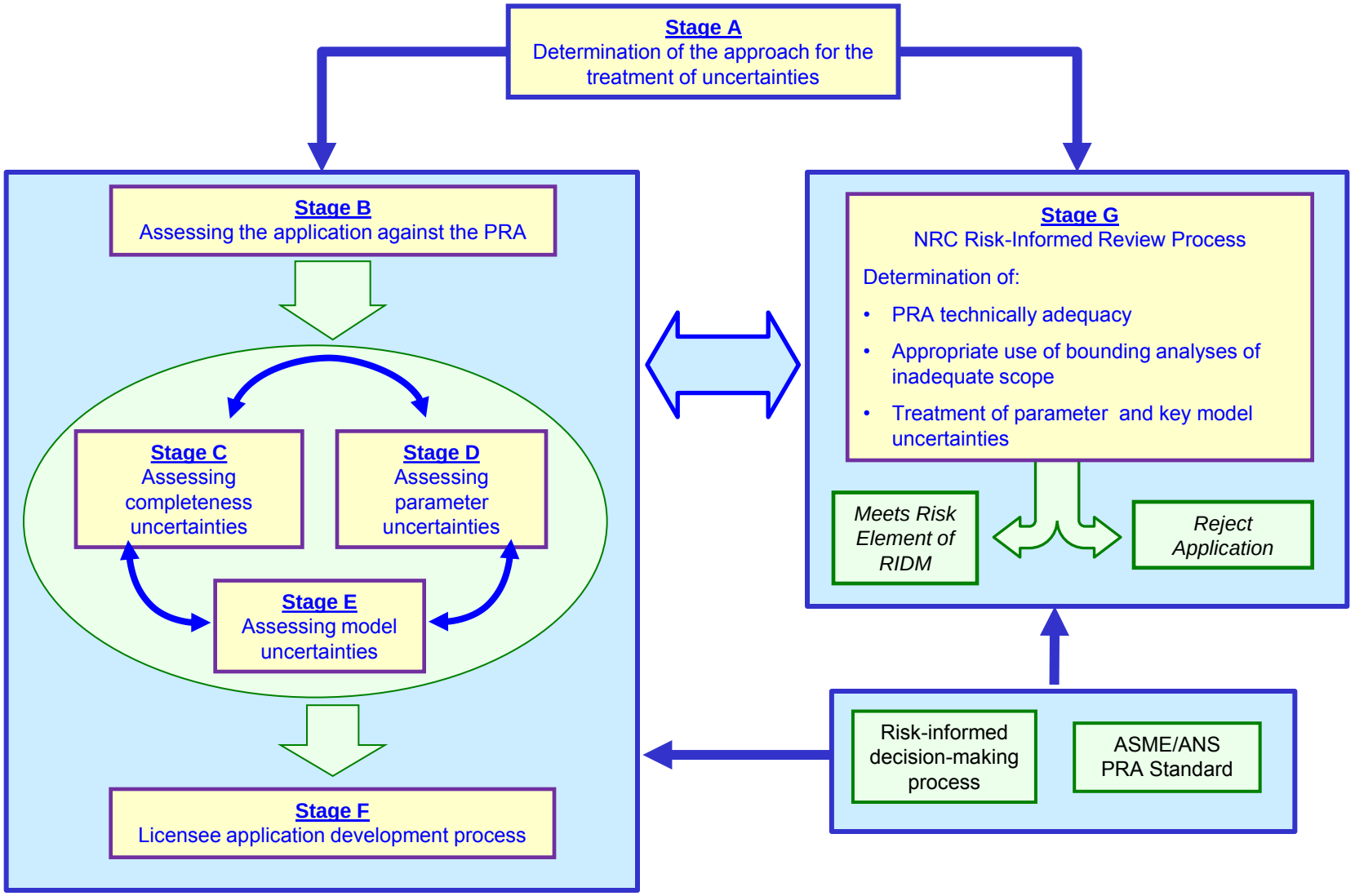
NUREG RESTRUCTURE

- Part 1 – Stage A: Determine if application is subject to NUREG-1855
  - This guidance generally involves understanding the type of application and the type of risk analysis and results needed to support the application.
- Part 2 – Stages B-F: Guidance for licensee or applicant
  - Stage B: Understanding risk-informed application and determining the scope of the PRA needed to support the application
  - Stage C: Evaluating the completeness of the PRA model and determining if bounding analyses are acceptable for the missing scope
  - Stage D: Evaluating the parameter uncertainties; i.e., determining if the risk results meet the applicable acceptance guidelines
  - Stage E: Evaluating model uncertainties to determine their impact on the applicable acceptance guidelines
  - Stage F: Developing strategies to address key uncertainties in the application
- Part 3 – Stage G: Process used by staff
  - This process generally involves confirming that the licensee has provided adequate justification regarding the risk results as compared to the acceptance guidelines

NUREG Restructure



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Overall Approach

- Both the licensee and the staff need to have a clear understanding of
  - the application and the risk contributors that can affect the decision
  - the uncertainties, in the context of the decision under consideration
  - the impact of the uncertainties on the risk results and acceptance guidelines being used to support the decision under consideration
  - the requirements in the ASME/ANS PRA standards regarding uncertainties, as endorsed by the NRC

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Types of Uncertainties

- Completeness uncertainty relates to risk contributors that are not accounted for in the PRA model.
  - This type of uncertainty may further be categorized as either being known, but not included in the PRA model, or unknown. Both known and unknown types of uncertainty are important.
- Parameter uncertainty relates to the uncertainty in the computation of the input parameter values used to quantify the frequencies and probabilities of the events in the PRA logic model.
  - These uncertainties can be characterized by probability distributions that relate to the analysts' degree of belief in the values of these parameters (which could be derived from simple statistical models or from more sophisticated models).
- Model uncertainty relates to the uncertainty associated with some aspect of a PRA model that can be represented by any one of several different modeling approaches
  - Uncertainty is introduced into the PRA results since there is no consensus about which model most appropriately represents the particular aspect of the plant being modeled.

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PRA STANDARD REQUIREMENTS

- For parameter uncertainties, the Standard, as endorsed by the NRC, requires:
  - Depending on the significance of the basic event, mean values or point estimates are acceptable with characterizing the uncertainty either qualitatively or with a probabilistic representation
  - Depending on the significance of the sequences and the state-of-knowledge-correlation, mean values or point estimates of the risk metrics are acceptable with an estimate of the uncertainty interval or with propagating the uncertainty distribution

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PRA STANDARD REQUIREMENTS

- For model uncertainties, the Standard, as endorsed by the NRC, requires:
  - Identifying sources of model uncertainty and characterizing the effect of those sources on the PRA (e.g., introduction of a new basic event, changes to basic event probabilities, change in success criterion, or introduction of a new initiating event)
  - 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 data, approach or model is known to have an impact on the PRA model. 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 which has a sound technical basis such that the basis would receive broad acceptance within the relevant technical community. The relevant technical community includes those individuals with explicit knowledge and experience for the given issue.

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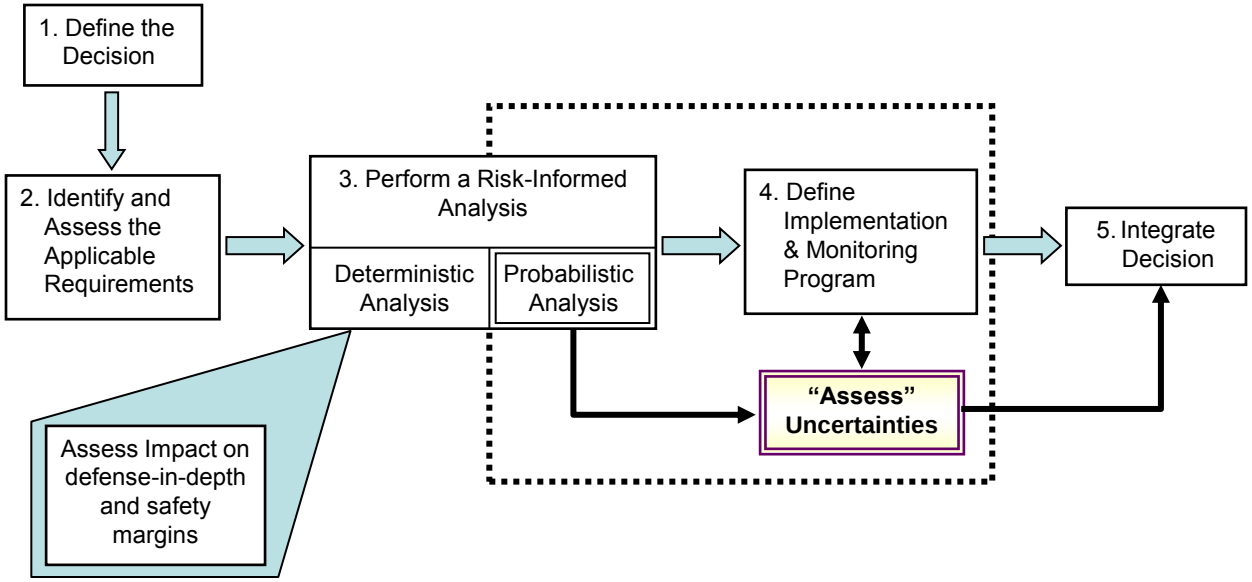
Risk-Informed Decisionmaking Process

- The NRC defined a set of key principles to be followed for risk-informed decisions:
  - Principle 1: Current Regulations Met
  - Principle 2: Consistency with Defense-in-Depth Philosophy
  - Principle 3: Maintenance of Safety Margins
  - Principle 4: Acceptable Risk Impact
  - Principle 5: Monitor Performance
- The principles of risk-informed decisionmaking are expected to be observed; however, they do not describe the process that is used in risk-informed decisionmaking.

RISK-INFORMED DECISIONMAKING PROCESS (CONT'D)



- The above elements constitute the steps of an integrated risk-informed decisionmaking process.
- The licensee identifies the uncertainties and determines their impact on the PRA results and, ultimately, on the acceptance guidelines.
- The NRC staff is determines whether the process followed by the licensee is adequate.

Stage A: Approach for Treating Risk Assessment Uncertainties

- Objective: guidance to both the licensee and the staff on determining whether the approach in NUREG-1855 for treating PRA uncertainties should be used for the risk-informed activity (i.e., the decision) under consideration.
- The approach used to address uncertainties can vary and is dependent on the nature of the risk-informed activity under consideration.
- The guidance involves two steps:
  - Step A-1: The type of risk results used in the application – Are the risk results PRA or non-PRA in nature?
  - Step A-2: Application of PRA results – If the results are from a PRA, how are the results being used to support the decision?
- Outcome: a determination of whether known regulatory risk-informed activities should be subject to the process in NUREG-1855 has been performed

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STAGE A (CONT'D)

- **Step A-1**: The purpose of this step is to determine whether the development of a PRA model is needed.
- This NUREG provides an approach (guidance) for the treatment of uncertainties relative to quantitative acceptance guidelines
  - for many decisions, the primary measure for determining acceptability of the decision is whether the quantitative acceptance guidelines are challenged by the risk results
- If a given risk-informed activity is determined to be a licensee-initiated regulatory activity, but does not utilize the results from a PRA, it is not subject to the approach for the treatment of uncertainties provided in this NUREG.

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STAGE A (CONT'D)

- **Step A-2**: the purpose of this step is to determine how the PRA results are used to support the decision under consideration. Addressing the uncertainties in the PRA is dependent on how the results are being used.
- Examples of different uses include:
  - The risk metrics from the PRA are continuously being evaluated such that at any time, the risk associated with the current configuration is known (i.e., a risk monitor).
  - The decision under consideration is based on reviewing the PRA risk results against specified regulatory acceptance guidelines.
  - The risk significance of a decision is being evaluated at the time of occurrence of an event.

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STAGE A (CONT'D)

Examples of applications subject and not subject to NUREG-1855:

- Technical Specification Initiative 5b, Risk-Informed Surveillance Frequencies
  - Evaluates Δ risk
  - Utilizes a PRA
  - Risk is not continuously evaluated
  - Risk is evaluated to support initiative
  - Risk not evaluated as a result of an event
  - Subject to NUREG-1855
- Maintenance Rule, 10CFR 50.65 (a)(2)
  - Utilizes a risk monitor
  - Utilizes a PRA
  - Risk is continuously evaluated
  - Risk not evaluated to support initiative
  - Risk not evaluated as a result of an event
  - Not subject to NUREG-1855

STAGE B: ASSESSING PRA SCOPE AND LEVEL OF DETAIL

- Objective: provides guidance to the licensee on determining the scope and level of detail of a PRA needed to support a risk-informed application.
- The required PRA scope and level of detail can vary for different risk-informed activities. It is important that the PRA address all important contributors to risk that can be affected by a proposed risk-informed activity and their associated uncertainties.
- The guidance involves 3 steps:
  - Step B-1: Understanding the risk-informed application and decision.
  - Step B-2: Identify the PRA scope and level of detail needed for the risk-informed application.
  - Step B-3: Address the missing PRA scope or level of detail needed for the risk-informed application.
- This is a new section that consolidates guidance from Sections 2.2, 3.1, 3.2 and 6.2 in previous version of NUREG-1855.

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STAGE B (CONT'D)

- **Step B-1**: The purpose of this step is to determine the aspects of the plant design and operation that will be affected by a proposed risk-informed application.
- A key aspect in this process is identifying what results are needed to support the application.
  - The results needed are generally formulated in terms of acceptance guidelines.
  - Acceptance guidelines can vary from decision to decision and include metrics such as CDF, LERF, and importance measures.
  - Acceptance guidelines also should include guidance on how the metric is to be calculated, in particular with regard to addressing uncertainty.
- All impacts of a proposed application including the effect on the prevention and mitigation of transients or accidents are identified. This includes effects on both safety and non-safety related features.

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STAGE B (CONT'D)

- **Step B-2**: The purpose of this step is to determine the PRA scope and level of detail needed to support a risk-informed application.
- PRA scope is defined in terms of the following:
  - The metrics used to evaluate risk.
  - The plant operating states (POSs) for which the risk is to be evaluated.
  - The types of hazard groups and initiating events that can occur
- Level of detail of a PRA is defined in terms of:
  - The degree to which the potential spectrum of scenarios is discretized.
  - The degree to which the actual plant is modeled.

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STAGE B (CONT'D)

- The required PRA scope and level of detail is generally determined by considering the cause-and-effect relationship between the application and its impact on plant risk through changes to SSCs and plant operation.
- A proposed application can impact multiple SSCs in various ways and may require changes to one or more PRA technical elements.
- Required modifications could manifest as changes to parameters in the PRA model; introduction of new events; or changes in the logic structure. For example:
  - Introduces a new initiating event or component failure mode
  - Introduces a new accident sequence
  - Changes system success criteria or dependencies
  - Eliminates, adds, or modifies human actions
  - Changes SSCs required to mitigate external hazards
  - Changes the potential for containment bypass

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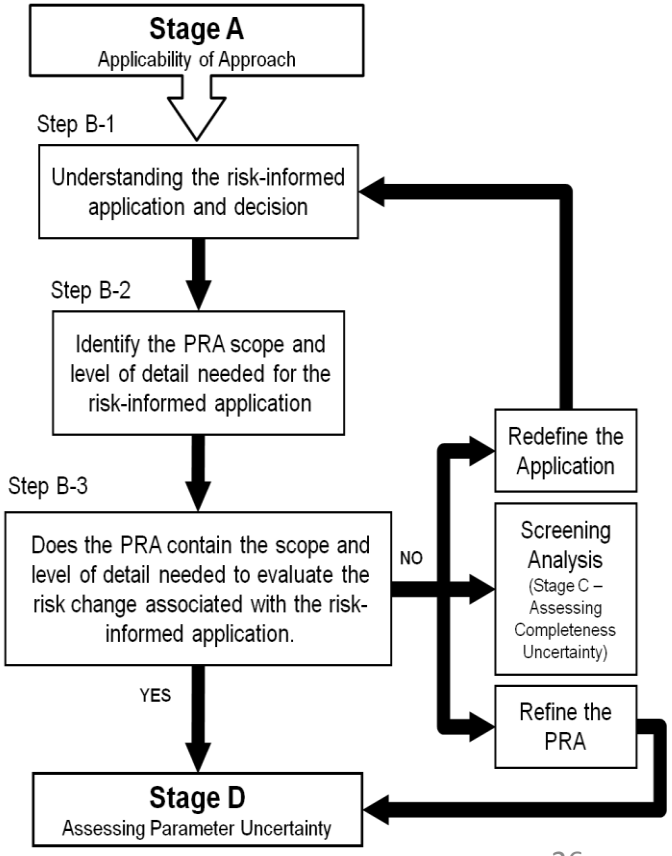
STAGE B (CONT'D)

- **Step B-3**: The purpose of this step is to determine if the PRA contains the scope or level of detail needed to evaluate the risk change associated with a risk-informed application.
- Stage B also addresses aggregation of results from different PRA models.
- Because hazard groups and POSs are independent, addition of their risk contributions is mathematically correct.
- However, several issues should be considered when combining the results from different hazard groups.
  - Level of detail and approximations may differ for different hazard groups with some being more conservatively evaluated.
  - The level of detail, scope, and resulting conservative biases in a PRA introduces uncertainties in the PRA results.
  - Need to consider the influence of known conservatism when comparing the results against the acceptance guidelines, particularly if they mask the real risk contributors (i.e., distort the risk profile) or result in exceeding the guidelines.

STAGE B (CONT'D)

- In assessing the necessary scope and level of detail of the PRA for the given application, the licensee will arrive at one of three conclusions – *The PRA scope and level of detail*

1. *is adequate to support the application*
   - Licensee moves to Stage D of the process
2. *is not adequate and the licensee decides to refine the PRA*
   - Licensee moves to Stage D of the process
3. *is not adequate and the licensee decides to redefine the application*
   - Licensee returns to the beginning of Stage B of the process
4. *is not adequate and the licensee decides to determine the significance of the missing scope and level of detail and if it's contribution can be bound*
   - Licensee moves to Stage C of the process



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Stage C: Assessing Completeness Uncertainty

- Objective: provides guidance to the licensee on how to address the completeness of the PRA results that are used in support of risk-informed applications.
- Addresses the scope and level-of-detail items that are not modeled in the PRA by determining whether missing items (e.g., a hazard group, an initiating event, a component failure mode, etc.) are significant to the decision under consideration.
- The guidance involves 2 steps:
  - Step C-1: Perform screening analyses to determine the significance of the missing PRA scope or level of detail to the risk-informed decision.
  - Step C-2: Determine if the PRA model needs to be updated or if the application needs to be modified to address the missing PRA scope or level of detail significant to the decision.
- The risk from each significant hazard group should be addressed using a PRA model that is developed in accordance with an NRC-endorsed consensus standard for that hazard group.

STAGE C (CONT'D)

- Changes on completeness uncertainty guidance:
  - Guidance on completeness uncertainty is now considered before parameter and model uncertainty in the new version.
  - The process in Step 1 of the old version, "Determining the Required Scope and Level of Detail Required to support Risk-Informed Decision" has been moved to Stage B in the new version.
  - A table has been added identifying the Supporting Requirements in the PRA Standard that address screening requirements.
  - Content has been reorganized in a more concise manor.

STAGE C (CONT'D)

- **Step C-1**: The purpose of this step is to provide guidance for determining whether the missing scope or level of detail of the PRA (as determined in Stage B) is risk significant to the decision under consideration.
- The process of determining the risk significance of a missing scope or level of detail PRA item can include performing either a qualitative or quantitative screening analysis.
- The screening and significance assessment process in Stage C consists of the following steps:
  - Substep C-1.1: Perform qualitative screening
  - Substep C-1.2: Perform quantitative screening
  - Substep C-1.3: Determine significance of unscreened scope items

STAGE C (CONT'D)

- **Substep C-1.1**: Utilize qualitative screening criteria to eliminate potential hazards or risk contributors from the PRA.
- The NRC staff is developing a position on acceptable qualitative and quantitative screening criteria which will be published in an Interim Staff Guidance document.
- Examples of qualitative screening criteria to eliminate hazards or other risk contributors include the following:
  - The contributor or hazard does not result in a plant trip.
  - The plant response to the hazard is not affected by the proposed application.
  - The contributor or hazard can be bounded by another event.
- Additional criteria can be defined for specific applications but the bases would have to be documented.

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STAGE C (CONT'D)

- **Substep C-1.2**: Utilize quantitative screening criteria to eliminate potential hazards or risk contributors from the PRA.
- The principal utility of a conservative quantitative risk analysis is to demonstrate that the risk contributions from non-modeled scope items as well as any change to the risk contribution that results from a change in the plant are small and, thus, not significant to the decision.
- If a PRA scope item is not screened based on a quantitative analysis, the results of that analysis can be used in the application to provide a conservative risk estimate if the item is not significant to the decision, as determined in Step C-2.
  - Conservative risk assessments exaggerate the importance of initiating events, component failure modes, and accident sequences
  - The usefulness of a conservative analysis is somewhat limited, particularly in applications relying on relative importance measures

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STAGE C (CONT'D)

- Different levels of quantitative analysis are used for screening or evaluating the importance of missing PRA scope and level of detail:
  - Bounding conservative analysis – includes the worst credible scenario that can occur. Can be bounding in terms of frequency, consequences, or risk.
    - For example, assuming that all fires or floods in a specific area (maximum frequency) fails all equipment in that location (maximum consequences) combined with taking no credit for mitigation systems (e.g., fire suppression or floor drains).
  - Conservative, but not bounding analysis - produces a quantified estimate of a risk metric that is significantly greater than the risk metric estimate that would be obtained by using a best-estimate evaluation.
    - For example, assuming all seismic events result in loss of offsite power (LOSP) transients or LOSP events combined with a small loss-of-coolant accident (LOCA), the latter assumption resulting in a more conservative model of seismic events, especially those of low magnitude
  - Realistic, but limited quantitative analysis – utilizes an iterative process of screening to try and eliminate a missing scope item.
    - For example, modeling an accident sequence where not all mitigating systems are credited.

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STAGE C (CONT'D)

- **Substep C-1.3**: Determine the significance of non-modeled scope or level of detail items by comparing conservative risk estimate against risk acceptance guidelines.
- The degree to which the conservative risk estimate can be used to support the claim that the missing scope or level of detail in the PRA does not impact the decision depends on the proximity of the risk results to the guidelines.
- Conservative risk assessments exaggerate the importance of initiating events, component failure modes, and accident sequences
- Care should be taken to make sure that any assumptions that are meant to screen out or bound a hazard group are not invalid for a specific application.
  - For example, the assumption that tornados can be screened based on the assumption of the existence of tornado missile barriers, may be invalid for situations where a barrier is temporarily moved for a particular plant evolution

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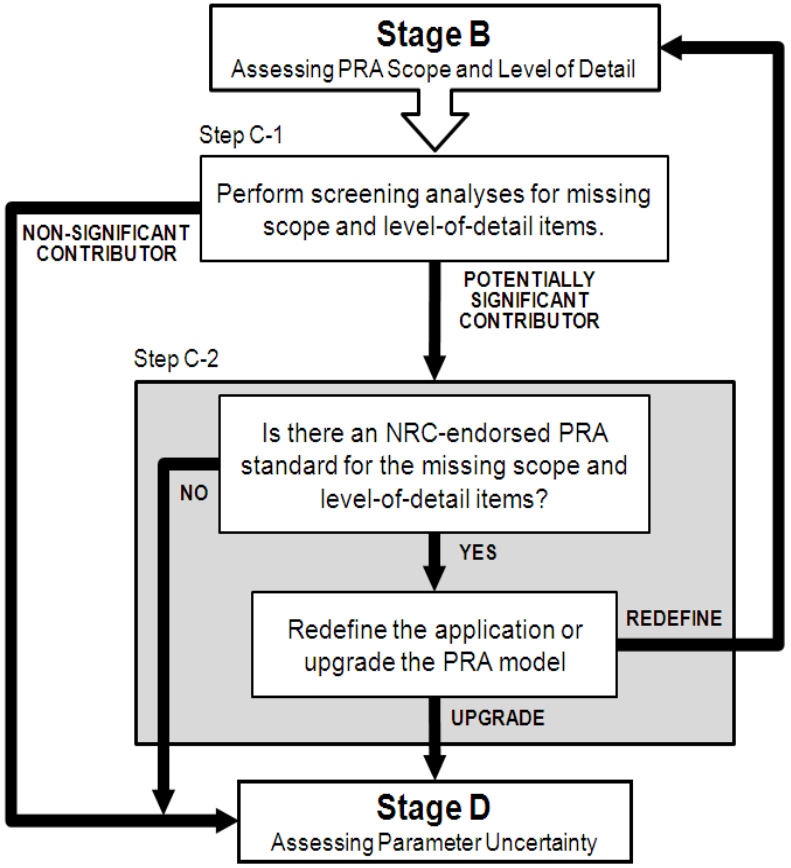
STAGE C (CONT'D)

- **Step C-2**: The purpose of this step is to provide guidance for determining the possible ways to treat non-modeled scope or level-of-detail items that are significant to the decision.
- A significant risk contributor is one whose inclusion in the application PRA model can impact the decision.
- The risk from each significant non-modeled scope or level-of-detail item should be addressed using a PRA model that is developed in accordance with a consensus standard for that item that has been endorsed by the NRC staff.
- However, if there is no PRA standard that addresses the missing scope or level-of-detail item in question, the licensee can submit the results of a quantitative screening analysis as part of the input into the decisionmaking process.

STAGE C (CONT'D)

- In assessing the missing scope and level of detail of the PRA for the given application, the licensee will arrive at one of three conclusions – *The missing scope and level of detail*

1. *is not significant to the application*
   - Licensee moves to Stage D of the process
2. *is significant to the application, and there is no standard endorsed by the NRC*
   - Licensee moves to Stage D of the process
3. *is significant to the application, and there is a standard endorsed by the NRC*
   - Licensee redefines the application and returns to the beginning of Stage B of the process
   - Licensee upgrades the PRA and moves to Stage D of the process



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STAGE D: ASSESSING PARAMETER UNCERTAINTY

- Objective: guidance to the applicant for calculating the PRA results and those uncertainties in the results that arise from the propagation of the uncertainty in the input parameter values.
- In this step the determination is made whether the risk results challenge the acceptance guidelines.
- The guidance involves three steps:
  - Step D-1: Acceptable ways to characterize the uncertainty in the parameters used in the various PRA inputs.
  - Step D-2: Acceptable ways to quantify the risk metrics, accounting for the parameter uncertainty and the state-of-knowledge-correlation (SOKC).
  - Step D-3: How to compare the results with the acceptance guidelines.

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STAGE D (CONT'D)

- The ASME/American Nuclear Society (ANS) PRA Standard contains a number of requirements related to characterizing the parameter uncertainty and to calculating the risk metrics.
- Because the PRA Standard recognizes that the level of detail, the level of plant specificity, and the level of realism needed in a PRA are commensurate with its intended application, the Standard defines three PRA Capability Categories (CCs) that are meant to support the range of applications.
- The guidance of Steps D-1 and D-2 is provided in a context that also provides direction for meeting the NRC position on those requirements in the PRA Standard that relate to parameter uncertainty.

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STAGE D (CONT'D)

- Major changes to the guidance on assessing parameter uncertainty since the March 2009 publication of NUREG-1855, they involve:
  - The scope was expanded from internal events to include parameter uncertainties associated with low power shutdown, internal fire, external hazards, and Level 2 PRA.
  - The NRC position on what is acceptable for meeting the requirements in the ASME/ANS PRA Standard on characterizing and propagating parameter uncertainty has been further clarified.

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STAGE D (CONT'D)

- **Step D-1**: The purpose of this step is to provide guidance on quantifying the probabilities (or frequencies) of the basic events and other PRA inputs that are formulated in terms of parameters with underlying uncertainty, and in characterizing that uncertainty.
  - The ultimate goal is to be able to calculate the mean and uncertainty of the risk metrics properly.
  - In order to do that, one has to first correctly characterize the parameter uncertainty associated with the inputs to the PRA. It is especially important to capture the parameter uncertainty of those inputs that constitute significant contributors, i.e., those inputs that contribute significantly to the computed risk for a specific hazard group.

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STAGE D (CONT'D)

- **Step D-1 (cont'd)**: What constitutes an acceptable approach depends on the CC:
  - CC I: Point estimates of the basic event parameters are calculated and their uncertainty is characterized qualitatively (e.g., specifying an uncertainty interval).
  - CC 2: Mean values are calculated for the parameters of the SIGNIFICANT CONTRIBUTORS, and the uncertainty is characterized by providing a probabilistic representation of the uncertainty of the parameter values for the SIGNIFICANT CONTRIBUTORS.
  - CC III: Same as CC II but mean values are calculated for the parameters of ALL the PRA inputs, and the uncertainty is characterized by providing a probabilistic representation of the uncertainty of the parameter values for ALL the inputs.

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STAGE D (CONT'D)

- **Step D-2**: The purpose of this step is to provide guidance for quantifying the frequencies and/or probabilities of the risk metrics and estimating their uncertainty due to the propagation of parameter uncertainties through the PRA.
- In carrying out the propagation, it is important to consider the state of knowledge correlation (SOKC) between events.
  - 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 influence or importance of the SOKC on the value of the risk metrics will vary from case to case.
- Guidance on determining the importance of the SOKC is provided in Section 2.4 of EPRI 1016737, the companion report to NUREG-1855.

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STAGE D (CONT'D)

- **Step D-2 (cont'd)**: What constitutes an acceptable approach depends on the CC and on the importance of the SOKC:
- When the SOKC is NOT important:
  - CC I: A point estimate is calculated for the risk metric. An estimate of the uncertainty interval and its basis is sufficient.
  - CC II: A mean value is calculated for the risk metric using the mean values of SIGNIFICANT CONTRIBUTORS, and the uncertainty distribution of the risk metric is calculated by propagating the uncertainty distributions of the SIGNIFICANT CONTRIBUTORS through all SIGNIFICANT SEQUENCES/CUTSETS using the Monte Carlo or similar approach.
  - CC III: A mean value is calculated for the risk metric by propagating the uncertainty distributions of ALL the input parameters (both significant and non-significant contributors) using the Mont Carlo approach (or other comparable means) through the PRA model, TAKING THE SOKC INTO ACCOUNT. The uncertainty distribution of the risk metrics is calculated by propagating the uncertainty distributions of all the contributors through all retained sequences/cutsets using the Monte Carlo or similar approach and TAKING THE SOKC INTO ACCOUNT.

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STAGE D (CONT'D)

- **Step D-2 (cont'd)**: What constitutes an acceptable approach depends on the CC and on the importance of the SOKC:
- When the SOKC is IMPORTANT:
  - CC I: A point estimate is calculated for the risk metric. An estimate of the uncertainty interval and its basis is sufficient. The effect of the SOKC is characterized.
  - CC II and CC III: A mean value is calculated for the risk metric by propagating the uncertainty distributions of the input parameters using the Mont Carlo approach (or other comparable means) through the PRA model, ensuring that the SOKC between event frequencies or probabilities is taken into account. The uncertainty distribution of the risk metrics is calculated by propagating the uncertainty distributions of the contributors through all retained sequences/cutsets using the Monte Carlo or similar approach and TAKING THE SOKC INTO ACCOUNT.
    - CC II: propagation of the uncertainty only for SIGNIFICANT CONTRIBUTORS in the SIGNIFICANT ACCIDENT SEQUENCES and CUTSETS
    - CC III: uncertainty distribution for ALL input parameters is propagated.

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STAGE D (CONT'D)

- **Step D-3**: The purpose of this step is to provide guidance for comparing the PRA results with acceptance guidelines.
- In this step the determination is made whether the risk results challenge the quantitative acceptance guidelines.
- The information needed consists of:
  - An estimate of the relevant risk metric(s), usually expressed as the mean value(s),
  - the acceptance guidelines to be used for the particular application, and
  - for some cases the uncertainty interval or distribution(s) of these risk metric(s) is also of interest.

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STAGE D (CONT'D)

- **Step D-3 (cont'd)**: The comparison of the risk metric estimates (usually the mean values) to the acceptance guidelines (usually formulated in terms of mean values) should demonstrate to the decisionmaker whether the guidelines have been met or not, as well as the proximity of the risk results to the guidelines.
- The uncertainty of the risk metric estimate resulting from the propagation of the parameter uncertainty MAY also be of interest to the decisionmaker:
  - If the risk metric estimate "challenges" or exceeds the acceptance guideline, the uncertainty distribution (or range) can provide useful additional insights.

Stage D: Assessing Parameter Uncertainty (App 6A)

- Objective: to provide an explanation of the SOKC and its possible effect on the mean value and uncertainty distribution of the risk metric.
  - No changes from March 2009 version of NUREG-1855
  - The SOKC stems from the fact that, for identical or similar components, the state of knowledge about their failure parameters is the same.
  - Ideally, each initiating event, equipment response or operator action would have its own database and thus would be statistically independent.
  - In practice, the data used for like components often has some common element, is pooled, or is correlated in some way. For example, the failure rate of one particular LPCI pump is typically based on experience with all "similar" pumps. Therefore, the data used for the pumps is not independent but is correlated.
  - To account for the SOKC, when using a Monte Carlo (or similar) approach to propagate uncertainty, for each pass through the process the same sample value drawn from the probability distribution of the parameter should be used to calculate the basic event probability of all basic events within the correlated data group.

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STAGE E: ASSESSING MODEL UNCERTAINTY

- Objective: guidance to the licensee for addressing sources of model uncertainty and related assumptions related to the base probabilistic risk assessment (PRA) and the application PRA.

- The goal is to determine whether (and the degree to which) sources of model uncertainty and related assumptions might cause the risk metric estimates to challenge or exceed the quantitative acceptance guidelines.

- The guidance involves 2 major steps and several sub steps:
  - Step E-1: Identify potential model uncertainties and related assumption and determine their significance.
  - Step E-2: Identify model uncertainties or related assumptions that are key to the decision.

- NUREG-1855 Rev 1 is unchanged from Rev 0 with regard to the treatment of model uncertainties and related assumptions.

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STAGE E (CONT'D)

- **Step E-1**: Provides guidance to identify and characterize model uncertainties and related assumptions in the PRA required for the application.
- This process involves the following sub steps:
  - Identify model uncertainties in base PRA
  - Determine relevance of model uncertainties to the decision
  - Characterize model uncertainties
  - Qualitatively screen model uncertainties based on consensus models.
  - Identify model uncertainties introduced by application PRA

STAGE E (CONT'D)

- **Step E-2**: Provides guidance to identify model uncertainties and related assumptions that are key to the application.
- For each relevant model uncertainty identified in Step E-1, this process involves:
  - Defining and justifying the sensitivity analyses
    - Define conservative screening, or
    - Realistic sensitivity analysis
  - Performing the sensitivity analyses
    - Use conservative screening in tandem with realistic sensitivity as needed, or
    - Use realistic sensitivity analysis directly

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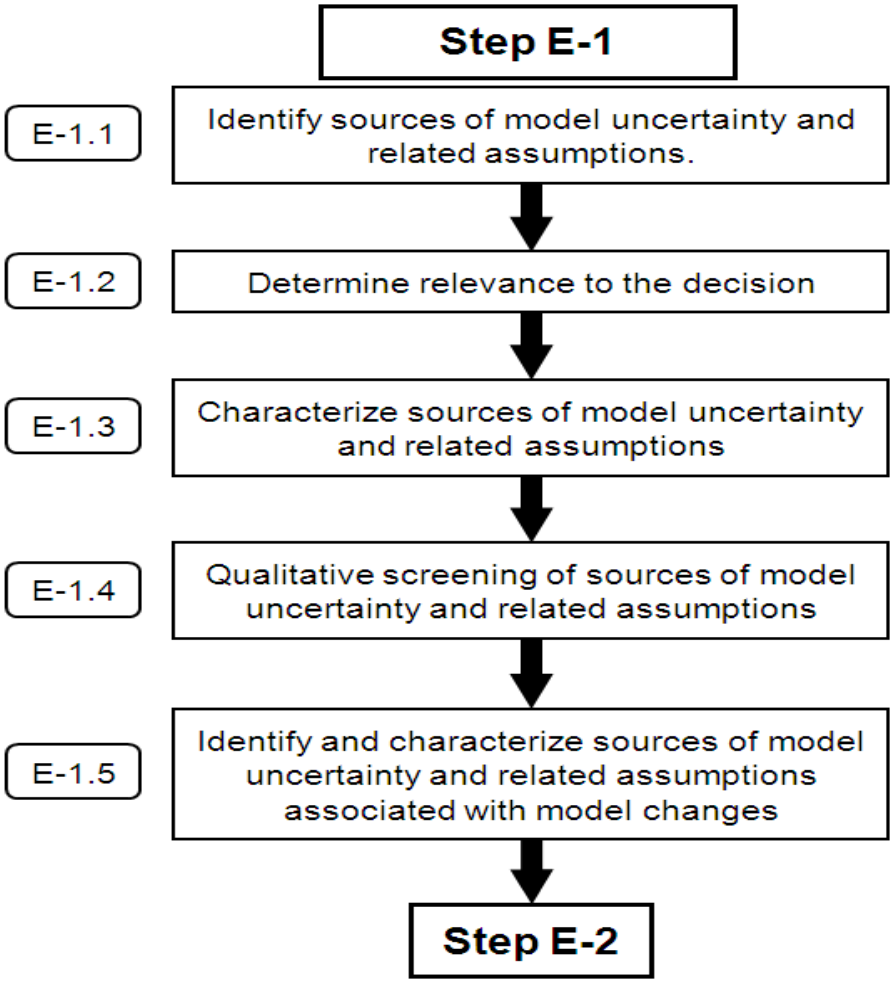
STAGE E (CONT'D)



STAGE E (CONT'D)

- **Step E-1.1**: Identify model uncertainties in the base PRA
  - Plant specific sources,
  - Generic sources – **EPRI report Tables A-1, A-2.**
- **Step E-1.2**: Identify relevant model uncertainties in the base PRA
  - Understand the way in which the PRA is used to support the application (Section 3.3, Step A-3)
  - Identifying base PRA sources of model uncertainty relevant to the PRA results needed for the application, e.g.,
    - DG AOT extension, only LOOP sequences need be considered.
    - Risk-Informed Categorization and treatment of SSCs (10CFR50.69) – Involves the entire base PRA.

STAGE E (CONT'D)

- **Step E-1.3**: Characterize model uncertainties. Identify:
  - The part of the PRA affected, e.g.:
    - a single basic event or multiple basic events
    - the logic structure of the PRA event trees or fault trees
    - a combination of both basic events and portions of the logic structure
  - The modeling approach or assumption used, e.g.:
    - Alternate HRA model may produce different HEPs or introduce new human failure events.
    - Alternate success criterion may lead to a different of system fault tree logic.
  - Use of conservative bias
    - Conservative assumptions in one part of PRA can mask the significance of another part—a part of the model that might be needed for the application.
    - This is true for applications that involve risk categorization or ranking.
    - Thus, if a source of model uncertainty or related assumption is identified as resulting in a conservative bias, the impact of this bias on the conservatism in the PRA should be assessed.

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STAGE E (CONT'D)

- **Step E-1.4**: Qualitative screening of relevant model uncertainties
  - Identify and validate whether consensus models have been used in the PRA to evaluate identified model uncertainties.
  - The use of a consensus model eliminates the need to explore an alternative hypothesis. Associated uncertainty is manifested in Stage D risk metric estimates.

- **Step E-1.5:** Identify relevant model uncertainties in the application PRA
  - Apply Steps E-1.1 through E-1.4 to the PRA as modified for the application.
  - **EPRI report Tables A-3 and A-4 provide additional useful information on generic issues.**

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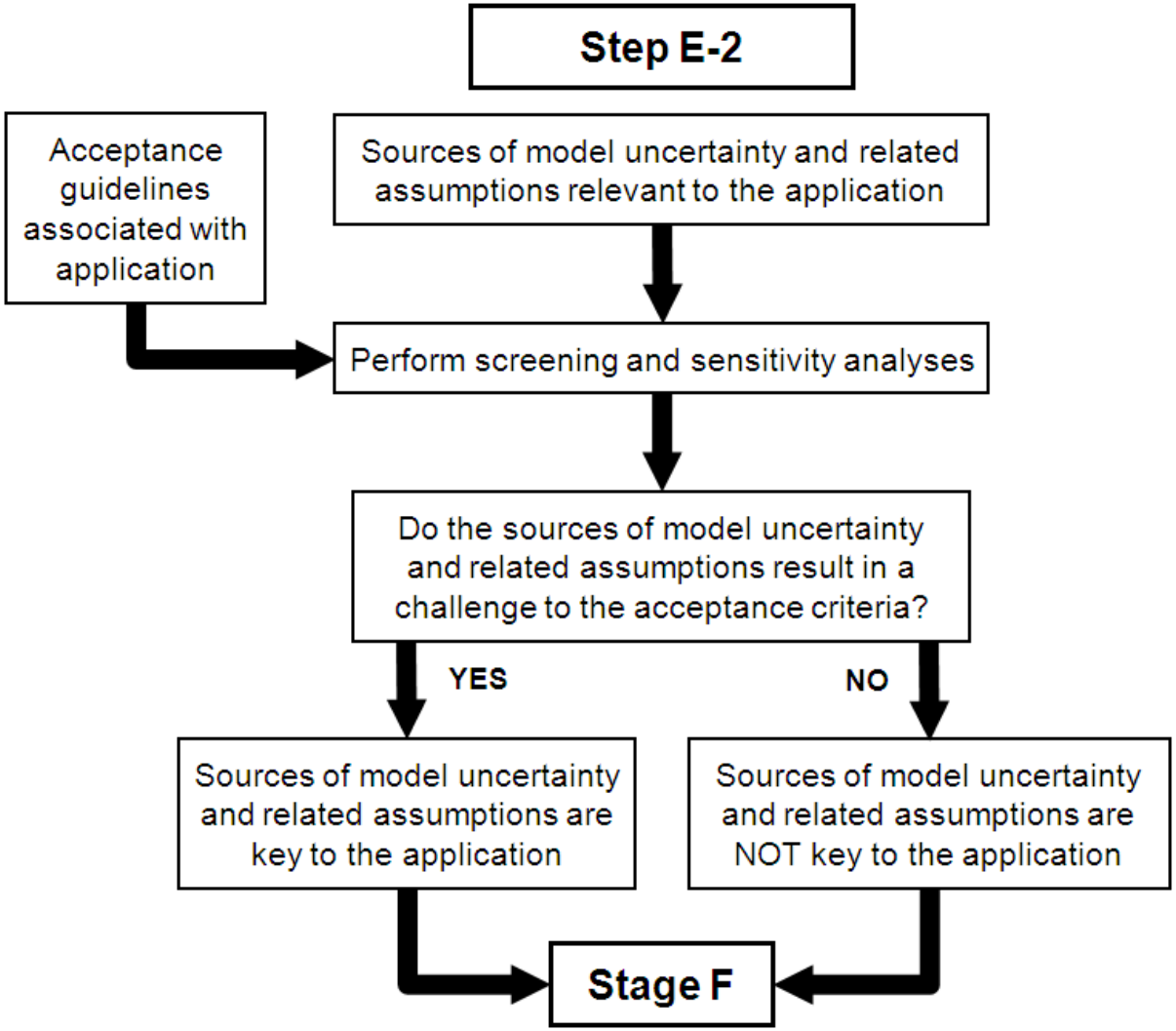
STAGE E (CONT'D)



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STAGE E (CONT'D)

- The set of candidate key model uncertainties and related assumptions from Step E-1 are evaluated for the potential to effect a decision.
- Perform screening and sensitivity analysis
  - Conservative screening can be performed first to avoid more complex sensitivity analyses: e.g.,
    - Compare RAW importance measures against a "maximum acceptable RAW" – based on a base CDF and a maximum allowable CDF acceptance guideline.
    - Approximate bounding evaluation (Step C-1) may be possible, e.g., impact of model uncertainty is limited to the later branches of low frequency accident sequences.
  - Realistic sensitivity analysis:
    - Develop reasonable alternatives or hypotheses associated with the model uncertainties.
    - Alternative or hypothesis is considered reasonable when it has broad acceptance in the technical community and a sound technical basis.
    - To develop the alternatives, an in-depth understanding of the issues associated with the model uncertainty is needed.
    - Examples – use previous experience on other PRAs, parametric variations (e.g., battery life).

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STAGE E (CONT'D)

- Screening and sensitivity assessments are discussed for two specific types of risk metric acceptance guidelines:
  - Single risk metric – Case 1 (e.g., CDF)
  - Multiple risk metric - Case 2 (e.g., CDF and Δ CDF)

- Four general types of model uncertainty characterizations (from Step E-1.3):
  - Single basic events
  - Multiple basic events
  - The logic structure of the PRA
  - Logical combinations

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STAGE E (CONT'D)

- Logical combinations of model uncertainties
  - Uncertainties associated with various model uncertainties can interact synergistically.
  - The associated sources of model uncertainty are known as a "logical combinations of sources and assumptions."
    - Importance of HPCI is affected by
      - Frequency of IEs.
      - HEP for depressurization
      - Availability of motor-driven feedwater pumps,
      - Alternate injection systems (e.g., fire water, service water cross-tie)
      - LOOP IE, CCF of DGs and batteries, and recovery of ac power.
    - Field flashing for DGs requires that DGs be restored be for batteries fail.
      - Potential impact of uncertainties associate with HEPs should be assessed together with DC battery depletion uncertainties.
  - **EPRI report Section 4.3.2 – Additional examples.**

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STAGE E (CONT'D)

- Guidance is given for eight subcases
  - Case 1a, Single metric, single basic event
  - Case 1b, Single metric, multiple basic events
  - Case 1c, Single metric, logic structure of PRA changed
  - Case 1d, Single metric, logical combinations
    - $RAW_{j,base} > RAW_{max}$
  - Case 2a, Double metric, single basic event
  - Case 2b, Double metric, multiple basic events
  - Case 2c, Double metric, logic structure of PRA changed
  - Case 2d, Double metric, logical combinations
    - $(CDF^{+}_{j,base}, \Delta CDF^{+}_{j})$ and $(CDF_{base}, \Delta CDF)$ are compared to acceptance guidelines

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STAGE E (CONT'D)

- Outcome for Stage E
  - Identification of any key model uncertainties
  - An understanding of the potential impact of these key uncertainties on the risk metric estimates
- Licensee's strategy to deal with key model uncertainties is developed in Stage F.

Stage F: Licensee Application Development Process

- Objective: provides guidance to the licensee on the process of developing a risk-informed application submittal, as related to the treatment of uncertainties associated with the application PRA.
- The purpose of Stage F is to help ensure that adequate justification is provided for demonstrating the acceptability of the risk-informed application.
  - Further, the guidance for this stage helps ensure that the argument for adequate justification of the application is included in the submittal documentation clearly and concisely.
- Stage F consists of a set of options that are used by the licensee throughout the uncertainty assessment process in determining that adequate justification is provided for the acceptability of the results.
  - redefine the application
  - refine the PRA analysis, or
  - use compensatory measures or performance monitoring requirements.

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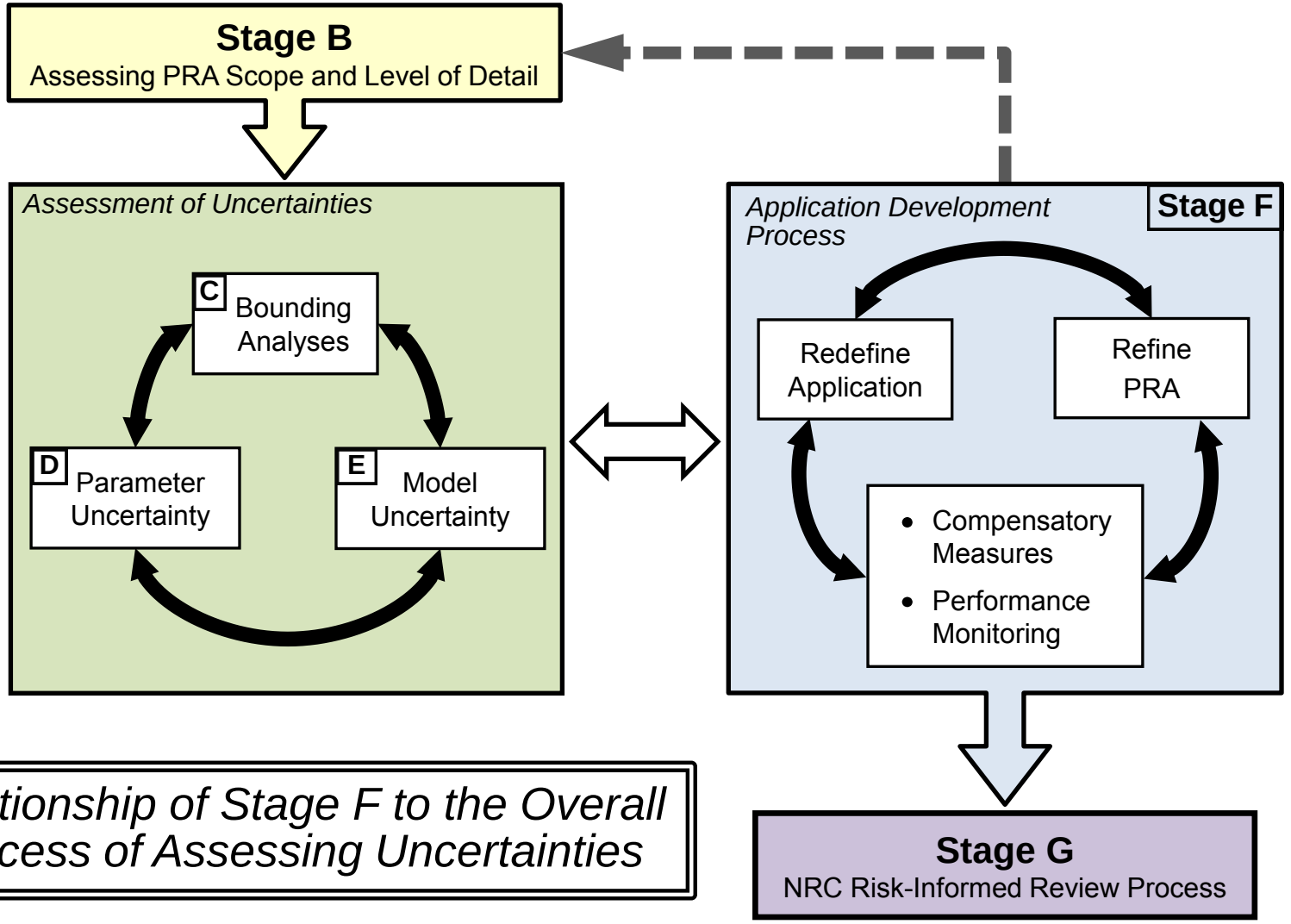
STAGE F (CONT'D)

- Changes on licensee strategy guidance:
  - This section is a new section
  - Previous NUREG had brief discussions throughout the document and unclear whether guidance was for the licensee or the staff
  - The guidance on the possible strategies is in support of the staff expectations for the licensee justification

STAGE F (CONT'D)



Relationship of Stage F to the Overall Process of Assessing Uncertainties

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STAGE F (CONT'D)

Option 1 – Redefining the Application:

- A licensee may choose to redefine the risk-informed application when it is incomplete in its coverage of significant risk contributors.
- The scope of the risk-informed application can be restricted to those areas supported by the risk assessment.
- If the risk-informed application is redefined, the licensee should subsequently perform Stage B to reassess the scope and level of detail needed for the redefined application.
- The licensee should then perform Stages C, D, and E again to determine if and how the impact of completeness, parameter, and model uncertainties has changed for the redefined application.

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STAGE F (CONT'D)

Option 2 – Refining the PRA:

- A licensee may choose to refine the application PRA to prevent the risk metrics from challenging or exceeding the application acceptance guidelines.
- If the application PRA is refined, the licensee should subsequently perform Stage D to recalculate the risk metrics and reassess impact of parameter uncertainty on the refined PRA.
- The licensee should then perform Stage E again to determine the impact of model uncertainty (including any new model uncertainties that were introduced) on the recalculated risk metrics.

STAGE F (CONT'D)

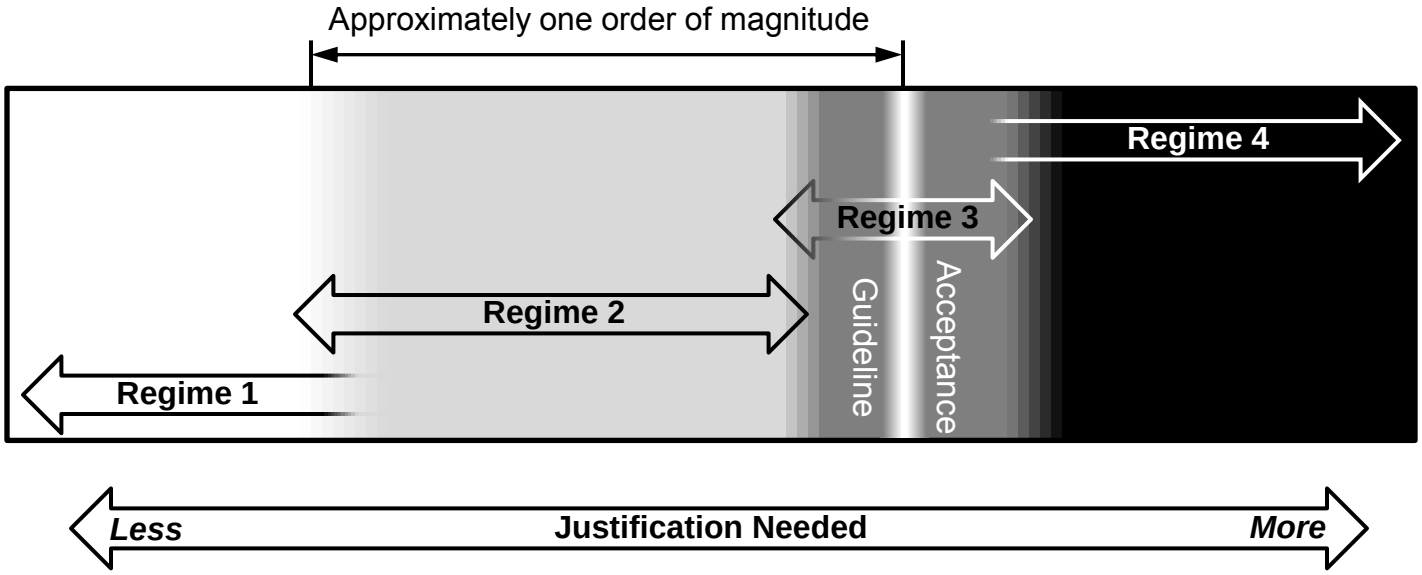
Option 3 – Use of Compensatory Measures or Performance Monitoring:

- A licensee may choose to justify a challenge to or exceedance of the acceptance guidelines by implementing compensatory measures or performance monitoring requirements.
- Compensatory measures are used to neutralize the expected negative impact of some feature of the plant design or operation on the plant risk.
- Performance monitoring are used to demonstrate that there is no degradation in those aspects of plant performance that are expected to be affected by the application.
  - Performance monitoring is effective when no predictive model has been developed for plant performance in response to a change.

STAGE F (CONT'D)

Preparing the Application Submittal

- The licensee is responsible for ensuring that the acceptability of the application is adequately justified and that the conclusions of the risk assessment are communicated clearly and concisely.



STAGE F (CONT'D)

Preparing the Application Submittal (cont'd)

- When justifying the acceptability of a risk-informed application, the application should demonstrate the following:
  - A clear understanding of the risk contributors and their impact on the results
  - Model uncertainties have been accounted for using the techniques in Stage E
  - The model has sufficient scope and level of detail to support the conclusions of the analysis using the guidance from Stage C
- Aggregation of risk results may require additional consideration.

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STAGE F (CONT'D)

Application Submittal Documentation

- The amount and quality of the documentation that needs to be developed for the application depends on the amount of justification needed and the proximity of the risk metrics to the acceptance guidelines.
- NUREG-1855 describes several elements of the documentation that should be included in the application submittal, some of which include:
  - A description of the acceptance guidelines that are used for comparison with the risk metrics
  - A discussion of the impact of the parameter uncertainty on the risk metrics
  - A description of the relevant sources of model uncertainty and their impact on the results
  - A description of significant modeling conservatisms

STAGE G: NRC RISK-INFORMED REVIEW PROCESS

- Objective: describe the process used by the staff to determine whether a licensee's risk-informed application demonstrates an acceptable treatment of uncertainties and that the proposed application represents an acceptable risk impact to the plant.
- The review process is based on determining whether the licensee has provided adequate justification for the application commensurate with the reliance on the risk analysis in the decisionmaking process and the proximity of the risk results to the acceptance guidelines.
  - In general, more justification will be needed for a given application when the risk results are closer to challenging or exceeding the acceptance guidelines than when the risk results are further away.
- In determining whether the acceptance guidelines have been met, the staff seeks to answer the following general questions:
  - How do the risk results compare to the acceptance guidelines?
  - Is the scope and level of detail of the PRA appropriate for the application?
  - Is the PRA model technically adequate for the application?
  - Is the acceptability of the application adequately justified?

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STAGE G (CONT'D)

- Changes on staff review process:
  - This section has been almost completely revised
  - Previous version written by discussing issues that either the licensee or staff needed to address
  - Previous version, unclear whether the discussion was guidance for the licensee or the staff
  - The approach that is taken by the staff is laid out
  - Decision criteria used by the staff is discussed

STAGE G (CONT'D)

Completeness Review:

- Specifically, the staff will assess whether the following criteria are met:
  - the PRA scope and level of detail and the licensee's use of any screening analyses are appropriate for the application
  - the base PRA and changes to the PRA that are used to support the application are technically adequate
- If the licensee does not provide adequate justification for the exclusion of the missing PRA scope and level-of-detail items (e.g., the licensee provides insufficient justification/screening analyses to show no impact from seismic if they do not have a seismic PRA) the staff will typically reject the licensee's risk-informed application.
- If the staff determines there is a PRA technical inadequacy of significance that is not sufficiently addressed, the staff will typically reject the licensee's risk-informed application.

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STAGE G (CONT'D)

Parameter Review:

- Specifically, the staff determines whether adequate justification has been provided for the acceptability of the risk results, as compared to the acceptance guidelines.
- The staff looks at
  - the relevant risk measure(s), usually expressed as a mean value(s)
  - the acceptance guidelines used for the particular application
- If inadequate justification, the staff will typically reject the licensee's risk-informed application.

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STAGE G (CONT'D)

Model Uncertainty Review:

- Specifically, the staff determines whether there is adequate treatment of the model uncertainties by the licensee.
  - Staff determines if the key sources were appropriately identified.
  - Staff determines whether the key sources were adequately characterized and their impact evaluated.
  - If determined that the key sources were not appropriately identified or treated, the staff will typically reject the licensee's risk-informed application.

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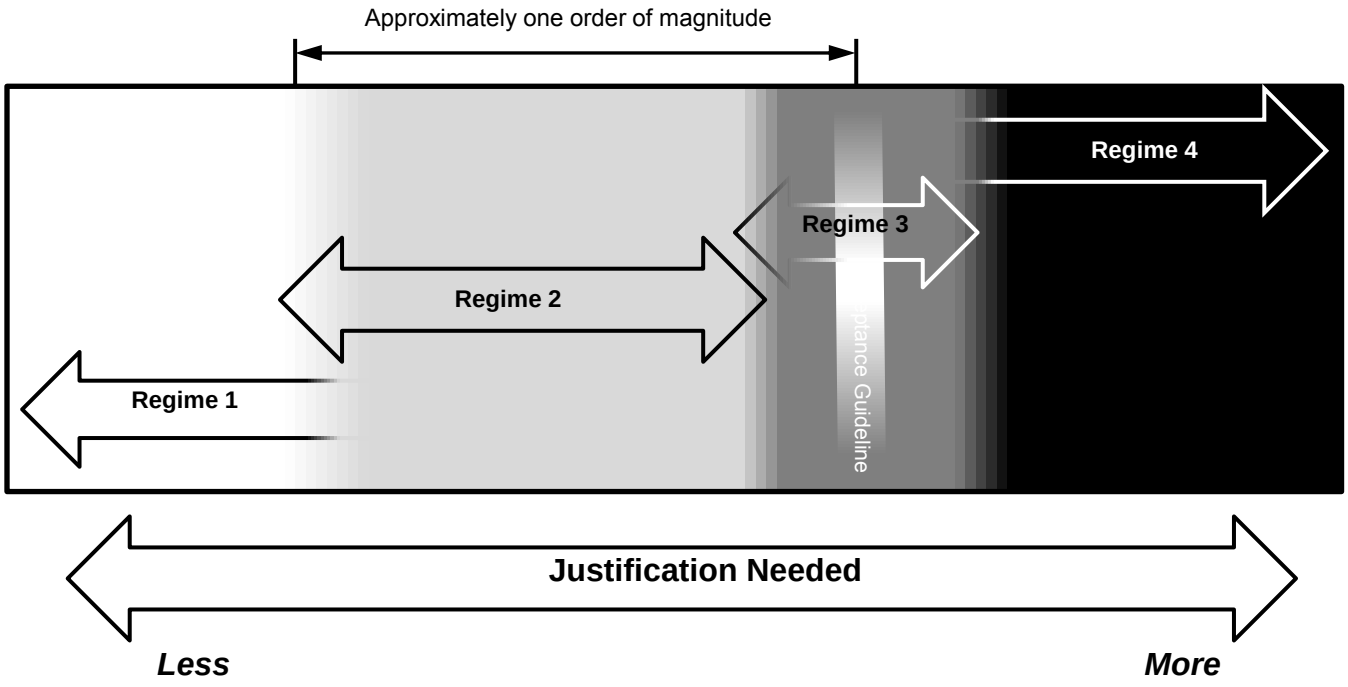
STAGE G (CONT'D)

Overall Review:

- Staff review typically begins with technical adequacy check and the comparison of the application risk results to the application specific acceptance guidelines.
- Justification provided by the licensee is dependent on the significance of the risk results; that is, on the proximity of the results to the acceptance guidelines.
  - Regime 1—The risk results are well below the acceptance guidelines.
  - Regime 2—The risk results are closer to, but do not challenge the acceptance guidelines.
  - Regime 3—The risk results challenge the acceptance guidelines.
  - Regime 4—The risk results clearly exceed the acceptance guidelines.

STAGE G (CONT'D)



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STAGE G (CONT'D)

Regime 1:

- Risk results are well below the acceptance guidelines by at least one order of magnitude.
- The staff would review the peer review findings of the licensee's PRA to identify any findings of particular relevance to the application.
- The staff would look for a qualitative or quantitative assessment of the state-of-knowledge correlation (SOKC) showing it does not impact the results of the PRA.

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STAGE G (CONT'D)

Regime 1 (cont'd):

- The staff would look to determine whether the validity of the assumptions made in the application PRA will be appropriately monitored via the implementation of specific performance measurements/strategies (key principle 5 of RG 1.174).
- The staff would look to see whether degraded performance can be detected in a timely fashion.
- Finally, the staff would generally not perform an audit on the application PRA when an application is in Regime 1.

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STAGE G (CONT'D)

Regime 2:

- Risk results are close to the acceptance guidelines by within one order of magnitude.
- The staff would examine the peer review findings with a higher degree of scrutiny than for applications that fall into Regime 1 so as to better understand how particular findings were resolved as well as the general impact of the findings.
- The staff would look for an quantitative assessment of the SOKC which shows it does not impact the results of the PRA.
- The staff would examine the application to ensure that the proposed performance monitoring is appropriate and adequate for the application and whether degraded performance can be detected in a timely fashion.
- In general, it is unlikely the staff would perform an audit on the application PRA for those applications that fall into Regime 2 unless there is a potentially significant issue raised with one of the above items.

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STAGE G (CONT'D)

Regime 3:

- Risk results challenge, but do not significantly exceed acceptance guidelines.
- The staff would examine the peer review findings with an even higher degree of scrutiny than applications in Regime 2 so as to better understand how particular findings were resolved as well as the general impact of the findings.
- The staff would look for an quantitative assessment of the SOKC which shows it does not impact the results of the PRA.
- The staff would examine the application to ensure that the proposed performance monitoring is appropriate and adequate for the application and whether degraded performance can be detected in a timely fashion.
- Applications in this regime likely will identify compensatory measures that are not credited in the PRA to show the risk results are less than calculated and staff will review these measures to understand their potential impact and seek some sensitivity analyses on some measures.
- In general, it is likely the staff would perform an audit on the application PRA for those applications that fall into Regime 3.

STAGE G (CONT'D)

Regime 4:

- Risk results clearly exceed the acceptance guidelines.
- Very rare that a licensee would make this type application.
- Consistent with RG 1.174, the staff would typically not accept these applications. If a licensee justified results were due to conservative or bounding analyses then the staff would have the licensee revise the application to provide and justify more realistic results.
- If as part of a combined change request, one aspect exceeds the guidelines while another aspect makes the overall risk results acceptable, the staff would, in addition to Regime 3 review:
  - Determine the appropriateness of being a combined change request.
  - Determine the appropriateness of compensatory measures and likely request sensitivity analyses to show risk results are below the acceptance guidelines.
  - Perform a more in-depth audit of the application PRA and peer review findings than would be performed if all aspects were in Regime 3.

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STAGE G (CONT'D)

- If accepted by the staff, the risk-informed application is considered to have
  - an acceptable treatment of uncertainties and
  - met the fourth risk-informed decisionmaking principle of posing an acceptable risk impact to the plant
- Conversely, if the staff rejects the application, the risk-informed application is considered to have an unacceptable treatment of uncertainties or poses an unacceptable risk impact to the plant.

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APPENDIX A

- Objective: Provide an example of the licensee application development process.
- A hypothetical example is developed, using a realistic PRA model, to illustrate the process described in NUREG-1855 and in EPRI report 1016737.
- The example has not changed from the one in the March 2009 publication of NUREG-1855, but even more caveats were added:
  - The example is strictly hypothetical,
  - The example is not a template that can be used to justify a similar license amendment request.

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APPENDIX A(CONT'D)

- Stage A : THE APPROACH FOR TREATING RISK ANALYSIS UNCERTAINTIES
  - The example is a hypothetical license amendment request (LAR) to revise the Technical Specification Allowed Outage Time (AOT) from 3 days to 7 days for the RHR/SPC system at a representative BWR, Mark II plant. The purpose of the technical specification change is to allow routine preventive maintenance currently performed at shutdown to be performed with the unit at power. The PRA model for the plant is consistent with the PRA technical adequacy requirements outlined in Regulatory Guide 1.200.
  - Based on this description, the approach described in NUREG-1855 is appropriate for the example LAR.

APPENDIX A(CONT'D)

- Stage B: ASSESSING PRA SCOPE AND LEVEL OF DETAIL
  - The **acceptance guidelines** and the corresponding **risk metrics** needed are identified. The application specific guidance documents are:
    - Regulatory Guide 1.174, where the risk significance is measured by changes in Core Damage Frequency (ΔCDF) and Large Early Release Frequency (ΔLERF),
    - Regulatory Guide 1.177, where the metrics are Incremental Conditional Core Damage Probability (ICCDP) and Incremental Conditional Large Early Release Probability (ICLERP)
  - Needed **scope** and **level of detail**: all POSs, all hazards:
    - At power hazards addressed quantitatively via PRA:
      - Internal Events,
      - Internal Floods,
      - Internal Fires
      - The existing PRA is a detailed PRA, and models the RHR loops in detail (shows cause-effect relationship associated with the LAR): has necessary level of detail.
    - Other POSs and other hazards are missing from PRA scope.

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APPENDIX A(CONT'D)

- Stage C: ASSESSING COMPLETENESS UNCERTAINTY
  - Hazards not modeled in the PRA are either screened from consideration or shown to be not risk significant based on a conservative analysis.
  - Low power and shutdown POSs are conservatively eliminated since the purpose of the LAR is to allow routine preventive maintenance, currently performed at shutdown, to be performed at power.
  - Hazards screened based on low likelihood of threat:
    - Accidental aircraft impact, external floods, extreme winds and tornadoes, turbine-generated missiles, external fires, pipeline accidents
  - Hazards screened based on limited role of RHR in their mitigation:
    - Accidents from nearby facilities, release of chemicals stored at site, transportation accidents
  - Hazards screened by a bounding conservative analysis:
    - Seismic Events – shown to be negligible by comparison of a conservative seismic analysis with internal events results.

APPENDIX A(CONT'D)

- Stage D: ASSESSING PARAMETER UNCERTAINTY
  - An initial comparison of the risk metrics with acceptance guidelines shows the acceptance guidelines could be exceeded.
  - To address the exceeding of the acceptance guidelines:
    - The fire PRA part of the analysis is refined to eliminate some demonstrated conservatisms,
    - Some compensatory measures are imposed prohibiting maintenance on other significant components.
  - The refined results show that the mean values of the risk measures now meet the acceptance guidelines (without considering the SOKC).
  - The EPRI guidelines are implemented to show that for this case the SOKC is not important for calculating the risk metrics.

APPENDIX A(CONT'D)

- Stage E: ASSESSING MODEL UNCERTAINTY
  - In order to identify the sources of model uncertainty, the important contributors to the results are identified with respect to the sum of the contributions from all hazard groups.
  - The examination of the cutsets and Fussell-Vesely and Risk Achievement Worth importance measures reveal that **15** items are important contributors to the change compared to the base case results:
    - Nine Internal Events Important Contributors
    - Six Internal Fire Events Important Contributors
  - Based on the identified important contributors **six** sources of **model uncertainty** are identified.
  - Based on the important contributors and the sources of model uncertainty identified, **four** individual sensitivity cases are identified for further exploration as **potential key sources of uncertainty.**
  - The sensitivity cases indicate that the acceptance guidelines could be exceeded for **two** of these items, which are identified as **key sources of uncertainty** :
    - Human Error Probability (HEP) development as a class
    - The basis for determining CRD survivability following containment failure scenarios

APPENDIX A(CONT'D)

- Stage F: LICENSEE APPLICATION DEVELOPMENT PROCESS
  - An initial comparison of the risk metrics with acceptance guidelines (Stage D) showed the acceptance guidelines could be exceeded.
    - The fire PRA part of the analysis was refined to eliminate some demonstrated conservatisms, and
    - Some compensatory measures were imposed.
  - Sensitivity cases for the key model uncertainties were explored, and additional potential compensatory measures were identified.
    - *HEP development:* Perform pre-shift briefs on potentially important actions.
    - *CRD survivability following containment failure:* Establish actions to consider pre-alignment of alternate injection systems when containment pressures approach the primary containment pressure limit.

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STATUS AND NEXT STEPS

- NUREG is currently going through internal staff review by the program offices (NRR and NRO)
- NUREG to be released for 60 day public review and comment in mid-August
  - Review and comment period closes mid October
- Revision 1 to NUREG-1855 scheduled to be published the end of November, 2012