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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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FUKUSHIMA SUBCOMMITTEE

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WEDNESDAY

APRIL 10, 2013

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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 8:30 a.m., STEPHEN P. SCHULTZ, Chairman, presiding.

COMMITTEE MEMBERS:

STEPHEN P. SCHULTZ, Chairman
J. SAM ARMIJO, Member
DENNIS C. BLEY, Member
CHARLES H. BROWN, JR. Member
MICHAEL L. CORRADINI, Member
HAROLD B. RAY, Member
JOY REMPE, Member
MICHAEL T. RYAN, Member
WILLIAM J. SHACK, Member
GORDON R. SKILLMAN, Member
JOHN W. STETKAR, Member

DESIGNATED FEDERAL OFFICIAL:

DEREK WIDMAYER

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

P R O C E E D I N G S

(8:31 a.m.)

CHAIRMAN SCHULTZ: Good morning. The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Fukushima Subcommittee. I'm Stephen Schultz, the Chairman of the Subcommittee. ACRS members in attendance are Dick Skillman, Harold Ray, Dennis Bley, Sam Armijo, John Stetkar, Mike Ryan, Bill Shack, Joy Rempe, and Mike Corradini.

The purpose of this meeting is to review and discuss the guidance document developed by NEI and endorsed by the NRC staff for seismic hazard re-evaluations to fulfill the requirements of the Near-Term Task Force recommendations for enhancing reactor safety in the 21st century.

The staff will also provide information on a nonconcurrence, which was filed regarding the NRC's endorsement of the main guidance document for conducting the seismic re-evaluations and provide the final NRC endorsement letter which contains information that resolved the non-concurrence issues.

The seismic hazard re-evaluations are recommended in the NTTF report in recommendation 2.1. The main guidance document that will be discussed in

this meeting is, Seismic Evaluation Guidance: Screening, Prioritization, and Implementation Details, effectionately known as SPID, for the resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic.

The staff will also briefly discuss and address the final version of and issuance of the guidance document brief to the Fukushima subcommittee on August 15th, 2012, which was guidance on performing a seismic margin assessment in response to the March 2012 request for information letter JLD-ISG-2012-04.

The subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the full committee if this is decided following the conclusions of this meeting. I would like to say that, as you can see by the introduction, there has been a tremendous amount of work done by the staff, and the public, associated with this issue over the past two years and before.

This was an issue that began prior to the Fukushima event, and I say it's a tremendous amount of work in a short period of time, because if anyone is familiar with activities similar to this that happened some decades ago, one and two, three decades ago,

those efforts last a lot longer. A lot of expertise has been put into this issue in a short period of time.

The meeting this morning is open to the public. 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. We have received no written comments or requests for time to make oral statements for members of the public regarding today's meeting. Derek Widmayer is the designated federal official for the meeting.

A transcript for the meeting is being kept and will be made available on the Web. I know that there are some participants in today's meeting who are on the bridge line. It's requested that all speakers first identify themselves and then speak with sufficient clarity and volume so that they can be readily heard. Thank you.

We'll now proceed with the meeting and I call on Nilesh Chokshi, Deputy Division Director of Site, Safety, and Environmental Analysis in the Office of New Reactors to open the proceedings. Nilesh, good morning.

MR. CHOKSHI: Good morning, and thank you,

Dr. Schultz, and thanks for delaying this presentation while we are working through some of the technical issues. At the table with me is Dr. Cliff Munson, Dr. Jon Ake, Dr. Kammerer, and Lisa Regner, she's a project manager, she makes sure everything comes together. Also, on the phone line, we have Dr. Budnitz and Dr. Ravinda.

And as you mentioned, Dr. Schultz, the SPID, and I'll start using SPID because you already introduced, is an industry document with a lot of input and interactions with NRC, and we have Kimberly Keithline, who led the industry effort, and two of the members of the industry task force, John Richards and Bob Whorton, so I think it's good that some of the details, they are very familiar with particular parts of the program, so they can answer, also, questions.

CHAIRMAN SCHULTZ: Thank you. We look forward to their participation.

MR. CHOKSHI: So as you mentioned, let's go to the next slide, we're going to cover, basically, the three things and spend most of the time on the SPID. We'll walk you through both the hazard part, the risk evaluation part, and couple of other topics, and then Jon, Cliff, and I are going to primarily conduct that part of the presentation. NRC seismic

margin, as you mentioned, is just to tell you where we are. We briefed you, technical portions haven't changed, so I just want to let you know, you know, exactly how they turned out.

And then also need to talk about, I'm sure you heard about this industry proposed alternative approach and where we are. I think we have taken a big step forward yesterday. In fact, after we prepared this presentation, the industry proposal is now formally here, and I'll talk more about that --

CHAIRMAN SCHULTZ: Yes.

MR. CHOKSHI: -- with the guidance document. Okay. So that's the goal to go through, you know, those three topics and I'll start. Let me just give you an overview of the SPID and let me go back. Next slide. I think Dr. Schultz, you already mentioned that, it was the final draft was submitted to us in November 2012 after intensive interactions and a number of public meetings, and which involved, I think, as you see at this table, from NRC side, let's start from the number of offices.

You know, Annie and Joan from the research, JLD people, and there is other technical people, so it was a counterpart of an industry task force that was a team, NRC team, which interacted.

And then we endorsed the guidance on February 5th, okay? And so that will be, now, the guidance that will be used in response to the Recommendation 2.1.

Just to give you what's in the SPID, there are, basically, seven sections; 2 and 3, well, 2, 3, and 4, to some extent, deals with a lot of hazard issues and also, issues related to the screening, and we'll be walking through that, and Jon and Cliff will cover that, and then I will talk about Chapter 6, which is a seismic risk evaluation, and compares a number of topics related to the planned evaluations and performing seismic risk or seismic margin analysis.

And then we'll also touch briefly on the spent fuel pool, it's a little bit different than the rest of the evaluation, but there's a guidance, also, on that, so I will cover. Now, all these topics can take a lot of time, so we're going to try to cover at a high level to give you a feel for what are the technical approaches and positions. Luckily, when we briefed you on the SMA, we had residualized some of these positions, so they were covered in some details, so you'll see some slides, probably, familiar, okay?

And this is a substantial document and there are four appendices with more details. Also,

behind these, there were a number of studies conducted to provide a basis for the positions, so I'll mention them as we go along, and we'll mention those studies. So I think this is a substantial document, and given the time, I think we'll give you the, you know, more complete picture, but not necessarily go down to the very deep details.

CHAIRMAN SCHULTZ: Thank you, Nilesh.

MR. CHOKSHI: So with that, I think I'm going to -- Jon, are you going to start with the hazard and screening key positions, and then go to the slide? Jon is going to cover these topics in details, so I won't take too much time, we'll talk about the three main parts of the seismic hazard re-evaluations, positions, and discussions, and then on the screening of research, how do the plans go into the next phase, whether they are to do the seismic risk evaluation or not, and how the criteria to determine what will work to make that determination.

So I think with that brief introduction, Jon.

MR. AKE: Okay. If we can move to the next slide. Yes, I'm going to talk a little bit about Chapter 2 of the SPID and the request in the request for information 50.54(f) letter requested the

operating reactors to develop site-specific estimates of the seismic hazard or ground shaking at each of the operating reactor sites.

And Chapter 2 of the SPID, along with of the appendices, Appendix B, describes the proposed path for conducting that. And this particular figure, schematically, illustrates that this process is really broken down, or can be thought of as being broken down, into three different pieces. First is the so-called seismic source characterization, that part of the problem where we identify where earthquakes might occur, how big they might be, and importantly, how often they might occur.

Then, given the occurrence of an earthquake, the ground starts shaking, how those ground motions are modified, or attenuated, or their frequency content changes as they travel from the seismic source to our site of interest. And then lastly, how the very near surface materials beneath the operating reactor site amplify, or de-amplify, or change the frequency content of those incident waves and then the seismic demands, ultimately, that arise within the structure itself.

So I'm going to talk, in the next few slides, about those three different component pieces

and how it's being addressed in the SPID. Next slide, please. There's a slight difference in the approaches that are being taken between the Eastern United States and plants located in the Western United States, and I'll touch on the reasons for that in just a moment. But for the Central and Eastern United States, those plants will use the latest regionally developed models for seismic source characterization, which I believe the committee has been briefed upon before, and that's the so-called Central and Eastern United States Seismic Source Characterization Project, or model, that was developed over the last three-plus years, or four-plus years, I guess, a cooperative agreement between EPRI, the industry, via EPRI, the DOE, and the NRC, and that's documented in NUREG-2115.

The slide on the right is an example of the breakdown of the larger regional of the Central and Eastern United States into different seismic source zones. In addition to that, for the ground motion part of the problem, the 50.54(f) letter indicated that staff would find it acceptable to use the 2004, 2006 regional ground motion model developed by EPRI to conduct those site-specific hazard evaluations.

There is an update to that model, it is in

progress at this time, that I'll touch on in a little bit more detail in a moment. So the EPRI 2004 model is specifically designed to produce ground motion estimates for hard rock site conditions, so those regional models could be used to develop the hard rock seismic hazard at each Central and Eastern United States reactor location. Next slide, please.

And I'll go over the details of the site response calculations in a moment here. A little bit of background on the EPRI ground motion model for the Central and Eastern United States. We previously endorsed that model in the 50.54(f) letter. Industry, based upon the fact that that model was actually -- the documentation was finished in 2004, but the actual development of the model occurred in about 2001, 2002 time frame.

The industry decided that updating that model was warranted at this time and they proceeded along the path of doing a SSHAC process, or Senior Seismic Hazard Analysis Committee, or process, to develop that update. The industry requested staff endorsement by the end of February of this year in order to meet the September 2013 deadline for computing the hazard re-evaluations, which is what's specified in the 50.54(f) letter.

In the briefing in the middle of February, the staff was unable to endorse that model at that time, and it was based, primarily, on two particular issues; one, the treatment of uncertainty within that model, as in the updated model, and also, the adequacy of the documentation that was available at that time. Next slide, please.

So the EPRI ground motion model, the update to that ground motion model, where we are currently is that, the industry presented a refined and updated version at a public meeting on March 26th that occurred here at headquarters. The staff concludes that that updated model does appear to address most of the issues that were raised by the SSHAC peer reviewers as well as the NRC staff.

We should emphasize that, primarily, at this point in time, since it is being conducted as a Senior Seismic Hazard Analysis Committee, or SSHAC process, they have an independent peer review panel that is involved in the evaluation of the model itself as this process is going along, that the NRC review process is somewhat in parallel to that at this point in time.

The industry requested a six-month delay for the hazard submittals for the Central and Eastern

United States plants based on performing this update. That would move the hazard submittals from September of this year to March of 2014, if that requested delay is granted.

MR. MUNSON: I just wanted to interject one point. We have a more complete presentation on this tomorrow afternoon, so we have about 10 or 11 slides that discuss the issues more fully, so tomorrow, we'll go over that.

CHAIRMAN SCHULTZ: For members in the audience, or on the bridge line, what Cliff is referring to is a briefing that's been scheduled for the ACRS fully committee tomorrow. We'll hear more about the ground motion model then.

MR. AKE: Right. And obviously, our endorsement of that will depend upon seeing the draft final report of this updated project and the documentation. And obviously, our endorsement will depend heavily upon the adequacy of that documentation, which we have not as yet seen. Next slide, please.

For those plants that are located in the Western United States, the seismic source characterization is somewhat different. Thinking back about the Central and the Eastern United States, there

are very few identified faults that project all the way to the surface that are characterized in the seismic source characterization model. The Central and Eastern United States does have earthquakes, however, they are generally not associated with faults that we can identify on the surface of the Earth.

And that's not necessarily the case when we look in places in the Western United States. This particular slide on the right-hand side is a map from the seismic hazard analysis of California, and you can see there are a large number of lines on that map. Those are all active faults, or seismic sources, that are identified by the State of California and the United States Geological Survey in California.

So there are a large number of identified seismic sources that are within relative proximity of some of the existing operating reactors in the Western United States, so the emphasis in the seismic source characterization is somewhat different and much more site-specific than it is in the Eastern United States. And as a result, for the Western United States plants, the seismic source characterization process is being done on a much more site-specific basis and all of the plants are currently following a SSHAC Level III process, which is a fairly rigorous and demanding

process with a series of at least three workshops that are conducted on various aspects of the source characterization.

It's also important to point out that, for the Eastern United States, there is not a great deal of data that does exist, ground motion data that does exist, for the magnitude and distance ranges that we are most concerned about from an engineering perspective, and that's not the case in the Western United States. There is much more data available to develop the ground motion model, so they rely much less on simulations and much more on actual data.

So each of the four plants in the Western United States, Palo Verde, San Onofre, Diablo Canyon, and Columbia are proceeding to do a seismic source characterization project, SSHAC Level III; each one of those sites. However, the ground motion model, a site-specific model, is being developed for Columbia. And the Columbia project is jointly partnering on their project with the DOE Hanford site, since they're, basically, co-located with the Hanford site.

And a regional ground motion model is being developed jointly by Diablo Canyon, San Onofre, and Palo Verde, and that will be a model that will be applicable for Southern California, Western Arizona

area.

CHAIRMAN SCHULTZ: Jon, what is the rough schedule associated with that work and how much review time do you anticipate once the models are completed?

MR. AKE: Good question. Those will be done in the next 18 months, approximately 18 months, for all those studies. The staff is attempting to attend all of those various workshops and stay abreast of what's going on. We're trying to do it as independent observers rather than not as part of the formal peer review panel. Each of these different projects has a formal SSHAC peer review panel associated with it. We are trying to do it as independent observers, to try and watch the process itself, as well as the technical details.

And I guess the thrust of your question is, once those are submitted to us, what is the review schedule?

CHAIRMAN SCHULTZ: That's correct.

MR. AKE: And I'm not sure we've --

MR. MUNSON: Yes, we haven't really actually discussed that in much detail. We allotted a three-year period for the Western U.S. sites to do their SSHAC studies, as opposed to the Central and Eastern U.S., where they already had a regional model

available that was approved by the NRC staff, they had a year and a half, which is going to extend to two years.

So there's a three-year period, those come in in March 2015, and so when those hazards come in, I imagine at least a year, depending on how much, you know, we have contracting resources, we have staff resources, so we'll probably have at least a year or so to review the submittals when they come in.

MR. CHOKSHI: You know, the focus, currently, is on the Central, Eastern plants, because they are coming in sooner, so we have developed review plans, and resources, and, you know, there's a plan for this. And then the next thing is to plan, in more detail, the Western U.S. So right now, the focus is -- you know, because they were supposed to come in September, now we will hear, maybe, March 2014, but that's more near-term activity, so that's where the planning is focused.

CHAIRMAN SCHULTZ: That gives us a good perspective. Thank you.

MEMBER SKILLMAN: I'd like to ask a question on your second bullet, please.

MR. AKE: Sure.

MEMBER SKILLMAN: Much credit is being

given to the SSHAC Level III process, what gives you confidence that that process is going to give you a firm, accurate basis for siting for those four sites on the West Coast?

MR. AKE: The thrust of that process is to recognize that, for most of these questions, data does not exist to allow unambiguous interpretations. And there are a variety of interpretations that are permissive with the data, may be permissive of, if you will, and that there are a number of different conceptual models that could be used to explain the occurrence of earthquakes or the characteristics of ground motions.

And the whole process is built around trying to ensure that the uncertainty that is associated with those different interpretations is represented reasonably and accurately, and propagated through the whole process. That's the fundamental structure of what the SSHAC process is about, is building something that recognizes that, how the study is conducted can influence the end result.

MR. CHOKSHI: I think work gives of confidence. You know, this was developed based on the past experience with Livermore and EPRI. That's why you look at, holistically, how do we do this, and so

it has been in existence for now, more than 20 years, and has been applied, used at, a number of places now, both in U.S. and other places. We have learned lessons, which were captured in the 211 file, so the process has matured and, I think, has shown that it can be, you know, applied correctly and has a confidence, so I think there is enough experience with that.

MR. MUNSON: I think Annie wants to point out, I mean, this is a good thing, NUREG-2117, which, John and Annie worked on it, is an update, or lessons learned, kind of from the SSHAC process and how we conduct SSHAC Level IIIs, and so it's an update guidance document on the process, and I would recommend, if you're interested to look at that.

One thing I'd also point out is, there are many programs in the Western U.S., specifically California, to model ground motions. There's a project called NGA West where they're developing the latest ground motion models for the West. There's Southern California Earthquake Center, which does a lot of modeling in the Southern California area, and so these SSHAC projects are able to rely on those previous efforts and those ongoing efforts to characterize the hazard for the West.

MEMBER SKILLMAN: Thank you.

MR. AKE: Any other questions before we move on?

MEMBER BROWN: Yes, you used the word, interpretations, and since I'm the uninitiated on a seismic basis, what do you mean by, interpretations of what in terms of developing the process? I mean, is it data? Is it interpretations? Do people really know what this data represents? I did not understand what you were talking about?

MR. MUNSON: Yes, so for example, on one of those faults that's shown, drawn, on the map there, the question is, what size earthquakes can that produce? Is it a magnitude 6 or can we actually go up to magnitude 7? So there's different interpretations. Is it the style of faulting strike slip, or is it more of a thrusting motion? So, you know, you characterize different interpretations of the fault and the sources, as well as, also, the ground motion; trying to predict the ground motion values for different magnitudes and distance ranges.

So there's different interpretations that the SSHAC process incorporates.

MS. KAMMERER: To answer, I think, more fully, it's based on a series of types of data,

different types of data, so it's the seismicity, it's the tectonics, it's the geology, it's paleo information. So one of the things that the SSHAC process does is take a series of datasets that are available, as Jon said, sometimes these datasets are permissible of multiple interpretations.

MEMBER BROWN: Let me condense that just a little bit. If I understand it, you're saying you've got data, you know there's a fault, you know it has some physical characteristic, and it's just a matter of figuring out how much ground motion can result from any motion of that, and that's where the uncertainty comes in? So people have different opinions? If that's what you mean by interpretations, I will simplify it down to something my somewhat pygmy brain can absorb here.

MS. KAMMERER: Yes, the characterization of exactly where it is and exactly what it's geometry is, and things like that, though, it's not crystal clear.

MEMBER BROWN: No, I just needed to understand what you meant by interpretations and I think I have this view, not necessarily the detailed view, but that's fine. I understand all that. I understand the terminology you used and what you mean

by it.

MEMBER CORRADINI: Since I'm similar to Charlie in that I don't really completely understand the underlying science, what you're really telling us is, the SSHAC committee has to come up with, I'll call them, scenarios on how all this fits together and the ensemble of the SSHAC committee's scenarios is what, essentially, gives you the seismic source and the ground motion. Excuse me, the seismic source.

MR. AKE: Seismic sources.

MEMBER CORRADINI: Okay.

MR. AKE: Because you characterize, that's one of the things in this process, the so-called probabilistic seismic hazard analysis. You're characterizing all of the sources in the area.

MEMBER CORRADINI: And the interpretation of what those sources are.

MR. AKE: Right. And an example of an interpretation in this particular case might be, you know, I don't have a very good -- I'm just seeing here. There's not a particularly great example on that figure, but I think, for example, if we have a fault that's mapped, that people agree, yes, this is a fault, and it's, maybe, 30 kilometers long, let's say, for example, and at the southern end it looks

somewhat like a Y, there's another fault that splays off of that.

An example of an interpretation might be, when this fault produces earthquakes, does it produce earthquakes only on the main strand or is the Y-branch down here involved at all times? So you end up with interpretations like that where the geological observations, especially, are those that don't necessarily lend themself to unique interpretations. You know, that's the kind of multiple interpretations that are captured within that process.

MS. KAMMERER: And it's characterized in a logic tree framework. So you have these, we call it, the center, body, and range of technically defensible interpretations.

MEMBER CORRADINI: Okay. It's a methodology for diverse opinions on limited and interesting data.

CHAIRMAN SCHULTZ: Go ahead, Jon. Thank you.

MR. AKE: Okay. We'll move on here to site response. So the last part of that picture that we showed, that schematic diagram we showed, when we began this part of the discussion, was the so-called site response, or what happens in those last few

hundreds of meters up to the surface beneath the reactor itself, or our site of interest.

And for all those sites that are not sited on hard rock, and I should have mentioned this a moment ago, and I'll point it out now, the ground motion equations that are being developed, both for the Western United States and the Eastern United States, are for hard rock site conditions. And so any deviation, if the plant itself is not sited on very hard rock, we need to make some evaluation of the amplifications that may occur near surface as the waves travel upwards beneath the reactor.

And the particular things that we need to characterize for each site, then, are, what are the layers of these soil units, or soft rock units, that occur above the so-called basement, or very hard rock, site conditions? How thick are those layers? What are the various physical, mechanical properties, like the shear wave velocity? What are their densities?

And if they're soils, what kind of non-linear properties might those soils exhibit when we pass very high amplitude seismic waves through those soils, they may behave non-linearly, we need to characterize the non-linear properties of those soils. And also, for all of those different things, those

four different items I outlined there, we also have to characterize the uncertainty in each of those different things that we're characterizing and find a way to propagate those uncertainties through the process.

MEMBER STETKAR: Jon? To give the members an appreciation for the importance of this part of the analysis, approximately what fraction of the sites in the Central and Eastern U.S. are either hard rock or are not hard rock sites?

MR. AKE: Yes, one minus or --

MEMBER STETKAR: Yes. Give us the hard rock sites.

MR. AKE: Well, you know, that's something that I have to say that we've probably changed our view on a little bit. You know, 25 years ago, we would have said at least 60 percent, or 50 percent, of the sites were "hard rock". Our definition of what was hard rock at that time was somewhat more permissive, I guess. At this point in time, given the fact that we indicate about 9000 feet per second, more or less, 2.8 kilometers per second, as being "hard rock" in the Central and Eastern U.S., is probably no more than about 30 percent, or so, of the sites.

So something like 60, 70 percent, roughly,

will have to do some sort of site response evaluation.

MEMBER STETKAR: Thanks. I just wanted the members to, you know, why are we focusing on this part.

MR. CHOKSHI: And I will discuss that issue further from the engineering point of view, but it does make a difference in what we do the analysis, and there is one of the area, in the risk evaluation also comes up.

MEMBER BROWN: So hard rock is characterized by the velocity with which the seismic wave propagates?

MR. CHOKSHI: Yes.

MR. AKE: That's correct, yes. That is the definition. You could think of it as either the shear wave velocity or the shear modulation --

MEMBER BROWN: So granite is not necessarily hard rock.

MR. AKE: Generally, unless it's highly weathered, granite would be considered hard rock, yes.

MEMBER BROWN: All right.

MEMBER SKILLMAN: So, Jon, you said 25 years ago you would have given one answer and here we are, 25 years later, you have another answer. What changed?

MR. AKE: The recognition that, in that, sort of, grey area, I know we probably don't have great context for this, but typically in the past, we would have used a value something like 6000 feet per second for hard rock, and recognizing that, if you have a, you know, few tens of meters, or a little bit more, of 6000 feet per second over 9000 feet per second, in frequencies of engineering interest to us, you will have amplification, and we were not accounting for that previously.

MEMBER CORRADINI: Since you answered his question so quantitatively, when you say amplification, the energy that's being transmitted doesn't change, but its spectrum changes, right? Unless there's geometric focusing.

MR. AKE: Right. Basically, to preserve the energy in that, you're changing the amplitudes of the waves.

MEMBER CORRADINI: So the spectrum is wiggling this way and then I pass through this multi-component thing and the spectrum changes, but the energy is not dissipated nor increased.

MR. AKE: Over distances like that, there's really not much energy dissipation, no.

MEMBER CORRADINI: It's just a matter of

how it changes.

MR. AKE: Right.

MR. MUNSON: And we have an example of what that looks like.

MEMBER CORRADINI: That's fine. I just wanted to make sure I understood it.

MEMBER STETKAR: I'm sorry I asked.

MR. AKE: The other thing that we have to point out here too, and we'll get to in just a little bit more in some detail in a moment, clearly, you know, the time frame over which the operating reactors were licensed span decades and the amount of information on these particular items, sub-bullets, that we've identified that we need for each site there, the amount of information available varies quite a bit across the operating reactor fleet.

There's more information available at some of the sites than others, but the investigations that were conducted at these sites represented state-of-the-practice at the time they were licensed, however, we do more detailed investigations today than we did, you know, 25 or 35 years ago. So that does play into this a little bit.

Recognizing that there is that variability in the amount of information that's available at all

the sites, Appendix B of the SPID outlines a process to try and estimate the site response amplification as robustly as possible, including the effect of those uncertainties. Clearly, at those sites that have less available information in terms of site characterization, there's a higher degree of uncertainty associated with the site response evaluation. That has to be propagated through the process. Next slide, please.

And with that in mind, this is, actually, a flowchart from Appendix B of the SPID that illustrates the general approach that's being taken in the process. I won't walk you through all of this. I will just point out a couple of key elements there, that there are differences in estimating the so-called shear wave velocity profile, or base shear wave velocity profile, and the large number of simulations that are required to go through and perform a site response analysis like this, this would be, sort of, the end member of the maximum amount of uncertainty that would be included in the process.

Not all the sites would have to do this much detail, because in some cases, that middle of the flowchart there, it says depth to bedrock, in some cases, we know the depth to bedrock very well, within

just a few feet, so there would not be an uncertainty that we would be assigning to that to produce different cases that we would run independently and try and capture that uncertainty.

In all cases, we'll probably generate a large number of random profiles once we have established a base profile for a particular site, and we try to do that to represent the variability that is likely to occur at the scale of a reactor footprint. In other words, there is some variability at that scale that we have to capture as well.

CHAIRMAN SCHULTZ: Jon, what's behind the magic number 30 in terms of the number of profiles that are developed and analyzed?

MR. AKE: Good question. That is what we feel is probably about the minimum number that we need to go through, and generate, and analyze to get a stable estimate of the median site amplification as well as the standard deviation.

MEMBER CORRADINI: So this is like a Monte Carlo sampling and that's the minimum sample set?

MR. AKE: Right, to get a stable estimate of the median and standard deviation, because I'll show you in slide in a moment how we end up using that standard deviation and how that impacts, ultimately,

the answer we're going to get at the end of this. Was I going to say something else about this? Oh, well, it'll come back to me at an equally random time.

Yes, I think we can move on. Not all sites will have to do this. Oh, I know what it was. It was your question, Mike. We're not doing this in Monte Carlo. This is actually being done brute force, so we're actually going through every branch of the tree and calculating this, and then going through and --

MEMBER CORRADINI: So that means there are 30 branches?

MR. AKE: There is a 1000 branches.

MEMBER CORRADINI: So then, you collapse them and take a representative bundle?

MR. AKE: No, from that, we calculate a median site amplification function as well as a standard deviation for the site amplification function.

MEMBER CORRADINI: Oh, okay.

MR. AKE: And we repeat this at a large number of different input amplitude levels as well.

MEMBER CORRADINI: Okay, then I misinterpreted. You can keep on going on. I understand what you said, kind of, but you lost me

because I was under the impression you would sample through this, but you're saying you sample all the branches.

MR. AKE: Yes.

MEMBER CORRADINI: Then how do you go from thousands to -- that's what I'm still not --

MR. AKE: You will produce an amplification function, you will produce thousands of those.

MEMBER CORRADINI: Right.

MR. AKE: And of those, you will be able to then determine what is the median and the standard deviation.

MEMBER CORRADINI: Okay.

MR. AKE: And that's what we'll end up using, subsequently, in our calculations.

MEMBER BLEY: You could actually say they'd calculate the whole probably family. It's a whole distribution. They can pick parameters off of it.

MR. CHOKSHI: We do the statistics on the research.

MEMBER CORRADINI: Okay. I think I got it. There's no point in trying to educate me. Dennis, he'll tell me later.

MR. AKE: Actually, it may become clearer if we go to the next slide. Yes. This is an example of three amplification functions. So if you think back to that flowchart we had there a moment ago, the figure on the left would be a representation of, the dark line is the median, log median, and the dashed line is plus one standard deviation. That's what the amplification function looks like for a particular site for a particular input amplitude level.

MEMBER CORRADINI: So given an earthquake, given a seismic source, given a ground motion calculation, given a site amplification watchahoozy, this is what you'd show to the plant that has to meet, and you'd sample this 30 times.

MR. AKE: No. Actually, this is the result of all of those.

MEMBER CORRADINI: Right. But this is what you hand to the plant to look at its built response to it.

MR. AKE: Not exactly. I'll show you that in just a moment, though.

MEMBER CORRADINI: Okay. We're getting closer, though.

MR. AKE: Yes. We're edging ever so slowly.

MEMBER CORRADINI: Thank you. That's fine.

MR. AKE: This is what an amplification, the lower left-hand corner there, would look like. If you just look at the dark line, that would be an example of a single amplification function. And what you can visualize is, there would actually be approximately a 1080 of those on that plot of slightly different amplitudes and slightly different shapes, okay?

And from those, at each of these different frequency levels here, you could determine what is a median and standard deviation, and really, connecting those dots is what you see there as the median.

MR. MUNSON: So the amplification is a function of the frequency content of the upcoming wave, so if you look at the frequency, say, at 1 Hz, you have an amplification that's close to 2, maybe, or so, or actually, yes, close to 2, in the 10 to the minus 4 kind of range, so that's how you, kind of, look at the amplification.

MEMBER CORRADINI: And the 10 to the minus 4, again, you said it, and I'm sorry, I don't remember what that is.

MR. AKE: It's basically, you can express

the input amplitude level in terms of an absolute amplitude level or in terms of an annual frequency of exceedance, and that's approximately the annual frequency of exceedance.

MEMBER CORRADINI: Oh, okay. So this is the seismic source and it's expecting --

MR. AKE: And the ground motion propagation, yes, all rolled together to give you that.

MEMBER CORRADINI: Got it.

MR. AKE: And the point I'd like to make here, that the Appendix B focuses very heavily on trying to capture those uncertainties inside amplification. And as I alluded to a moment ago, it's a function of the amount of information we have available at each of the sites, as well as the amplitude of the input motions, and that's the point I wanted to make with the three pictures at the bottom.

Notice that there are slight changes in that median amplification function, the dark line, as you move from 10 to the minus 4 to 10 to the minus 6, but notice, especially, how the plus one standard deviation, how much larger the uncertainty is as you move to higher and higher input amplitude levels;

moving from left to right here is moving from lower to higher input amplitude levels that you're putting into the base of the soils, and that does effect the answer, as we'll show in just a moment here.

Any other questions? We can move on to the next slide then. And how that gets translated, then, into what we're ultimately going to handoff to the engineers to say, okay, this is what you need to evaluate the plant for, is the following. All right. Keep in mind that what we said a moment ago, that the source characterization and ground motion characterization are used to develop an estimate of the rock hazard at each individual site.

And in this particular case, I've shown by the solid black line on this figure. And if you then look at the effect of incorporating what we really though is not -- for a reactor that's sited on a soil, what we don't want, we don't want that rock. What we really want is what the soil hazard is. What's the hazard at the top of the soil column that the reactor actually sits on? And that's indicated by the dashed lines to the right.

And in the example that we showed before, what you'll end up getting is something like the dashed red line there to the right. Incorporating

these uncertainties tends to increase the hazard, in other words, increase the expected ground motions for a particular annual exceedance frequency, and that's what almost, universally, happens.

MEMBER CORRADINI: So magic appears between the three curves here and here, and the magic is, you're somehow taking the frequency, the amplitude spectrum, and then rolling it up into -- so any one of these Gs, actually, is a distribution function.

MR. AKE: Yes.

MEMBER CORRADINI: Okay. That's all I was trying to get at.

MR. MUNSON: So this is for a particular 1 Hz input motion.

MEMBER CORRADINI: Well, I mean, just to pick a point, in the previous graph, you don't have to go back, you have 10 to the minus 4, 10 to the minus 5, 10 to the minus 6, so that's an exceedance, that exceedance probability, that essentially, anchors you somewhere on the y-axis, and then a spectrum, essentially, is built into the either the red dash or the blue dash.

MR. AKE: That's correct.

MEMBER CORRADINI: Okay. This is the mean.

MEMBER CORRADINI: This is not the one signal.

MR. AKE: Yes. This is just the mean hazard.

MEMBER CORRADINI: Got it. Thank you. And just for the sake, I'll forget it, of completeness, let's say we take the red with the with epistemic. How is the amplitude frequency boiled down to one point there? Is it just a simple protocol of some sort of integrated averaging?

MR. MUNSON: So I'm going to show you plots of, actually, the seismic response spectra that they used to compare to the design basis of the plant, but basically, what you would do is, we're concerned most between 10 to the minus 4 and 10 to the minus 5. So you would go over to those levels, and for 1 Hz, you would go down and say it would be, like, for this example, it's 3G, or actually, 2-1/2G, on the red curve, you would come down, and then that would be one value on your seismic response vector that I'll show you.

MR. AKE: Any other questions on this before we move on? When the SPID was being evaluated for concurrence by the NRC staff, there was a non-concurrence issued on this particular document. And

there were three basic issues that were identified in the non-concurrence for this. I'm going to try and summarize each one of those here. They're the high-level bullets here.

And then what the staff's conclusions about those non-concurrence issues are indicated with the carrots, the little carrots, in this slide. The first issue is an apparent inconsistency between NUREG-2115, which is the document that documents, if you will, the Central and Eastern U.S. seismic source characterization model, the collaborative effort between DOE, NRC, and the industry that was conducted to represent seismic sources in the Eastern United States, and the guidance that's within the SPID document.

Specifically, NUREG-2115 calls for potential site-specific adjustments to the model to apply it to a particular site. The staff concluded, at this point in time, at least, that there was not a basis for updating that model, and that was the reason that the staff was willing to endorse the SPID. The Central and Eastern U.S. seismic source characterization project was extremely detailed. It's very refined.

It is also, at the time that it was

conducted -- really, it's viewed as a regional model, per se, but all seismic sources that were known in the literature, or through word of mouth, or anything else, that the team that was conducting that project evaluated every seismic source that they could find in the Central and Eastern United States.

So as far as we know at this point in time, and I should say, at this point in time, there are no additional seismic sources that have been left out of that model, that we know of, today.

MR. MUNSON: Let me give you an example, though, to help you. The ESPs and COLs, for example, that you've seen coming in, they have used an older EPRI source model that was developed in the '80s, mid-'80s, and that model didn't have the latest information on New Madrid, that it was a repeating large magnitude source, or Charleston. We have, you know, paleo information, paleoliquefaction information, on that.

So the applicants for COLs and ESPs, they took the old EPRI model and then they took the new information on Charleston and New Madrid and incorporated it into the older model. So the EPRI model was the information from the mid-'80s, but with updated information plopped into the model.

NUREG-2115 envisions a similar process as the CUES-SSC, this recent model, ages with time, as we get new information about magnitudes and geometries of sources, it envisions, also, a process where you would update that source model. Our conclusion on this non-concurrence issue was, this model was developed and completed in 2012, and it's also very refined, so we feel like it's providing the latest information and we didn't believe that each of the individual licensees needed to go through a process of seeing if they need to update that CEUS-SSC model.

MEMBER CORRADINI: I don't want to spend too much time, the Chairman will stop me, but I don't understand non-concurrence issue. You're going to have to explain a process to me. So does that mean a member of staff, there was a consensus among staff that this was an okay approach, but an individual, or individuals, felt uncomfortable with that, and then there was a resolution within staff that, given a comfort level, that just stood out there because the preponderance was on a different margin, is that what that means?

MR. MUNSON: Yes.

MR. CHOKSHI: And, you know, the process calls for a true documenting the non-concurrence

itself and the responses, and those are -- it's like 250 pages analysis, so that's all available, and I believe the committee has that.

CHAIRMAN SCHULTZ: Yes, that's right.

MEMBER CORRADINI: Yes, we do, but I just want to understand the process. So once the process is concluded, it's simply documented and then you move on. So then the point was, on the non-concurrence, there was, I'll use the term minority opinion, the minority opinion was, there needed to be a continual refreshment of this by each site?

MR. MUNSON: Yes. Each site would take a look at CEUS-SCC model and say, do those magnitudes and source geometries make sense for my site?

MEMBER CORRADINI: Okay.

MR. MUNSON: The way they characterize the sources, and our consensus was that the model is refined and up to date, so that was not necessary for this exercise, but a Fukushima response.

MEMBER CORRADINI: Okay. And then, so my follow-on question is, the last thing you said, which is, now it's 2012, in 2022, or '25, there is, in the EPRI document, I have the EPRI document, I'm sure I can find it, a methodology to incorporate new information going forward though.

MR. MUNSON: Right.

MEMBER CORRADINI: Okay. That's what I thought. Okay.

MR. CHOKSHI: I'll talk more about that.

MEMBER CORRADINI: Okay. Thank you.

MR. AKE: So I should point out, though, is, you know, at the time that that model was concluded, there were new developments that had occurred at the 11th hour right as the final touches were being put on the documentation for that model. For one, the occurrence of the earthquake in Mineral, Virginia. And the team that was producing that model at that time looked at that information and concluded that it was generally consistent with the model as it stood and there was no need to try and update the model at that time.

The second issue that's pointed out in the non-concurrence is, there are constraints outlined in the SPID on source distances, in other words, how far away from my site do I need to include seismic sources?

And the SPID contains some constraints on the applicable sources for use in the hazard calculations themselves, specifically, you know, consistent with the Appendix A 320 kilometers for so-

called background sources, so you have to include all sources of earthquakes that arise, not from mapped faults, but from so-called background, or area, source zones within 320 kilometers of your site, and out to a 1000 kilometers for what are referred to as large repeating seismic sources.

The staff concluded that those distance constraints do not exclude any significant seismic sources and that we were comfortable with moving forward with that. It's important to point out here, one thing, that the exercises, as Cliff and Nilesh pointed out here, is to try and perform an evaluation in response to Fukushima Recommendation 2.1, which is to evaluate the hazard at your site relative to what the original design was for your plant, and that's represented by something called the safe shutdown earthquake, or SSC.

And Cliff's going to go over the screening in a moment, and the screening process generally relies on comparing something called the ground motion response spectra, or GMRS, which is an estimate of the seismic demands that we might estimate based on the hazards today versus how does that compare to the existing SSC of the plant? And the staff's analysis looked at these questions with respect to, do sources

beyond this range have, potentially, impact relative to the coming up with a hazard estimate that is less than the SSC, the existing SSC?

And we felt that we're not missing anything that would challenge the SSC by sticking with these general distance ranges. However, I think it's important to point out, especially on these last two bullets, the non-concurrence evaluation resulted in modifications to the endorsement letter that the staff produced for the SPID.

The last bullet is one that gets back to the site response questions we just talked about a moment ago, that no new site investigations are called for in the SPID. The expectation in the SPID is that licensees will use the available information to try and come up, geological and geotechnical information that they have at their site, as well as anything that's easily available in the literature, or something, or, you know, regional information, to try and come up with the characteristics of the soils and soft rocks beneath their site.

And the staff's evaluation went back and looked at a lot of the existing FSARs for operating reactors and concluded that there was actually a lot of, a great deal of, information that was collected

during the initial investigations and licensing of the plants, and that we were satisfied that that could be used to characterize the outside site-specific hazard at each operating reactor.

MR. MUNSON: As Jon said earlier, the SPID emphasizes how we -- we have to incorporate uncertainty into this process. So if we do have a site where there's not as much information, we, generally, will have higher uncertainty and that effects the answer that you saw on the hazard curves.

MEMBER BROWN: When are you going to know that? Which ones have uncertainty? Do you know that going into this or are you going to depend on the licensee to tell you that they are uncertain, which is a little bit suspect?

MR. CHOKSHI: I think that's what the Appendix B in the SPID, that talks about the process for determining that.

MR. MUNSON: So you have that logic tree that we showed you where you have different models and you put different values on uncertainties, so it depends on how much information is at the site. So we're doing in-house, each site, just for our confirmatory analysis, but the licensees will prepare the site response for their site amplifications for

their site as part of the hazard re-evaluation. So we'll have a review period where we'll ask REIs and try to resolve that.

MEMBER REMPE: So it is possible you might say they just don't have enough data when you get into the details in your evaluation of what they provide to you where they might be asked to get more data?

MR. MUNSON: We do not envision asking for them to go out and do more soil borings, and, you know, taking the rig out. I mean, the reactor building exists there so it's not like you can dig underneath it and find --

MEMBER REMPE: But you don't envision there would ever be any need from what you have --

MR. MUNSON: Right.

MEMBER REMPE: In the document --

MR. AKE: Well, they may conclude that they --

MEMBER REMPE: They may, but do you --

MR. AKE: Right. As they go through this process, the impact of propagating those uncertainties through the process, they may conclude that that's to their benefit to go forward and do something like that.

MEMBER REMPE: Okay. Your documentation

sometimes emphasizes that the SPID process is conservative and I haven't heard you discuss that today at all, and I just was wondering, could you point to come examples of why you feel that it is conservative? I saw you kind of shaking your head like, no, I don't think it is conservative anymore, so I was just curious.

MR. MUNSON: If you go back to that flowchart, the one that has -- yes, that one. So this is a very detailed process where we're going to look at -- this is, you know, treating epistemic uncertainty, modeling uncertainty, within the whole site response process. And we're looking at three different soil profiles, velocity profiles, so we have a base profile, but then we're going to have an upper profile and a lower profile, and randomize 30 profiles about that.

So we have aleatory uncertainty about the epistemic uncertainty. So this is, generally, for ESP or COL, they'll have one base case and randomize 30 about it, or 60. Here, we're doing three base cases, we're considering, you know, the potential to have different depth to bedrock, the potential to have two different non-linear models for the soil behavior, so, you know, we're capturing, generally, more uncertainty

than what's done for ESPs and COLs.

MEMBER REMPE: So it's a guess estimate, sensitivity studies, I don't see anything that's conservative.

MEMBER STETKAR: That's not conservative. That's a better characterization of the uncertainty.

MR. MUNSON: Yes, that's why we hesitate to say conservative.

MEMBER STETKAR: It's more realistic in a sense.

MEMBER REMPE: Right.

MR. AKE: We are not trying to be conservative. We're not trying to make a biases estimate. We're trying to make our best estimate and attempt to formally propagate the uncertainties and let them inform the answer to the maximum extent practical.

MEMBER STETKAR: It's my impression that the seismic hazard part of the SPID, what we've been discussing here, is a realistic characterization of the uncertainties given the available information. The best you can do.

MEMBER REMPE: But the endorsement letter talks about how the --

MEMBER STETKAR: I think that the entire

SPID, which includes the guesses about fragilities and the way you treat implant response to the acceleration, people would claim as conservative.

MEMBER REMPE: Okay.

MEMBER SHACK: But specifically, I think, for example, the endorsement letter suggests that the 1000 kilometers for the large sources is a conservative number. I think that's -- you know, there's an occasional word, conservative, hidden in here, but certainly, the emphasis is on characterizing the distribution.

MR. MUNSON: So if I have a site in Florida, do I need to capture New Madrid?

MEMBER SHACK: That was where the conservative word came.

MR. MUNSON: That's what we meant by conservative.

MR. CHOKSHI: That's a good point.

MEMBER BLEY: Well, and they toss it in, things like that, but it's really about the best you can do as far as I can tell.

CHAIRMAN SCHULTZ: Systematically characterizing the uncertainty in a more robust way is going to have an effect on the results. It's likely that it's going to become more conservative for at

least some sites, especially those sites which have changed in their characteristics over the last 20 years.

MEMBER STETKAR: Just for the record, I would say it's likely to become more realistic for those sites.

CHAIRMAN SCHULTZ: That is right.

MEMBER STETKAR: Worse than the previous optimistic estimate.

CHAIRMAN SCHULTZ: That's correct. That's what I was trying to say. Thank you for the correction.

MR. CHOKSHI: And one thing the other way is the added value versus the balance of time and resources, and everything else, and what is more important, get to the plant, because I think from all that, this is, I think, you know, the right place to be. And as you said, the site or licensee may decide by themselves that they want to reuse those, you know, uncertainties and do more realistic.

MR. AKE: I guess just to summarize on the non-concurrence too, that the evaluation of the non-concurrence issues by staff did result in several changes to the endorsement letter that we felt were justified.

MR. CHOKSHI: And add more clarification on some of the issues.

CHAIRMAN SCHULTZ: The committee appreciates that. We've reviewed that carefully also and we've seen that as a result.

MR. AKE: Do we have any other questions on --

MR. MUNSON: This is a good summary slide for the hazard part.

MR. AKE: To summarize, the probabilistic seismic hazard analysis for what we refer to as the ground motion response spectra, or GMRS, which is what Cliff is going to talk about next, spend the next little bit of time talking about, really, is broken down into these three pieces; the seismic source characterization, ground motion model, and ultimately, then, deriving seismic hazard curves for rock.

And, you know, we've discussed how the Eastern U.S. is being done a little bit differently for seismic sources and ground motions than the Western United States plants. The approach is somewhat slightly different. And then for those sites that are on rock, you know, the green box is where we end up, and those are the rock hazard curves. And for those sites that are on soil, or soft rock, we have to

go through the site response to come up with the ground motion response spectra, or GMRS.

And Cliff's going to go over how we --

MR. MUNSON: Can you go to the next slide? So what do these curves look like? These are plots of seismic response spectra. So we take those hazard curves, and basically, we look in the 10 to the minus 4 to 10 to the minus 5 range and we compute what we call GMRS, ground motion response spectra, and those are the red curves in each of these figures. And then we take those GMRS and compare them to the site SSC, which was determined in a deterministic fashion back in the '70s looking at, like, a maximum-type scenario.

So in the first box in the upper right-hand corner is a scenario where the GMRS is computed and it's enveloped by the SSC for the site. In that case, the licensee would screen out of having to do any further analysis. We go down to the bottom, in the left-hand corner, this is what, actually, a hard rock site looks like. You get a GMRS that's amplified in the higher frequency range, so this one has a peak at around 25 to 30 Hz.

And so the GMRS does exceed the SSC for this case, but what we're interested in for the plant structures and systems is mainly in the 1 to 10 Hz

range, and that's where the natural frequencies are for most of the system structures and components.

So our comparison between a GMRS and SSC is focused between 1 and 10 Hz, so in this case, where the exceedance is above 10 Hz, this licensee would not need to do further risk evaluation, but instead, would rely on a testing program for high frequency sensitive components, which EPRI is conducting right now, and which Nilesh will talk much more about.

So for this scenario, we would look at electrical relays, and switches, and things that are sensitive to this high-frequency chatter that could chatter at high-frequency ground motions.

MEMBER CORRADINI: So just from an empirical standpoint, everything you just said, then, is consistent with what occurred at North Anna, right? If I remember correctly, when the utility came in to give us their, kind of, post mortem, their redline, from what they experienced, was only exceeding the equivalent grey line at high frequency and only a small amount?

MR. MUNSON: Actually, there's two problems. These are free-field motions. Okay. So these represent motions in the free field away from structures. Okay. At North Anna, we didn't have free

field recordings of the earthquake. We had recordings of the earthquake within the structure itself, at the base mat, at the top of containment. So you have the structural motions that are influencing the ground motion that came in.

So they weren't able to make a direct comparison between the SSC, which is free-field motion, and the motion they actually recorded in the plant. However, the exceedances, they did actually have exceedances between 1 and 10 Hz. They did have exceedances that were, they're not huge, but at the base mat level, they weren't huge.

But they did have exceedances, so they did do, you know, the thorough walk-downs of all the plant systems, structures, and pods.

MEMBER CORRADINI: Okay.

MR. MUNSON: So there were exceedances between 1 and 10 Hz.

MEMBER CORRADINI: Okay. All right. I guess I forgot about that. Well, that's enough. I don't want to keep this going. I'm sorry.

MEMBER SKILLMAN: Cliff, let me ask this question, please. You mentioned that the frequency of interest is between 1 and 10 Hz. I spent years in Germany at the Bundesrepublik GSK, the Sicherheits

Commission required 3 to 30 Hz and we spent an immense amount of effort demonstrating compliance, seismic robustness, in the 3 to 30 Hz. You mentioned 1 to 10. Why 1 to 10? And I have a second question that's built on that, how is this being applied to a Part 52 license so that new builds don't end up in your upper right-hand corner where the GMRS vastly exceeds the SSC?

MR. MUNSON: Okay. Let me start with the second question and then I'll answer the first one. My structural engineer to the left here can do the first question. So for new reactor situation, Part 52, each design, AP1000, EPWR, they have what are called certified seismic design response vectorum. Those are anchored at 0.3G. They have similar shapes to the SSC you see on the pictures there. Basically, the one in the upper right-hand corner is probably the best example, but they're elevated up to 0.3G.

So the anchor point is 0.3G and the whole spectrum is elevated. Okay. So those are the designs for the AP1000. They show that they meet those designs in the certification of the AP1000, or EPWR, or whatever. So then we do calculate a GMRS, or applicants calculate a GMRS, as part of their ESP application or COL application, they compare that GMRS

to the CSDRS for the site, if there are exceedances, then they have to go do more soil structure interaction, more detailed analysis, to demonstrate that the plant design can handle this GMRS, so there's more detailed analysis.

MEMBER SKILLMAN: Got it on 52, now let's talk about 3 to 30 versus 1 to 10.

MR. CHOKSHI: Yes, I think because most of the plant structures and the components of interest in the nuclear plant, they have fundamental frequencies between 1 to 10 Hz, most of them, and so from the past studies, we have seen that that part of the spectrum is very important, because that's where you find the least contributors, so that's the focus. Now, the high frequency part, primarily, it effects the electrical contacts, and relays, and things, and so we are dealing that in a separate fashion, and I will talk about that more.

But to just mention about the screening, we are using 1 to 10. As you do plant evaluations, then you look at the, you know, whole spectra, which is used in the response evaluation. So from the screening perspective, I think 1 to 10 Hz is very important, and you will see that when I talk about this. A number of criteria on the risk evaluation are

dependent on that, you know, factor.

MEMBER SKILLMAN: Okay. Thank you.

MR. MUNSON: So in the upper right-hand corner we have a scenario where the GMRS exceeds the plant safe shutdown earthquake response vectorum between 1 and 10 Hz, you know, in several places. And so that plant would need to do a seismic PRA, in this case, seismic probabilistic risk assessment. So I have more information on that.

MR. WIDMAYER: Hey, Cliff? On that Outcome 3. Yes. Do they also have to do the industry testing programs since they had exceedances?

MR. MUNSON: Yes.

MR. WIDMAYER: Okay. So they do the whole nine yards.

MR. MUNSON: Yes.

MR. WIDMAYER: Okay.

MR. MUNSON: Okay. So an additional factor is, we bring in the IPEEE analysis that was done. So this isn't the first time we've looked at seismic ruggedness of plants. We had the SEP program in the '70s, we had USIA46 program, and then the IPEEEs in the '90s, and so plants have done walk-downs. Many of the plants have done either margins assessments or seismic PRAs as part of the IPEEE.

So licensees are able to use their IPEEE results in certain cases. Now, just to talk about the picture first. This picture shows, the dashed line is what we would call the IPEEE spectrum. So that's the review level earthquake spectrum for this plant and it's anchored at the actual HCLPH that the plant demonstrated, for this case, in an SMA that they did.

So this plant was able to demonstrate a plant HCLPF of 0.3G, and so in this case though, the IPEEE spectrum doesn't help them because the GMRS exceeds that also, so for this example. So which plants can use IPEEE results? The plants that did SPRAs or the plants that did full or focused scope SMAs. Plants that did reduced scope SMAs cannot make use of the IPEEE results for the Fukushima response.

An additional requirement is plants that did the focus scope need to enhance that to make it the full scope SMA. The requirements, they need to demonstrate that the IPEEE commitments were carried out, the commitments resulted from the IPEEE analysis, that any modifications were completed and are still in effect today, that they took care of any deficiencies that were pointed out in the safety evaluation that the staff prepared.

And then they need to show the adequacy in

a written evaluation of the structural models, selection of equipment, screening, walk-down, peer review, the fragility system modeling, there's other elements, but they need to go through and demonstrate that those particular aspects are still relevant for the hazard that we re-evaluated for today in the form of the GMRS.

So that's the exercise that they would go through to make use of the IPEEE results. When we say make use of the IPEEE results, that's using a slightly, in most cases, higher spectrum for the screening evaluation.

MEMBER STETKAR: Cliff?

MR. MUNSON: Yes.

MEMBER STETKAR: Let me ask a couple questions about this use of the IPEEE stuff. In the endorsement letter, it talks about what you just summarized and there's a statement that says, "As such, even if one or more of the criteria are not deemed to be adequate, the staff may still decide that the overall IPEEE analysis is adequate." You know, that addresses the sub-bullets down there on the right-hand side of your slide.

That, to me, interjects some degree of subjectivity and uncertainty into this process, how

are you going to determine whether they're adequate and how do you determine that mine is adequate even though I didn't do a walk-down, and somebody else's is inadequate because they did a walk-down, but they didn't look at enough things? For example, that qualification in the endorsement letter really --

MR. CHOKSHI: Yes, I think the reason for the qualification was, and you picked on one of the key elements, if the walk-downs were done, not properly, I think the, you know, decision would be swayed considerably by that, but there might be a question that the models, for example, maybe not the best models, but if he got that means that it gives me the lower bound on the capacity so it's adequate for the screening.

So we want to leave that room for that kind of judgment because, you know, again, overall, this is subjective because, you know, there are going to be some qualitative and some quantitative arguments, but we didn't want to take away that possibility that people can, you know, demonstrate adequate for these purposes and may depend not only all the factors being, you know, perfectly mentioned. That was the thought.

MEMBER STETKAR: Are you developing

guidance, Nilesh, you know, if a licensee comes in and says, we feel our IPEEE analyses are adequate for this purpose, does that just initiate a dialog?

MR. CHOKSHI: Yes, we haven't thought about developing the guidance, but I think this is worth it, you know, and I think throughout this process, the experienced reviewer and peer reviewer, those elements become very important, you know? And so we're going to rely on whatever. You know, that's why peer review element is included in this part, you know? What was the regional peer review and do we have, you know, better belief, you know, or confidence in what was done?

So it's subjective and I think it's going to be relying on the experience of the, you know, reviewers.

MEMBER STETKAR: Thanks.

MS. KAMMERER: Nilesh, you might also mention, though, that there has been -- the original peer review, but also, there's been discussion in-house of having a panel, sort of, review these as a group, and that will make consistency and allow for a more in-depth look at the elements to say, what would move the needle; what wouldn't?

MEMBER STETKAR: That helps me an awful

lot in terms of the notion of consistency. It could be pretty intense, though, because, you know, you're going to get a lot of these over a relatively short period of time, but that would help, having a panel that invokes some consistency.

MR. CHOKSHI: And I think one of the things we emphasized in our discussions with the industry on this is that, documentation of these aspects, the way the base is, it's extremely critical, because otherwise, you know, it will be very hard to make judgment. And as Annie said, I think when all people are looking at the same, you know, detailed information, hopefully we will get to the same conclusions.

MR. WIDMAYER: Hey, Nilesh, along those lines, any idea how many folks will want to use the IPEEE for screening?

MR. CHOKSHI: No, I don't have any idea and I'm just looking at Kimberly or Jon, do you have any idea?

MS. KEITHLINE: This is Kimberly Keithline from NEI. We don't know the answer to that question yet, you know, about who will end up -- they're all reviewing right now to see what state their IPEEEs are in and how much work we do. This is a, potentially,

huge amount of effort. So it's a judgment between whether they think they're in a region where the seismic hazard might increase significantly and whether it might be worth spending the next year, you know, doing this very intense effort or not. We don't have the answer.

MEMBER STETKAR: One other question, and perhaps for Nilesh, I'm not sure, or Cliff, you drew a little line there through reduce scope and I'm not sure if I understand what that means. In particular, about a fairly large percentage of the IPEEE submittals used the EPRI seismic margins approach. Is that what you mean by reduced scope here?

MR. CHOKSHI: No.

MEMBER STETKAR: Okay.

MR. CHOKSHI: You know, when we did the IPEEE there were three categories of planned; reduced scope, focus scope, and full scope.

MEMBER STETKAR: Okay.

MR. CHOKSHI: Reduced scope where the seismicity was so low that they only looked at SSC.

MEMBER STETKAR: Okay.

MR. CHOKSHI: They didn't go beyond that, so this just automatically falls out.

MEMBER BLEY: That's what I thought.

MR. CHOKSHI: So that was the reduced scope.

MEMBER STETKAR: Yes, because I'll get to that on the next slide, then, if that's what that means. In the sense, though, of the plants, and I think I copied down some numbers here, 42 submittals, 62 units performed seismic margin assessments using the EPRI methodology. In the draft version of JLD-ISG-2012-04, it says, "The EPRI SMA method is not acceptable for satisfying the objectives described in the 50.54(f) letter."

So if I now come in with my IPEEE seismic margin analysis done according to the EPRI methodology, are you going to determine that's okay?

MR. CHOKSHI: Yes, I think if they are shown that the plant capacity is sufficiently higher than the GMRS, then we are going to say okay. Now, you know, that ISG, going forward, for the plants which have to do the evaluation, we don't want them to use the success part, because the decisions which you have to make in phase 2, I think they are better made with the risk type of information rather than the, you know, success part, so that was the thought.

MEMBER BROWN: I don't understand. You say, in one case it's not okay to use it, in the 2012,

and then you said, yes, it is if they come and say it's okay?

MR. CHOKSHI: You know, we are using screening that, you know, if you know that the plant has a significant higher capacity than the new ground motion, we are saying that's okay if it's demonstrated, so we'll use that information, you know, and not require further evaluation.

MEMBER SHACK: So there's another subjective element here is how much margin you have?

MR. CHOKSHI: Yes, well, the GMRS, it's already, like, 10 to the minus 4, 10 to the minus 5, so you know what the hazard exceedance level is. And so your plant capacity is already shown to be higher than that, it's sufficient. We don't say that, you know, how much higher?

MEMBER BROWN: No, it just sounded, what he said, is that, hey, we told you you can't use that, but you didn't believe us, and we're going to ask you to do it anyway. That's what it sounded like. And if that's not the case, that's fine. I just didn't understand the nuance. If everybody else understands it, I quit.

MEMBER STETKAR: Yes, I did. Thanks. That helps.

MR. MUNSON: Okay. So there's a couple of other considerations on the screen. If the GMRS exceedance is very slight over a very narrow range, then a risk evaluation isn't needed. And then another case on the bottom where the hazard is very low, the GMRS is very low, and the exceedance is only in the very lowest low, below 2-1/2 Hz, in the low frequency range, for that plant, they would identify systems, structures, and components, like tanks, perhaps, that are susceptible to this lower frequency motion, in the 1 to 2 Hz range, and then they would look at the capacity of those pieces of equipment relative to the GMRS that they calculated and they wouldn't need to do a full risk evaluation.

So these are two slight nuances that were included in the SPID guidance so that plants wouldn't have to spend the three to five years doing risk evaluations for their other plants.

MEMBER STETKAR: Something you said, I don't think I got from the SPID. You said, in that lower right-hand corner, in the area where the blue is above the green in the low frequency, in this particular example, those plants would still need to demonstrate the HCLPF capacity for structure --

MR. MUNSON: For components.

MEMBER STETKAR: -- whatever, components or structures?

MR. MUNSON: Right, that are susceptible to --

MEMBER STETKAR: Within that frequency.

MR. MUNSON: Yes.

MEMBER STETKAR: Okay. I didn't get that. I thought they just got a get out of jail free card.

MR. MUNSON: No.

MEMBER STETKAR: Okay. I probably misread something.

MR. CHOKSHI: And, you know, the type of things which could be, like tanks --

MEMBER STETKAR: No, no, yes, I don't care about the specific items. For some reason, I missed the fact that they would still need to do some evaluation in whatever frequency range where you might exceed the --

MEMBER SKILLMAN: I'm interested in why there's a pass where the ground motion exceeds SSC, even for some very limited frequencies, because it could be that, at 1-1/2, 2, 3 Hz, those are your component cooling water pumps, where they, certainly, above 10 Hz you're getting into the relay chatter high frequency stuff.

MR. MUNSON: Okay. So above 10 Hz, they would still have to do the high frequency evaluation and demonstrate the capacity of high frequency components. They don't get a pass on the high frequency, but in the 1 to 10 --

MEMBER SKILLMAN: In the 1 to 10, it seems like you're saying, hey, there are several discreet frequencies where it's okay to exceed by 10 percent. And it seems to me that that is an unwarranted pass because it could be that the most important component just has to be, just maybe resident, at that particular location.

MR. CHOKSHI: Yes, but I think there are two caps; one is on the amount of exceedance. It's like 10 percent. So you can't exceed by very, you know, huge, you know, did you get a sharp peak? You know, it's limited by that. And second is number of frequencies you can exceed is limited. So there is a dual criteria there in order to meet this requirement. So when you look at that, the overall effect of the spectrum is no different than what you -- you know, they are not that different when you apply both the criteria.

MS. KAMMERER: I mean, I think it's worth mentioning, too, that 10 percent exceedance, you have

to remember, these components have margin in them which should well exceed that, you know, when you're starting to get to the beginning of inelastic deformation. It doesn't mean failure of the component, so there should be margin enough in this particular component so that a 10 percent exceedance above design should still -- we should still have confidence in its performance.

MEMBER ARMIJO: But why 10 percent? Why not 15 percent, or 5 percent, or 20 percent? I mean, where did the 10 percent come from? Is it arbitrary?

MR. CHOKSHI: I think it's based on the knowledge we have. You know, we know what kind of margins they have, the experiences with the, you know, past analysis. You know, the question, I think, is, you know, this is a screen, whether to do more PRA. I think we want to try to be judicious, that are we making people do the effort which is not going to result into, you know --

MEMBER ARMIJO: In any significant benefit.

MR. CHOKSHI: Right, benefit.

MEMBER ARMIJO: But let's assume over the whole frequency range of 1 to 10, you exceeded it 10 percent across the board.

MR. CHOKSHI: That will fail this test.

MEMBER ARMIJO: Why isn't the same reasoning applied to components in the --

MR. CHOKSHI: Because then, sort of, when you apply across, the overall energy level is changing. You know, isolated. You know, because when you talk about isolation, you got peaks and dips. So overall energy level is still pretty similar, you know? And as you said, at some point, you want to draw a line. And so we are using this dual criteria, exceedances, amount of exceedance, and the number of frequencies. So we want to control that it should not be uniformly higher, otherwise, you would have just said 10 percent, you know, for the screening.

We just wanted to control that, you know, the spectrum will not effect overall response of the plant.

MEMBER SKILLMAN: Let me follow-up. What you're talking about is narrow band exceedance, and I recognize this is an example at 2 Hz, and maybe 7 or 8 Hz, it's an example, is the SPID informed as to what components might be in unique frequency response ranges such that you could say, hey, you really don't need to do a margin analysis? In other words, it just strikes me that the two, in this particular example,

frequencies that you have said, hey, you don't have to do anything else, may be frequencies of components that are very highly important.

And I understand what Dr. Kammerer has said, there should be margin in those components, but I've been around long enough to know that sometimes it's not there. And so the very components that you may be depending upon that are exceeding are the ones that --

MR. CHOKSHI: Yes, but the thing we are talking about, the 10 percent higher risk ones. You know, because already, you have designed a component to that blue curve, and now you have a 10 percent more. So, you know, we know that most of the seismic designs, the design practice itself, has a tremendous margin. And if I do change my fragility by that small amount, would that make any difference in my PRA results? I would say, no.

And so that's the thinking, you know, that doesn't really change anything, you know, particularly because you are talking about one or two components, you know, not the entire plant, and that's one of the reasons why not go uniform increase 10 percent.

MR. MUNSON: Our thinking, this is very restrictive. It's 1/3 of an octave. So it's 1/6 on

either side of a point that has less than 10 percent exceedance. So it's very restrictive exceedance; the very narrow band exceedance.

MS. KAMMERER: I think the calculation that you're suggesting to would be very hard to map directly because these are ground motion inputs in the free field and they don't necessarily map exactly to the input --

MEMBER SKILLMAN: To the device.

MS. KAMMERER: Right.

MEMBER SKILLMAN: At the location.

MS. KAMMERER: Right. So to do that generically would be challenging, I think.

MEMBER SKILLMAN: Well, what I was really going after is, you know, it's not out of bounds a little bit, it's still a home run, but it's just kind of over that line by a little bit, and I think this committee has a responsibility to challenge whether or not even slight deviations can be significant.

MR. CHOKSHI: I think Jon Richards --

MR. RICHARDS: My name is Jon Richards with EPRI. I would say that that particular criteria was effectively borrowed out of the IEEE standard for seismic qualification of equipment and you are allowed to have a 10 percent exceedance, or a 10 percent

exceedance of your required spectra, beyond your capacity spectra, provided it meets these narrow band exceedance criterias.

So if you had that kind of difference in an IEEE-344 test, you'd still be able to say that that item meets the qualification requirement, but it's a pretty tight constraint.

MEMBER SKILLMAN: Thank you.

MR. CHOKSHI: Good. Thanks, Jon.

CHAIRMAN SCHULTZ: Any other questions related to screening? Before we move into the next section on the key SPID positions, I'd like to call for a break in the discussion, and we'll return at 10:20.

(Whereupon, the foregoing matter went off the record at 10:03 a.m. and went back on the record at 10:21 a.m.)

CHAIRMAN SCHULTZ: We'll bring the meeting back to the record and continue the presentation.

MR. CHOKSHI: All right. Thank you, Dr. Schultz, and what you heard, I think, basically, the first five chapters of the SPID, Jon and Cliff, took you through a lot of hazard screening, then those elements, and I'm going to cover, basically, Chapter 6 and 7 of the SPID, dealing with the risk evaluation.

And, you know, the risk evaluation has the three components, maybe I should have put the slide, hazard, fragility, and systems modeling. They cover the hazard in detail.

And the Chapter 6 covers the rest of the PRA elements, but primarily focusing on the fragility or the response calculations and the capacity calculations. There's several, I think, the focus in this general. First of all, I think is to come up with the positions on the issues where you want to assure consistency from a licensee to licensee, so I think that's one of the purpose of this thing, that, sort of, people are applying the standard requirements in a consistent fashion.

It's to assure that there is alignment on how the ASME standard can be used. The second thing I think is important element here is how efficiently we can use the existing information and, when appropriate, use, you know, the available information and minimize doing a lot of new work, because to do this in a reasonably timely fashion, we need to use limited resources in a very effective way.

So I think there are a number of reasons why I think it was very important, you know, when you move into this part, because the total response and

fragility is where the, to me, real crunch comes into the -- and both aspects of interpreting the requirements from the standard and coming up with a common implementation approaches, and second, using the resources effective. So a lot of this discussion centers around that.

If you look at that Chapter 6, it's basically talking to the certain categories; response categories, capacity categories, screening, and some other topics, like larger release frequency and the peer review, and the documentation, other parts of the complete story. And then the Chapter 7 is spent, which I'll cover very briefly.

So this first slide deals with the elements of the structure of models, doing the seismic responses, and the things we discussed earlier about rock, and I'll discuss that a little bit more in detail. So the purpose of the first position on structural modeling is to make sure under what conditions you can use existing models. You know, what set of criteria needs to be justified and, you know, the criteria is in terms of that; am I capturing appropriate frequency, are the current responses critical for my analysis?

And is the criteria is such that it

requires, again, the use of an experienced structural engineer to make summary judgment. And when I come to peer review section, it sort of demonstrates why the peer review process, the way we describe, and why it's an important element. The seismic response scaling is another important element in terms of determining when I can do this.

And I think some of these things, when we came and talked to you about SMA, ISG, because they incorporate similar positions, because this is across both the matters. And again, is under what conditions I can use my in-structure response spectra to scale to a new demand? And there again, it depends on the frequencies of interest; what were the shapes used in the original?

This becomes critical because as Cliff showed the spectra of comparisons, the new ground motion model and what were used in the original design differ drastically in some cases, so this is an important question because that will decide whether you need to do a new analysis or not. So again, this is a specific criteria and people have to demonstrate in order to say, yes, I can do the scaling.

And if you go to the SPID, it provides examples under what conditions you can do and you

can't. Now, the third bullet is the fixed-base analysis criteria. You know, as Jon mentioned that, earlier, we used to think rock differently. In fact, I think if you go into the older SRP, if I remember right, my numbers, shear wave velocity of 3500 feet per second was considered when you go to the fixed-base analysis.

In the SPID, they talk about 5000 feet per second, and they have done additional analysis, and it's in Appendix C, to come up with where it's appropriate to use original fixed-base analysis. Fixed-base analysis you do when you have hard rock, but basically, what you are saying, that I don't have a soil spectra interactions because, you know, my rock is very hard.

So under what conditions I can use that. They have done some supporting analysis, and again, the criteria are specified. So those are the primary positions associated with dealing with the calculation of responses involving structures and soil/structure interaction.

The next position deals with doing the fragility and capacity calculations. You know, the way we do fragility, it incorporates both the responses and the capacity, so now there's a second

part of the fragility. And I think we had an extensive discussion. I remember --

MEMBER STETKAR: We did, but I need to get something else on the record, so I'll let you go through the slide.

MR. CHOKSHI: So now, again, I think there is a discussion and then in Appendix D, I think there is additional, you know, just provided the basis for this, but what this position does, it allows the use of hybrid approaches where you can use conservative deterministic failure margin analysis because more people can do that, it's very prescribed, it requires less judgment, and again, it identifies conditions, how you will use it and what are the uncertainty parameters you will use? That's where the table is.

But I think also, in addition to that, use of that, there is also a requirement that at the end of the analysis, you will take the dominant risk contributors and do a separation of variable or traditional fragility analysis. So, you know, where this SPID has come from, I think --

MEMBER STETKAR: Okay. Let me quickly --

MR. CHOKSHI: Okay.

MEMBER STETKAR: This, again, it's supposed to be a, whatever it's called, conservative

deterministic --

MR. CHOKSHI: Failure margins.

MEMBER STETKAR: -- failure margins analysis. The key being, conservative and the purpose is to identify SSCs for which you may need to do a more detailed analysis. So we want to be pretty sure that it is, indeed, conservative. The process is such that the larger beta-C you apply, the less conservative it is. And in fact, it can be optimistic because the median capacity becomes higher and higher, as you've shown here by this multiplier, although, it's difficult for people to see exactly what that means.

So my fundamental question is, and I've looked at a lot things, there are statements in the SPID that says it's very unusual to have beta-Cs less than about 0.3, which indeed, in practice, is really true. Why don't you just say, use, for CDFM, beta-3 for everything? That will be conservative. It's not unrealistic. It's not beta-C equals 0.1, which is, you know, contrary to actual experience, but a beta-C of 0.3 for everything will certainly give you realistic to conservative estimates and would tend to highlight areas better, perhaps, where you need to do more detailed analysis.

Rather than this structured approach for, pick one from Column A and use this, pick one from Column B and use this other one, and so forth, that's, to me, a bit troublesome.

MR. CHOKSHI: I think you are right.

MEMBER STETKAR: I don't know how much difference it would make, but I know that using too large a beta-C could give you optimism. That's the troubling part.

MR. CHOKSHI: Yes, particularly if your starting point is the 1 percent.

MEMBER STETKAR: Particularly if your starting point is the 1 percent.

MR. CHOKSHI: Right, because that is going to shift the median further out.

MEMBER STETKAR: Yes, you will.

MR. CHOKSHI: Yes. But I think this was based on the experiences that, you know, as you say, the random part, which primarily comes from the ground motion, remains constant for everything. It's the other part which is reflecting the beta-You part, and I think, to me, this tried to capture the differences between the structures and components, you know, as we have learned from the past experiences.

But I think, you know, you are right, it's

for certain that if I use beta-C of 0.3, I'm going to be conservative.

MEMBER STETKAR: Right. And again, the point of this is not to do a detailed analysis, it's to, as you said, highlight items, because you're going to run these capacities through a model and determine what are, ostensibly, at least, at your first cut, potentially important risk-sensitive SSCs for which you may to do more detailed analysis. You know, there are statements in the SPID that says, well, the results are relatively insensitive to beta-C. I'm sure that smart people wrote those sentences.

If that's true and they're relatively insensitive, then use a small value for beta-C because the implication of that statement is that it won't effect your results very much.

MR. CHOKSHI: And as you said, the Appendix D, that's coming from Bob Kennedy's, I think, 1999 paper, but exactly, I think the point here is made that, if I vary beta from 0.3 to 0.6, what I get into the overall results is not that significant.

MEMBER STETKAR: Well, I'm sorry, 0.3 to 0.6 makes a factor of 2 difference in the median.

MR. CHOKSHI: Yes.

MEMBER STETKAR: And a factor of 2 can be

pretty large, depending on the shape of your hazard curve, in terms of frequencies of failures.

MR. CHOKSHI: Yes, you know, but we have had a lot of discussion with this. But I don't think in the identification of dominant risk contributors it's going to be that, you know --

MEMBER STETKAR: I don't know.

MR. CHOKSHI: I think what we will see and I think, you know, but I definitely do agree that 0.3 would definitely tell if it's conservative.

MEMBER STETKAR: Okay.

MEMBER CORRADINI: Can I ask a different question? So just to follow Jon. So do you have a justification to make it larger than 0.3? That's another way of asking it.

MEMBER BLEY: My kind of the thing that's going on here is, usually, if you overestimate your uncertainty, usually, it's in the conservative direction. The trouble is, in this case, they're taking this thing, which, if it were centered where it belongs, would do that, but they're anchoring it in an artificial point, which shoves the whole thing out to the side.

MEMBER STETKAR: The normal process is to estimate a median acceleration on uncertainty, and

then the larger uncertainty, indeed, accomplishes a conservative estimate because it pushes the lower bound of the capacity down to lower accelerations. Here, they're fixing the lower bound and assigning and uncertainty to stretch the upper end up.

MR. CHOKSHI: Yes, that's the reason for the check, because in the end, you want to do estimate median first and then see whether you are winding up in the right place.

MEMBER CORRADINI: Thank you.

MR. CHOKSHI: Okay. Can we go to -- now, we talked about the high frequency, you know, that, and I think Cliff mentioned that the way we are dealing with high frequency, the industry proposal is to deal with it by doing tests, and I think, to me, that's an important step forward because our traditional approach has relied on combination of things, doing circuit analysis for that sort of thing, and some --

MEMBER BLEY: It's fairly important, I think, and this came out real strongly, I think, during the North Anna discussions around here, the tests, compared to most earthquakes, are kind of extreme in the time duration.

MR. CHOKSHI: Exactly right. Yes.

MEMBER BLEY: Which means you're putting a lot more in than you would get in those earthquakes. So the tests give you a lot margin, really, for most earthquakes.

MR. CHOKSHI: Plus, you know, these are not the type of thing you can analyze in any meaningful fashion, you know? These are functional failure models and I think you have to test. So the test program, again, it's, you know, as Cliff mentioned, these are the high frequency sensitive components; relays, contactors, circuit breakers. The things which will, because of the chatter, or high frequency, will get you into either lockout, you know, lock-in, or ceiling circuits.

And the other important thing is, this is applicable for the plants which are screened out based on the 1 to 10 Hz, but there is exceedances in the high frequencies, so a lot more plants will have to really use this information. Then I'll tell you a little bit more about what the test program is, and luckily, we have Jon Richards, because he's managing the program for EPRI.

MEMBER BROWN: Nilesh, is that going to be on a plant -- each licensee will have to evaluate their stuff individually and determine whether they

need to do their own testing or is that going to be a generic --

MR. CHOKSHI: Test is generic and they are collecting, actually, the representative sample for all of the components.

MEMBER BROWN: Who's doing that?

MR. CHOKSHI: This is EPRI.

MEMBER BROWN: Oh, so EPRI is going to take, like, relays, or contactors, or switches, or whatever. But all relays, and all switches, and all contactors are not uniform throughout the entire fleet, so --

MR. CHOKSHI: Well, that's why they are collecting the samples, you know, that they can cover the wide range of the components. And then those test results then would be used by the individual licensees to, I'd say, how that equipment, you know, meets, you know, this particular part of the SPID. Okay. So it's a generic program and let me tell you a little bit more about, actually, what the program looks like.

The program was developed in two phases. And the phase 1 is complete, okay? And the phase 1 was a pilot effort to develop all the computings to understand fully all the parameters, testing protocols, because there is a -- we're talking about

a large number of components. So before they actually go into to start doing the testing, they wanted to make a number of things, the ability of, you know, the shake table for the motions, what are the right range of frequencies, you know, and how do they actually do the testing?

You know, workout all the potential issues and based on the phase 1 test program, they did revise their original phase 2, you know, proposal. And so what's in the SPID now, it reflects the lessons they have learned from the phase 1. And for example, now, in the phase 2, they are going to look at the 20 to 40 Hz range. Initially, it was 60 to 64, if I remember right, and now, based on the testing, this is probably a much better control, plus, this is the more significant range, you know, they need to worry about.

So the phase 1 is complete.

MEMBER STETKAR: Nilesh, in phase 1, did they look at, I don't know what equipment they looked at, did they look at any solid state equipment? Not, you know, chipsets, but --

MR. CHOKSHI: I think they were only looking in the solid state, only the mounting and connections, Jon. That's the extent of the things we are looking at solid state, if I remember right, you

know, because the idea was whether this, you know --

MEMBER STETKAR: Yes, okay.

MS. KAMMERER: Jon Richards is saying yes.

MEMBER BROWN: Let me amplify or expand on the other question just a second. You say it's going to be a generic test, EPRI is doing this, to cover so that all licensees will then have a base from which to draw their information, but how does EPRI determine what the frequency and amplitude that they have to deal with if they don't have the GMRS's already defined for all the various licensees?

MR. CHOKSHI: I think the good question, because of that, not knowing that, they have defined, knowingly, very high level with the view that, you know, when actual licensees are coming, they'll be bounded by this.

MEMBER BROWN: Okay. The existing IEEE standards and other things for qualification testing under these regimens, or regimes, are not necessarily going to be suitable, the existing standards are not necessarily suitable for any of the new GMRS's that are defined, the accelerations and frequencies, which you may find. So are they going to define a new level based on this?

MR. CHOKSHI: Yes.

MEMBER BROWN: So they're not going to be relying on existing standards to say those are okay.

MR. CHOKSHI: Yes, the input motion, particularly, is very carefully chosen to reflect the characteristic of what we expect the GMRS to look like.

MS. KAMMERER: Yes, and maybe Jon can correct me if I'm wrong, but phase 1 was really focused, not only on -- there's a sampling of equipment that got to the breadth of equipment out there, but there was a significant effort looking at the different inputs, so different types of the waves came in focuses on different portions of the frequency band.

Some of the work was conducted to verify some of the applicability of standard testing, and so that's why a smaller number of components were conducted there, but it was a very broad program in terms of the input to try to really answer, fundamentally, some of the questions about how the right way to conduct the broader program where a much larger number of pieces of equipment were tested.

And so it might be of interest to look at the phase 1 to see what was conducted, and as Nilesh said, they're basically taking the amplitudes as high

as possible to make sure they --

MEMBER BLEY: Okay. Relative to that, are they doing both symmetric vice asymmetric type frequencies?

MEMBER BROWN: Let me offer you something on that, Charlie, because about 25 to 30 years ago, mechanical folks were doing this testing and then they got electricals into it as well, and there was a big program that went on for many years, but they finally realized they needed to test circuits powered, to test the electrical --

MEMBER BLEY: Kind of a good idea.

MEMBER BROWN: Well, they hadn't been doing that before, but this was a long time ago and then they learned that, yes, it makes a difference, so they've been testing, and I think that's still going on, and they test a whole circuit arrangement powered and then with power and without to see what happens; what's different under those conditions.

MS. KAMMERER: And also switching state.

MR. CHOKSHI: In phase 1, and Jon, correct me, but they found that energized circuits generally don't have the problem. It's the de-energized that tends to be the --

MEMBER BLEY: At that time, one of our

friends came in my office and said, did you relays are polarized, or something, what are you talking about? He said, well, look, I'll hook a battery up to this thing, and before that, I shake it, and you could hear him shake, I hook this up and they don't shake. I said, well, there's a giant electromagnet that. But they know that now so they're being very careful about that.

MR. RICHARDS: Yes, this John, in specific answer to your question, in phase 1, we ran testing on a variety of different styles of testing. We ran sine sweep testing in one axis at a time, all three axes separately. We ran random multi-frequency testing, all three axes together. We did some of that with, effectively, a sine bead imposed on top of that to get some narrow banded things on top, so we ran all that kind of variations and came back to the idea that a 20 to 40 Hz test, all three axes at the same time, with the parts powered, at least monitored and all that, was an effective way of doing testing to figure out the high frequency sensitivity for the parts.

MEMBER BLEY: Okay. But when you say it's all powered, but then, this is based on my experience, that I had a lot of stuff that is not powered and that you don't want to actuate and start something in the

process, even momentarily, you can create problems. So I don't understand, if you did no unpowered testing for certain types of contactors, relays, switches, then that could be a problem.

MR. RICHARDS: Yes, the relays, and contactors, and switches are most sensitive when they're de-energized, and you monitor the contracts to see if they bounce open, and that is the controlling case. We also ran testing with the relays energized to hold them in position, and we found out that they didn't chatter, actually, up to our table --

MEMBER BROWN: Similar experience.

MR. RICHARDS: Yes, exactly.

MEMBER BLEY: But if I can go a little further, at least to one, and I didn't look through the phase 1, but at one time in the past, they also have whole circuits. So they'll have those contacts hooked up to a valve, or something, to see if you really move the device you care about during this chatter. Is that still true?

MR. RICHARDS: Yes, in our case, we're just testing the relay.

MEMBER BLEY: Okay.

MR. RICHARDS: We're not doing a whole circuit, and we're going to do a lot of relays. But

you're right, there is an opportunity, and I think there's a slide that'll come up that'll indicate that, to look at the circuit that you're using that relay in to determine whether or not it's critical.

MR. CHOKSHI: How it is used, I think I'm going to go through. And I think one important thing is that, this is an ongoing activity. So we are still interacting with the industry. We've been focused on other things now, the phase 1 results, we haven't discussed in details, so phase 2, so I think it's ongoing process. But to me, this is probably one of the most important outcomes because we have been wrestling with this question for a long time and I think this gives a lot more better perspective on the whole issue going through, you know, more of this.

So let me go to the next --

CHAIRMAN SCHULTZ: I wanted to catch John while he was there. I wanted to understand what is the right way to characterize how the 20 to 40 Hz range captures what happens from 10 to 20 Hz, because this morning, earlier, we were talking about high frequency, that would be above 10, so what's the right way to characterize how that covers it?

MR. RICHARDS: So the answer to that is that, normal qualification is taking care of that

frequency range. So the normal qualification under the IEEE standards for relays would be a peak between 4 and 15 Hz. By the time you get the shake table to do that, it's kind of rolling off at around 20. And so that's one of the reasons that we can start at 20, because that lower frequency is already covered, we're trying to figure out what's happening at the high end.

MEMBER BROWN: Well, what if the amplitude of the GMRS is even higher than what the IEEE standard test demanded when those tests were run?

MR. RICHARDS: Right. So what would happen, and in the big picture, is that you'd probably, in that case, be ending up in a full risk evaluation, and you'd have a capacity established for the part, and you'd end up considering that into the fragility calculations.

MEMBER BROWN: So you'd have to do it based on this additional analysis, or risk assessment --

MR. RICHARDS: Yes.

MR. CHOKSHI: Yes, there is a flowchart, it's coming, I think, after this slide, how these results will be used in actual evaluations.

CHAIRMAN SCHULTZ: Let's go forward then. Thank you, John.

MR. CHOKSHI: Okay. So now the phase 2, and I think the first phase 2 testing is sometime in May. John, am I correct? So they are starting on the phase 2 test which will, again, we can expand the sample of the high frequency to cover the distribution of manufacturers, you know, address the diverse population in the plants.

And then again, it's a variety of mechanical motions and we try to cover as much as we can in this program so most of the licensees can use for their, you know, facility.

MEMBER BROWN: Okay. This is maybe too far down on the grass if it is, I understand covering all the manufacturers, but there is a vast array of manufacturers that make these components, relays, contactors, et cetera, et cetera, and you can look at a particular manufacturer, my concern is somebody says, hey, this guy's is similar to somebody else's, therefore, we'll test this one and it's okay.

But yet, if you look at the contents of the springs and/or whatever manner they use to hold them open or closed in various circumstances to counteract so they don't prematurely actuate, all that kind of stuff, there's a lot of nuances in terms of the detailed design of those components, including the

electromagnetic forces that are applied when they're on and everything else.

Some hold, some are not quite so beefy and robust, so the generic stuff has to be -- you have to really cover the waterfront.

MR. CHOKSHI: Yes, this was actually one of the big point of discussion. And the way to at least get around some of this question is, they are actually getting some of the components from the facilities, because, you know, as you said, people replace things and sometimes, you know, you can't necessarily find the same component. So I think, like John described, because this was one of the big issues, how are you going to, you know, test all the variety of things out there?

MEMBER BROWN: I mean, one other point, again, another small detail is, things fail in normal operations and now you get a replacement, that replacement may not be the same as the one you originally had in there ten years ago. It may not have the same robustness, it may not have exactly the same configuration, but electrically and physically, it fits in the space and will suit the application, which has always been somewhat nervous when we're looking at replacing parts; electrical parts.

MR. RICHARDS: I suppose I would say two things. First, we are going through an exercise right now of working with some of the utilities who have relay lists for seismic PRAs so that we can focus, not on all the safety-related ones, but the ones that are showing up in risk assessments that are the most important ones. And so we're using that to try and help focus on what are the right items to look at.

For the most part, they will be component-specific capacities. You're right about that. We may be able to draw some broad conclusions, but we'll have to work our way through the process to see what kind of broader conclusions we can draw, but that's the process we're using right now. We probably want, in this process right here, be able to get to a 100 percent of the relays that the utilities care about. As they work through seismic PRAs, they might find certain relays that we didn't cover, so we'll have to work our way through that process as we get there.

One option is, we could give them the testing protocol and they could execute the test or there may be an opportunity to do some follow-on testing to cover some specific parts.

MEMBER STETKAR: In practice, having been through this, what people is, they say, some great

Gods tested a bunch of relays, here's what they tested, here are the specs on those relays. I have some of those, I got some other things that aren't those. I'm going to claim that, you know, relay X is like relay 37 that they tested. And then it's incumbent upon me to justify why relay X is like relay 37.

And in some cases, if you can't justify that, sometimes people just replace the relays because it's cheaper to do that.

MR. CHOKSHI: Actually, you have three choices at that point in time.

MEMBER STETKAR: Honestly, that's the way it's shaked out in the past. Pardon the pun.

MR. CHOKSHI: And that's what the next slide too, you know, you have, basically, three choices; either you do a circuit analysis and show that doesn't matter, that, you know, this relay, whether it, you know, functions or this functions, doesn't cause me, from this perspective, any problems; replace a component with something which has already been tested; or do a fragility analysis, you know, by -- at that point, you might do additional tests for your own specific thing, or you try to come up with some, you know, other argument, similarity, and other

things.

So the testing will provide, sort of, overall, you know, framework of what -- and to the extent people can use, directly, the results, they will use it, otherwise, they will have to go through this process. So it would have to be brought back into the, you know, risk evaluation and we might windup seeing some of those actually modeled into the PRAs.

MEMBER STETKAR: Nilesh, on this chart here, that lower left-hand corner, it says, "Credit Circuit Analysis", I understand what that means, or operator action, and there are a couple of things in the SPID, and I'll read you a quote, "In the case of the annunciation following an earthquake, operators will reset control room annunciations and then evaluate those annunciations that do not properly reset. These are examples where relay or contactor chatter is considered acceptable."

That says any relay or contact chatter than can create any kind of spurious signals in the control room is okay because I know the operators will reset the stuff and respond perfectly to what is left. And that seems to be a basis for screening out relay chatter as a source of spurious indications in the

control room.

There are other statements, it says, "Other relay chatter effects can be resolved by operator actions. Examples include resetting lockout or seal-in relays that lead to undesired plant conditions. In general, the above approach ensures the adequacy of potentially high frequency sensitive components and specific demand to capacity comparisons or calculations of the required fragilities for inclusion in the seismic PRA models will typically not be required."

So it sounds like the SPID is saying, well, I can invoke that little word, operator action, down there without doing a detailed evaluation of human reliability, because I know that operators will reset those annunciators, and I know that they will respond correctly.

MR. CHOKSHI: Yes, I think some of that comes from the few plants where we have done exhaustive relay chatter-type of evaluation. I can, you know, count about three or four, and some other stories, but I think is, again, one of those things when we will have to look at that, you know, and this is where --

MEMBER STETKAR: But I didn't see any

cautions in anything from the staff saying --

MEMBER BLEY: And I'll tell you the truth.

MEMBER STETKAR: -- you're not endorsing that.

MEMBER BLEY: Most operators are really good on the mechanical stuff, not electrical, and the things in these circuits that can positively lockup are very obscure, and unless you can go to the prints and chase them down, which can take some time, it's not, you push a button and everything's back to normal.

MR. CHOKSHI: The two I'm familiar with, Hatch and Diablo, it was exhaustive circuit analysis. You are right.

MEMBER BLEY: Diablo I know did. I didn't know Hatch did it.

MR. CHOKSHI: Yes, Hatch did it when they were doing their seismic margin, and those were the two studies I would point to anybody looking into the details, but you are right, it's a tremendous amount of work. But I think what you are saying, I think this is something in our review guidance we will have to focus on.

MEMBER STETKAR: Yes, I do know that, you know, real cautions or anything in there --

MEMBER BLEY: Since you brought that up, I do know that Diablo put their own electrical engineers through all of those circuit diagrams and built a book of this, which wasn't there before they did the analysis, so that they could support their operators if they needed to do that.

MR. CHOKSHI: I don't remember the name of that person, Bruce, maybe you worked with quite a bit --

MEMBER BLEY: I haven't seen him in ages, but yes.

MR. CHOKSHI: Yes, this issue is one of those things, again, that's why I think, to me, in overall process, that the peer review, and I'm going to talk it towards to the end, becomes so critical and why the in-process period becomes so critical when these judgments are being made.

MEMBER BLEY: I do agree with John on this one because it's much more obscure than most people would think.

MS. KAMMERER: But let me clarify something. So this whole study is still ongoing, as we were just talking about. The main portion of the work is being done in May, in terms of the testing. It was always the idea that additional guidance that

comes out of this would be developed in terms of how this is used specifically in the PRA.

MEMBER STETKAR: Except the SPID is saying, I don't need to worry about it because I can take credit for operator actions, so that it doesn't have anything to do with the relay chatter testing itself, and it doesn't have anything to do with the peer review if the peer review is being done according to the guidance in the SPID. The SPID says, I can toss this out, I've tossed it out, the peer review team comes in and says, you tossed it out, that's consistent according to the SPID, everybody's happy.

MS. KAMMERER: But additional guidance in terms of how it's implemented in the PRA is part of this program.

MEMBER STETKAR: Except in the SPID that's been endorsed by the NRC staff, it says, I don't need to consider this particular issue because I can take credit for the operators. It doesn't say I have to perform a human reliability analysis. It doesn't say I have to perform a timing analysis to see what's going to happen if I have a seal-in relay locked in and the operators don't decide to do something. It just says, I can, basically, screen-out those types of impacts.

MR. MUNSON: One thing, also, you have to remember is, if you look at the GMRS, right, what kicks you into a risk evaluation? If you have exceedances between 1 and 10 Hz. Now, if you're in a risk evaluation and you have exceedances between 1 and 10 Hz, you generally aren't going to have the type of high frequency rock spectrum that just kicks you into referencing the high frequency testing by itself. So, I mean --

MEMBER STETKAR: Let's take the example, though --

MR. MUNSON: -- the demands in the high frequency range for a plant that's doing a PRA, that's because the GMRS succeeded between 1 and 10 Hz, the demands, generally, aren't as high in the higher frequency range.

MEMBER STETKAR: Let's take the site, your traditional site that is absolutely fine from 1 to 10 Hz, but it's exceeded at greater than 10 Hz, a distinct possibility for a fraction of the sites in the Central and Eastern U.S., for those sites, they have to go through this type of process that's, sort of, illustrated on this screen here. It doesn't say that they have to do a seismic PRA, but they have to do something, and the problem is, the something in the

operator action just says, well, the operators are going to be perfect because they know exactly what to do and I can take credit for the operators doing that.

It sounds an awful lot like fire analysis, that I'm going to take credit for operators being perfect for all of my fire scenarios so I don't have any worry about any of this stuff. Now, Nilesh says, you know, if they have problems and they don't want to replace the equipment, and it doesn't meet the seismic capacity, they may have to do a risk assessment, and I think the implication is that.

MEMBER BLEY: I'd even go further, even if they do a risk assessment, unless they got real electricals onboard, they might not spot this. I think this is worthy of a warning. This is fairly subtle to fix this problem and if it's day shift and everybody's there, somebody will probably fix it. If it's not, okay, maybe not even then.

MEMBER STETKAR: Maybe. I'll give them some non-zero probability there.

MEMBER BLEY: But if it's not day shift, they're going to sit there for a very long time.

CHAIRMAN SCHULTZ: Nilesh, have we made our point?

MR. CHOKSHI: Yes, but I was just looking

into the documentation part, how do we -- I understand your point and how do we get to know what judgments they are making? And I think we need to think about that.

CHAIRMAN SCHULTZ: Well, because the SPID seems to be fairly clear.

MR. CHOKSHI: Yes, we need to think about that.

CHAIRMAN SCHULTZ: Okay.

MR. CHOKSHI: That's a good point because we like to -- yes, it's complex, that I know, and it's not obvious.

MS. KAMMERER: Can I ask, maybe, EPRI, when do you intend on putting out additional guidance that was based on the outcome of phase 2, just in terms of the timing for that?

MR. RICHARDS: Yes, phase 2 testing starts in May with a test every month, one week every month, through November, take a break for Christmas, and then again, January, February, March, so it'll be some time, a month or so, two, after that that we'll have a summary report that will roll-up all the results. Now, we'll have some insights along the way, but, you know, it'll be into the second quarter of next year, we'll have a roll-up of the results.

And we will be providing some recommendations on how to apply the results at that point.

MR. CHOKSHI: Yes, and I think as Annie said, that may be an opportunity to look at it comprehensively.

MS. KAMMERER: Yes.

MR. RICHARDS: Right.

MR. CHOKSHI: Thanks. That's an important point, yes. You know, one of the key experience and lessons learned from the IPEEE, and so on the previous, doing the PRN margin analysis, that you have to be very careful when you do the screening of the components. And then when we are writing standard, a lot of attention was paid to that particular element. And I think this SPID comes up with a process, which I think, probably, can be used broadly, not only for this application, and it really is a very carefully thought-out process, plus they have done supporting studies.

What it does is to split components in, basically, three categories. One is what we know and there is no, you know, controversy or any -- you know, everybody agrees that some components are inherently very rugged, you know, they're like wide body or

things like that. It's very clear. And there are components we know that needs to be evaluated. You cannot make a judgment whether they are automatically -- it's the middle component. Middle components are the problematic, that you know it's high capacity, but you're not sure that you're going to throw them out of the analysis, but do you want to spend an effort to do the detailed analysis of that?

So this is what this position addresses, and it's critical because we found that the ability of some of the IPEEE analyses was not as high because the screening was done, not properly, and that left, you know, some -- you could not, John can speak to that, use in a future application, so I think it's very important.

So what does this position focuses into the single block? It basically says that if the components are identified as a high capacity, we had to come up with different nomenclature, inherently rugged, high capacity, and which doesn't meet those two. So for those high capacity components, the position basically says that you will allow them a screening label for fragility.

You will not do a very specific calculations, but you will come up with a screening

level. You want to keep them in the model. So what that should be the screening level? And the screening level, there is two ways, as shown here, either the HCLPF capacity is about 2.5 times the GMRS or it's equivalent to that HCLPF that leads to the fragility frequency of 5 times 10 to the minus 7.

Both of these will lead to a very site-specific screening level because it depends on the shape and the level of the hazard. And so you will do that, include into the model, but in the end if you find when you go through the analysis that these components turnout to be, actually, one of the dominant contributors, then you will go to that additional check; how much really.

Then the way you do is by artificially increasing the capacity very high and see how much reduction you get into the core damage or whatever the metric you are trying to look at; LERF or core damage. So I think, to me, this is, again, probably an important element and I think it really addresses one of the key, you know, things we have found, and this gives us arms around handling this issue because otherwise, it was pretty much dependent on the usual things and how the people applied the screening criteria. So this is, in my view, an excellent

development.

So now, in addition to these response and capacity parts of the fragility, also, the SPID addresses the large early release frequency. Another important is the comparison to ASME/ANS, and I'll talk about little bit more, I think, why it's important, and some of the things we discussed earlier in the hazard come into the play of the rough information when you look at the future.

Peer review, that's important and I think I know the committee was interested in knowing the peer review process and, you know, why. We also spend a lot of time on documentation. That was another lessons learned from the IPEEE. But there was extensive guidelines in IPEEE, but what came in, not necessarily, every case followed. You know, so I think this now, having that incorporated in SPID, I think, will ensure better consistency across the board.

It will also give us, you know, a better review document. And then I'll touch on spent pool fuel integrity evaluation. On the ASME/ANS PRA standard, one of the goal, I think, and the SPID discusses, that they basically want to try to meet the category, second category, of the standard, so that

can be used to widen it. And so they have gone through and compared by both high level and the supporting requirements, both from the Addendum A 2009, which is the version out on the street, and Addendum B may be already out, because the last I heard was, it was in publication.

I haven't received my final copy. I have the copy because I worked on it, but I don't have, actually, official copy. But they went through all of these requirements, how they are meeting for these purposes, and, you know, also was to judge whether it will hold up for some other application. One of the things, if you look in the SPID, we say that, you know, if you want to use this PRA for the future, you have to meet some of the key standard requirements.

It has to reflect the current planned configuration, you know, then updating the hazard, because we know the hazard thing changes. So I think this is an important element and it also lays out a path for the future use. So this is very valuable also, for some other people, you know, for doing the PIFR, different connection, this will serve, to me, as somewhat of a roadmap, or some guidance, so this was an important element.

And it was useful, I think, for everybody

involved to go through that. The peer review. The peer review is the one interesting -- we had a lot of discussion. As the discussions were ongoing, the NEI put out their guidance for the external hazard peer review independently of the discussions we were having with the NEI task force.

Now, that peer review process followed very similar to the internal event. It does not distinguish between the in-process or at the end of the completion of history, neither does the standard. Reg Guide 1.200 has a requirement about the peer review, so we were trying to bring all of that element. And one of the critical piece we wanted to bring into the process was this concept of in-process peer review.

And to me, and I think everybody involved in the seismic PRA, it does not make sense to wait until the end because there is always reluctance to go back and do my analysis. And so much, you know, it depends on the type of things we talked about. You are making judgment all along the process and you need that different collective set of eyes. And so the biggest thing, I think, is the in-process peer review. We made it that that is acceptable.

MEMBER BLEY: Well, it's acceptable. It's

a shame that's all we can say.

MR. CHOKSHI: You know, but the amount of confusion -- and we may have contributed partly to it, because we started with a participatory peer review, which SSHAC endorses, but the participatory imply different things to the different people, and that's why if you look at the sub-bullets, that we still want to maintain independence, you know, because peer review person is involved and they still need to look at the end overall process, because looking at different pieces, you may be making, you know, decisions which, in the end, you need to look at comprehensively.

So that's, I think, the biggest, you know, important element into this.

MEMBER BLEY: Are we likely to get any in-process peer review? So I mean, if it's only acceptable. If it's not a requirement.

MR. CHOKSHI: Well, I think, no. The thing is that --

MEMBER BLEY: It costs more. Maybe in the end it doesn't when you have to fix --

MR. CHOKSHI: But our discussion with the industry was, they would prefer to do in-process peer review.

MEMBER BLEY: Really?

CHAIRMAN SCHULTZ: I think the industry was actually promoting that.

MEMBER BLEY: Good. Okay. That encourages me.

MS. KAMMERER: It was really a necessity on our part to clarify that it was acceptable.

MR. CHOKSHI: Because there was a running --

MS. KAMMERER: Because industry wanted it, most of the NRC staff wanted it, but --

MR. CHOKSHI: Because the standard --

MEMBER BLEY: There's a part of you that says you have to be totally independent and look when everything is done.

MR. CHOKSHI: Everything is done, because the standard --

MEMBER BLEY: It's a different kind of review, but it's not really helpful for what we're doing.

MR. CHOKSHI: And the confusion was coming because the standard was silent. It didn't say that you can't do it. And so that's the reason, I think, to make explicitly clear that you can do, you know, that was important.

MS. KAMMERER: I think in the SMA guidance, we did manage to say that it was preferred in the end. I think that one slipped under the radar.

MR. CHOKSHI: Actually, that's where the dialog started because we had to put out our SMA guidance before the SPID, so we sat on that issue there and the SPID, basically, brought it into the, you know, light.

MS. KAMMERER: And just to clarify. We started out with one process, but what we ended up with was that the -- because originally, the discussion was going on in terms of the SPID, but it turned out there was, sort of, this parallel path was also happening in research, and we were able, then, to bring alignment between some of the work in research and then the work for Fukushima.

So what ended up happening was, that research put out a document endorsing, with clarifications, the NEI document, and the clarifications, and I think there were a few exceptions, but it clarified that, according to the NRC staff, we just want to clarify that either of these approaches are okay.

CHAIRMAN SCHULTZ: So Nilesh, looking at the three bullets, what I gather is that the desire

was, in fact, to maintain in-process peer review, but that there was some concern that, how does one remain independent if you get involved in the process and the project early on and start to be thinking as if you were the -- part of a different team than the peer review team?

But then, the third bullet suggests that perhaps only a few of the peer review team would be in-process, but the whole peer review team, there'd be others that would remain independent? Is that --

MR. CHOKSHI: Yes, the thought was that, for example, you are making a key assumption in the area of fragility. A person which meaningfully can provide not, maybe from the entire team, two or three people who are, you know -- but in the end you want to look at -- every member of the team needs to look at, are the studies done to make sure that everything now comes together, you know, and makes sense.

CHAIRMAN SCHULTZ: Which is more of a cross-disciplinary review.

MR. CHOKSHI: Cross-disciplinary and overall, you know, that all these different pieces is giving me, you know, insights. Does it make sense, you know?

CHAIRMAN SCHULTZ: And the guidance on

that third bullet, my interpretation of that is, that's the peer review team is the peer review, the same bodies, for the entire project because there's been some bad experiences from the fire analyses where peer review team A came in and gave them some comments and then, you know, a couple years later peer review team B, different bodies, came in and just said that the things that peer review team A said was okay or were terrible.

So you do get deviations among peer review teams, depending on the bodies. That's been a complaint among some of the people doing the fire analyses.

MR. CHOKSHI: And the NEI guidance and our ISG addresses those type of things. Right. Exactly. You know, how do you do that? So why don't we go to the next one. Spent fuel pool, basically, the focus here is on the rapid drawdown, okay? And not as much on the structural strength. The structural strength is only addressed in the term of, that you need to make sure that there is a checklist, which is NUREG-1738, which was the decommissioning study.

And some of that, sort of, qualitative aspects to make sure that you don't have any obvious things which is outside of the, you know, information

used to confirm that your structure has the margin and strength. And then it focuses on, basically, to the way of you can lose the inventory, looking at the penetrations, looking at the syphoning effects, and other potential effects, such as the sloshing due to the, you know, earthquake motion.

And then when you do that, again, you address those things in, basically, two or three ways. First of all, whether it's of any consequence. You know, as you see on the flowchart, penetration not, you know, for 72 hours, there is no uncovering. And if it turns out that you cannot address and answer that in years, then there is two ways to look at it, whether there is, seismically, enough capacity that you want get the penetration, it will remain intact, or look at your make of capacity that you can quote with that.

Now, you know, so that's the focus on spent fuel pool is more, you know, in that and it's not a risk evaluation like for the reactor. So that's all I planned to say on this.

MEMBER STETKAR: I think I know the answer to this, but I've actually forgotten. Is the requirement for the licensee to look at all modes of operation?

MR. CHOKSHI: No.

MEMBER STETKAR: Oh, then I didn't know.

MR. CHOKSHI: Let me think about that.

MEMBER STETKAR: In particular, the concern is, during refueling operations, there may be seismic failures that can result in a drawdown of the spent fuel pool that are not present during normal operation. In particular, because the fuel transfer canal is opened and gates are opened, so you may expose yourself to seismic failures. Some plants have drain connections to the bottom of the fuel transfer canal, that if they break, you can drain down, at least to the bottom, so the transfer slots in the fuel pools, not a complete drain down below the top of the active fuel, but certainly, a lot of water.

So if the licensees were required to look at seismic failures during all modes of operation, that, in principle, would pickup those types of failures. I thought that they did. That's why I was surprised when you said no, so I'm glad I asked.

MR. CHOKSHI: Yes, because it's been a while since we have been discussing that. Let me come back to that.

MEMBER STETKAR: Okay. Thanks.

MEMBER BLEY: Let me ask you one more

thing about that. It talks about breaks in lines and other things that could drain it. Do you need to do the circuit analysis part two to see if there's some way you can open up a valve and pump it down, and if not, why not? Most plants, you can't pump it all the way down, but you can pump it down real close to the top of the old fuel.

MR. CHOKSHI: Because of the type of --

MEMBER BLEY: Yes, exactly. And you drive a gate valve of its seat, it doesn't have to go very far before it's got almost full flow through it. It doesn't have to open wide, it opens a few percent, and you'll get a lot of water through there. I don't see any specific words -- you know, there's words that one could interpret that way. You have to look at ways you might drain it down, but there's nothing that really says you ought to look at it.

MR. CHOKSHI: Yes, we didn't explicitly say that, you need to look at the areas. It's just a general --

MEMBER BLEY: Well, it's kind of reach to read it into it.

MR. CHOKSHI: That's a good point, but it's not --

MEMBER BLEY: I think you ought to look.

I mean, it's pretty unlikely, but not all of them are hooked up the same way.

MR. CHOKSHI: That's a good point. Yes. We didn't discuss that specific scenario.

MEMBER CORRADINI: I wanted to know, the 72 hours, where did the 72 hours come from as a decision point?

MR. CHOKSHI: Now, it comes, probably, from many things, because there is also the whole flex and other things, you know, which is a long-term, but I think that the 72 hours, I think, we have used many places. By that time, you can probably do a number of things for the makeup capability and if you had to.

MEMBER CORRADINI: So okay. So that's what I guess I was -- I assumed it had something to do with some auxiliary equipment that was sized such that if it really took three days to drain down, you could put something in that could refill with the drainage, but I just wanted to make sure.

MEMBER BLEY: Yes, and this would assume, I'm assuming, that this implies they would start the drain down right after the earthquake.

MR. CHOKSHI: Right.

MEMBER CORRADINI: So if it takes three days, then it's a pretty small leak.

MR. CHOKSHI: Right. Yes. There is some discussion in the SPID about the 72 hours, but again, it will be the ability to bring in, you know --

MEMBER CORRADINI: All right.

MR. CHOKSHI: Let's go to the next one. Okay. This shouldn't, hopefully, won't take long, because, you know, after we briefed the ACRS in August, it was issued for public comments. I think there were some comments which were incorporated and we had, I think, discussion about how we were addressing these comments. And then the version went out into the September 2012. We got comments, but very few comments, I would say, of any kind of substance. I would say almost none. Most of them were clarification.

MS. KAMMERER: No, there was no comments.

MR. CHOKSHI: And one of the things I attribute, you know -- as we move toward enhancing the RSM into looking more like a PRA, and as the PRA introduce some use of things like CDFM and stuff, the differences between them narrowed in terms of the effort required. You know, from what I hear from industry, most of the plants will do PRA, which, to me, makes sense. You're going to get a lot more, you know, in the future use --

MEMBER BLEY: On the other hand, it's always kind of made sense, and yet, it hasn't happened very much.

MEMBER STETKAR: You heard a lot of people, originally, transferring to NFP-805 too, so be careful what you hear really.

MR. CHOKSHI: So we issued finalized numbers according to the schedule. There were, essentially, no change. The one significant change, and I think Annie talked about, this peer review section, and that was actually, you know, we called it the avenue to get that in-process in place. And because it was our guidance, we added the things, provisions, about the team composition, what is independence, more detail, so I think we took the pieces from the other available guide, and so I think it's more comprehensive.

I would say, that's probably the only significant change. The other technical positions, will you go the next slide, addressing the main part of the SMA, essentially, unchanged. So all of these things are what you have seen before. All right. Now, I think some more talk about one important development, which I'm sure you have heard about, that industry has proposed what the industry calls

augmented approach, what we call expedited approached.

There are a number of nomenclatures, you know, the way you look at it. But what it does, and this sort of, if you remember --

MEMBER RAY: Nilesh, let me interrupt you for a second, because I think before we go to this, this is kind of a distinct discussion we're about the enter into, as I look at this, I'm trying to think back on what are the requirements that we're trying to satisfy here? And we didn't start out with a summary of that. I'm sure it's been presented and what you're telling me is, look back at so and so.

But what is it that I would want to refer to as the requirements that we're all trying to meet here? Do I just look in the Near-Term Task Force report? Do I look in the authorization bill off the Hill? What is it that we're --

MR. CHOKSHI: There are three pieces.

MEMBER RAY: All right.

MR. CHOKSHI: The one is the task force, which is the high level, it says, here are the recommendations, and we are trying to address Recommendation 2.1, which says that, "You will re-evaluate the hazards at the operating reactor sites using the approach that you are using for the

licensing for new reactors. And then evaluate whether you need to modify design basis or make some other planned modifications." Okay. So that's the overall recommendation.

MEMBER RAY: I got number one.

MR. CHOKSHI: Right. Then the Commission issued the 50.54(f) letter, request for information, that is March 12, 2012, which lays out the details of, that in order to meet this recommendation, here is what each licensee has to do. What is the request or actions? What is the request or information? It's the information. So that's what we are in that piece; that part of it. That, in order to collect that information, what kind of guidance we need to have so the people can go and generate the information and give it back to us?

So hazard re-evaluation we discussed and this criteria is for that, and this, actually, your question is at the very right time, because this figure lays out that process. So if you look at that overall recommendation, and the processes are identified in the 50.54(f) letter, is in two phases. The phase 1 is the collection of information and there are two stages.

That first stage, you will do, basically,

your hazard evaluation. You are looking at coming up with a new assessment of what we have been calling GMRS. Okay? And at that point, you know, Cliff described the screening part of that. Depending on the outcome of that screening, you go into the stage 2, which is the doing the plant risk evaluation, in a broad sense.

And when all of that information has come to us as a part of the response to the 50.54(f) letter, the phase 2 is what the later part of the recommendation, and asking you to make a decision, with the regulatory decisions, do they need to take any action.

MEMBER RAY: Yes, I mean, I always envisioned that phase 1, as you said, was a gathering. It's got these two stages to it, and phase 2 is something we'll deal with later. We're not trying to say we're defining what phase 2 consists of here, are we?

MR. CHOKSHI: No, no. Right now, we are focusing on the phase 1.

MEMBER ARMIJO: Well, okay. What is the purpose of phase 2? What is your objective? Is it to find that set of plants that really have substantially greater seismic risk? I hope that's your --

MR. CHOKSHI: Yes, and then make the decisions that any regulatory actions needs to be taken to, you know, enhance safety or there is, you know --

MEMBER RAY: But we're going to talk about that later, aren't we?

MR. CHOKSHI: Later, yes.

MEMBER RAY: Because my point is that, at this juncture, we're only talking about phase 1 in terms of what we're trying to accomplish.

MR. CHOKSHI: Absolutely.

MEMBER RAY: All right. Because that wasn't terribly clear to me.

MR. WIDMAYER: Is staff attempting to do the phase 2, if you will, for seismic and flooding at the same time or do you think you're going to have to address those two things separately?

MR. CHOKSHI: No, I think, as the information comes in, we will, you know, start the process. So if you look at the timing of the flooding and seismic, not necessarily they coincide.

MR. WIDMAYER: Okay.

MR. CHOKSHI: Okay. So as we finish phase 1, we will move into the phase 2.

MR. WIDMAYER: Okay.

MEMBER RAY: Well, just to finish up, my concern is, we'll never realize when we've moved into phase 2. It'll sort of just happen on its own and things will -- we won't have a discreet point in time when, as Sam's asking, what is it that we're trying to accomplish here? And we never ask and answer that question.

MR. CHOKSHI: Yes. I think maybe this might help. At the end of the phase 1, there will be a staff evaluation report, okay, that release that information and, you know, first, to make sure that information does address what we request. Do we have a problem? At that point, when you go through this review, it'll be clear which one needs to be evaluated for the phase 2. You know, in some cases, it might be very simple. Plant has a very high capacity, there is no risk, and the process ends there.

For the plants which we have a question, then you enter into the phase 2, and use the regulatory processes as shown here for that part.

CHAIRMAN SCHULTZ: Are you saying, Nilesh, that the last box on stage 2 is some integrated evaluation that the staff is going to perform?

MR. CHOKSHI: No. This is for each licensee. So each licensee, stage 2, the last box, is

the -- yes, that's NRC evaluation of, you know, what licensee submit to us. That closes the --

CHAIRMAN SCHULTZ: On a licensee-by-licensee basis.

MR. CHOKSHI: Licensee-by-licensee, right.

CHAIRMAN SCHULTZ: So that'll be over some period of time, evaluation plant 1, plant 2, plant 3, site 1, and so forth.

MR. CHOKSHI: Right.

CHAIRMAN SCHULTZ: Okay.

MR. MUNSON: I think it's fair to say we need to do some work on what the criteria would be for phase 2 and --

CHAIRMAN SCHULTZ: During stage 2. Is that what you're saying, Cliff?

MR. MUNSON: Yes.

MR. CHOKSHI: Because right now, the focus, I think, as you say, is phase 1.

MEMBER RAY: Yes, but I wasn't really getting that crispness that you've given to it now, that we're going to talk about phase 2 at another time.

MR. CHOKSHI: Yes. I think as Cliff said, we need to do some more work on that.

MEMBER ARMIJO: It seems to me, if I

understand your chart, that the NRC prioritization at the end of stage 1 is probably the key step.

MR. CHOKSHI: Yes.

MEMBER ARMIJO: And if in the prioritization, there are a number of plants that there's no need for, literally, even doing stage 2, is that possible?

MR. MUNSON: Yes, plants will sometimes screen-out. That number is unknown right now because, you know, we're still evaluating the new ground motion and everything now.

MEMBER ARMIJO: Yes. But then you'll have to say, what are the criteria for saying these are the ones, you don't have to do anything else; these are the one, you ought to do a little bit; and these are the ones, you've got big problems.

MR. CHOKSHI: Yes. Cliff showed that, remember, those three outcomes, you know, and that will dictate, you know, which plants have to do, and also, it will dictate the priority, and I think I'll touch on that when we come to the next --

MR. MUNSON: Just fair to say that, obviously, for those plants that screen-in that, the greater the deviation of the new predicted ground motion from the SSC, those with, you know, highest

probability of having a very large impact will go first.

MR. CHOKSHI: So now, this is, you know, what I described was originally the approach outlined in the 50.54(f). The industry has come up with a modification too. Why don't you go to the next slide? They will meet all of what is outlined in the 50.54(f), you know, in terms of doing the hazard evaluations and the risk evaluations for the plant which are spending, but then they are also incorporated an interim step, which is doing an expedited review of a selected system, and has been shown here, looking at the FLEX phase 1 installed plant equipment, you know, which is to cope with a station blackout and loss of ultimate heatsink.

They will do interim evaluations as soon as the ground motions are computed to make sure that if there is need for a modification, they will do that as soon as possible. And our target is to do that by 2016 and it might go beyond, depending on if some of them have to be done in the outage. But the goal is to at least look at the FLEX phase 1, you know, while the PRAs are out and those are being performed. So at least there is some plans in additional coping capability, because this process, it's a long process.

So the idea was to at least get some upgrades in the plant. Okay. So, you know, and as shown here, that will be limited to the FLEX phase 1, basically, you know, this is all station blackout, the steam-driven systems, and it will look at the components. Next slide. Okay. Here is the, you know, what does that consist of?

It's, as I mentioned, the coping with the loss of AC power and it will look at the RCIC and AFW, and then the associated supports, and equipment. The focus will be on to the seismic capacities of this to make sure that, you know, the plant can cope with that. And the approach the industry has come up with, I would say they are selecting the reviewable ground motion, this is generally higher than GMRS, so I think there is, actually, a conservatism to make sure that you're looking at a higher level of ground motion, and those will be modified.

Now, you know, the components which are found, they can't show that high confidence, low probability of capacity, they'll be modified. The industry has developed a guidance for these, you know, on this, and that guidance, we have been discussing. There have been three public meetings and let me go to the next slide. That just gave me, yesterday, the

guidance is now here for the final endorsement, or the staff endorsement, and it deals with this interim evaluation.

Now, in doing this, because now this is an ELES step and this is the same group of people who do the PRA who will do the DC evaluations, it stretches out the risk evaluation schedule by a year, overall. I won't go in detail because I think that, very soon, we're still working through all of those details, but industry also has, along with this letter, with the augmented guide, they have submitted two other pieces that intend to use the new ground motion model, continue with the update, which will stretch the -- Cliff showed that the submittal of the hazard results by six months.

And it will stretch the PRA schedules, roughly, by a year. Now, the thing is that, again, you know, one unknown in this, how many plants wind up into that second. That might effect the final schedule, but right now, that's the, you know -- and it says the industry to formally submit, but it's here. And I think the path forward is for us to now work through our endorsement process and, you know, again, keeping management, you know, all of the things we have to go through to get there, management

consensus on that.

MEMBER RAY: Nilesh, when you're talking about schedule, you're talking about Central and Eastern schedule, right?

MR. CHOKSHI: Yes. And that's what -- now, the PRAs, you know, Central and Eastern, you are right. It's important.

MEMBER RAY: It is in the sense that, does this alternative approach do nothing more than alter the schedule, the ultimate outcome remains the same?

MR. CHOKSHI: Exactly. That's why. Because it still does everything the 50.54(f) asked.

MEMBER STETKAR: But other than a delaying tactic, what technical benefit accrues from this?

MEMBER RAY: That's a pejorative.

MEMBER STETKAR: And as a subcommittee member, I'm allowed my pejoratives.

MEMBER RAY: I was trying to get there more slowly.

MEMBER STETKAR: That's okay. We're running out of time.

MS. KAMMERER: Okay. So in the 50.54(f) letter, it talks about the fact that, in some cases, interim actions may be undertaken, but there was no real clarity in terms of what that meant. So what

industry has come in with is proposing a program, which we did not immediately have, which is to look at all the FLEX 1 equipment as soon as the hazard come in, and compare the capacity of the FLEX equipment against the new ground motions, because currently, it's against the design basis.

And to say that if that equipment can't be shown to meet the new ground motions, that modifications will be made in the short-term. So what we're getting out of this, which actually, I think is very substantial, is plant modifications to assure that that coping capacity is there to the new ground motions, happening before we would ever be doing any modifications resulting from the PRAs that would come in.

And that would happen 2018, so we'd get the reports -- 2016, and then some of it would have to be performed during an outage.

MEMBER RAY: But the concern is that it would be in lieu of rather than --

MS. KAMMERER: No, no, no.

MEMBER RAY: I know. The words interim are clear here, and it is, I think, as you say, has a benefit, at least as we're understanding it at this point, because the gap between having this exceedance

and doing something about it is so long, it's going to be a target for challenge and I think this is something that seems to speak to that.

MR. CHOKSHI: Exactly. Because, you know, if you look at the 50.54(f), we really don't talk about when, actually, we are going to do plant modifications because it depends on phase 2. This gives something concrete interim.

MEMBER RAY: As long as it doesn't become a substitute for getting to the endpoint, ultimately.

MR. CHOKSHI: No, and the industry letter is very clear on that, you know, along with the schedule, so that, you know, what are they going to do? So I think you are absolutely -- that first one we heard, that we wanted to make sure that this does not replace this.

MEMBER BLEY: So is the FLEX equipment onsite? I thought it was going to come from elsewhere.

MR. CHOKSHI: No, there are three phases, right? Phase 1, phase 2, phase 3. Phase 1 is, they install the equipment.

MEMBER RAY: Okay.

MR. CHOKSHI: And what this -- actually, I shouldn't say that. What this thing is going to

look at, not only the phase 1 installed equipment, but all the hookup for the phase 2 and phase 3. So the phase 1, station blackout, is going to vary from plant to plant at the time you cope with that. So to make sure that you have an extended coping capability, they are going to look at all of those pieces also. So if I need to, say, for example, I have installed a particular, you know, thing in order to be able to hook my portable equipment, that would be part of the assessment.

MS. KAMMERER: I think we need to make sure that you guys get a copy of what was submitted yesterday so that you can read it because it's got a lot of information. As Nilesh said, we've had a whole series of public meetings on this and we've provided sets of comments, at least twice, that they have been incorporated. They, basically, incorporated all of our comments.

MEMBER BLEY: Did they? So you're pretty happy with it.

MS. KAMMERER: I am, because I feel like it's a win/win, because we're getting mods early and we knew we always were going to have challenges on both sides in terms of resources and this is a rational way to get something early, but also, give

the PRAs sufficient time that we get quality products in.

MR. CHOKSHI: Yes, another thing is, it's not a substitute for PRA, for many reasons, because this is looking at, you know, the coping capability with a blackout and, you know, we need to look everything else.

MEMBER STETKAR: That's a bit of my concern is that, some of the full scope PRAs that have been done, surprisingly enough, station blackout isn't necessarily the most important seismic contributor. And if we get tunneled into this notion that station blackout is the only seismic issue, there could be surprises later.

MR. CHOKSHI: Exactly. And that's the reason I think, you know, that we -- but I think many questions, you know, the balance between prevention, integration, defense-in-depth, unless you do the PRA, you're not going to get those answer, you know? So we have to. You know, it fills the gap. You know, that's why it's an interim action.

MEMBER STETKAR: The reason for my pejorative comment was to make sure that I was hearing some feedback that there is actual technical value added and I've got some assurance of that.

MS. REGNER: We probably need to add just a clarification just for full disclosure and that it's not all FLEX 1, it's not all of the coping equipment, it's a subset of the coping equipment. I just want to make sure that was clear, and it's also not all phase 2 connections, it's one set, so it's a subset. It's significant subset, but it is a subset of that entire range of --

MEMBER STETKAR: Those caveats are described in whatever was submitted yesterday?

MS. REGNER: Yes.

MEMBER BLEY: But the subset is one that if the things in the subset worked, you're okay.

MS. REGNER: Right. Is that what you wanted to say, Kimberly?

MS. KEITHLINE: No, this is Kimberly Keithline from NEI. I wanted to point out, because I think this will help alleviate one concern, I know the slides say alternative approach. We, in industry, are not calling it alternative approach. We've been very careful to refer to our overall approach as an augmented approach because we are going to do what was requested in the 50.54(f) letter and we decided it was prudent to add this deterministic expedited evaluation that will result in an earlier demonstration of

additional seismic margin and some plant modifications that will enhance safety.

And so we've been careful among ourselves not to let the utilities think that this is an alternative, an option, that they can choose to just go do instead of what you requested.

MR. CHOKSHI: I would like to, this is, you know, again, how the words create, you know, because for some reason, augmented has not played real well with us inside the agency, and now the alternative is not playing well.

MEMBER RAY: That was a good clarification she gave.

MEMBER BROWN: Okay. Can you go back to Slide 34? I just want to make sure I understand how Harold's start integrates into here. After reading these two slides, it seems to me that, forget about what you call it, the industry approach is in the stage 1, between where they finish their updated GMM and you're all doing your screening, they stick this in there and start evaluating what they may do in some circumstances while you continue the screening and prioritization in accordance with this game plan.

MR. CHOKSHI: Right. And that's what that light-blue box in the chart.

MEMBER BROWN: Yes, I know. But this comes in right after they -- well, but that's just hazard re-evaluations. That's not the interim. It's all part of that -- it follows that. Once they get the new GMMS, then they will go in and do this relative in whatever this abbreviated, or subset, of phase 1 of their FLEX phase 1 and phase 2.

So, to me, based on that understanding, I didn't view this as a delay, it seems to me, really improving the process in getting some stuff done early, as opposed to waiting till 2018, or whatever the heck it is. So it seems to me that the industry was proposing -- and I'm trying to be non-pejorative relative to a delaying tactic. I think this was a positive thing.

MR. CHOKSHI: We see value, you know. I think, you know, this does stretch up one year, but I think there are two things. First off, some plants will have made some modifications which will actually increases capacity. Second thing is that, the resources will be better utilized and I think that will probably result in better quality, ultimate, you know, PRA story.

MS. KAMMERER: And for those that aren't making mods, we'll have a better assurance of that

defense-in-depth capacity that's demonstrated to the higher ground motions.

MR. WIDMAYER: Hey, Nilesh. I remember during some early parts of the discussion of this, I think you had a discussion with industry about whether or not the FLEX equipment needed to have qualifications, what kind of qualifications the FLEX equipment was -- have you guys ironed that particular issue out?

MR. CHOKSHI: Yes, the way they are going to do is, the evaluation is, using, basically, that process we used for the seismic margin evaluation, there is an EPRI guidance document, they have to follow that, and that talks about, how do we evaluate the capacities of the equipment? A lot of this equipment was installed equipment.

MS. KEITHLINE: This is Kimberly Keithline again. I know there have been discussions related to this effort, but there are different discussions that have occurred related to the FLEX effort, the response to the orders for Recommendation 4.2, where part of that response will involve temporary portable equipment, and there have been discussions about what level of qualification that equipment needs to have. That equipment is different from this effort.

We're looking at the installed parts of the plant here. So we're not changing what's being done over there, so our seismic margin assessment approach that we're doing here does not effect the temporary portable equipment.

MS. KAMMERER: This is like a classic demonstration of seismic margin.

CHAIRMAN SCHULTZ: Nilesh, can we shift back to 37; Slide 37?

MR. CHOKSHI: Okay.

CHAIRMAN SCHULTZ: And I just wanted to clarify, the letter that has been received, is that the second bullet; the formal submittal?

MR. CHOKSHI: Yes. So the letter contains three pieces of information. One is their plan to continue with the ground motion model. Second is this approach with the A-word, and its overall schedule, how does that, you know, effect the schedule? So this really ties-in all the pieces.

MEMBER STETKAR: Well, I guess we'll see that. What I'm struggling with is words like, a year here, a year there, a zillion here, a billion there.

MS. KAMMERER: It's all laid out in the attachment, which is the schedule; the specific schedule.

MEMBER STETKAR: Well, I heard, you know, some rationale for a delay of around six months in the ground motion response spectra. I'm curious why this other additional analysis, you know, then adds another six months on to the end of that, for example, but I guess we'll see it in the --

MR. CHOKSHI: You know, because it's the same people who will be doing PRA, will be doing this interim evaluation, particularly, the structural fragility people.

CHAIRMAN SCHULTZ: All right. That's the presentation. I'd like to have an opportunity for the committee to provide additional comments or questions. Mike, starting with you.

MEMBER CORRADINI: Every time I get this topic, it's an education. I will say, though, that maybe we should discuss in P&P, but as we're going to be getting changes in membership, I think, maybe, another tutorial like we had, I can't remember, some of the folks in front of us here did this for a whole day a few years ago, whether it's two, three, four, five years ago, I remember it.

But doing this again, I think, helps us because we're going to have to come back to this again and again as this becomes more detailed. But other

than that, I appreciate the staff's time.

CHAIRMAN SCHULTZ: We'll look for an opportunity. Joy?

MEMBER REMPE: I also appreciate the staff's time, but I have no comments.

CHAIRMAN SCHULTZ: Charlie?

MEMBER BROWN: No more comments.

CHAIRMAN SCHULTZ: Bill?

MEMBER SHACK: It was a good meeting.

CHAIRMAN SCHULTZ: Mike? John?

MEMBER STETKAR: Nothing more.

CHAIRMAN SCHULTZ: Sam?

MEMBER ARMIJO: Yes, I thought it was an excellent presentation. A lot of work's been done. The staff's on the right path. I like this new initiative too. I see it as an augmentation or an improvement over what we were going to do. In fact, there could be some frustration that real hardware wasn't really being upgraded when there was an identified increase in the hazard, or the risk, and this addresses that, and so I think that's a very positive thing.

So, you know, these things take a lot of time, but if we can go in parallel, upgrading equipment where there's a benefit, I think that's a

great initiative.

CHAIRMAN SCHULTZ: Dennis?

MEMBER BLEY: Nothing new to add. I, too, appreciated the presentation and the staff, and I think you got a great approach.

MR. CHOKSHI: And by the way, we have answered one of the questions, we looked up, so after everybody finishes --

CHAIRMAN SCHULTZ: Okay.

MR. CHOKSHI: Okay.

CHAIRMAN SCHULTZ: Harold?

MEMBER RAY: Well, we're just at the beginning of a long heavy burden of work. It's sequestered here, I'm told. I'm not sure how it's all going to match-up with what lies ahead, but we'll see. I don't think anybody can say right now, and that will be my main point. It kind of echoes what Mike said, which is, we're going to have a lot to look at, ultimately, but this certainly a good status update.

CHAIRMAN SCHULTZ: Thank you. Dick?

MEMBER SKILLMAN: Thank you for a thorough presentation. Look forward to hearing from you again.

CHAIRMAN SCHULTZ: Right now I'd like -- oh, you said you had one response?

MR. CHOKSHI: Yes. I think, Dr. Stetkar,

your question about the refueling?

MEMBER STETKAR: Yes. I remembered. I was thinking. Thank you.

MS. REGNER: Yes, one of the criteria for uncovering the stored fuel addresses when the pool and reactor are configured for refueling, so that's one. The 72 hours goes back to the walk-down guidance.

MR. CHOKSHI: That's true. This also came from that.

MS. REGNER: So that's pulled from walk-down guidance.

CHAIRMAN SCHULTZ: All right. Before I close the meeting, I'd like to provide an opportunity for public comments. If there are members of the public in the audience here in the meeting room, if one would like to make a comment. Seeing none, we have the bridge line open now. Yes. And so if anyone on the bridge line would like to make a comment, please introduce yourself and do so.

Hearing none, I'll close the public comment period. I would like to say, we have made some points during the meeting that, Nilesh, you've taken some notes on. Two areas, specifically, we talked in response to the spent fuel pool integrity evaluation, one piece of it, but we also raised the

issue associated with operator action that --

MR. CHOKSHI: Right. There are two things I have. One is the relay chatter with the spent fuel pool.

CHAIRMAN SCHULTZ: Yes, exactly.

MR. CHOKSHI: And operator actions on the relays to that.

CHAIRMAN SCHULTZ: And we talked about additional interaction and I think we all noticed, both the staff as well as the committee, that we are in the first box of many on the chart that is well-developed, so we look forward to those additional interactions. And I want to thank each of you for the presentations today as well as your responses to the questions of the committee. It's been very valuable to have the input at this point in time.

And we've been looking forward to it, as you indicated, Nilesh, for the last several months, so it's good to be able to come together and we'll look forward to further interactions. So with that, I'll close the meeting and thank you.

(Whereupon, the meeting in the above-entitled matter was concluded at 11:52 a.m.)

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Presentation on Seismic Evaluation Guidance and NRC Seismic Margin Assessment

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Outline of Presentation

- Overview of Seismic Evaluation Guidance (SPID)
- NRC Seismic Margin Assessments (SMA) Guidance
- Industry Proposed Alternative Approach

SPID Overview

- **Industry developed the guidance document through interactions with the NRC**

  "Seismic Evaluations Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," EPRI 1025287, November 2012
- **NRC endorsed the SPID guidance on 02/15/2013 with four clarifications**

Contents of SPID

1. Purpose and Approach
2. Seismic Hazard Development
3. GMRS Comparisons and Screening of Plants
4. Seismic Hazard and Screening Report
5. Prioritization (Schedule)
6. Seismic Risk Evaluation
7. Spent Fuel Pool Evaluation

Four appendices to SPID with detailed guidance on special topics

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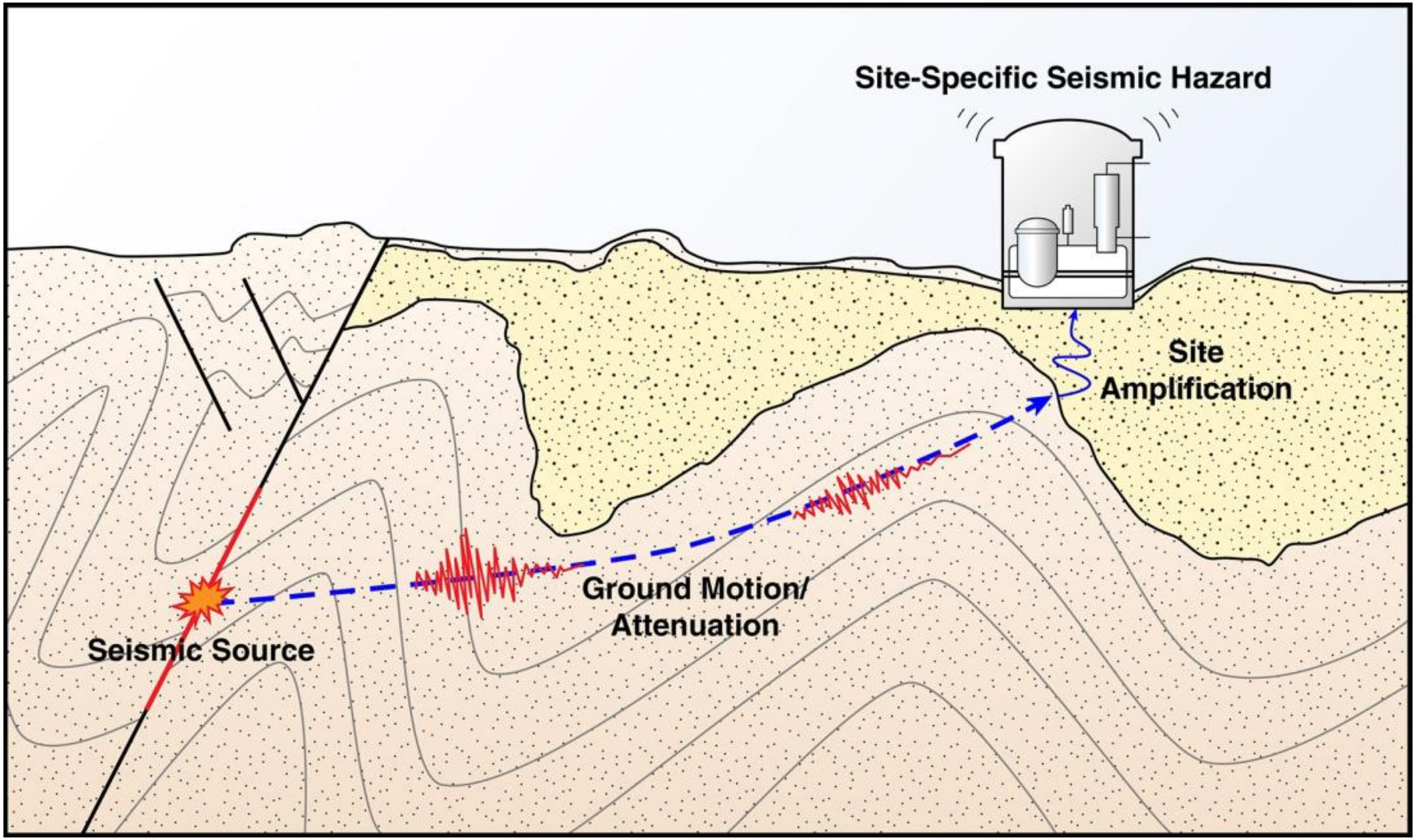
Key SPID Positions – Hazard and Screening

- R2.1 Seismic hazard reevaluations
  - Seismic source characterization
  - Ground motion models
  - Site amplification
- Screening of results
  - Reevaluated hazard (GMRS) vs. design basis (SSE)
    - Screening evaluation focused on 1 to 10 Hz range
    - Guidance for special cases (narrow banded exceedances and low frequency exceedances)
  - Use of IPEEE capacity for screening
    - Criteria for adequacy of the IPEEE results

Site-Specific Seismic Hazard Development

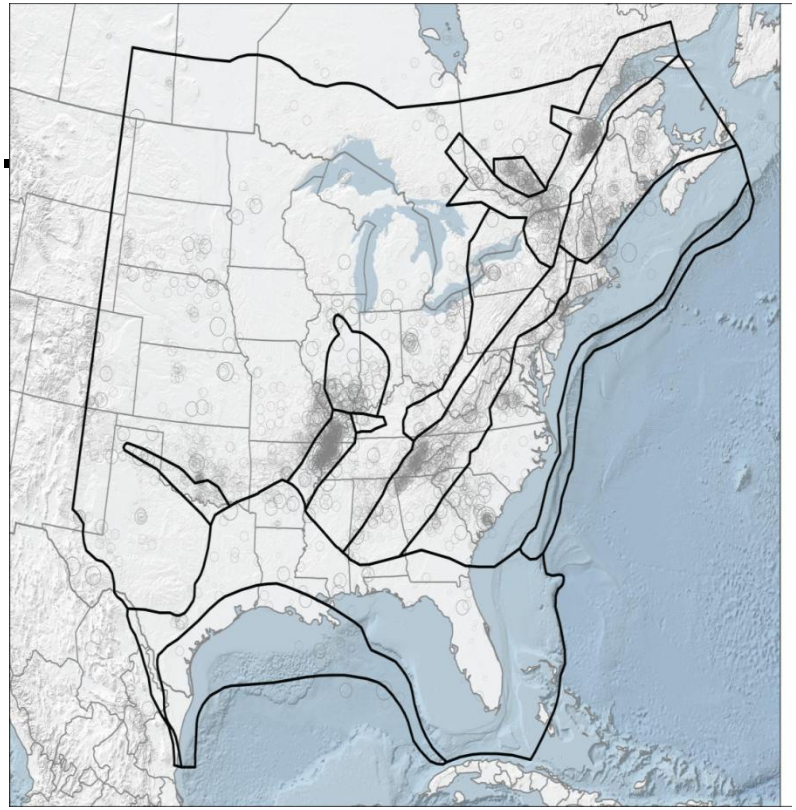


Regional and Plant Specific Approach for Development of the Site Seismic Hazard (CEUS)

- **CEUS plants will use the latest regional models for seismic source characterization-CEUS Seismic Source Characterization Model (NUREG 2115, 2012)**

- **EPRI 2004/2006 regional ground motion model for the CEUS was identified in the 50.54(f) letter. Update in progress.**

- **These regional models will be used to develop the hard-rock seismic hazard at each CEUS reactor location**



CEUS EPRI Ground Motion Model (GMM)

Background

- Staff has previously endorsed EPRI (2004, 2006) CEUS GMM and specified its use in 50.54(f) letter
- Industry is proceeding with update of EPRI GMM
- Industry requested staff endorsement by end of 2/2013 in order to meet 9/2013 due date for CEUS hazard reevaluations
- Staff unable to endorse updated EPRI GMM
  - Treatment of uncertainty
  - Adequacy of documentation

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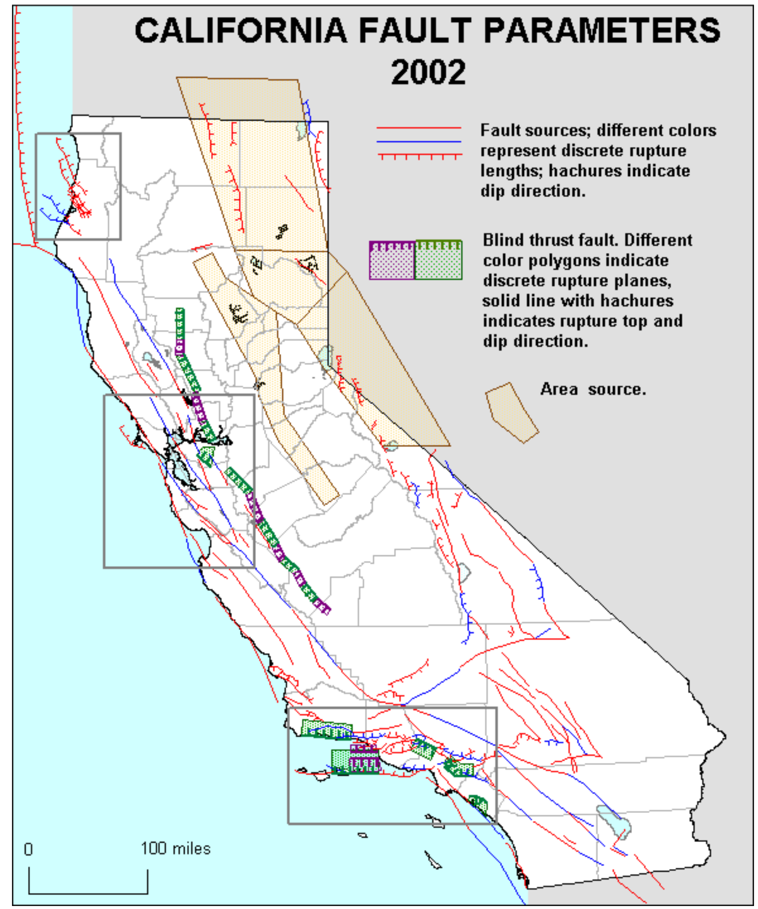
CEUS EPRI Ground Motion Model (GMM)

Current Status and Path Forward

- Industry presented updated GMM at public meeting on March 26
- Updated model appears to address issues raised by peer reviewers and staff
- Industry requested 6 month delay for CEUS hazard submittals
  - Hazard submittals moved from Sept 2013 to March 2014

Regional and Plant Specific Approach for Development of the Site Seismic Hazard (WUS)

- **WUS characterization of seismic sources is much more site-specific.**
- **Seismic source characterization is being done on a site-specific basis following a SSHAC Level 3 process**
- **More data is available to develop ground motion models**
- **A regional ground motion model being developed for Diablo Canyon, San Onofre and Palo Verde and a "site-specific" study for Columbia (jointly with the DOE Hanford site)**



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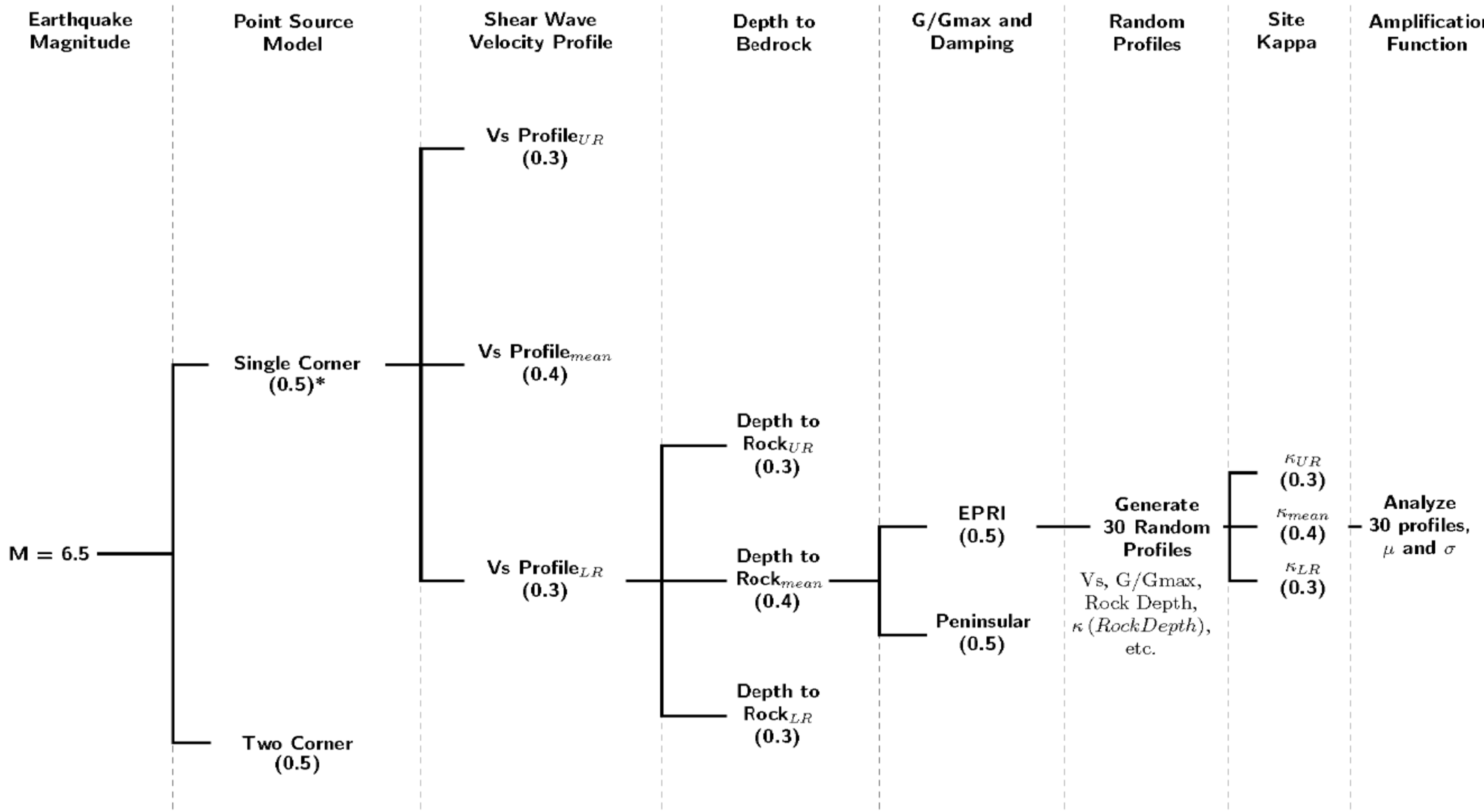
Site Response Evaluation

- For sites not founded on hard rock- an evaluation of the amplification that may occur is necessary
- For each site
  - Layering of soil and/or soft rock
  - Thicknesses of layers
  - Shear wave velocity and densities
  - Nonlinear properties of the soil
  - Uncertainties
- As each site varies in available data Appendix B of the SPID outlines a process to estimate site response amplification including the uncertainties



Appendix B Site Response Approach

* Assigned weight

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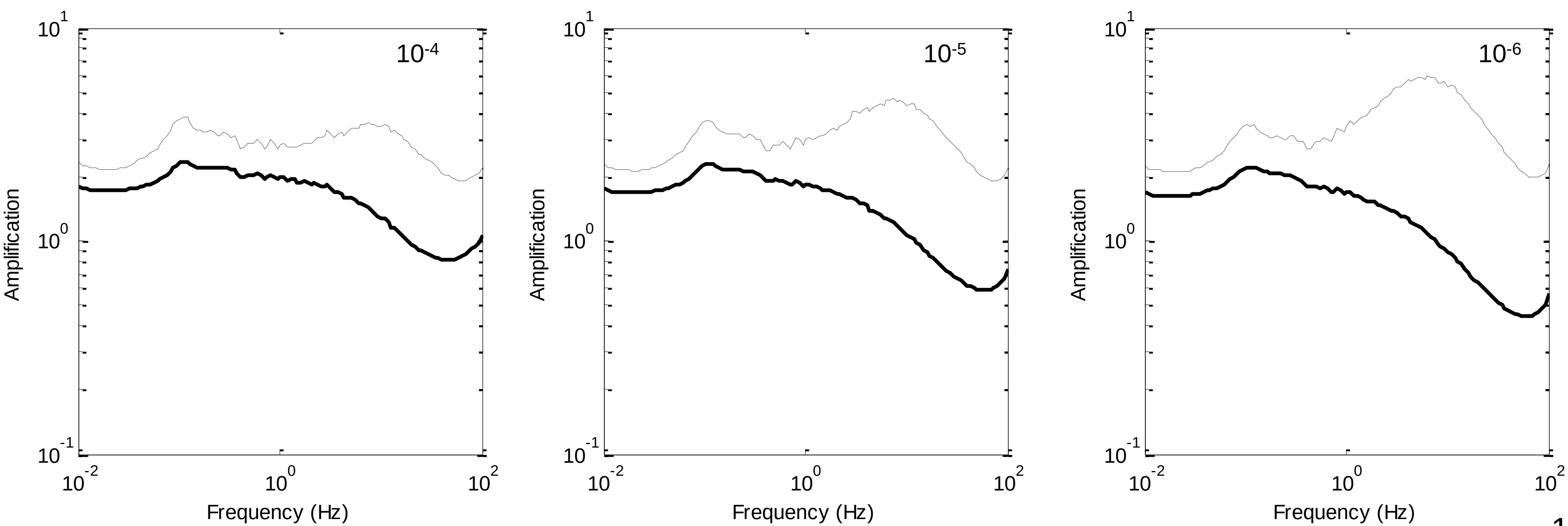
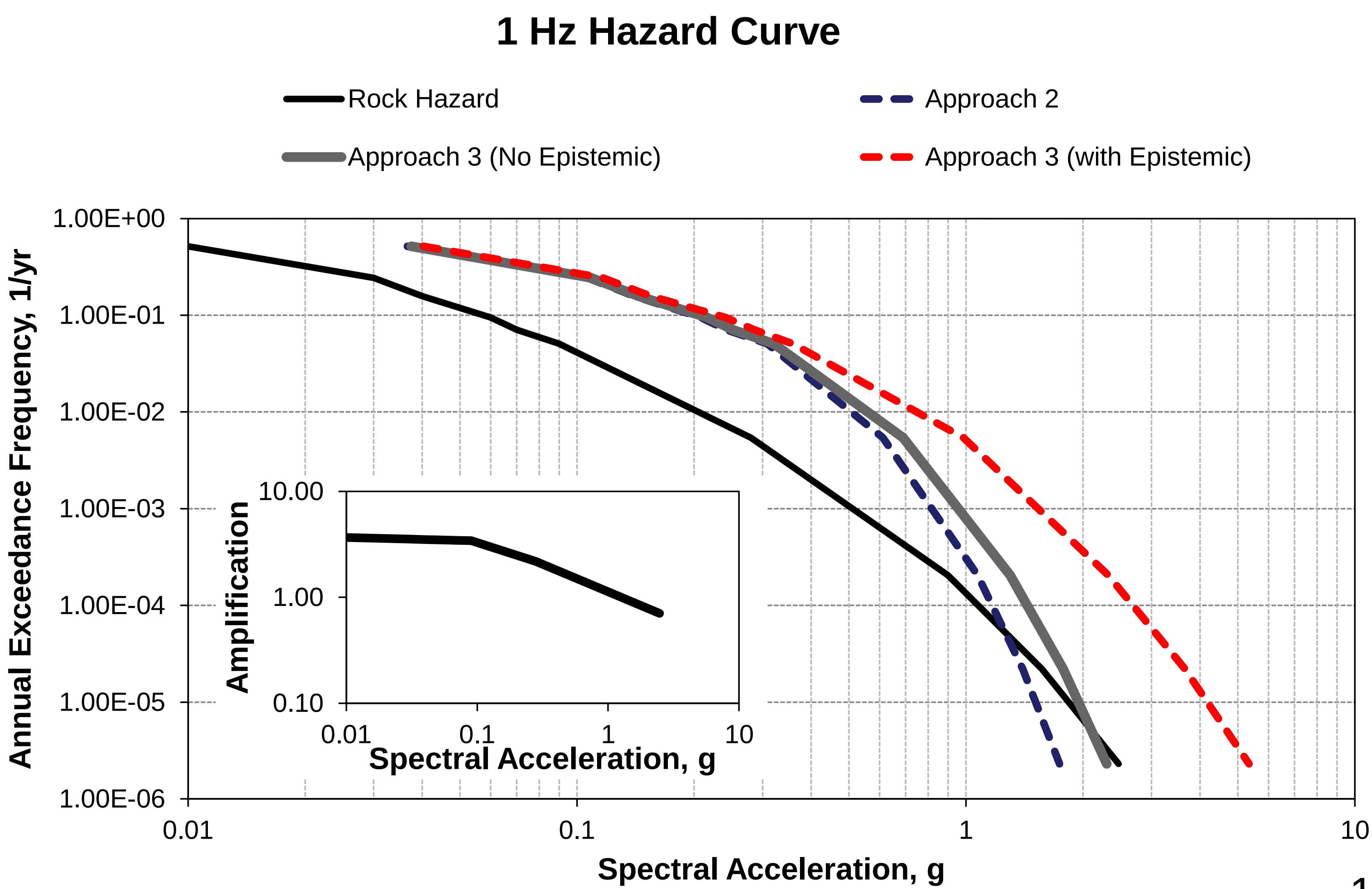
Uncertainty in Amplification Functions

- Appendix B attempts to capture uncertainty in site amplification as a function of amount of information available and amplitude of input motions
- This uncertainty translates into changes in predicted soil hazard.



Effect of Uncertainty on Soil Hazard



SPID Non-Concurrence Issues

- Consistency between NUREG 2115 and SPID
  - NUREG calls for potential site-specific adjustments
  - ➢ *CEUS-SSC is refined & up-to-date source model*
- SPID constraints on source distances
  - SPID constrains applicable sources for hazard characterization
    - 320 km for background sources
    - 1000 km for large repeating sources
  - ➢ *Distance constraints do not exclude significant sources*
- New site investigations not called for in SPID
  - further geologic and geotechnical investigations
  - ➢ *SPID relies on existing site characterizations and emphasizes uncertainty in site response*

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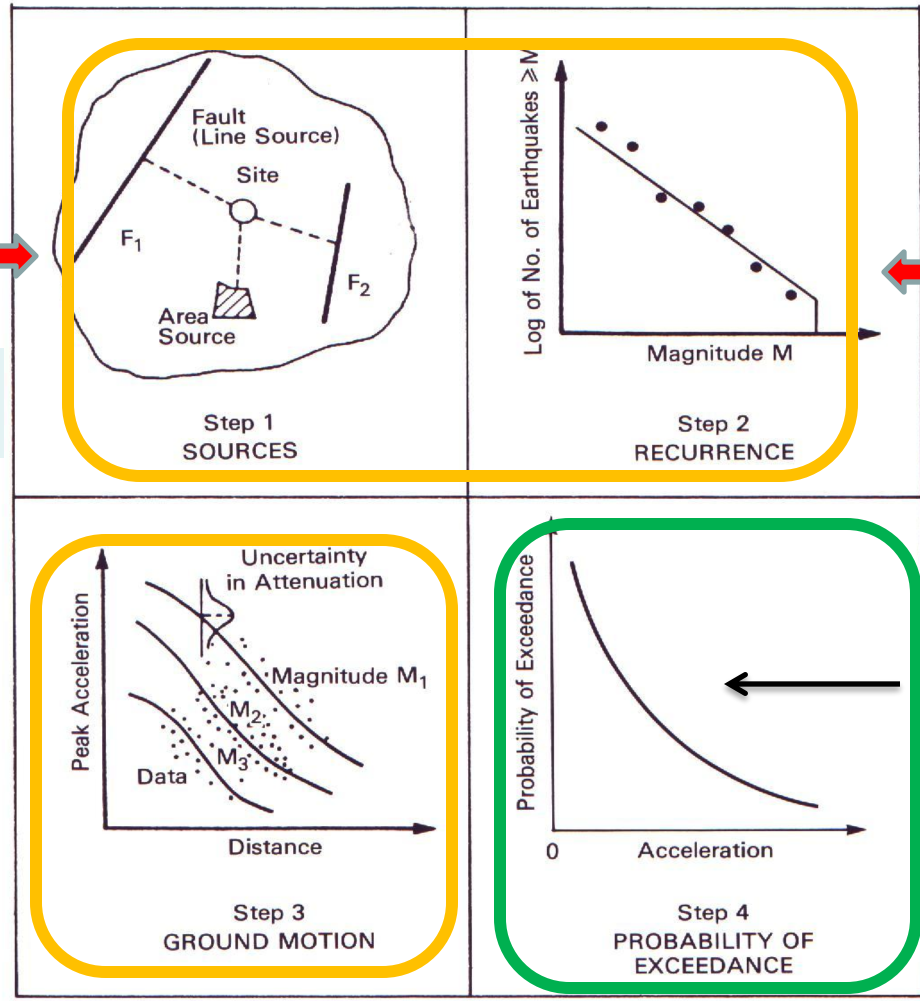
Probabilistic Seismic Hazard Analysis
for GMRS

Seismic Source Characterization Model

Seismic Sources Magnitudes & Locations



Earthquake Recurrence

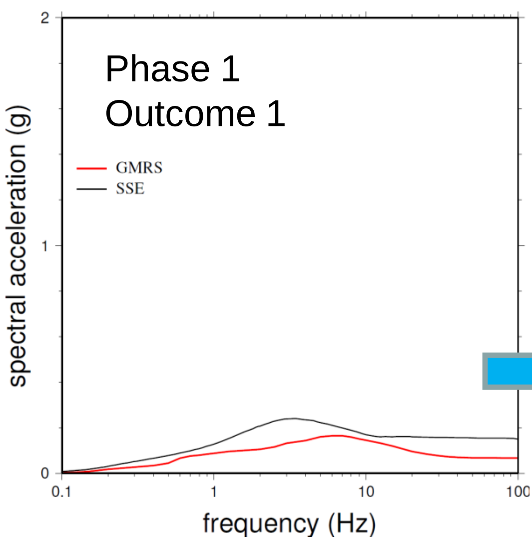
Ground Motion Model

Seismic Hazard Curves

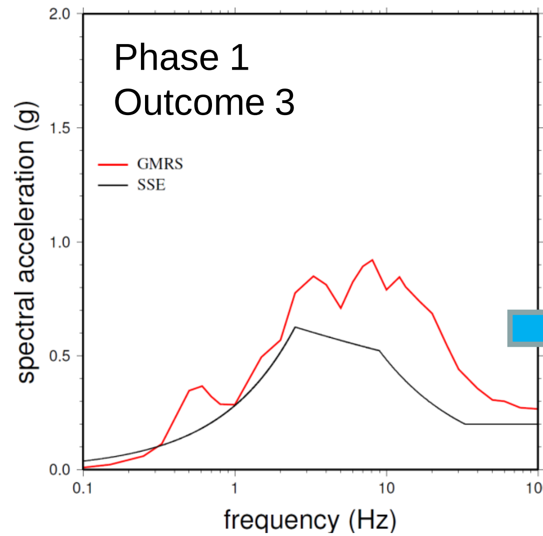
Local Site Response

GMRS

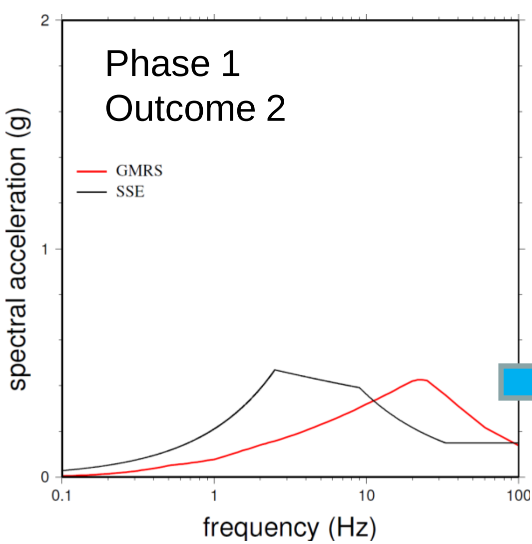
Screening – GMRS to SSE Comparisons



No Further Analysis

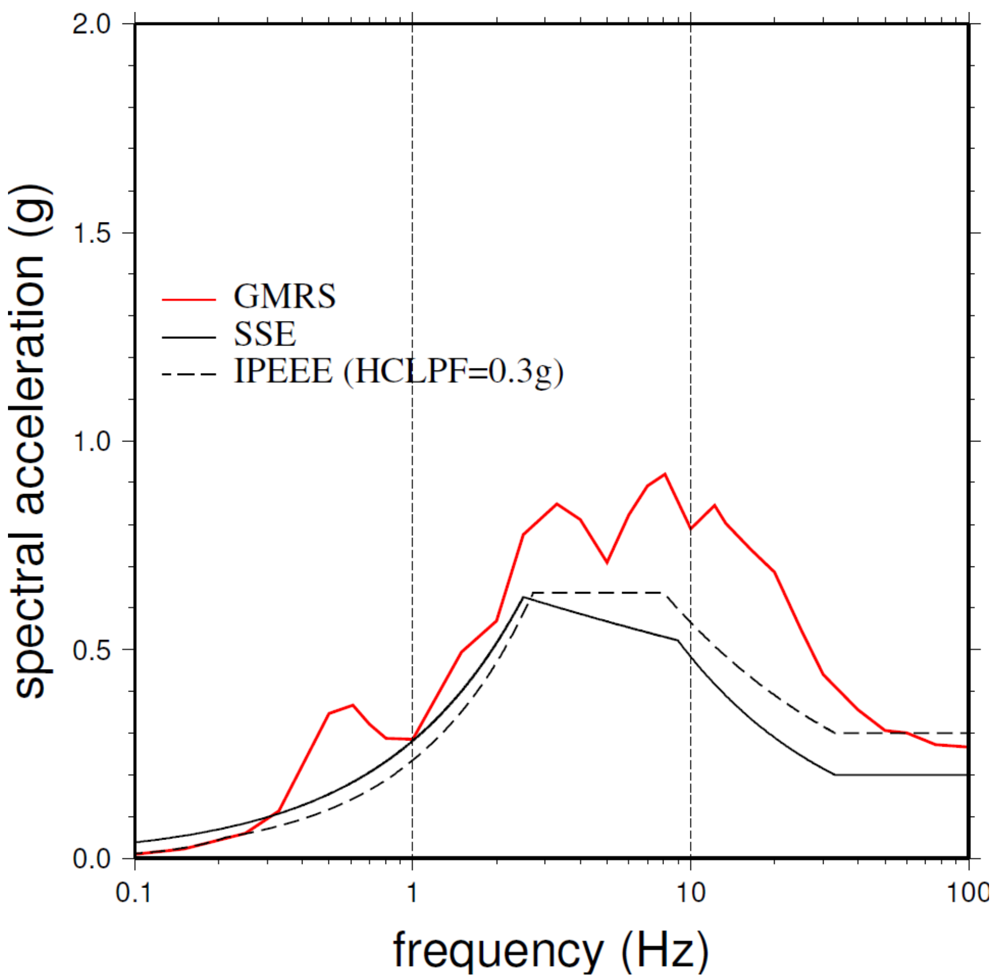


Plant Risk Evaluation Needed (SPRA)



Industry Testing Program for High Frequency Sensitive components

Screening – Use of IPEEE Results



Applicability

IPEEE SPRAs

IPEEE SMAs (Full & Focused)

~~Reduced Scope~~

Enhance Focused to Full

Requirements

- IPEEE Commitments
- IPEEE Modifications
- Deficiencies from SER
- Adequacy of
  - Structural models
  - Selection of equipment
  - Screening
  - Walkdowns
  - Peer review
  - Fragility/System modeling

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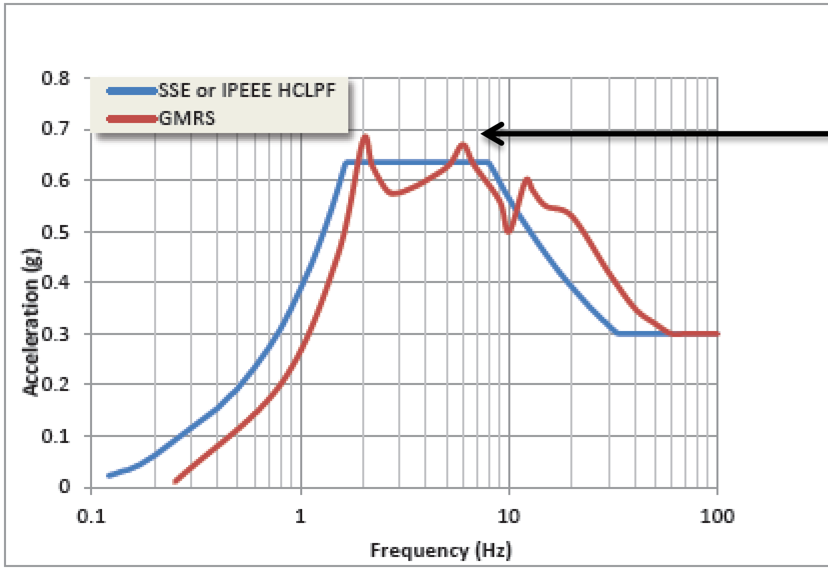
Screening – Other Considerations

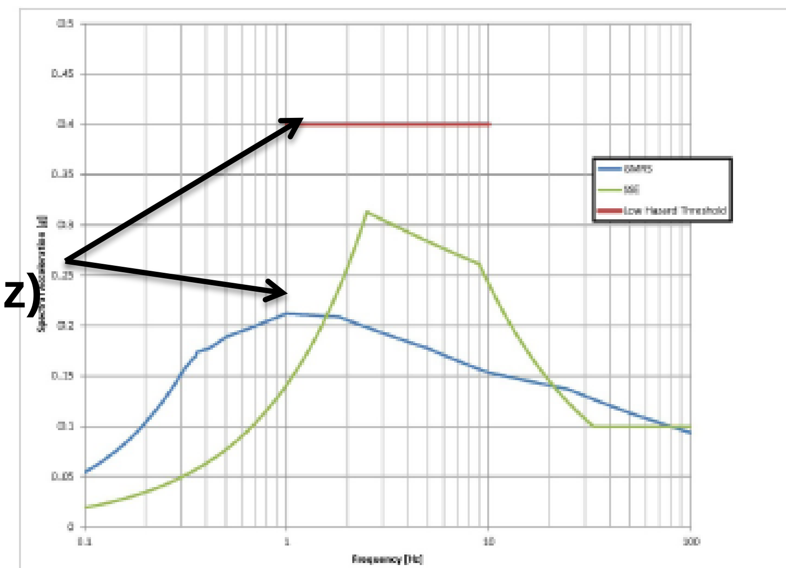


Narrow Band Exceedance

- Up to 10% over limited range
- SPRA or SMA not needed

GMRS below Low Hazard Threshold & Low Frequency Exceedance (<2.5Hz)

- SPRA or SMA not needed
- Identify susceptible SSCs
- Determine HCLPF capacities



Key SPID Positions –Structural and SSI Response

- Structural modeling
  - Facilitate use of existing models when appropriate
  - Criteria against which existing models should be reviewed
- Seismic response scaling
  - Previously developed in-structure response spectra (ISRS)
  - Shapes of the previously used spectra vs. reevaluated spectra
  - Structural natural frequencies, mode shapes, and participation factors
- Fixed-based analysis criteria for sites previously defined as “rock”

Key SPID Positions – Fragility/Capacity Calculations

- Hybrid approach for fragilities - Facilitate use of CDFM approach
- Dominant risk contributors also evaluated using fragility approach

Type SSC	Composite βc	Random β_R	Uncertainty βu	$C_{50\%}/C_{1\%}$
Structures & Major Passive Mech. Components Mounted on Ground or at Low Elevation	0.35	0.24	0.26	2.26
Active Components Mounted at High Elevation	0.45	0.24	0.38	2.85
Other SSCs	0.40	0.24	0.32	2.54

Key SPID Positions – High Frequency Test Program

- Industry has undertaken a test program to evaluate the capacities of high-frequency sensitive components
- Plants where reevaluated hazard is predominantly in the high-frequency range (>10 Hz) will reference test results
- Test program is divided into two phases

High Frequency Test Program: Phase 1

- Phase 1 was conducted as a pilot effort to develop testing protocols for expanded Phase 2 program
- Representative sample of components selected for Phase 1
- Focus was in the 20 to 40 Hz range using different types of input motions
- Amplitude increased until equipment failed acceptance criteria

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High Frequency Test Program: Phase 2

- Phase 2 will test an expanded sample of high-frequency sensitive components
  - Distribution of manufactures
  - Variety of contact mechanical motions and physical forms
- Phase 2 test results will be used to confirm the adequacy of components subjected to high frequency input motions
  - Plants with only high-frequency GMRS
  - Plants performing risk evaluations

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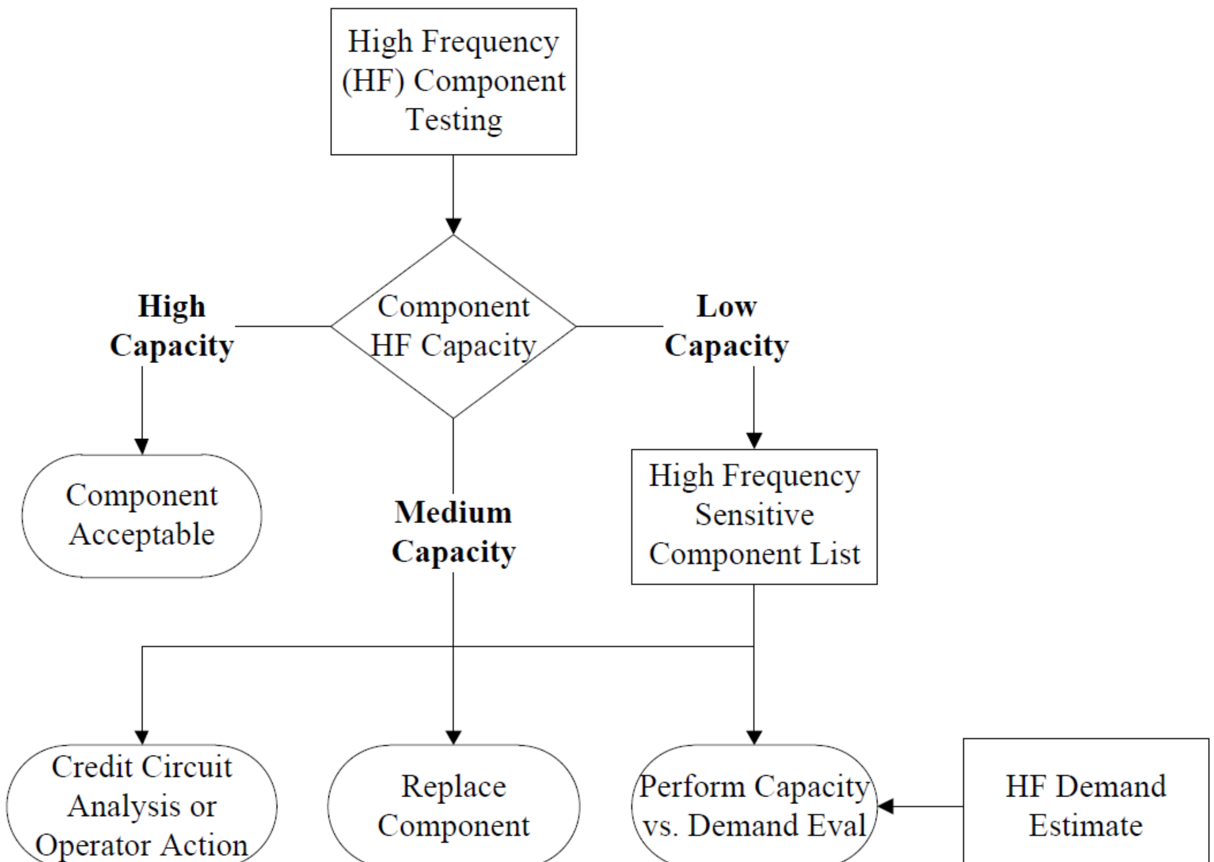
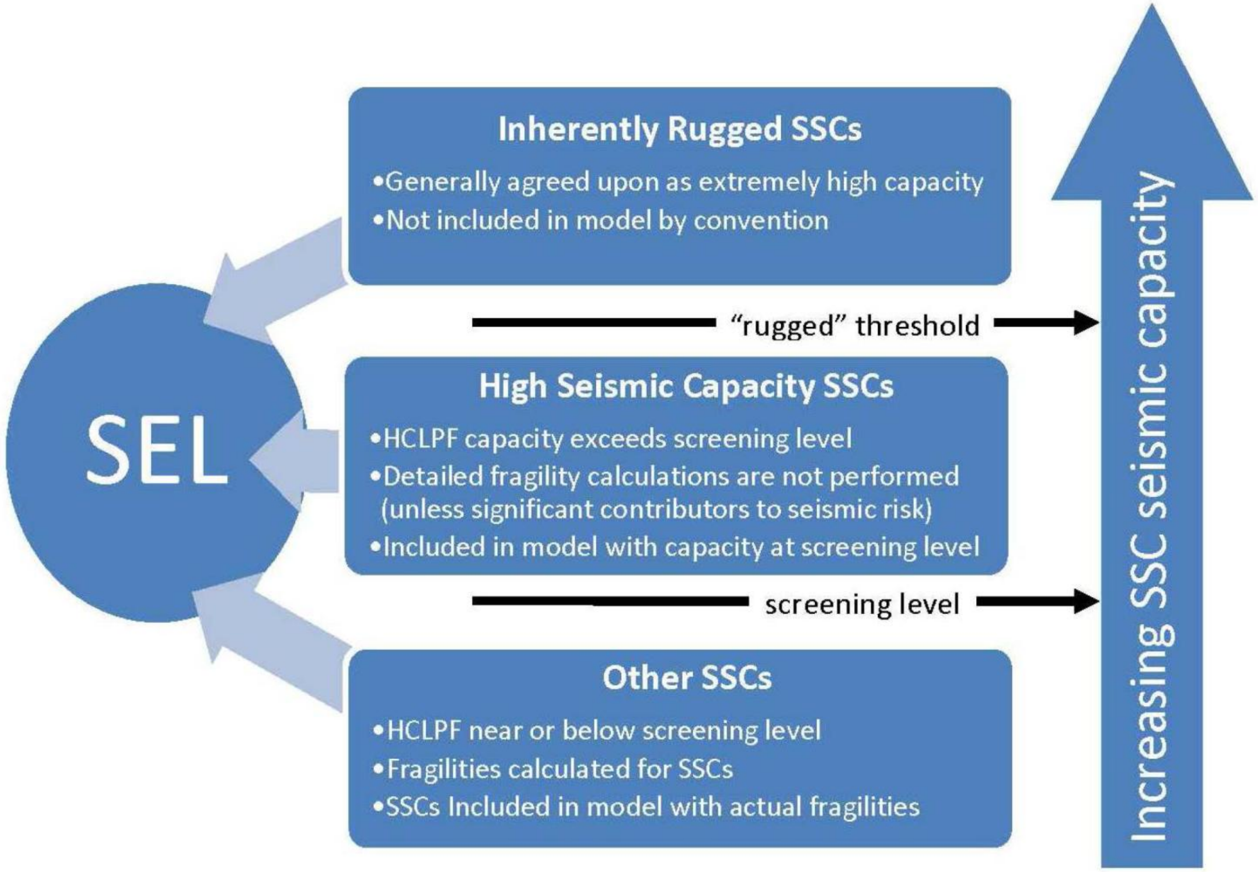
High Frequency Component Screening



Key SPID Position – Capacity Based SSC Selection



Key SPID Position – Capacity Based SSC Selection

- Components identified as “high capacity“ SSCs are assigned capacities equal to the screening level and retained in the system model
- Screening level may be set as either
  - Level consistent with a HCLPF capacity that is 2.5 times the GMRS or
  - Level equivalent to the HCLPF that leads to a frequency of failure on the order of $5x10^{-7}$/yr using a mean point estimate
- After performing the analysis a check must be conducted to assure that the screening level was not too low

Key SPID Positions - Additional Guidance

- Large Early Release Frequency (LERF)
- Comparison to ASME/ANS SPRA Standard
- Peer Review
- SPRA Documentation
- Spent Fuel Pool Integrity Evaluation

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Comparison to ASME/ANS SPRA Standard

Standard Element	Requirements from Addendum A	Requirements from Addendum B	Relevant Intent of Guidance in SPID
HLR-SFR-E	The seismic-fragility evaluation shall incorporate the findings of a detailed walkdown of the plant focusing on the anchorage, lateral seismic support, and potential systems interactions.		
SFR-E1	CONDUCT a detailed walkdown of the plant, focusing on equipment anchorage, lateral seismic support, spatial interactions and potential systems interactions (both structural and functional interactions). *CC I-II-III*	CONDUCT a detailed walkdown of the plant, focusing on equipment anchorage, lateral seismic support, spatial interactions and potential systems interactions (both structural and functional interactions). *CC I-II-III*	No change in Addendum B. This consideration is not addressed explicitly in the SPID.
SFR-E2	DOCUMENT the walkdown procedures, walkdown team composition and its members' qualifications, walkdown observations, and conclusions. *CC I-II-III*	DOCUMENT the walkdown procedures, walkdown team composition and its members' qualifications, walkdown observations, and conclusions. *CC I-II-III*	No change in Addendum B. This consideration is not addressed explicitly in the SPID.
SFR-E3	If components are screened out during or following the walkdown, DOCUMENT any anchorage calculations and PROVIDE the basis justifying such a screening. *CC I-II-III*	If components are screened out during or following the walkdown, DOCUMENT the basis including any anchorage calculations that justify such a screening. *CC I-II-III*	Wording changes in Addendum B account for the need to document the basis for any screening in addition to that based on anchorage calculations. Screening during the walkdown itself is not addressed explicitly in the SPID. Note, however, that Section 6.4.3 of this document provides explicit guidance for screening SSCs recognized to be very rugged and for performing more limited fragility calculations for certain other SSCs.

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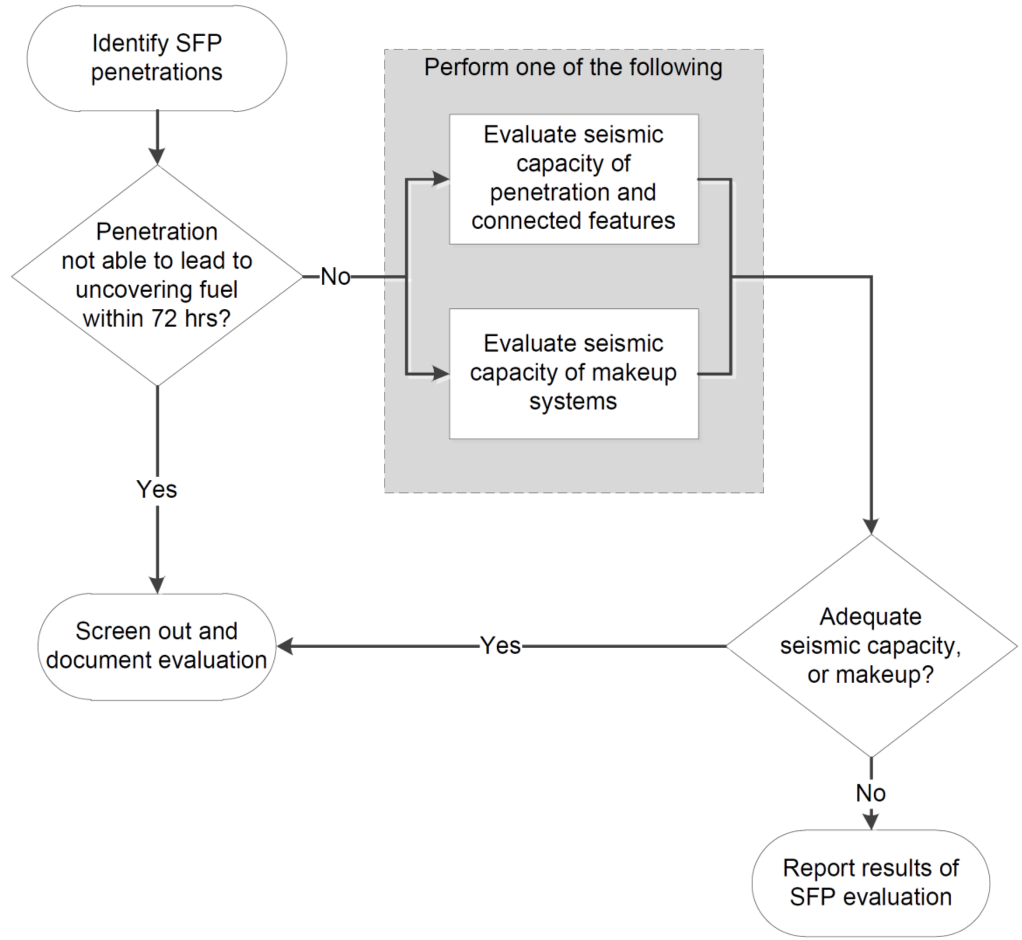
Peer Review

- "In-process" peer review is acceptable
  - Reviewers need to remain independent
- Findings should be based on a consensus process
- Final review by the entire peer review team to occur at completion of the project

Spent Fuel Pool Integrity Evaluation

- Failures of elements of the SFP due to a seismic event leading to draining of the SFP
  - Previous detailed assessments of SFP structural integrity
  - Evaluation of SFP focuses on potential failure of penetrations



NRC SMA ISG

- Draft ISG issued for public comments – September 2012
- Most of the comments related to clarifications
- Final ISG (JLD-ISG-2012-04) issued – November 2012
- No significant changes, peer review section revised to reflect the latest guidance and acceptance of “in-process” review

Staff Positions on Technical Issues

SMA Scope 4.2	• Addition of certain containment functions and systems to assess LERF • HCLPF capacities for core-damage and large early release sequences • Separate analysis of HCLPF capacities of sequences with and sequences without non-seismic failures and human errors • Chatter analysis and treatment of high-frequency response of certain SSCs
Ground Motion and In-Structure Response 4.3	• Selection of the Review Level Earthquake • Soil failures • Development of in-structure response spectra • Median seismic responses of systems and components
Systems Analysis 4.4	• Enhancements to the PRA-type systems SMA model beyond those in the original guidance • “Mission time” for the accident analysis • Selection of the Seismic Equipment List
Fragility and Capacity 4.5	• Plant walkdown methodology • Screening approach and level for of SSCs • Fragility analysis method for evaluation of the HCLPF capacity of an SSC • CDFM method for evaluation of the HCLPF capacity of an SSC
SMA Integration 4.6	• Plant margin evaluation using the Convolution Method for sequence-level and plant-level HCLPF capacity • Guidance on using the “Min-Max” method for sequence-level and plant-level HCLPF capacity

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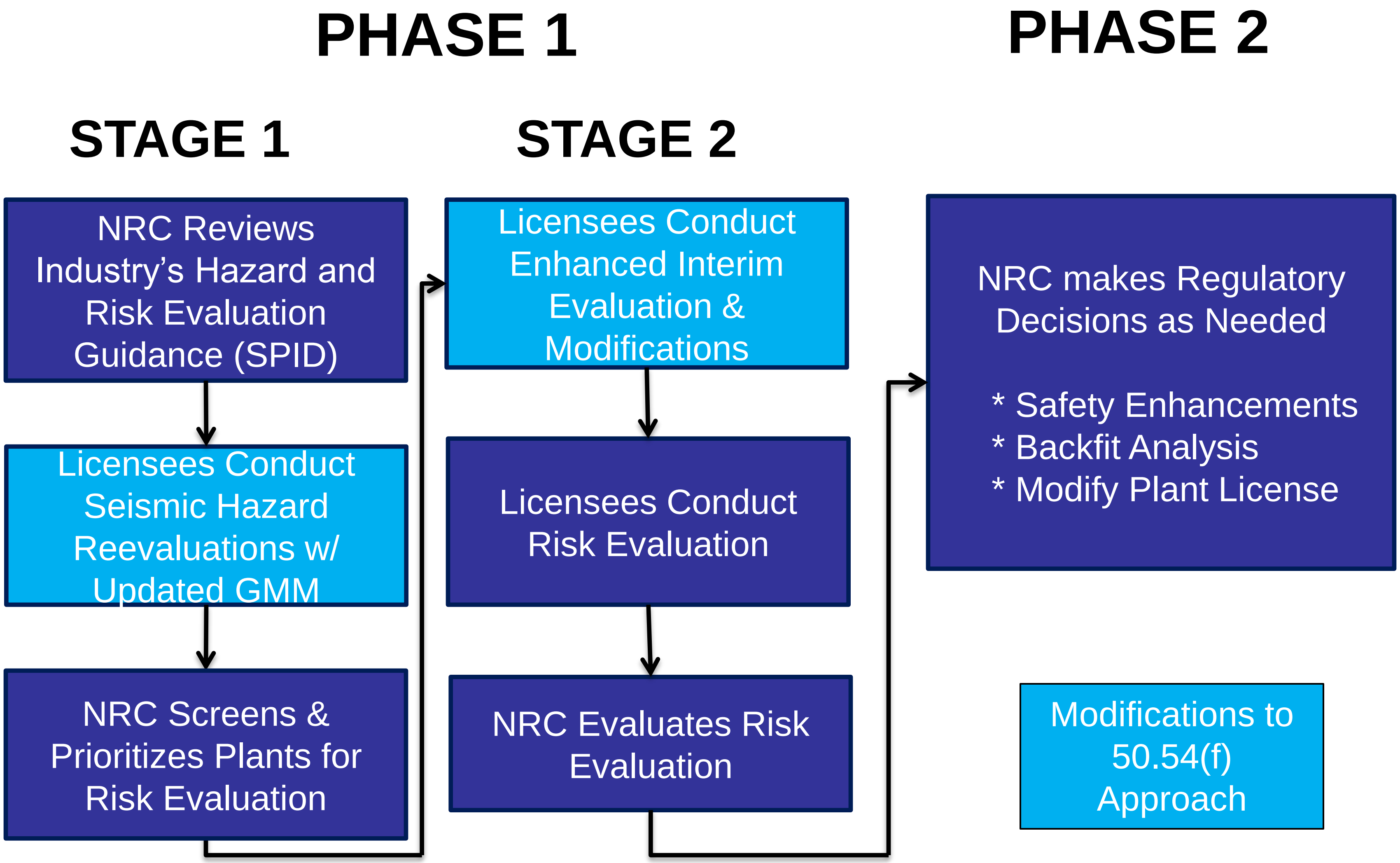
R2.1 Overall Approach



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Industry Proposed Alternative Approach

- Enhanced interim seismic evaluations and potential upgrades for FLEX Phase 1 installed plant equipment
- Licensees conduct interim evaluations
  - for plants where new hazard exceeds design basis
  - in parallel with detailed risk evaluations described in SPID guidance
- Licensees develop an expedited seismic equipment list (ESEL) from FLEX for scenarios involving loss of AC Power

Industry Proposed Alternative Approach

- Strategy for coping with loss of AC Power relies initially on installed plant equipment (FLEX Phase 1)
  - BWR: RCIC pump and valves etc. and electrical equipment
  - PWR: AFW pump and valves etc. and electrical equipment
- Using reevaluated hazard (GMRS) licensees develop Review Level Ground Motion (RLGM = Scaled SSE)
- Demonstrate that ESEL items have sufficient capacity to meet RLGM
- Modify ESEL items whose HCLPF is less than RLGM

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Path Forward

- Staff and industry work to reach consensus on GMM for CEUS by August 2013
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- Industry to formally submit Alternative Approach