# Official Transcript of Proceedings

# NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
600th Meeting

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Friday, December 7, 2012

Work Order No.: NRC-2067 Pages 1-50

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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600TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

FRIDAY

DECEMBER 7, 2012

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., J. Sam Armijo, Chairman, presiding.

COMMITTEE MEMBERS:

J. SAM ARMIJO, Chairman

JOHN W. STETKAR, Vice Chairman

HAROLD B. RAY, Member-at-Large

SANJOY BANERJEE, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR. Member

MICHAEL L. CORRADINI, Member

DANA A. POWERS, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

STEPHEN P. SCHULTZ, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

GORDON R. SKILLMAN, Member

NRC STAFF PRESENT:

EDWIN M. HACKETT, Executive Director, ACRS

MARY DROUIN, RES

ANDERS GILBERTSON, RES

ALSO PRESENT:

GARETH PARRY, ERIN Engineering*

MARY PRESLEY, EPRI

*Present via telephone

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

(8:31 a.m.)

CHAIRMAN ARMIJO: Okay. Good morning. This is the second day of the 600th meeting of the ACRS. This morning we are going to hear from the staff on guidance of treatment of probabilistic risk assessment uncertainties, and John Stetkar will lead us through that presentation.

VICE CHAIRMAN STETKAR: Thank you, Mr. Chairman. Just a brief, very brief, background. We are here to hear about NUREG-1855, treatment of uncertainties. EPRI is also here. They will be summarizing some companion documents that have some examples for the treatment of uncertainty and risk-informed applications.

For members who are not familiar with this whole process, NUREG-1855 was originally issued back in 2009. I think that's right, Mary, isn't it? Do you have some of the history, so I don't repeat things.

MS. DROUIN: Yes.

CHAIRMAN ARMIJO: I'll let you do the history, then. With that, I'll turn the meeting over to Mary Drouin.

MS. DROUIN: Thank you. Mary Drouin

with the Office of Research. Also with me is Anders Gilbertson from the Office of Research, and of course Mary Presley from EPRI.

Just real quick before I get started, I just always like to acknowledge, you know, the full team that worked on this project. It just wasn't us two, but Sandia and Brookhaven National Labs were heavily involved, and both -- also staff from NRR and NRO, particularly in this revised revision of NUREG-1855.

I'm not going to try and -- next slide. I'm not going to try and spend a whole lot, but I'm going to quickly go through the objective scope and background, and then we want to focus on the restructure of what happened in Rev 1, what we did in the restructure. We recently had two subcommittees with ACRS, and to go over, you know, the feedback we got from ACRS, and where we are today and what our next steps are.

Next slide.

The objective of 1855 has not changed over time. It was always to provide guidance on identifying and characterizing the various sources of uncertainty, performing uncertainty analyses, to understand their impact on the results, and then

factoring those sensitivities and the uncertainty into the decisionmaking process.

So that's what we were developing guidance for for both the licensee and then how the NRC would deal with that in application space.

When we started this effort and dialogue with EPRI, we both recognized that both organizations had developed work in this area. So we got together under an MOU and decided to collaborate. And what we did is that instead of trying to come up with a single document, because there were differences in what we were doing, but it seemed to work together, and so we have made sure that both of our efforts mesh and support each other.

And so where that has fallen out is that our document pretty much provides the guidance, and their document gets into details on the state of knowledge correlation, provides a generic list of sources of uncertainty, and provides a detailed example. And Mary will get into more, you know, the EPRI work.

VICE CHAIRMAN STETKAR: Mary, one quick process question for the benefit of the other members who weren't at the subcommittee meetings.

This is a NUREG, so it's not regulatory -- formal regulatory guidance. And the NUREG does not formally endorse the EPRI documents as part of regulatory guidance. Is that my correct understanding of this?

MS. DROUIN: Yes. I mean, you know, when we say "endorsed," that gives me pause of what you mean by that in a legal sense.

VICE CHAIRMAN STETKAR: That's what -- but in some sense, I am trying to address that question

MS. DROUIN: And normally, you know, when we endorse something, then that means that we have read line by line and agree with every sentence that is in there. I mean, it's like, for example, when we endorse a standard --

VICE CHAIRMAN STETKAR: Right.

MS. DROUIN: -- I mean, it's like we agree with every single thing that is written in that document.

VICE CHAIRMAN STETKAR: And this is not of that ilk.

MS. DROUIN: No.

VICE CHAIRMAN STETKAR: Okay.

MS. DROUIN: This is not of that nature.

VICE CHAIRMAN STETKAR: It also affects, to some extent, actually to a real extent, the scope of our review, because we typically do not review and comment on industry documents unless those reports are submitted in direct support of a licensing activity, a topical report/technical report is submitted on the docket for a licensing activity, or if those reports are formally endorsed in regulatory guidance -- for example, some NEI methodologies are formally endorsed as part of regulatory guides.

MS. DROUIN: Right.

VICE CHAIRMAN STETKAR: And because these EPRI reports are not part of the regulatory basis in that sense, we don't normally comment. We, as the ACRS, don't normally comment on the technical content of those types of reports. So we have a bit of a disconnect here.

MS. DROUIN: Yes.

VICE CHAIRMAN STETKAR: I just wanted to make sure that I understood --

MS. DROUIN: But they --

VICE CHAIRMAN STETKAR: -- that process.

MS. DROUIN: -- are meant to be companion documents. And when you go through 1855,

you will see many places that we refer the reader --

VICE CHAIRMAN STETKAR: Right.

MS. DROUIN: -- you know, for more information and for guidance to the EPRI document.

VICE CHAIRMAN STETKAR: Thanks.

MS. DROUIN: Okay. Next slide, please.

Going back historically, this whole program really got initiated because of letters from the ACRS back in 2003 where the ACRS, you know, noted that this was a hole and that we did not have guidance of how to deal with uncertainty, and it was a fairly significant hole.

The staff agreed with that and initiated this program. And back in 2007, we issued the first draft for public review and comment, and then for use in 2009. We met with the subcommittee in 2009, and they supported where we were -- had published.

Then, we had a workshop in May, and we got a lot of gradient sites out of that workshop. And the main insight we caught was, gosh, this is a great document, but I can't figure out how to use it. A lot of good information in there, but it is more kind of esoteric, and where is the real guidance, and what do I have to be doing as a licensee versus what, you know, the NRC is doing.

So --

MEMBER SKILLMAN: Mary, before you change the slide, please, in that first sentence you identified how to perform sensitivity and uncertainty analyses. Then, in the bullet, you point to uncertainty. What I'm curious about is, are the words "sensitivity" and "uncertainty" synonymous? Or are those different features?

MS. DROUIN: This is a poor choice of words on the slide. When we talk about doing sensitivity analyses, we are talking about sensitivity analysis we are doing for sources of model uncertainty, and that is how we address that in the document.

Uncertainty analyses can encompass both parameter and model uncertainties. So this was not the best choice of words here to explain that.

MEMBER SKILLMAN: Thank you, Mary. Thank you.

MS. DROUIN: Okay. So, you know, we went back to the drawing board, and we did a major what I call a restructure of the document. We kept everything that was in that original revision. It was cut and pasted in different places, and then a lot more explanation to clarify the guidance was

added, and we also created a whole new chapter in terms of what the staff process is, and Anders is going to quickly, you know, go through that.

Also, during this timeframe, we got a user need that asked us to expand. The sources of uncertainty include low power shutdown, internal fire, seismic, and Level 2 PRA. And that really did not affect our document too much. It really affected the EPRI work, and EPRI agreed to update the -- and they have chosen to do that through an additional report to address these.

We did have a workshop in end of February of this year to get a handle on these sources of uncertainty. It was a day and a half workshop where we brought experts in on each of these areas to solicit them of what were, they felt, the sources of model uncertainty. And that was the major input into this work.

MEMBER SHACK: Who requested the additional work on low power and shutdown, fire and seismic?

MS. DROUIN: It came from a user need letter from our program office, NRR, and NRO.

MEMBER SHACK: Both or one or the other?

MS. DROUIN: It was a single user need

letter signed by both offices. Then, we met with the ACRS, we revised the NUREG, and we came back and met with the ACRS again very recently on October 19th to present our final changes. And we are getting ready now to issue it for public review and comment.

So at this point, I am going to -- Anders is going to walk you through what is this Revision 1.

MR. GILBERTSON: Okay. Good morning, everyone. So the guidance in this document was reorganized to provide a better structure and flow for the user. The new document consists of seven stages that were organized into three main parts. Of particular significance, as Mary had discussed, was the inclusion of the Stage G, as you see at the bottom there. It says, "The process -- Stage G describes the process used by the staff for the risk-informed review process."

Also of importance is the Stage G that was included. This is a stage that helps -- that provides guidance to the licensee with regard to the development of the risk-informed application as it applies to the treatment of uncertainties.

This diagram is meant to illustrate the

overall flow of the process for the treatment of uncertainties. The way it is written in the NUREG we structured it in a sequential manner, so you go through and you reach Stage A, B, C, all the way through G.

But one of the purposes of this figure is to demonstrate the iterative nature of the whole process. So you have -- for example, on the left side, with regard to the licensee's process, you have Stages C, D, and E all have these double-ended arrows. So there can be multiple iterations going through those stages for the licensee to refine their analyses.

And, likewise, between the licensee and the NRC's risk-informed review process, there is another double-ended arrow there to illustrate the fact that there may be dialogue between the staff and the licensee.

So some of the main points with regard to this restructuring, you know, we restructured the document to match the flow of the diagram. And, specifically, we included new language that tells the user whether this is -- guidance is being provided for the licensee or for the NRC staff. In some cases, it is being provided to both the

licensee and the NRC staff.

As I stated previously, adding Stages F and G were a significant addition. The intent of doing this was to just better foster alignment of the licensee's strategy for the development of their process, their treatment of uncertainty, with the staff's risk-informed review process.

We revised the guidance to emphasize that the technical acceptability of the PRA must be established. And in seeking to better align the strategy -- the licensee's strategy and the NRC's risk-informed review, we provided a new discussion that relates -- that talks about the relationship of the -- between the amount of justification needed by the licensee for a given application relative to the proximity of the risk results to the application acceptance guidelines. And I'll go over this in the next couple of slides.

Finally, we revised the guidance to include a new discussion on a generic application of the treatment of uncertainties.

So as I mentioned in the last slide, this diagram was developed to help provide -- or to illustrate the relationship between the results of a risk-informed application and the justification

needed for a risk-informed application relative to the proximity of the risk results to the acceptance guidelines.

So you can see here we defined these four regimes. The acceptance guidelines are, you know, shown there in the sort of fuzzy white line, and at the bottom there you have this sliding scale, the justification needed. And it is -- of course, it is a relative measure, and I will go into now the description of these four regimes.

So for the regime 1, this is a case where the risk results from the application are well below the acceptance guidelines. In this case, we are talking approximately an order of magnitude less than the acceptance guidelines, or greater or less.

In general, the staff would perform just a general review of the peer review findings, but would probably not perform an audit of the application PRA. In their review, the staff are looking for the qualitative or quantitative assessment of the state of knowledge correlation, so that it demonstrates that there is no impact on the risk results.

Additionally, the staff would assess the appropriateness and the adequacy of the performance

monitoring, just to make sure that the application adequately detects changes or can adequately detect degraded performance.

So this second regime -- this is a case where the risk results are closer to the guidelines but are not challenging the application guidelines. And for the applications that fall here, the staff would still perform a general review of the peer review findings. It would be a little more focused, and this would be to better understand how specific findings are resolved by the licensee.

In this case, an audit is still not likely to be performed. And we are also looking for a quantitative assessment of the state of knowledge correlation.

For the third regime, this is the case where the risk results do challenge the acceptance guideline. So in this case, you would fall just below or just above the acceptance guidelines. In these cases, for these types of applications, the staff would perform a more focused review of the peer review findings using a higher degree of scrutiny. And it is likely that an audit of the application PRA would occur.

Additionally, for these types of

applications, there are typically compensatory measures included, and the staff would review these to determine the appropriateness and the adequacy, and then also it is possible that we -- the staff would request additional sensitivity analyses for some of these compensatory measures.

MEMBER SKILLMAN: Anders, in regime 1, and in regime 3, you use words that the plant operators use every day. In the second green bullet on regime 1, appropriateness of adequacy of performance monitoring for the timely detection in the graded performance, and then bullet 3, you identify includes review of the appropriateness of comp measures, and what I'm remembering is the taut relationship both sides have with the region's PRA specialist. The taut relationship that most sites have with the region PRA specialist.

As you explained this, are you talking about real-time contemporaneous interaction between a site that is sustaining a degraded condition and a region or headquarters for that condition that is evolving?

MR. GILBERTSON: I believe the answer to that question would be no, but it --

MEMBER SKILLMAN: I'm wondering if this

is guidance for real-time activity between the facility and the region, or if this is something that is retrospective. The event occurs, there is an event report, and you go back and take a look at it 30 or 90 days later.

MS. DROUIN: Okay. Remembering that this is what -- the staff is looking at the submittal, so they would be looking at -- to see what has the licensee proposed in terms of their compensatory measures, and do we think it's adequate.

MEMBER SKILLMAN: But very commonly comp measures is something that you are doing in real time. You have a casualty or you have a degraded condition, you're into your license and your tech specs and you are trying to see --

MS. DROUIN: Right. But this is what the licensee --

MEMBER SKILLMAN: -- if they're going to shut down.

MS. DROUIN: -- has proposed in his submittal as his compensatory measure to deal with something that has not been granted yet.

MEMBER SCHULTZ: Could it not be used for discussions between the licensee and the region

with respect to an incident, and then compensatory measures that were taken in that evaluation that normally occurs?

MS. DROUIN: Okay. But see, you're talking something that has occurred.

MEMBER SCHULTZ: Yes.

MS. DROUIN: The licensee has come in and has requested a change that the NRC has not granted yet. And the licensee is saying, "Okay. I will put into place this compensatory measure to deal with this change." So now --

MEMBER SCHULTZ: So that's the sole circumstance of application that is described here.

MS. DROUIN: Yes.

MEMBER SCHULTZ: Not in dealing with incidents in the reactor oversight process and evaluating compensatory measures that a site might have taken to respond to --

MS. DROUIN: Now, how that gets implemented once the decision has been granted is not what we are talking about here. You know, this is just looking to see if the compensatory measure, you know, is adequately addressing the change, whether or not the change that is being requested by the licensee, whether they will be able to monitor

it.

MEMBER SHACK: So it's before the fact, not after the fact.

MS. DROUIN: That's right. This is before the fact.

MEMBER SHACK: Okay. I mean, this is typically in support of a 1174 kind of application.

MS. DROUIN: Yes.

MEMBER SHACK: But, again, I mean, it's general. You certainly could use it, for example, in the significance determination process to kind of determine, you know --

MEMBER SCHULTZ: That's what I was looking for --

MEMBER SHACK: What you're really saying --

MEMBER SCHULTZ: -- extension to that at least.

MEMBER SHACK: -- is the true significance of something. I mean, it is mostly aimed at 1174, but it's a general kind of PRA result, I mean, that you -- any time you are using the PRA, you have uncertainties, and you want to see how those uncertainties impact, this guidance would be helpful.

MS. DROUIN: Yes. It could.

VICE CHAIRMAN STETKAR: And part of that is -- I mean, we had some discussion during the subcommittee meeting regarding the sort of deemphasis of uncertainties if your point estimate value is in that regime 1, let's say, area.

If there is very large uncertainty, there could be a measurable probability that the -- in the context of a significance determination, or in terms of as the document is written in terms of like a 1174 submittal, there could be significant measurable probability that you are fairly close to an acceptance criteria, or, in the significance determination, you trip over one of those more gray boundaries between, you know, yellow and a white or something like that.

So without understanding those uncertainties fairly well, even though the point estimate comparison might be fairly far from whatever your target is, it doesn't seem that the decisionmaker has all of the information available.

The decisionmaker either in terms of the NRC staff evaluating the acceptability of a forward-looking type submittal, or the decisionmaker in the region trying to make a determination of whether or

not to elevate attention to a particular incident that has happened, you know, after the fact, when you are doing the determination assessment.

We did have some discussion about that during the subcommittee meeting, and I wanted to -- it is somewhat relevant to Dick's question about, you know, how does this play into evaluation, essentially, of anything that has happened, whether it's forward-looking or retrospectively looking.

Because the title, indeed, just says "Guidance to the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking." And all of those things are risk-informed decisionmaking.

I think we -- you know, we certainly understand how the guidance is organized.

MR. GILBERTSON: All right. I will move on to regime 4, then, I guess. This regime we are talking about a situation where the risk results for a given application clearly exceed the guidelines that have been established for that application.

It is generally quite rare that these applications are even submitted. We scratched our heads a little bit, and there could be a case, but it's often -- it is not -- these are not typical

that these would get submitted. They would generally be rejected by the staff.

MEMBER SHACK: Or not even exposed to the light of day.

(Laughter.)

MR. GILBERTSON: Yes.

MEMBER RAY: Well, wait a minute. If you were asked to make a submittal using this methodology, and your licensing basis was what it was, but you've made this -- answer the question. These are just guidelines, so --

MEMBER SKILLMAN: It's --

MEMBER RAY: -- hide, my point. Do it all the time. Do it, anyway, not all the time, certainly in IPEEE space. People answered the question regardless.

MEMBER SKILLMAN: Yes. I can see an example of this where you have a significant chemistry excursion. And one would say, "Well, that's no B," but the materials individuals would say, "Hey, that is a very significant challenge to the reactor coolant system pressure boundary," or whatever it --

MEMBER CORRADINI: It's an analysis that we have done internally, but it wouldn't be

necessarily submitted.

MEMBER SKILLMAN: If I have a major chemistry excursion, I will tell you I'm online with the region. And the region might say, "That is really serious," and my response might be, "I know it's serious. I'm running my polishers. I expect to be out of this in 36 hours. But I'm way over where I should be in terms of my tech specs or whatever."

And the region might say, "You are -- you know, you are off the -- you know, you are off the chart, but we're -- if you haven't lost your conviction and you're operable, we're going to let you go." But I could see an incident like this. And if the guidelines allow some flexibility, then, okay.

But just because the plant finds itself in this very awkward position should not necessarily trigger a shutdown or some perhaps even greater excursion that exacerbates the issue that I am working with. Reactor coolant pump seal leakage is a good example. A reactor coolant system leak that is below threshold is of grave concern because of the location of the leak, if you can identify it.

Those are issues where you would say,

"Hey, this is not where we want to be," but it could be precipitous just to, say, push the button and scram the plant. That could result in a transient that could be worse than the issue that you are dealing with.

MEMBER RAY: Well, I'm not even thinking about it in operating space. I'm just thinking about it as a licensee review. Everybody submit their response to some request for submittal, given some assumptions, and it may not meet guidelines because it's -- those assumptions aren't part of your licensing basis. If you want to backfit the licensing basis, that's another discussion, you know. Isn't that right, Mary? I mean, you would respond and say, "We don't meet the guidelines for a new plant," but the plant is 30 years old?

MS. DROUIN: Well, I mean, if a licensee put in an application and they clearly exceed the acceptance guidelines for that application --

MEMBER RAY: Well, I know. But if it's a new plant guidance, for example, the guidelines are for new plant licensing. But if people are asked to respond and evaluate existing plants, that's what I'm talking about.

MS. DROUIN: I'm not following your

question.

MEMBER RAY: It isn't a question.

MEMBER BLEY: You're talking about very different things I think.

MEMBER RAY: I am. The point was made that nobody would -- I think Mike said nobody would submit anything that exceeded the guidelines. It would seem to me like you would if you were asked to evaluate an existing plant to some guideline that doesn't necessarily apply, but necessarily -- but you would do the evaluation in any case.

VICE CHAIRMAN STETKAR: I think what we are hearing -- we are pressed a little bit for time, because we only have until 9:30, and we want to make sure we have enough time to hear from EPRI.

I think what you're hearing here is that this document, and, indeed, you'll hear more when you hear the EPRI presentation, has in some sense been created with a very narrow focus in terms of the treatment of uncertainties.

And that focus -- and, Mary, correct me if I'm wrong -- is primarily associated with risk-informed changes -- licensee-initiated risk-informed changes to the current licensing basis, in effect a submittal that would be evaluated under the guidance

in Regulatory Guide 1.174.

Is that primarily --

MS. DROUIN: If you go to Stage A, and Stage A is -- has a series of criteria that narrows you down to what primarily the document has been created for.

Even though we recognize that it has generic implications, you know, the bias of how it was written --

VICE CHAIRMAN STETKAR: Is --

MS. DROUIN: -- was --

VICE CHAIRMAN STETKAR: -- is that context.

MS. DROUIN: -- is in that context and --

VICE CHAIRMAN STETKAR: And I think what you're hearing here now from other committee members is that the more generic the Stage A, that winnowing out, in principle, you could use this guidance for evaluation of uncertainty in any type of application, whether it's response to an active event, whether it's response to, you know, an information -- a risk-informed information or test regarding, you know, revisions to the licensing basis.

MS. DROUIN: Yes. But when you talk about -- you know, when you get into Stage F and Stage G, you know, you move away from the generic application of it.

VICE CHAIRMAN STETKAR: That's right.

MS. DROUIN: That is now what the staff review process is after you have gone through Stage A.

VICE CHAIRMAN STETKAR: Right. Right. Okay. Thanks. Thanks. Thank you.

MR. GILBERTSON: Okay. So, again, just in the interest of time, I'll just mention that these were some of the -- this is a summary of some of the feedback we received from the ACRS subcommittee in past meetings. And the resolution of these issues were, you know, addressed and discussed actually at the last ACRS subcommittee meeting on the 19th. And the document was fairly well received, so --

It has been -- for those of you who were at the subcommittee meeting, there were some changes made to the document between -- or like a subcommittee meeting and this meeting. We do have a redline strikeout version of that, and we don't have time to go through that.

I think it's fair to say that there wasn't -- let's just say there weren't substantive changes made in terms of the overall approach or any of the guidance or anything like that. There were some clarifications in response to our comments.

I just wanted to alert the members that if you look carefully at what we saw during the subcommittee meeting we do have a document that walks you through those changes.

So where we are right now, we are currently -- actually, perhaps even today we will be sending over the two-week impending publication notice to NRR and NRO. And we are going to -- we have some comments from NRR and NRO, and we are planning to address those alongside with the public comments, because we have been so involved with the program offices during the process of developing this revision. And we anticipate the Revision 1 of 1855 to be published in early 2013.

VICE CHAIRMAN STETKAR: Do you have a 30-day, 60-comment period? Have you decided yet?

MR. GILBERTSON: We are doing -- well, let's -- we are doing a 60-day comment period.

VICE CHAIRMAN STETKAR: Okay.

MR. GILBERTSON: Yes.

VICE CHAIRMAN STETKAR: And how much time have you allowed to address the issues and questions that come from the public -- comment review and the other agency reviews?

MS. DROUIN: We try and turn it around in 30 days once the public review and comment period -- you know, that all factors into what kind of comments -- we don't -- you know, I'll be honest, I don't expect that we will get public comments on this. We may well, but I imagine they will be few.

MEMBER SHACK: The public that is mostly likely to comment is kind of deeply involved in it already.

MS. DROUIN: Yes.

VICE CHAIRMAN STETKAR: Okay. Any other questions for the staff regarding the NUREG itself? Because now we are going to switch gears and hear from EPRI with the presentation of the information that is in that companion report that we referred to in the introductory remarks.

And, again, this is not -- for the benefit of the committee, this is not a direct part of the NUREG. It is referred to extensively within the NUREG, but it is not a part of the NUREG in the legal and in the sense of our review of these

documents.

CHAIRMAN ARMIJO: Isn't a NUREG a standalone document that doesn't require any input or parallel use of the EPRI guidance document when somebody is doing this?

VICE CHAIRMAN STETKAR: You can ask Mary that.

MS. DROUIN: No. They are companion reports, and they are meant to be used together.

CHAIRMAN ARMIJO: They are meant to be used together.

MS. DROUIN: They are meant to be used together. And as you go through 1855, it will refer you to -- now, do you have to have the EPRI report to do the NUREG? No. It will make your life more difficult --

CHAIRMAN ARMIJO: Okay.

MS. DROUIN: -- because, you know, a lot of the stuff that is in EPRI, you know, they have done the -- they have done your homework for you.

CHAIRMAN ARMIJO: Okay. Thanks, Mary.

MEMBER REMPE: Will this be an open EPRI report, or would one -- if one didn't have access to the EPRI library from other sources, do they have to contact EPRI and pay for it, or how does that work?

MS. PRESLEY: Currently, it is like every other EPRI report. You have to have membership to get access to the report.

VICE CHAIRMAN STETKAR: That's another reason, quite honestly. I want to keep this straight. We will be writing a letter on NUREG-1855. Provided the rest of the committee agrees to that, we plan to write a letter.

We will not be commenting on the EPRI report, because I can't determine how we can legally do that. We don't have authority to comment, nor do I think is it appropriate for the Advisory Committee on Reactor Safeguards to comment on industry produced reports that are of this ilk. It is a restrictive report, it's not part of a licensing basis for any plant, and it's not endorsed in any formal NRC regulatory guidance.

So it's --

MEMBER CORRADINI: It's not part of the regulatory guidance.

VICE CHAIRMAN STETKAR: It's not part of the regulatory guidance framework. I think it's important for the members -- the reason we have this presentation -- to understand what is in that EPRI report, because it is -- there are hooks to it, and

we can certainly discuss, you know, this measure. But my plan currently is --

MEMBER BLEY: That brings up a question for me for Mary. If somebody uses the NUREG to do -- determine certainty analysis, and then cites that they have based their analysis on the example of the EPRI report, does that carry some weight for staff, or do you have to review it as if there was no guidance in an EPRI report?

MS. DROUIN: No. That carries weight with us.

MEMBER BLEY: It carries weight even though it is not endorsed or it's not part of regulatory guidance. I'm a little confused. I hadn't thought about this before right now.

MS. DROUIN: I mean, we are very much aware of what is in their document, and we have provided comments on it. Now, if there were substantial problems we had with their document, you know, then we would have factored that into account in our document.

MEMBER BLEY: So if I use it and say I used it, that's kind of like having used a reg guide and NRO or NRR might say, "Okay. That's good enough for us."

MS. DROUIN: We are encouraging people to use their document via our document. We send the reader to the EPRI report and say, you know --

MEMBER BLEY: But we don't endorse it or ever -- it just seems an awkward spot I guess.

VICE CHAIRMAN STETKAR: Let's move on. We need to discuss this during our deliberations.

MS. DROUIN: We believe in endorsement versus, you know, we agree that this is a good approach. I mean, we reference and recommend industry documents all the time without going through a legal endorsement of it.

MEMBER SCHULTZ: But you wouldn't expect a reviewer of an application to dismiss the need to review anything that is associated with the EPRI report because of what Research has established in this. In other words, an application that comes in, the application would still be reviewed. The appropriate evaluation of the EPRI document and its application with regard to the submittal would be fully reviewed.

MS. DROUIN: Yes.

MEMBER SIEBER: I think from a legal standpoint John is right. NUREGs don't endorse other outside reports but regulatory guides.

VICE CHAIRMAN STETKAR: Regulatory guides certainly do.

MEMBER CORRADINI: But that means that whatever they reference has been reviewed.

VICE CHAIRMAN STETKAR: That's correct. Regulatory guides can either hold in total, endorse a -- you know, an industry document, or it can endorse parts with exceptions.

MEMBER CORRADINI: Right.

MEMBER SHACK: And there is a difference between referencing and endorsing that is quite substantial.

VICE CHAIRMAN STETKAR: That's right. And there's a difference between referencing in a NUREG and endorsing in a regulatory guide.

MEMBER SIEBER: So I think John's interpretation is correct.

VICE CHAIRMAN STETKAR: Anyway, the reason that I brought this up is that it is clear that we, as a committee, during our deliberations regarding this letter will need to be aware of this issue at least. And I do want to leave 18 minutes now for Mary to at least tell us what is in those EPRI documents. Now you have to speak really fast.

MS. PRESLEY: Okay. That's good. I

allotted I think 10 minutes for this, so you would have time for questions.

The new report is practical guidance on the use of PRA in risk-informed submittals with a focus on the treatment of uncertainty, and it's EPRI document 1026511. And I just wanted to acknowledge ERIN Engineering helped us prepare the report, so if you can go onto the next -- go ahead. Go on to the next slide.

So the project history, you have already heard about the fact that we have the MOU with the NRC to work on this. We have been working with them since revision 0. Revision 0 of 1855 came out with the first companion document, which is EPRI 1016737.

And that guidance specifically focused on providing some guidance on how to deal -- how to know when state of knowledge correlation is important for the characteristics of a model that -- or state of knowledge correlations -- an important issue.

And then, also gave some figures on how much it would contribute to results, and then it also gave guidance on how to characterize model uncertainty and how to choose sensitivity studies, and then provided appendices with a list of generic

sources of model uncertainty for internal events at power. And then, it builds upon some prior work EPRI had done on uncertainty.

So if you go to the next slide, please.

And we have been continuing this collaboration with the NRC through Revision 1. They revised 1855 and put the structure in with the stages. And the EPRI document -- the new EPRI document, 1026511, is not meant to replace the old EPRI document, 1016737.

John, we did modify the report, so there is not any overlap anymore.

VICE CHAIRMAN STETKAR: Oh, good.

MS. PRESLEY: So they are separate.

VICE CHAIRMAN STETKAR: Good.

MS. PRESLEY: This new document really takes the stages in 1855 and describes how to apply it in a very practical way. So Anders had mentioned their iteration points, and that document shows the generic double-headed arrows. But we really dig down deep and, well, where do you iterate? How do you iterate? So it's very much process of --

VICE CHAIRMAN STETKAR: It sounds like you have done some editing work on that document since our subcommittee meeting in October. Is that

right?

MS. PRESLEY: We have.

VICE CHAIRMAN STETKAR: Okay. Thank you.

MEMBER BLEY: But we haven't seen that, right?

VICE CHAIRMAN STETKAR: We haven't seen that. We haven't seen, that is correct.

MS. PRESLEY: Okay.

VICE CHAIRMAN STETKAR: I don't know who else has seen it, but we have not seen that.

MS. PRESLEY: Okay. There is a backup slide that shows the lists of changes we have made since the subcommittee meeting, if that is helpful. So that is the intent of this new document, and I will get into some of the specifics of what is addressed in this new document in a couple of slides.

The other major point of collaboration with Mary's group was this joint workshop we had to help us identify sources of uncertainty for fire and seismic hazard groups as well as low power shutdown and Level 2 PRA. And we have included those sources of uncertainty in our appendices. So if want to go ahead and go to the next slide.

So this is actually just a table of contact, tells you what is in our report. Chapter 2 is that process that I described of the overall how do you perform, or how do you assess PRA results?

It is a five-step process. I have included a flowchart in the next slide to show you what that process looks like but it really is about defining the iteration points, where do you screen, and then the flowchart you will see in the next slide has the mapping to the stages of 1855, so it flows nicely.

Chapter 3 provides some specific guidance on if you are analzying results, how do you do that? Break it down into, if I look at it by hazard, look at it by initiating event, so it gives some practical guidance on how do you slice and dice your results to make sense and extract all of those risk insights that you are trying to extract.

And then, Chapter 4 gives a comparison -- 1855 defines the regimes, and Chapter 4 gives some detailed guidance on how to compare your PRA results against these acceptance guidelines, what you do when you're in the different regimes -- how do you do it, to what level of detail, that sort of thing.

And Chapter 5 really talks about, how do you package it all together to not only provide the quantitative results but to really make sure you pulling out all of the risk insights, you understand what your uncertainty is telling you, and you integrate it with the other principles of risk-informed decisionmaking, particularly defense in depth.

And then, we also have a short but hopefully useful section on how to deal with very large uncertainties.

And then, we -- the Appendix A provides an example of a risk-informed application using the stages in 1855. This was originally intended to be part of 1855 Revision 0, I believe -- Mary, you can correct me if I'm wrong -- but I think we agree that it made a little bit more sense in this document, and it follows more closely the process that we describe in our document.

And then, Appendices B through E are those generic -- those tables that have generic sources of uncertainty for fire, seismic, low power, and shutdown, and Level 2.

So that's, in a nutshell, what is in our report.

I am not going to step through the process, but this is the process that we describe in Chapter 2. You can see the little feedback loops and the iteration points. I just want to draw attention to the blue bubbles, and these are the relationships to the different stages in 1855, so you can see -- 1855 provides some really great guidance on specifics on how to do things.

For instance, we describe in Step 2 you have to assess the adequacy of the existing PRA model to model the cause-effect relationships. So make sure that your model is correct, has the right points to model your changes.

And then, we refer to Stage B2, which provides a list of the things that you need -- the details of what specifically you need to consider when you are assessing the cause-effect relationship. Do I need to add a basic event? Do I need to change my logic? That sort of thing.

So that is the mapping, and then you can see EPRI 1016737 really just feeds into Step 5, and it provides some specific methods on performing Step 5. So, and we took out -- I think I mentioned we took out some redundancy.

So if you want to go ahead to the next

slide.

Our next step, publications planned for December of 2012, actually, it has been published. We did look at combining with the old document, but the old document references the standard so heavily, and the standard is changing.

So we didn't think it was reasonable at this point to combine the documents, but maybe in the future if we have to revise -- particularly if we need to revise our document as a result of maybe public comments that 1855 receives, we don't -- obviously, we don't expect it to be substantially different. But if it is, we may look at having to revise our document and then combining.

VICE CHAIRMAN STETKAR: But in practice, users are directed to both of those documents, not --

MS. PRESLEY: Yes.

VICE CHAIRMAN STETKAR: -- both from 1855, and 1855 references both of them. And it sounds like you have at least clarified some of those overlaps that we had discussed during the subcommittee meeting. There is some confusion about which is -- which is the most operative document. And so that should at least help clarify the users'

needs.

MS. PRESLEY: Great. And then, I do have a backup slide on the differences if you are interested, but I don't want to harp on that. They are not substantial. They are mostly editorial and restructuring, in that sense.

VICE CHAIRMAN STETKAR: It's up to the members.

CHAIRMAN ARMIJO: Well, if you weren't at the subcommittee, it doesn't make much sense to --

VICE CHAIRMAN STETKAR: That's right. So in the interest of time, I don't hear a lot of -- I mean, I have skimmed through them. I can see what you've done.

Well, thank you. I thought it would -- and I think that's useful, for the members, especially those who were not at the subcommittee meeting, to have an appreciation -- and I think -- of what's in the document. Certainly, the backup slides walk you through a lot more of that detail.

We obviously don't have time to go through all of that, but it at least gives the members of the full committee some of that perspective that, unless you attended the

subcommittee meeting, isn't available.

Are there any other questions for either the staff or for EPRI?

CHAIRMAN ARMIJO: Yeah. I don't know whether this is appropriate, but any -- anyway, this issue about treatment of large uncertainties, is this kind of a new thing? A new approach? Or is it -- because that's really where I think we have most of our problems with --

VICE CHAIRMAN STETKAR: Go to Slide 25 in your package there. I think that's what Dr. Armijo is looking at.

MS. PRESLEY: I also want to mention, we have Gareth Parry on the bridge line, and he may want to jump in. I don't know.

VICE CHAIRMAN STETKAR: Okay. We'll have to open it up, because we have, I believe -- Gareth, if you are screaming at the phone, we can't hear you yet. So we need to get the bridge line open if we can, so that we can hear Gareth, please.

MS. PRESLEY: Meanwhile, fundamentally, large uncertainties are not that different than any other model uncertainty in terms of the way you deal with them. We have looked at the issue -- that section was actually fairly short -- but we have

looked at the issue and defined some points where large uncertainties really intersect with decisionmaking.

And there is -- as you seen in this table, there is the potential to overestimate the computed risk. There is potential to mask change in risk, and there is the potential to underestimate the computed risk. And so we describe those -- how those happen in a little bit of detail and how you can look for those.

And then, once you find them, what you can do about it, and really that goes into sensitivity studies.

We also talked specifically about this idea of the cliff edge effect where you hit something and everything goes downhill really fast. And from that perspective we provide a little bit of guidance on how you can look at the problem on its head, and say, okay, given my acceptance guidelines, I want to reverse engineer what my hazard likelihood has to be to get me into that region, and then look at the hazard likelihood and say, okay, what are the contributors to that likelihood, and how much do I believe that to get me to that frequency?

So in external flood, if the hazard

likelihood is so low that really the contributions to uncertainty at that stage is, does climate change have a big effect, then you say, okay, well, that's -- at least now I know what the contributions to uncertainty are in that regime that I care about.

So instead of trying to deal with the whole pie at once, you are just looking at the slice that you really care about.

VICE CHAIRMAN STETKAR: Do you want to have Gareth add something?

MS. PRESLEY: Gareth, do you --

VICE CHAIRMAN STETKAR: Gareth, just say something so we know the line is open first.

MR. PARRY: Okay. I'm here.

VICE CHAIRMAN STETKAR: Okay. Good. If you want to add something, first, just identify yourself so that we know who you are, please.

MR. PARRY: Okay. Yeah. This is Gareth Parry from ERIN Engineering. I've given Mary sort of the job of -- what the concern was -- I think to a certain extent, external flood is the poster child certainly.

What we are really dealing with is other -- don't have much confidence in the actual frequencies that you are using. And the angle -- to

a certain extent is, how do you relate -- of safety margin and -- as opposed to --

VICE CHAIRMAN STETKAR: Gareth? You're breaking up pretty badly. I don't know if you are too close to a mic or -- try something.

MR. PARRY: I'm afraid I don't --

VICE CHAIRMAN STETKAR: We are only picking up about a quarter of what you're saying. So I think the important thing that you said is Mary covered it pretty well I think for our purposes. And given the time, I'm afraid it is probably pragmatic just to say thanks.

MR. PARRY: No problem.

VICE CHAIRMAN STETKAR: And have a good holiday.

MS. PRESLEY: And that was worth getting up at 6:30 in the morning.

So, yes, basically the slide summarizes what we had to say with large uncertainties. But that's -- did you have any other specific questions? I can't recall.

VICE CHAIRMAN STETKAR: Do any of the members have any other questions? Again, for either the staff or for EPRI.

MEMBER BLEY: I guess I'm going to

dangle on that last thing. Are all nuclear utilities now members of EPRI from the U.S. again?

MS. PRESLEY: Yes.

VICE CHAIRMAN STETKAR: Yes?

MS. PRESLEY: I am 99 percent confident that that is the case.

(Laughter.)

VICE CHAIRMAN STETKAR: Okay.

MEMBER REMPE: I think there is another issue where you have the foreign vendors coming in that are dealing with issues where they are not members of the owners groups in the U.S. that make things difficult.

VICE CHAIRMAN STETKAR: We have, I believe, an example of that where one of the new plants will be submitting risk-informed technical specifications, for example.

MS. DROUIN: Well, Mary and I are going to --

VICE CHAIRMAN STETKAR: -- and I'm not sure that they are a member of the owners group or EPRI.

MS. DROUIN: Mary and I are going to have to talk offline, because the original agreement that we made with EPRI years ago is that this had to

be publicly available.

VICE CHAIRMAN STETKAR: Okay. That's something, you know, between, you know, you obviously, that you'll need --

MEMBER BLEY: I know for sure it is not today. I just looked.

MS. DROUIN: We will get that resolved, because we can't reference legally a non-publicly available document. So --

MEMBER BLEY: Maybe that's how we end it.

VICE CHAIRMAN STETKAR: Obviously, there is some issues here that need to be worked out I think, it is probably safe to say, between those two documents. And, again, in our deliberations over the letter I'm sure we'll discuss, you know, how we are going to address this, but --

MEMBER REMPE: But if we know the answer of how you worked it out when we're delivering --

VICE CHAIRMAN STETKAR: We're not going to know that today, though.

MS. PRESLEY: It will be whatever -- I assume it will be the same as what 1016737 was.

VICE CHAIRMAN STETKAR: The answer is we're not going to know that today.

With that, I'll ask for public comments.

MEMBER BLEY: Mr. Chairman, on this issue -- this has happened before -- it is very disappointing that we don't see any observers from the staff on these issues of uncertainty.

VICE CHAIRMAN STETKAR: Thank you. And I agree with you completely.

If there is nothing else, Mr. Chairman, I will turn the meeting back to you after I say thank you very much. I appreciate you getting through a lot of material, and I really do appreciate -- the staff and EPRI has put in a lot of work on this document, especially over the last six months since we had the meeting in June.

And I -- you know, I really appreciate the effort here. I think that the whole project hangs together much better than it did. And I think it is really useful.

MS. DROUIN: Thank you.

VICE CHAIRMAN STETKAR: That's my opinion.

CHAIRMAN ARMIJO: Okay.

VICE CHAIRMAN STETKAR: Back to you.

CHAIRMAN ARMIJO: Thank you, John. And I'd like to thank the presenters for patience with

us and a good presentation.

We'll take a break, and we will reconvene at 9:45.

(Whereupon, at 9:32 a.m., the proceedings in the foregoing matter went off the record.)

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

**Mary Presley** EPRI

**Gareth Parry, Doug True, Don Vanover** ERIN Engineering

**Advisory Committee on Reactor Safeguards**

**Full Committee Meeting**

December 7, 2012

# Overview

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

# Project History

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

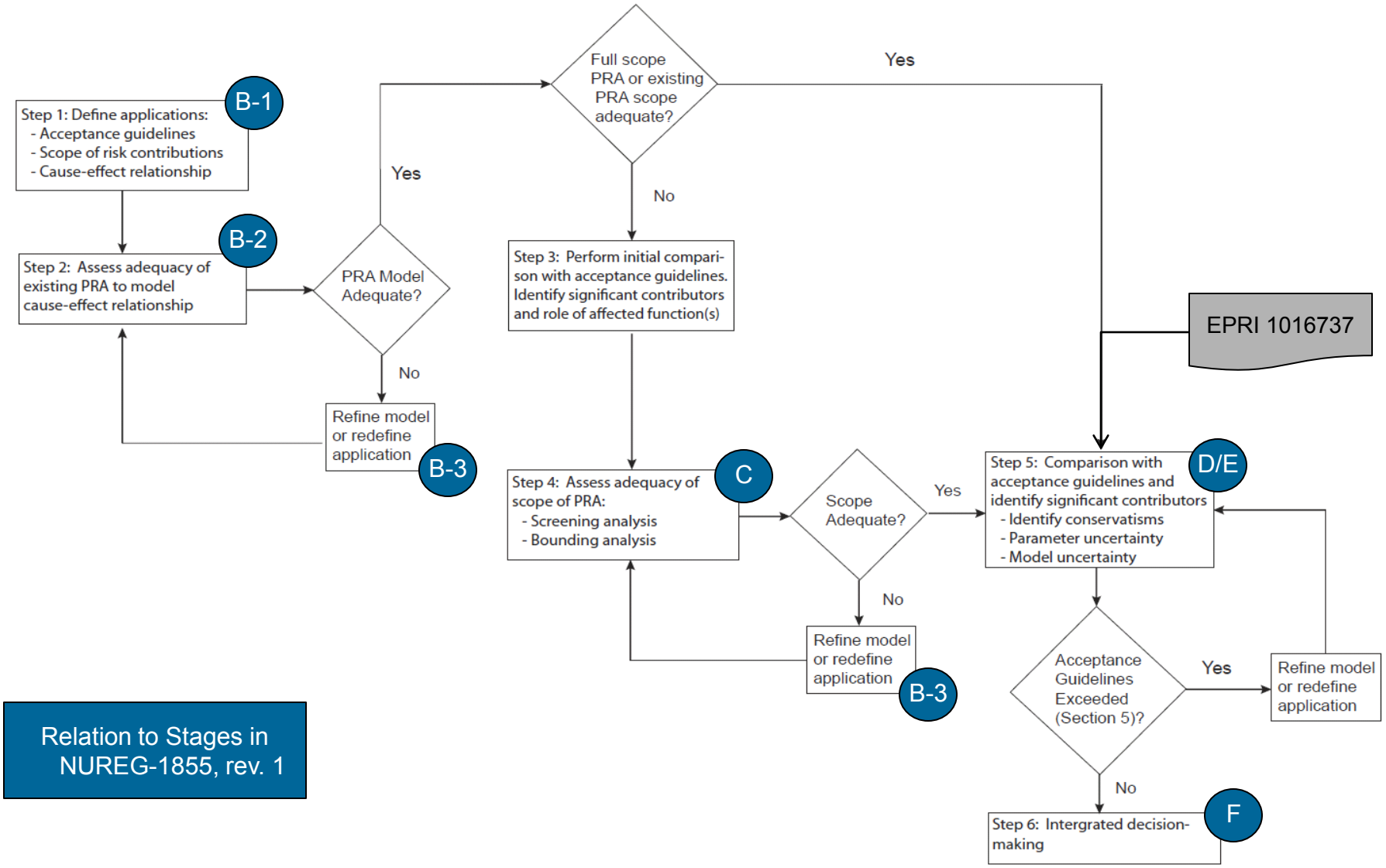
# Ongoing Collaboration with NRC

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

# New EPRI Guidance

- Ch. 2: Process for Assessing PRA Results for the Purpose of Risk-Informed Regulations
- Ch. 3: Analysis of Results
- Ch. 4: Comparison of PRA Results with Acceptance Guidelines
- Ch. 5: Decision Making in the Face of Uncertainty
  - Use of PRA Results
  - Addressing Defense in Depth
  - Dealing with Very Large Uncertainties
- Appendix A: Example Implementation in a Risk-Informed Regulatory Application [RHR example]
- Appendix B: Generic Sources of Fire PRA Modeling Uncertainty
- Appendix C: Generic Sources of Seismic PRA Modeling Uncertainty
- Appendix D: Generic Sources of LPSD PRA Modeling Uncertainty
- Appendix E: Generic Sources of Level 2 PRA Modeling Uncertainty

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




Relation to Stages in NUREG-1855, rev. 1

# Next Steps

- Publication is planned for December, 2012 (prior to anticipated release of NUREG-1855, Rev. 1)
- Potentially need a Technical Update to current EPRI report if the final version of NUREG-1855, Rev. 1 is substantially different than the draft to be released in January.

# Backup

# Changes Made Since ACRS Meeting

- Updated process figure and description to bypass steps 3 and 4 when PRA scope is adequate for application
- Clarified relationship to EPRI 1016737 and NUREG-1855
- Restructured Chapter 4 to clarify determination of Regime
  - Clarified the concern with parameter uncertainty was related to the effect of the state of knowledge correlation
- Changes to Chapter 5
  - Clarified distinction between parameter and model uncertainties
  - relationship of cliff edge to uncertainty
- Changes to Appendix A
  - Added summary table to show link to the process steps
  - Clarified portions of the analysis, including where additional documentation is needed to justify the analysis
  - Added footnote on use of Appendix B in the fire analysis
- Added examples of possible approaches for addressing model uncertainties in Appendix E
- Numerous editorial changes

# Assumptions

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

# Assumptions (Cont'd)

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

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

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

* (NUREG-1855 Stage B)

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

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

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

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

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

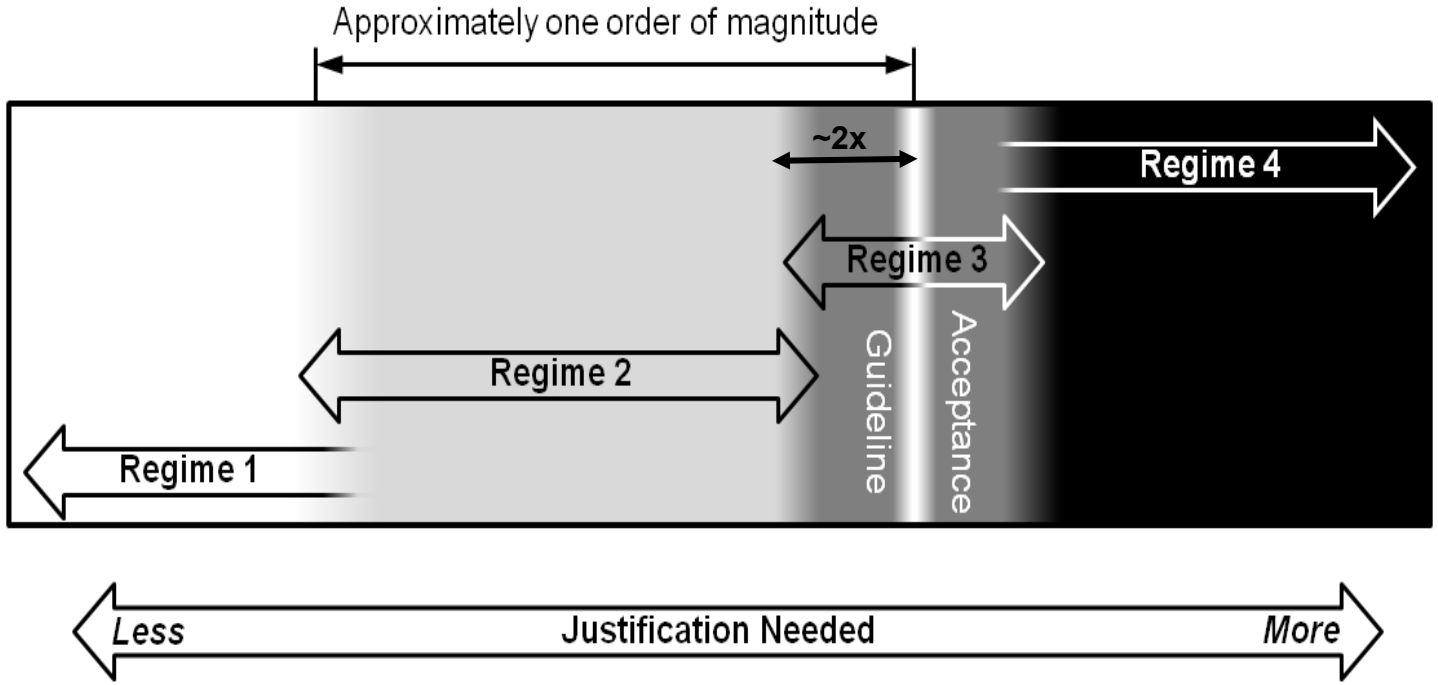
* (NUREG 1855 Stage B-3, C)

# Step 5: Final Comparison with the Acceptance Guidelines

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

# A Graded Approach to Dealing with Uncertainty

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



# A Graded Approach to Dealing with Uncertainty (2)

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

* (NUREG 1855 Stage D, E)

# Step 6: Integrated Decision-making

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

* (NUREG 1855 Stage F)

# Integrated Assessment

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

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

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

# Proposed Approach for addressing DID*

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

** This approach has not been endorsed by NRC*

# The Role of DID in an Integrated Decision

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

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

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

# Addressing Large Uncertainties

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

# Large Uncertainties (Cont'd)

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

# Large Uncertainties – Steps 2 & 3

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

# Results Decomposition (Chapter 3)

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

# Example Table for Sources of Uncertainty

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

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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 Full Committee on PRA

December 7, 2012

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# OUTLINE

- Objectives
- Scope
- Background
- NUREG Restructure
- ACRS Feedback
- Status and Next Steps

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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 process of identifying and characterizing uncertainty and on the process of factoring the results into the decisionmaking
  - Process developed for licensee risk-informed activities for PRA sources of uncertainty
  - Process is generally generic and independent of the activity and specific source of uncertainty
- Scope (EPRI report) –
  - State-of-knowledge correlation (SOKC)
  - List of generic sources of uncertainties for Level 1 and Level 2 for internal hazards and seismic and all plant operating modes
  - Detailed example

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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 credible approaches are used
- NUREG-1855 was first issued for draft in November 2007 and then for use in March 2009.
- The staff met with the subcommittee on March 27, 2009, the Committee supported the proposed staff changes
- A major public workshop was held on May 5 and 6, 2009
  - Most significant insight was the difficulty to discern guidance for the licensee versus guidance for the staff.

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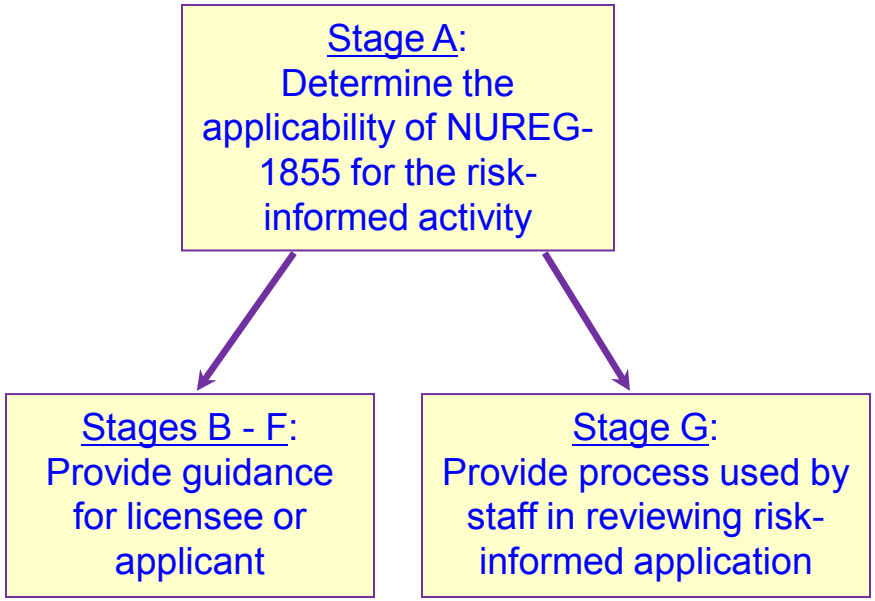
# BACKGROUND (CONT'D)

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

# NUREG Restructure

- Guidance was reorganized 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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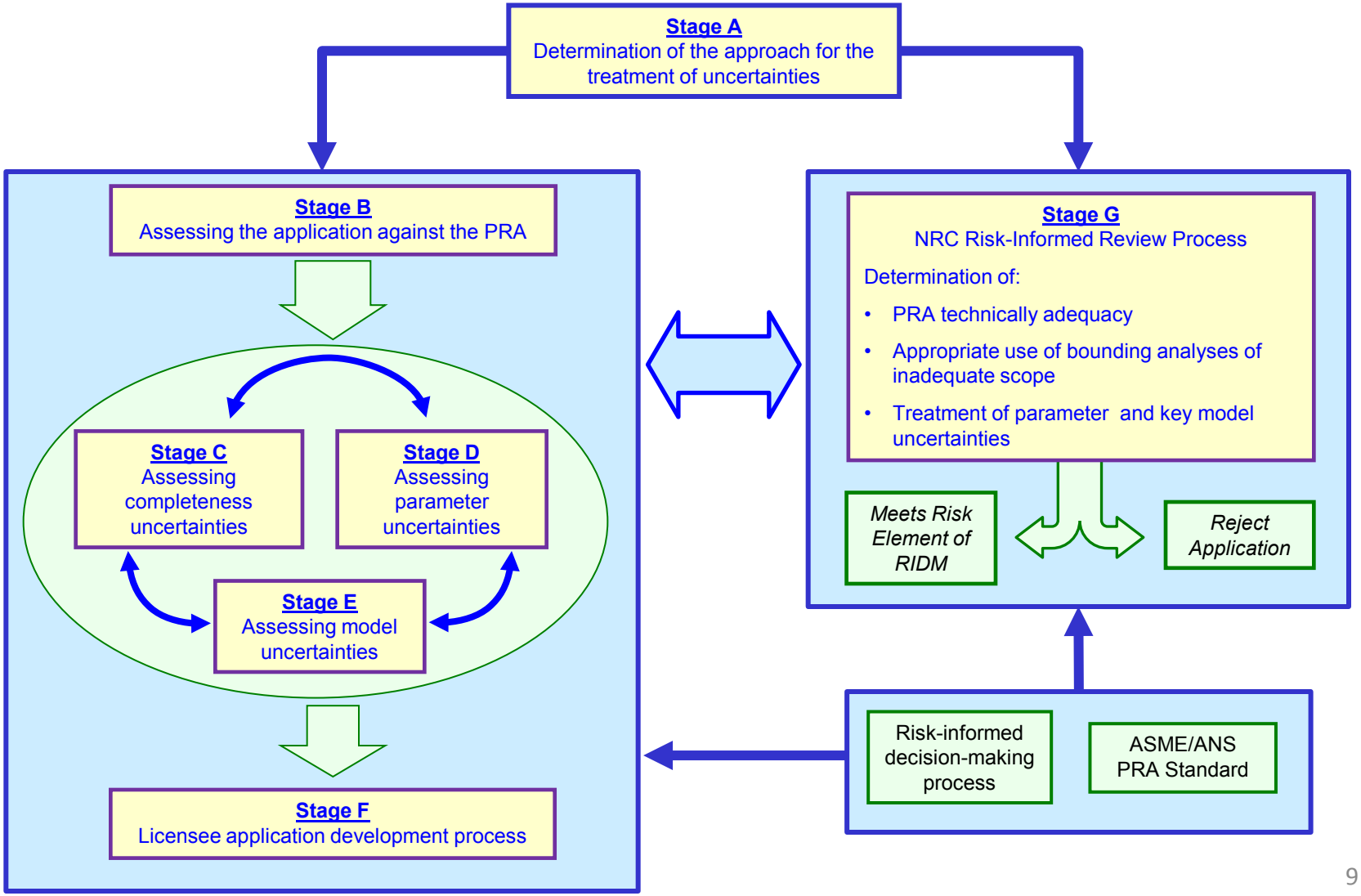
# NUREG RESTRUCTURE



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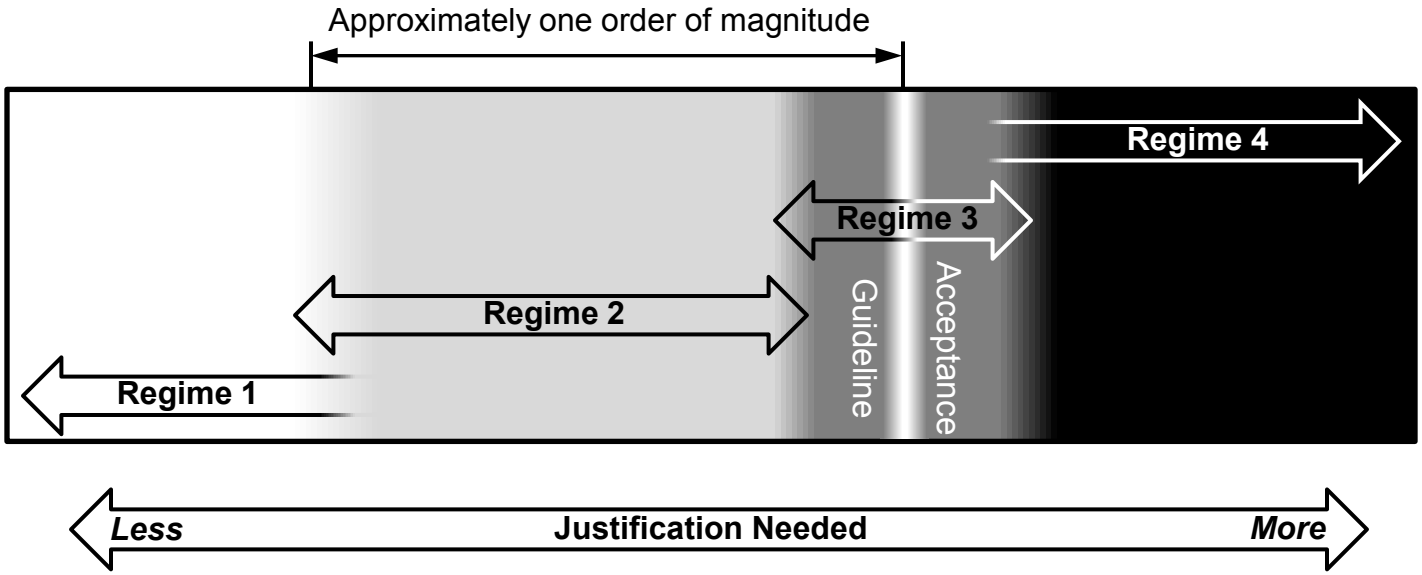
# NUREG RESTRUCTURE (CONT'D)

- In restructuring the NUREG, the majority of the information was reorganized with additional language that clarifies whether the guidance is intended for the licensee or for the staff
- A fundamental change involved the inclusion of guidance on the licensee strategy that promotes better alignment with the staff review process
- The technical acceptability of the PRA has to be established
- The amount of justification provided by the licensee for the decision under consideration should be commensurate with the proximity of the risk results to the acceptance guidelines
- Guidance is provided on the generic application of the process

# NUREG Restructure (cont'd)



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# STAGE G

## Regime 1: Risk results are well below guidelines

- The staff would perform a general review of the peer review findings, but an audit of the application PRA would generally not be performed
- The staff review would look for:
  - Qualitative or quantitative assessment of the SOKC demonstrating no impact on the results with regard to the acceptance guidelines, however they are defined
  - Appropriateness and adequacy of performance monitoring for the timely detection of degraded performance

## Regime 2: Risk results are closer to guidelines

- Similar to Regime 1, but includes a more focused review of the peer review findings for a better understanding of the resolution of particular findings. An audit of the application PRA is still unlikely.
- Quantitative assessment of SOKC

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# STAGE G (CONT'D)

## Regime 3: Risk results challenge the guidelines

- Same as Regime 2, except that the staff reviews peer review findings with a higher degree of scrutiny. An audit of the application PRA is likely to be performed.
- Includes a review of the appropriateness of compensatory measures. Staff may seek sensitivity analyses on some measures.

## Regime 4: Risk results exceed the guidelines

- Applications in which the risk results exceed the acceptance guidelines are rarely submitted. Such an application would typically be rejected.

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# Summary of Feedback From ACRS Subcommittee

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

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# Status and Next Steps

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