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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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FUKUSHIMA SUBCOMMITTEE

REVIEW OF TASK FORCE RECOMMENDATION

2.1 GUIDANCE DOCUMENTS: RESPONDING TO THE

MARCH 2012 10 CFR 50.54(F) LETTER;

SEISMIC AND FLOODING HAZARD REEVALUATIONS

+ + + + +

WEDNESDAY

DECEMBER 5, 2012

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:00 p.m., Stephen P. Schultz, Chairman, presiding.

COMMITTEE MEMBERS:

STEPHEN P. SCHULTZ, Subcommittee Chairman

J. SAM ARMIJO, Member

SANJOY BANERJEE, Member

DENNIS C. BLEY, Member*

CHARLES H. BROWN, JR. Member

MICHAEL L. CORRADINI, Member

DANA A. POWERS, Member

HAROLD B. RAY, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

NRC STAFF PRESENT:

DEREK WIDMAYER, Designated Federal Official

MICHELLE BENSI, NRO

NILESH CHOKSHI, NRO

CHRISTOPHER COOK, NRO

HENRY JONES, NRO

ANNIE KAMMER, NRO

JOSEPH KANNEY, RES

ANNIE KAMMERER, NRO

ED MILLER, NRO

JEFF MITMAN, NRR

UNDINE SHOOP, NRR

ALSO PRESENT:

BOB BUDNITZ*

JIM RILEY

*Present via telephone

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

1:04 p.m.

CHAIRMAN SCHULTZ: Good afternoon. I would like to call the meeting to order. This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Fukushima.

I'm Stephen Schultz, Chairman of the Subcommittee. Members in attendance are Jack Sieber, Dick Skillman, Harold Ray, John Stetkar, Sam Armijo, Bill Shack, Charlie Brown and Sanjoy Banerjee and Mike Corradini. Joy Rempe may join us later.

The purpose of today's meeting is to discuss with NRC Staff the guidance documents prepared to fulfill Recommendation 2.1 of the Fukushima Near Term Task Force Report to conduct reevaluations of flooding vulnerabilities at nuclear power plants. The agenda originally planned for this meeting also included discussions of the guidance documents prepared to fulfill Recommendation 2.1 of the Fukushima Near Term Task Force Report to conduct reevaluations of seismic vulnerabilities at nuclear power plants, but this part of the meeting is being postponed to a later date.

The entire meeting is open to the public. Rules for the conduct of and preparation in the

meeting have been published in the Federal Register as part of the notice for this meeting. The Subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions appropriate for deliberation by the full Committee.

Derek Widmayer is the Designated Federal Official for this meeting. A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. It is requested that speakers therefore first identify themselves and speak with sufficient clarity and volume so that they may be readily heard.

We've received no written comments or request for time to make oral statements from the members of the public regarding today's meeting. We will have an opportunity for public comment later in the meeting however.

I understand there are individuals on the bridge line who are listening into today's proceedings. We will have the bridge line on mute, but again we'll have an opportunity for comment later on by members of the public on the bridge line.

We'll now proceed with the meeting and I will call upon Dr. Nilesh Chokski, Deputy Division Director of Site, Safety and Environmental Analysis of

the Office of New Reactors to open the proceeding.

Nilesh, welcome.

DR. CHOKSHI: Thank you, Dr. Schultz. And good afternoon. I'd like to thank Dr. Schultz and the Subcommittee for inviting us and giving us this opportunity to brief you on this. I think there is material which everybody gets somewhat different application of using techniques. So it will be nice to see what your viewpoint is on those things.

Basically, we're going to talk about the guidance related to the implementation of the Fukushima Recommendation 2.1 with respect to flood. As you may recall, the intent of the request was to ask licensees to look at their flood hazard in terms of the current practices we use for new reactors and then, if need be, conduct additional studies and plant evaluations.

So what you will see in this guidance development and both the flood hazard and the plant evaluation are in towards actually those objectives and how we collect the information conditioned with the request from 50.54(f). So as we step through, that's the goal we are trying to do. That was the goal.

The development of both the NRC and

industry implementation guidance, it has and continues to occur through a very intense public open interactive process. NEI has the task force and luckily Jim Riley who is leading the industry task force is here. And that's good because he can provide some perspectives on it. So it's been a very interactive process.

On the Staff, people from various offices involving various expertise have been working toward. If you look across the room, you can see the representation from Research and NRR and NRO. And that's how we have continued to work on this work. All of this guidance is seismic or hydrologic.

Let me introduce who the speakers are and then I want to talk about how we're going to do the presentation.

Chris Cook on my right, he just recently took the position of Chief Hydrological Engineering Branch. He's a hydrologist, a doctorate from UC Davis. And he has been the lead on this issue. So he has been basically looked to the complete development of 50.54(f) and the guidance. And he continues to manage some of the other activities.

Dr. Henry Jones is a materialist and oceanographer and masters in Materialogy.

Michelle Bensi, I'll call Shelby. If I say Shelby, I'm referring to Michelle. She just has also joined NRO. She was in Research. And her background is in seismic risk.

And I think there are two other people around the table are Ed Miller. He's the project manager. And he has I think probably the difficult job of logistics of bringing everybody together internally and externally and make sure everything goes smooth.

And Joe Kanney, right now he's on rotation. And I think that's very good for us because Joe has been also working on 1.59. So the coordination between the two approaches, it's important and I think it's operating in a more natural fashion.

I think on the agenda if I remember right, Dr. Schultz, it was the overview which will be given by Chris. And then we had an integrated assessment. I will propose that we go with Chris' presentation. Then go to Henry talking about surge and tsunami. So cover the hazard first and then go to integrated assessment. That way the information will flow more smoothly. So if you have no objection we'll do it that way.

CHAIRMAN SCHULTZ: The agenda has that option available within it.

DR. CHOKSHI: Okay.

CHAIRMAN SCHULTZ: So we're good to proceed with that program. Thank you.

DR. CHOKSHI: So I think on -- Finally, I think just as you mentioned there was a seismic proposed on this. Late emerging issues we need to work on and then we are going through that process. We'll have a better handle I would say by probably the end of next week or soon about how much time it's going to take. And then my plan is to then get in consult with Ed and Derek and then talk about when we should reschedule coming back.

And depending on what the situation is, we may look at other options for the briefing or partial briefing or something. So let's have a better sense of timing before that. With that, I think I'm going to turn it over.

CHAIRMAN SCHULTZ: So, for clarity there then, what you're saying is you don't have a schedule today to discuss about where that project will be.

DR. CHOKSHI: Yes. Right.

CHAIRMAN SCHULTZ: Within the next week or two you'll be in a position to understand what the

timing will be going forward

DR. CHOKSHI: Yes. Because right now I think we're just looking at the process and what on the staff needs to occur before we can even know.

CHAIRMAN SCHULTZ: Chris, before you start for the record, Members Dana Powers and Joe Rempe and Mike Ryan have joined us.

MEMBER REMPE: Should we say we're sorry we're late?

CHAIRMAN SCHULTZ: No.

(Off the record discussion.)

MEMBER CORRADINI: If you get a sorry out of Powers, I want it on the record.

MEMBER POWERS: The appropriate fines will be extracted. It's fines to them for the honor of our presence.

MEMBER CORRADINI: As I said, if you get a sorry out of Powers.

CHAIRMAN SCHULTZ: Chris, we welcome you and look forward to your presentation. Thank you.

DR. COOK: Thank you. It's nice to be back talking about the activities that have been going on associated with the Recommendation 2 activities. And my presentation is sort of an overview in order to help place the interim staff guidance (ISGs) sort of

in place with the larger picture. Just so that everybody has the bigger picture view.

And then the plan was then to winnow down and then talk about the ISG that was dealing with tsunami, surge and then the integrated assessment. And hopefully you'll see why when I get done with mine where we're also thinking the agenda format, having the hazards first and then the integrated assessment makes sense.

I've briefed this to you before so I'm sure you all are familiar. But I just wanted to put this in context. These are the recommendations from the Near Term Task Force July 2011 report that came out. There were different versions as we went through the 50.54(f) letter.

But you'll hear me talk about Recommendations 2.1 and 2.3. And these I think very succinctly just state that Recommendation 2.1 is the hazard reevaluation that we're doing and the important part here is that it's the current or present day guidance that's there.

And then Recommendation 2.3 is a separate activity which are walkdowns which we came to see you about earlier on when there was walkdown guidance that was written sort of jointly, but put forward by NEI

that was endorsed by the NRC. So we came to see you at that time. And so Recommendation 2.3 is in the walkdowns, the actual physical walkdowns, of the plant that are there. Next slide.

So this slide sort of graphically just represents the cascade of information. Sequentially, the sequential ordering of the recommendations and the due dates for when everything comes in are not in sync.

In fact, the first thing that comes in is Recommendation 2.3 which is the walkdowns which were, as the previously slide had stated, interim actions to be done while the longer-term hazard reevaluations take place. The whole point for the walkdowns were to have those done to the current licensing basis of the facility while the hazard reevaluation using present day methodologies and guidance are being completed.

We'll have that information. In fact, the walkdown information was just coming in this last week and the last few are trickling in down on the walkdown reports that are there for all the sites throughout the entire United States. We have all those coming in.

And then the flood hazard reevaluations are going on. Then the integrated assessment that's

--

MEMBER POWERS: Mr. Cook.

DR. COOK: Yes.

MEMBER POWERS: When we did some enhanced assessment of fire hazards for plants, we encountered a great deal of difficulty knowing exactly what the licensing basis for the plants were with respect to fire.

DR. COOK: Yes.

MEMBER POWERS: Did you encounter similar challenges in knowing what the licensing basis was for flood?

DR. COOK: Speaking personally, I've had the opportunity to be involved in early site permits going back to 2003 during a lot of this and having the opportunity to look through numerous USFARs for the operating fleet.

I would sort of agree with you that for a number of them it sort of left me wondering what the final answer was because you have what's in the USFAR. But then you also have licensee commitments that are there that aren't necessarily as part of that and everything going through.

So one of the parts in the walkdowns actually, one of the first things that came in and one

of the first sections that has to be documented, is actually what is the current licensing basis for flood, what are your emergency action levels that are there and then how do you protect the facility.

That was actually knowing that some of it may be there and the amount of work that it takes to pull all these different aspects. It's all there. You just sometimes have to work to pull it all together.

In order to facilitate our review, we actually asked for that up front as part of a walkdown review. And that was the very first thing that came in.

DR. CHOKSHI: To supplement that, I think when we started developing walkdown guidance that was one of the major issues.

DR. COOK: Yes.

DR. CHOKSHI: And we had extensive discussions and some of that even involving OGC what's the design basis, the licensing basis. And that was captured in industry guidance to avoid confusion. I think having done all that when we start looking at walkdown with the reports looking into this we'll see how successful we were. But that was clearly recognized that authority on this issue --

DR. COOK: Is key before we go forward.

MEMBER POWERS: The fires it was challenging to distill out exactly the licensing basis for the plant was.

DR. COOK: Especially with the activities that had gone on. I mean some plants with the SEP and then we've got IPEEE. You have all these different things. So that was key. And that's why we had wanted the in there to start with what that current licensing basis was.

MEMBER POWERS: Like you said we'll find out how successful.

DR. CHOKSHI: I think it's perfectly true with I think similar to fire because it was procedural, hardware, all different components.

MEMBER POWERS: Other than something that plants don't pay attention to every day. And so it becomes more historical and too much anecdotal perhaps.

DR. CHOKSHI: That's right.

MEMBER POWERS: Interesting. I'm glad to see that you anticipated the difficulty.

DR. CHOKSHI: Yes.

DR. COOK: And often times, too, they talk about different levels. They evaluated and looked at

different things and those different evaluations are all captured which you sort of want when you do this sort of thing and especially when you get into the integrated assessment where you're saying "Okay. Now if your new hazard is higher..." Well, higher than what? We wanted to make sure we had that clarity up front.

MEMBER POWERS: Very good.

DR. COOK: Let's see. The cascade of information, it's not sequential. 2.3, 2.1 going through. And then finally you get into the regulatory actions that are there at the end that I'll talk about a little bit more actually in the next slide. With that, let's go forward.

This sort of then winnows down. My whole presentation is to give the overview and put everything into place so you know where everything sits. And this is looking at Recommendation 2.1, just the one where we're talking about the hazard reevaluations.

And in order to make sure that we were clear on everything, what we did is we wanted to break it up where we were looking at both phase one and phase two. Generally speaking, phase one involves licensee actions. Phase two really involves NRC

actions at that point, regulatory action.

Of course, in phase one, there is review. So activities are going to be going on, but the burden is on the licensee to produce many of these documents that then key off.

In phase one, they're within two stages. Stage one as go through all deals with the hazard and the hazard reevaluation that there's. The licensees conduct the flooding hazard reevaluation. We have then another box that's there where we're talking about interactions that would be taking place with industry on the integrated assessment, developing the guidance.

MEMBER RAY: Integrated assessment, can you -- That's a phrase that's used a lot like it's self-defining.

DR. COOK: Yes.

MEMBER RAY: What does it refer to? What does it mean?

DR. COOK: You know that's an excellent question. What I'd like to do the third presentation that's here in the series is exactly that. So we have Dr. Bensi's, Shelby's presentation.

MEMBER RAY: To be defined then.

DR. COOK: We'll go through it. In a lot

of ways, it's when you're looking at and with the analogy we have the same flow chart with seismic. And it's looking at seismic risk. It's sort of that analog that's here with flooding.

MEMBER RAY: I had the same question with seismic. I reviewed it thinking we were going to look at that.

DR. COOK: Yes.

MEMBER RAY: Okay. I'll look forward to finding out what an integrated assessment is.

DR. COOK: Exactly. And it's new and it borrows a lot from the seismic area and some of this seismic stuff that's going on. So you'll see that. But in essence that's the whole point for this last presentation, having that time, and I'm glad we have it to go through.

Okay. Stage two really is this integrated assessment which we'll have lots more details that are coming. What's that?

DR. BENSI: I was nodding.

DR. COOK: Okay. Good. That's stage two, the integrated assessment that comes in as well as additional actions that the licensees may do.

And that then all leads into phase two which is then going to be NRC actions. Now we have

this information. We have the information because remember the 50.54(f) are request for information that have been sent out before we modify, revoke or suspend a license. So we have these information requests.

We're going to get the information in from Recommendation 2.1 as well as 2.3 with the walkdowns. And now then phase two is where we then use this information to determine if necessary we need to make some sort of regulatory decision.

There's a whole potpourri of different thing that can be chosen to be done, safety enhancements, backfit, modify the license, how we do that licensee commitment. So there is that whole range of things.

MEMBER CORRADINI: So not to describe it.

DR. COOK: Yes.

MEMBER CORRADINI: There is a filtering process here. You do something. And if you don't pass the something you go to the industry and they tell you you've got to go do option. You've got to go option two which is the integrated assessment. That's the way I read the boxes.

DR. CHOKSHI: It's not an option. The stage two, the stage one, we do the hazard evaluation and here's the criteria.

MEMBER CORRADINI: Okay.

DR. CHOKSHI: If the hazard is below what you have been in the original design basis you're done.

DR. COOK: So stage one is required.

DR. CHOKSHI: So the new estimate if it increased --

MEMBER CORRADINI: I understand. Then you do the integrated assessment.

DR. CHOKSHI: Right.

DR. COOK: Right.

MEMBER CORRADINI: Got it.

DR. COOK: And then if necessary we go to phase two.

MEMBER RAY: Again, this may emerge from defining what integrated assessment means, but why do you interact with the industry?

DR. CHOKSHI: That was in the development of guidance because that was one of the clear directions from the Commission that implementing this recommendation the implementation guidance should be open to not industry but everybody.

DR. COOK: In the SRA.

DR. CHOKSHI: So the process is clear because we are doing -- All plants have to do these.

So we wanted to come up with a guidance which can be used by everybody which we produce informant and consistent information.

MEMBER RAY: And I get that as a result of interacting with the industry.

DR. CHOKSHI: Well, I think like anything we do -- Like regulatory guidance, we have a process which involves public interactions. Because of the time frame involved here, this was a more intense process. We had to have a lot more frequent interactions just go get through that time period.

MEMBER RAY: This means NRC interacts with the industry.

DR. CHOKSHI: Right.

MEMBER RAY: I thought it meant because of what he said that I, the licensee, interacts with the industry. Because you said phase one was all things done by the licensee.

DR. COOK: Got it. No, just where it said licensees conduct.

MEMBER RAY: All right.

DR. COOK: Yes, I misspoke. The proper thing is NRC interact with the public including industry on integrated assessment guidance.

MEMBER RAY: Okay. That's fine. I

understand that.

CHAIRMAN SCHULTZ: So it is broader. It's with stakeholders.

DR. COOK: It's with stakeholders. Open to the public. It's a public process. That's a good --

MEMBER CORRADINI: So you're going to go into this anyway.

DR. CHOKSHI: Yes, we see the guidance.

MEMBER CORRADINI: Yes, In fact, if we're confused, we just should be quiet.

(Off the record comments.)

DR. COOK: All right. Shelby, if you would go to the next slide. What I was using this graphic for was really to show where everything fits. So now that I've gone through it, I've circled then the different boxes that were there where you see that these things fit in and the presentations that are going to be coming for today for the rest of them.

So we have the tsunami, surge or seiche hazard evaluation internal staff guidance. That is all part of it. That feeds in and that's going to be useful as part of the hazard reevaluation.

One of the things I wanted to mention here because of the request that came from Derek Widmayer

was that there were some questions about NEI's Dam Failure White Paper that was there. So that depending where that all ends up would also feed into the hazard reevaluation. That's all with the hazard.

The integrated assessment ISG feeds into the second part. And I could have circled other boxes that were in there. But we were sort of on the stage in this part of phase one before the hazard review. So that's why I circled that particular box where you have that. And that's that whole presentation we're going to be going through. This just sort of shows you where everything fits in together. Next slide.

You've been asking why should we develop the hazard tsunami, surge or seiche hazard ISG. Why should we be participating in different public meetings talking about dam failures and is that guidance already available?

Well, I put this together to sort of answer that question that we get. Yes, we do have a Senior Review Plan. Section 2.4 is there. ANSI 2.8 and 1.59, these were sufficient to go forward and as an agency review and look at the early site permits that were issued as well as the combined licenses, the COLs, that were there.

However, when you look at we've done, what

has been completed, we've had a lot of applications that were submitted, but only a few that were completed. And therefore there were only a limited number of present day examples.

It's one thing to have some of the guidance, but to really have examples that you can point to and look at. And so it seemed to use that there really was a need for some new guidance that summarizes some of the lessons learned as we went with the ESPs and COLs to put those things out there. Because there were some significant things we thought should be captured and put through so that we could be efficient or effective as we go through doing the hazard reviews for this recommendation.

And we also saw a reason for new guidance in order to discuss certain situations that hadn't yet been encountered with the ESP and COL reviews because we're doing this fleet wide. So there were a number of situations where we're going to have, situations that weren't encountered yet and we need to have some guidance to talk to those issues.

MEMBER SKILLMAN: Chris, ESP is the early site permit.

DR. COOK: Yes. It's the early site permit.

MEMBER SKILLMAN: Thank you.

DR. COOK: So then the question for why then should we develop the integrated assessment. For us, we realize that there were methodologies that we wanted to use when we were going through looking at after the hazard reassessment to look at the plant and the plant's response to the flood that were going on.

And there were numerous methodologies that existed in the seismic review area to go about using this. Those of you that are familiar with that may recognize some strong correlations from things like success path, things like seismic margins and SPRA. You'll see similar themes that are in the integrated assessment slides as we go through that.

MEMBER RAY: One thing that doesn't carry over seemingly is the Shack process, correct?

DR. COOK: Yes.

MEMBER RAY: Why?

MEMBER CORRADINI: Why not?

MEMBER RAY: Just a second. To repeat what Mike's already asked, why not? What's the reason for that? I mean you could defer it until we get to that discussion if you want. But since the comment was made here I want to ask the question.

DR. CHOKSHI: I think the question is

probably more general. Why don't we have a probabilistic flood hazard analysis whether it's in the Shack process or any other process? And I think the hydrologic community doesn't feel that they can do that a state-of-the-art or practice or things they need exist for them to do for all mechanisms.

Now you're going to hear about when we talk about Surge ISG you will see one area that is a possibility of doing a probabilistic. So there are pockets which can cause flood causing mechanics where the community begins with that issue feels now.

You know we have this workshop for this whole issue coming up in January. And it's to basically pose that question to the specialists and experts where we are, what we can do at the current time and where we can go and what needs to be done.

MEMBER RAY: Okay. Well, that's just an important issue. No need to dwell on it right now.

MEMBER STETKAR: I mean it's easy to that a morphous set of those experts out there say they don't know how to do it. When you talk to people who do those things, they all say, "Well, we know how to do this part." So which particular area is the sticking point?

DR. CHOKSHI: I'll tell you where I think

people feel a little bit comfortable and then I'll let the expert speak to this. But surge and tsunami I think are the two areas where people have done probabilistic flood hazard analysis. And you are hearing that that can be done.

One interesting thing about in planning this workshop is the first thing we need to provide is the context in which we are asking this question. And I think to me that question has not been posed to the technical experts in how we use this, this is what it means, how we deal with our other uncertain hazard. So provide the background. Then I'll let hydrologist answer. But I've seen a strong discomfort like riverine flooding, PMP, all those kind of things where the data is basically under 500 time frame.

DR. COOK: One hundred to 500, yes. In the time frame for this for riverine flooding.

MEMBER RAY: But the same thing can be said about big earthquakes.

DR. COOK: That's right.

MEMBER RAY: Go ahead, Mike. I'm sorry.

MEMBER CORRADINI: I just wanted to ask. So it's really a time period issue. In difference of seismic there may be thousands of years of history here. We're talking hundreds of years of history.

DR. CHOKSHI: I think it is more than that.

DR. COOK: There's more than that. There's also -- As you look at it and try to come to agreement on what the statistical fit should be, I mean if you're looking at some sort of an extreme value function as you go out because you only have 100 years. What fit do you apply?

And there have been several ones over time. You know Tippett-Fisher. I mean Log-Pearson Type III.

MEMBER STETKAR: The problem is you deal with statisticians.

DR. COOK: Yes.

MEMBER STETKAR: And in many cases you find that a precisely defined statistical function is irrelevant to solving the problem. If you just look at the available evidence and take a spray can and use that spray can to bound the uncertainty distribution of the experts you don't worry about a specific statistical function that might best fit somebody's assessment of what is available. And that's part of the seismic.

DR. COOK: It is. And I think the points on a lot of this, too, and also could the Shack

process instead of having a senior seismic hazard analysis committee have a senior flooding hazard analysis committee.

MEMBER RAY: Yes.

DR. COOK: They're our allies. And you can see it. And there are papers that are out there that you can see. Part of this just technically personally speaking for myself looking at this, too, we're a bit bounded in what we're presenting to you today by the nature of what we're doing which is we're presenting guidance that's going to be used for the 50.54(f) response that the Commission told us to do. And part of what the Commission told us to do was to employ present day methodologies and guidance.

MEMBER RAY: They also said for plants in the west use the Shack process for seismic, too.

DR. COOK: For seismic. But for flooding they said very clearly --

MEMBER RAY: I know. You're right. I just don't understand why.

DR. COOK: Because there's new research things that come out, too. As Research develops new guides, can we pull that in? There's a lot of push and pull.

For this luckily, for this particular

activity, where the hazard reevaluations are already due, they're committed on a schedule for all the plants March 2013, 2014 or 2015. It's sort of looked at in that frame work.

DR. CHOKSHI: But I think there are also other technical reasons like for example riverine flooding. You know the river channels and things shift in time. The time frames are much smaller than the geological time frame for the seismic processes. So there are certain issues we need to work out whether you can either model physically or have a better understanding.

MEMBER SHACK: It seems to me that -- Can we open the bridge line? There are people who would like to comment like Bob Budnitz.

MEMBER CORRADINI: I knew he'd be out there.

MEMBER POWERS: Before Bob chimes in, I would say two things. One, I have seen probabilistics inflicted on two other disciplines. In both cases, they swore to be damned that it could not be done. And so there's an inherent conservatism in any discipline.

DR. COOK: I don't feel like we're saying that.

MEMBER POWERS: And the other problem is here they may be what because in several of the flooding areas, particularly local flooding river hazards be likely distributions, are these peculiar heavy tailed distributions which you cannot calculate a variance. I mean you can calculate variance. It just happens to be infinite. And that makes a challenge to the existing probabilistic structure.

DR. COOK: It's a very challenging problem and one I've thought about some. I mean I think you all saw some presentations on Fort Calhoun just to use one particular site. And just to sort of describe certain things, you start looking at a riverine flooding and you look at the challenge of the plant. At the end of the day, we're looking at the plant and plant response and the risk. So it's more than just the water level.

The other thing, too, is I hear a lot of people just hear about water level. And it's a little bit more than that, too. That particular site saw inundation for 84 days. When they had the inundation that was going on, there was also extreme scouring of the riverbed that went on.

At that time, the riverbed literally was dropping beneath it. It's also a function of the

upstream dams and how much water they release.

As although it's sort of nice as an academic looking at those things and saying it's probabilistic, I agree with you that, yes, there are these things and you can do. But for flooding it's a very challenging problem.

I'm not saying it can't be done. But it's very challenging when you have to take river bathymetry, morphology, into account. You have to look at the upstream controls. You have to get agreements and some of those things dominate, way dominate, anything else. And it's a risk as far as your consequence.

And what are you looking at? Is it water level? Is it inundation as you respond? So that's why in some ways the deterministic approach --

MEMBER POWERS: It would be if you get the agreement.

DR. COOK: Yes.

MEMBER POWERS: The agreement may hold right up until it doesn't.

DR. COOK: You mean like for the dam and how they're operating.

MEMBER POWERS: Something happens that they say, "They didn't take this into account when we

made that agreement. So we're going to let the water go."

DR. COOK: In some ways as a hydrologist to me looking at it and the way we're looking at it with this integrated assessment which, Dr. Ray, we still need to give you a good answer for what this is.

But to me looking at it and looking at it as a total plant response and how we're responding to it and why we're looking at all that, where you use the input water level as one thing. You use the duration as another part or as input factors.

And as we get information, as we do those things, you can then update it. To me that's a real logical way to proceed and how we go forward in laying it all out.

MEMBER CORRADINI: So can I ask a question? Unless we go the phone line. But mine would be shorter.

(Laughter.)

I guess I want to do this in the context of what you do for the community. So here I have this community. I have a nuclear power plant. I'm worried about it. There's a dam up there. There's max participation. There was a riverbed. And working the heck out of the plan.

What sort of analysis is done for the community? So as I protect the plant I just wash away that part of the state. I'm trying to figure out in context to emergency planning in the region. Is the emergency planning in the region commensurate with what we're doing here? Or is it even less than?

DR. CHOKSHI: There is a slight --

(Off the record comments.)

That is from any point of view.

MEMBER CORRADINI: Dr. Kanney.

DR. KANNEY: Say for example you're a --

CHAIRMAN SCHULTZ: State your name and introduce yourself.

DR. KANNEY: My name is Joe Kanney from Research. If you have a high hazard dam, current statutes require high hazard dams to have an emergency action plan. Part of that includes coming up with failure scenarios for the dam, looking at the inundation that would result and the consequences to property and people downstream.

In this case, a nuclear power plant would be one of the things downstream that would be included as part of the emergency action plan, but just one thing. The other things that are included are the people and the their property as well.

MEMBER RAY: How is that different from an earthquake though? I guess I'm still sort of puzzled. My original question was if we use the Shack process to derive consensus about earthquakes why can't we do it about flooding. And I haven't heard -- I mean I've heard responses, but to somebody like me they're not persuasive.

DR. CHOKSHI: One of the things you have is two experts available to that kind of solicitation. Hydrologists don't agree.

MEMBER RAY: Do they just keep them in a room until they finally --

(Laughter.)

MEMBER STETKAR: Let me ask Joe something. You mentioned that for high hazard dams there are emergency plans.

DR. KANNEY: There are emergency requirements. I'm not saying that everyone has them.

MEMBER STETKAR: Requirements. Are those flooding emergency plans characterized in terms of 100 year flooding event or a 1,000 year flooding event or a 10,000 year flooding event or a million year flooding event or? Is there a notion of frequency built into those assessments? I mean, how do you determine that you have a high hazard dam?

DR. KANNEY: Well, that actually -- There's a definition for high hazard and that basically -- I think FEMA actually established the definition for high hazard dam. And it has to do with the height of the dam, the amount of water it retains and whether its failure could result in loss of life downstream.

MEMBER STETKAR: So that's a consequence even if it was guaranteed to never fail.

DR. KANNEY: Correct.

DR. CHOKSHI: A condition study.

MEMBER STETKAR: Not a frequency.

DR. KANNEY: No. That classification is not based on frequency.

DR. COOK: Yeah. And part of what we're doing and you'll see a slide coming up when it comes to dams that are on there looking at dam failure that we have a dam safety officer at the agency. Ken Kurawski is our dam safety officer that's there.

And so he has been able to allow me to go down to the interagency committee on dam safety which was set up following the Teton Dam failure with President Carter. So all the different agencies sort of coordinate and get together and talk about these things.

And we've had some presentations. We've been talking with them. I'm trying to find out more of exactly what you're talking about where you have inundation studies that are there as part of the emergency action plan where you assume that you have failure.

Some of these require post 9/11 is my understanding that were done. Different agencies are at different stages of completing these inundation studies.

But then you also have what the dam was designed to. And then you also have their own priority ranking for what we assign money to maintain, to fix, to upgrade the different things. So you can almost have at least three different categories and three different rankings. And that varies from Corps of Engineers, Bureau of Reclamation, for where it thinks their licensees should be. So you have all these different ones.

And so a lot of this is our dialogue with them realizing that at the end of the day our issue is with the plan. The plan has its own emergency action plan. And then trying to look at those water levels that are there that could -- And then looking at the end of the day with Part 100 the total radiological

risk.

MEMBER STETKAR: I understand that in our own little world. But I was kind of crossing the loop what I thought Mike was asking. That is if you have a city of 100,000 residents that are located adjacent to a river or below a large dam, are there contingencies or emergency plans in place for those people who live there. They're real people. Nice little city. And what's the basis for those?

I mean if they are based on things like the 100 hundred flood, then society says "Well, we trust government. They'll protect against the 100 year flood." And that happens once every 20-30 years in my experience.

But that also has implications now in our business.

DR. COOK: Right.

MEMBER RAY: Because all of the hydrologists and meteorologists and whatever ologists are comfortable dealing in those terms because they can look at a couple hundred years worth of kind of sort of data.

MR. BUDNITZ: Hi, this is Bob Budnitz. Can you hear me?

CHAIRMAN SCHULTZ: Yes, we can.

MR. BUDNITZ: I tried to chime in before, but you couldn't. So I went to another phone. I have a perspective on this that I think Dennis will resonate with for sure. And it has to do with the ability of these river people to come up with a probabilistic estimate.

Now I'm going to quote John Garrett. The fact is that for any problem like this at all there is for sure a state of knowledge of the technical community. This is a lot of uncertainty. Acknowledge it. There's a lot uncertainty. But you don't know that until you go through the process.

And these folks that are reluctant to go through the process are throwing their hands up and saying "It's too uncertain.

When I talk to some of them, some of them say, "My God, it's going to be uncertain by a factor of ten, plus or minus." This whole process is uncertain by a factor of ten, plus or minus. We do it routinely. And we make decisions based on that.

So I'm just as technically willing to accept what that is until they've gone through the process. And we have a process. We know it works. We've been using it for a lot of other different problems.

And they ought to go through the process on a big river like the Mississippi at a specific site or something like that. And end up in a -- What is their state of knowledge of the 5,000 year recurrence? What is their state of knowledge of the 700 year? Until they go through it I think it's blowing smoke without really having gone through it. So I would like to push that that be done.

DR. CHOKSHI: And, Bob, the whole point of the probabilistic flood hazard workshop is to provide the perspective.

MR. BUDNITZ: I, of course, understand that, Nilesh.

DR. CHOKSHI: Yes.

MR. BUDNITZ: I think it's really overdue. Now understand you can't get all that probabilistic stuff done in time for 2.1. But you need to start now so that two years from now we have.

DR. CHOKSHI: Exactly. My hope is that after this workshop we were needing a SSMRP type of project which moves this whole state of the art in a --

MEMBER STETKAR: I sure hope not.

MR. BUDNITZ: I believe that you need to do something like that. It doesn't have to be that

elaborate. But in the meantime you ought to start with the probabilistic hazard analysis of the kind used in the Shack process. I don't want to blow a horn here, but I'll say it.

And then that process will guide the research by saying where the experts say certainly it's big and can be reduced and where they say it's big and can't.

DR. CHOKSHI: I think, Bob, I agree with you. And luckily the Research people who are organizing are here.

MR. BUDNITZ: Yes, that's why I'm saying this. And the ACRS are there to write a letter that says it's urgent.

MEMBER BANERJEE: Can I ask you a question, Bob?

CHAIRMAN SCHULTZ: Excuse me, Sanjoy. Bob, I just want to let you know we do need to put the phone back on mute.

MR. BUDNITZ: Of course. Go ahead. I'm done.

CHAIRMAN SCHULTZ: Because it's sparky here. Thank you.

MEMBER BANERJEE: May I ask a question, Christopher, as a hydrologist? You're a hydrologist,

right?

DR. COOK: Yes. Hydrology.

MEMBER BANERJEE: Is there any fundamental reason why the plants is involved in the prediction or finetooth correlate these things with some distributions as such that the average internal which you look -- You know there are many processes that we look at.

DR. COOK: Right.

MEMBER BANERJEE: Where you cannot get a distribution as in the way Dana was pointing out fundamentally. The aspects of turbulence, for example, is following that. So it could simply be a very hard problem to handle within this frame work. The geomorphology changes with the time scale which is rather quicker than what happens subsurface.

So I'm trying to understand. Is there a reason or is it simply the reluctance of hydrologists to commit themselves to the process?

DR. COOK: My personal, professional opinion is that when we say these things we first need to be very clear in what we're defining as far as which hazard. We need to think of it are we --

MEMBER BANERJEE: So level and duration, right?

DR. COOK: Well, level and duration. But then I was also thinking too what hydrological process. Because seismic at the end of the day I mean we talk about -- I know somebody who recently said in a very good meeting that "seismologists aren't very good at predicting earthquakes. But they can come up with predictions for ground motions and the frequency for those ground motions."

And so if you look at flooding and in flooding level we're looking at duration and we're looking at water level that there's, are we trying to get that from an ice dam? Are we trying to get that -- Because ice dam is part of what we're looking at. Are we trying to get that from a tsunami? Are we trying to get that from the storm surge?

So the initiating event. And for each one of those initiating events you're going to run into different technical challenges.

My professional opinion is that I think that each one of those if enough time, money and effort was spent we may be able to make some very good progress in going on. But is there something right now that I'm aware of that I can pull of the shelf and say this is it? I'm not aware of that for other processes.

MEMBER STETKAR: I think part of what Bob was advocating -- Thank you, Bob -- was that I hear people saying that and everybody loves numerical precision, 15 significant figures with a factor of plus or minus 10 percent confidence. And indeed your observation, if enough time, money and effort were spent, all those people who loved precision would start to feel a little bit more comfortable. And perhaps if you don't spend an awful lot of time or money or effort you might be able to start to understand the problem and where the uncertainties really lie.

MEMBER BANERJEE: Unfortunately, New York proved that two meters or two feet can make a helluva difference. So precision is required. That makes a big difference, you see, unfortunately. That's my view on this. You might want to define a maximum.

DR. COOK: Which is somewhat how we got here with the problem maximum flood which is probably the maximum flood that you're going to have at that site.

MEMBER STETKAR: Bill, you have the quote.

DR. COOK: Anyway, shall I continue on?

CHAIRMAN SCHULTZ: Yes please.

DR. COOK: Okay. The next slide please.

Dam failure, there was a question beforehand about the White Paper. Could we talk about that? So I wanted to give an update on just what was there. The White Paper is deemed written and put together by The Energy Institute. We have Jim Riley who happens to be in the audience that's here with the White Paper on Dam Failure that's in the process of being developed.

This particular White Paper through NEI, they've organized a flooding task force to help develop this and is putting this together. Drafts have been shared publicly that's been there through our public meeting process.

The first complete draft, there was slide presentations that were done earlier talking about maybe what should happened. But the first sort of outline draft was submitted in early August.

The next public meeting that we're having on this is the 13th and 14th of December. We're continuing to work on that document to go through the different topics that are there to try to reach some alignment.

These documents that have been submitted to us are all publicly available to everyone. And as we go through and write comments or anything else they're preserved in a public meeting record.

Sometimes we put the document up on the screen. We will add different comments to it and then that's preserved as part of the meeting summary that's going through.

That was really all I thought was probably germane and appropriate for today to talk about this unless there were other questions that were there. I know at least through Derek there seemed to be some interest from the Subcommittee on this.

MEMBER SKILLMAN: I would be curious how extensive that White Paper is. Is it segregated to regions of the country?

DR. COOK: No.

MEMBER SKILLMAN: Is it focused on --

DR. COOK: It looks at dam failure. It's limited to dam failure. And then it goes through and it talks about different methods of failure. So you can have -- Generally for the work that we're doing you look at hydrologic methods for failures or rainfall causes some sort of overtopping event or you have that causes an erosion of the face and other mechanisms.

You can have seismic failures. So ground motion would then cause it. You can also have sunny day failures which is a term that we use.

That somewhat varies from agency to agency. For us what we're talking about are latent design flaws. Certain mechanisms that were there where you designed it and you have a failure that's not due to flooding. You don't have a failure to a seismic event.

But you're sort of out on a particular day and there's the concrete has had some issue. And you have some spaulding. Or somebody didn't account for the geology of the site appropriately and therefore you had some sort of a failure. It's not an enemy of the state. It's not a terrorist activity that's causing failure.

MEMBER ARMIJO: So they are either design or construction issues.

DR. COOK: Right. Exactly. That's our sunny day. So we have those three different mechanisms that are there. There's also for another topic that's being discussed is if you look at some of the sites they can have upwards of hundreds if not literally thousands of dams that are in the -- There's a National Inventory of Dam Database by the Army Corps of Engineers. We call it the NIDDS database.

There was a -- If you look at some of these sites that are downstream you literally have hundreds if not thousands of dams. So there needs to

be some way to look at that ensemble of dams and somehow find out ones that are noncritical.

MEMBER SKILLMAN: Is that part of this White Paper?

DR. COOK: Yes, exactly. So a process would be there. So you really identify what the critical dams are so you can put your effort on there. You're not doing a detailed analysis for tens of thousands of dams. That's just not a practical problem. That's covered in it.

MEMBER ARMIJO: Are there classes of dams that are more vulnerable to failure, let's say, earth failure, concrete versus -- Is there any way to bound these?

DR. COOK: We're reaching out to the different technical experts that are there. That's part of the White Paper. As well as once the dam fails, are there differences in breach? If you have an earthen dam or if you have a dam that has earthen areas on the side and then with a concrete spillway and a concrete powerhouse and you do have a failure, you would have different failure modes that would go on. Perhaps the earthen embankment would fail, but the concrete wouldn't. That then limits your breach width that you would have with it.

So the other part that I was trying to remember to come up with was looking at breach parameters and ways to deal with that. That's all part of the White Paper and all part of that.

DR. KANNEY: The White Paper does concentrate on earthen dams. I mean those are like 90 percent of the dams that we have. Appropriately it focuses on that.

MEMBER BANERJEE: How quickly can a dam fail?

MEMBER SIEBER: Pretty damn quick.

MEMBER CORRADINI: Precise answer within two feet.

MEMBER BANERJEE: That does not mean that you need a precise answer. So you need to know in terms of the quickest.

DR. COOK: Well, there are different empirical equations that are out there. This is where a technical expert --

MEMBER BANERJEE: But then can you actually bound it? Because the speed of the failure sets up the -- You'd better get an idea of this.

DR. KANNEY: You can't bound it just by vaporizing it. You bound it by that.

MEMBER BANERJEE: But you could.

(Several speaking at same time.)

DR. KANNEY: But a time to failure on the order of a few hours is not unrealistic for many dams.

MEMBER CORRADINI: I think it's generally a leak before break.

DR. KANNEY: Especially earthen dams. You get a lot of erosion.

MEMBER BANERJEE: But what can you do? If it leaks before break, what will you do? Pour concrete on it or something or what?

MEMBER CORRADINI: Get out of the way.

PARTICIPANT: It's the Johnstown flood.

DR. CHOKSHI: I think one of the more critical factors is the distance.

MEMBER CORRADINI: To the target.

DR. CHOKSHI: Right. If you're just interested in the -- of the site. And so the target time or warning time is very important.

MEMBER BANERJEE: Unfortunately, the problem with dealing with normalcy against dispersion which is not dissipation in these situations. So that's the guy needs to chase this thing on horseback. There's this famous paper in the Royal Society.

PARTICIPANT: For the boar that would --

MEMBER BANERJEE: Yes. So it doesn't

disperse in the same way. So be very careful about how you do this thing.

DR. COOK: And how it breaks. And then you like you said trying to model that way. Yes.

MEMBER BANERJEE: It matters.

DR. CHOKSHI: Now you know why it is taking so time to get to that.

MEMBER BANERJEE: It has.

DR. COOK: All right. There are activities that Staff are doing as well that are related to dam failures. I already mentioned ICODS, the Interagency Committee on Dam Failure. It's there. And I mentioned before it's a permanent forum that serves for coordination of Federal activities related to dam safety and security.

We did a presentation there of the Recommendation 2.1 activities that were going on, talking about this. And a number of agencies were very interested in what we were doing, very interested in what we were going to be saying about the dams that are under their regulation and their purview and their operation.

So the result was that a request was that we, NRC, would then be the chair of a small group that's going to be there to meet and discuss these

issues further, how we're going to talk about data transfer, additional information, results that are coming out.

The point of contact for the different Federal agencies, most of them have submitted points of contact. Then our first kickoff meeting is actually tomorrow in the afternoon. So we're making progress on this going forward.

All the Staff through the Dam Safety Officer we've met individually with a number of the agencies, one-on-one, government-to-government meetings to try to understand if they have certain risk tolerances and factors that they use, both emergency action plans as well as their design that would be relevant to what we're doing.

CHAIRMAN SCHULTZ: Chris, you described it as an information gathering activity.

DR. COOK: For our end, it will be information gathering. For their end, it will be sharing and then also trying to develop mechanisms that we can use to exchange data. Particularly a lot of information on dams is sensitive.

And so what would be the processes say if some licensee wanted to go through and say that it's not incredible. This dam would fail under a certain

seismic ground motion. How would you go about getting the information that somebody would need to come to that conclusion that it wouldn't fail?

CHAIRMAN SCHULTZ: Thank you.

DR. COOK: This brings us back then to the ISG which is the purpose for us being here today. You know as Nilesh mentioned we have an NRC wide team that really collaborated. And you're going to see the ISGs. We have Henry and Shelby here talking as the leads that were doing this.

But also just wanted to point out that these are really documents that were generated. People from every major program office, NRO, NRR, Research as well as the regions contributed to this. Had input. You know we had PRA folks. We had Human Factors folks.

A lot of people that as you'll see as the people go through their presentations that really contributed to this. You see us up here, but it was really a large team effort by the collective agencies that developed it.

There are also numerous public meetings that were there on the Federal Register. And then I listed the schedule as well.

The integrated assessment. You know the

50.54(f) letter had a date in it that was told to us by the Commission I believe in an SRM that was there. So we had an established date to get the guidance done for the integrated assessment.

We finished that on time which was quite a challenge. I knew this was coming up right after Thanksgiving. But we got it done and a lot of the Staff worked very hard to accomplish that at the end of November. A lot of thanks go out for that.

And then also the tsunami surge, that one's still a bit of a work in progress. We're almost done. That didn't have the same due date by the Commission, but we're there because a lot of these hazard reviews are ongoing and we need to get that done. So we're targeting the 21st of December.

And then my last slide, this sort of shows the time lines. Many of these you're familiar with. I just broke it down into actions that occurred in the past, actions that are going forward in the future. You can look through these. I don't see a lot of reason to dwell on it.

MR. WIDMAYER: Chris, do you have a prognostication on that dam failure paper? I noticed that wasn't on your schedule.

DR. COOK: It'll be after that. I mean

it's ongoing. Part of this and I'll let Jim if he wants to add anything. Part of it is there are several different topics that are there. I don't know if the dam failure white paper will be at the end when complete document or whether it would be more efficient to say we've come to some agreement perhaps on breach parameters. We're done with that and we can get that done where we have these other ones.

I guess I don't have a firm prognostication for the final date. We're trying to wrap up as soon as we can.

Jim, feel free to add.

MR. RILEY: I'm Jim Riley from NEI. I guess I have to go along with what Chris is saying. We had anticipation the paper would be done already. But as we go we continue to develop issues that need to be fleshed out further, seismic evaluations of dams, coincidence of events that become part of a seismic evaluation of dams, how you interpret that with respect to OBE, SSE with respect to current date, seismic approaches.

The screening criteria. We've developed several, but we need to go through them. And the issue, of course, of once you have a seismic ground motion of a dam, how do you then develop the fragility

analysis to determine what the effect on the dam is going to be.

So I think Chris' statement makes a lot of sense. And that would be that there's pieces of this that are maturing faster than other pieces. And I think we're going to be footing it out as we complete the work on that.

But I can tell you that we have a number of folks that are working on this essentially most of their time now since the walkdowns are done. That was part of what was soaking up everybody's effort here until November 27th. And it is a priority item for us because there are plants that need this in place in order to complete their evaluations.

All that said, I'm not giving you a final date you may have noticed. And that's because I don't have a good feel of when that date will be either at this point.

DR. COOK: I think it's safe to say though that the teams involved all see the need for this though. The need to have something where we come together through these thorny issues and sort of looking at how we deal with the seismic mechanisms, the seismic ground motions, what we're going to be using for that, how we deal with screening.

So there is a definite need for us to continue to have this and a purpose to put it together. But we just don't have a firm date for you yet that we can feel like we can stick to.

MR. RILEY: And this is an issue that the industry is pushing on just as hard as the NRC is. They need this document so that they can perform their evaluations.

DR. CHOKSHI: And that's why these two major meetings coming up, one tomorrow, probably we'll have a little bit better sense. But these are crucial pieces.

MR. RILEY: Yes.

DR. CHOKSHI: Particularly the interagency one is the first time everybody has agreed to that this is our problem and see how we can approach.

CHAIRMAN SCHULTZ: Chris, you mentioned the schedule that you work under to complete the work and I congratulate the Staff not only for completing it on schedule, but also for the level of effort that must have been applied to it. It certainly seems as if a lot has been accomplished in order to get there.

With that type of schedule though, sometimes there's an opportunity to miss out on either peer review or expert review of the work that's

performed. Do you feel comfortable about the review that the approach has been subjected to? Or are there plans for future review through the workshop or other meetings or interactions that you're having that could weigh in now that you've got it at least in place?

DR. COOK: You know documents could always be better. They could always be improved and as we go through this as guidance. And so we have to remember this is guidance that's used. And I'm relatively young. I have no doubt that we'll improve this guidance throughout my career that's here.

But I think that when you look at it this was -- We had an incredible amount of management support and being able to pull different people across the agency and to have them dedicate time. And looking at it, it was really sort of impressive that we could do that. And I know a lot of other review schedules were somewhat shifted in order to make sure that we got that.

I think we were able to get the center body of range of discussion. Everybody was to come together to talk about what happens. We had a lot of differing opinions and views. We were able to work through those.

Especially when you start looking with the

integrated assessment, we have operator manual actions, how you deal with those. We had some very fruitful discussions that came through and I think we ended up with a document that the managers and the staff hopefully all agreed and were able to concur on through that discussion.

I think that it was heard. We also had lots of discussion from industry and a lot of meetings that were held late. A lot of folks flew out here. They were in-person, face-to-face meetings that were going through that dedicated to it.

I feel that it's a great thing. I may be biased. But I do feel like it really came together.

DR. CHOKSHI: I think you rightly point that this is a guidance we have developed and what you learn from actual application is always things you might not have anticipated. So we anticipated that that really apply. Some of the things may become clearer and that lessons learned will be captured. In fact, we have discussions with industry.

I'm sure every time you use it. So we learn it. Then there will be appropriate time. But I think the oral framework I think are the reasons what Chris said. I feel very comfortable that we have captured the framework. There may be some details we

may be able to definitely improve on or maybe there will be some small step here. But as we start working on it, I think we'll capture that.

DR. COOK: And I think the first applications of it and, Jim, you said it. The first application especially the integrated assessment as we do that and this is sort of new in the flooding area.

CHAIRMAN SCHULTZ: Right.

DR. COOK: I think that there are going to be some things that come out and do that.

PARTICIPANT: I appreciate the comments.

MR. RILEY: Jim Riley again. A couple of thoughts at least from the industry's perspective here regarding Chris' last comments. We do have a plant that's agreed to -- Well, will be one of the first through an integrated assessment that's agreed to cooperate in the sense of allowing the public to participate and learn as it goes through this process. And perhaps if we come up with issues that we need to address in the integrated assessment, maybe we hadn't thought about them ahead of time. We'll flesh them out there.

There's another thing we developed during a walkdown guidance process that I hope we may be able to use. We called it a frequently asked question

process where if questions come up regarding interpretation of the guidance that we've again identified later we can put those, document them down, address them during public meetings and arrive at a place where it looks like we've got a logical approach to interpreting this particular question or clarification that's come up. I hope we'll be able to use that again as we proceed with the integrated assessment.

DR. CHOKSHI: I think that's a very good point and I anticipate that we will have to do that.

MR. RILEY: Yes.

CHAIRMAN SCHULTZ: Thank you.

DR. COOK: All right. Well, that's it for my overview presentation. I would now like to turn it over to Dr. Henry Jones.

CHAIRMAN SCHULTZ: Any questions for Chris before we move on?

(No verbal response.)

Okay. Henry, your presentation is then next.

DR. JONES: Yes. Dr. Henry Jones. As an introduction, I'll just go over the purpose and the needs for the ISGs and then for each section, the surge and tsunami cover the relationship to the

current practice and key technical positions for both. And then I end with the public comments which I'm still working on here and the status and the schedule.

The purpose was to try to bring to the stakeholders an acceptable method that we use currently for surge and tsunami. When we started back about five years ago we had no new guidance really for -- Well, yes, we did. Annie Kammerer, a lot of them did a great work in providing guidance that we currently use. They updated the NUREG-0800.

And what we're trying to do is present the lessons learned through the tsunami analysis and the back and forth between industry and ourselves that we've done. You've seen some of it with our presentations before the ACRS, STP Levy County, etc. So we're trying to reflect the current practice that NRC is doing and actually have options for any state or current practice including probabilistic that's out there.

For the need, it's been about 30 years. The last guidance the NRC put out was actually a 1979 document, mostly 48 transforms. We haven't put anything out really until Research took over in about 2004 to 2006.

Oceanography and Meteorology has advanced

so much that the model we use today mostly started in the `60s, starting to mature in the `70s and really started going in the `80s when I was still in graduate school. Actually, oceanography was 10 years behind meteorography. And numerical modeling has now I think caught up. There are a lot of changes going on.

Significant advancements really in the computer resources. And most of you remember when the PC just came out in the early 1980s. And we used to do everything with cards. And now computers have advanced so much now we can do more now than what we could before. So that's changed the whole paradigm.

A lot of our guidance before was for people who weren't subject matter experts. So they could kind of cookie cutter their way through. They didn't even have to have a subject matter expert. So I want you to read the NWS-23 and get some type of hyper as-model and be able to perform the analysis. Now like I said before they were just taking it out of our NUREG and that was about it.

We needed to capture the lessons learned. We've had several reviews, 15 applications. We've had several tsunami and surge analysis to base our standard practice on.

Also events. Research really started

going in the Indian Ocean tsunami in 2004 in Sumatra. So it wasn't something new for Fukushima when they started the work back then.

And then you had Hurricane Katrina come out. And so that really made an emphasis on the surge side. And that was followed by, of course, Fukushima. And then recently we've had Hurricane Sandy which actually verifies a lot of the guidance that we're putting in our document.

For storm surge.

MEMBER CORRADINI: I'd like to ask a question.

DR. JONES: Sure.

MEMBER CORRADINI: It was my impression that tsunami analysis in Japan is actually fairly sophisticated. The Japanese Society of Civil Engineering has a standard which was issued back ten years. And as I understand it, most of the Pacific area used that standard as a basis. Or am I wrong about that?

DR. JONES: I worked with Professor Mimura. He's the one who essentially started that standard. I worked with him on IAEA and his tsunami model is what's used mainly by the other countries where we use the Mole School and a whole bunch of

other models. But they use that.

They're still working. It's still in progress. They're still trying to get it down pat as you know what happened. They're still trying to get it. It's very mature. There's a different region. Different sources than for the United States. I mean they have the earthquakes.

MEMBER CORRADINI: Certainly as I understood it was the source versus the methodology if I knew the source.

DR. JONES: Different.

MEMBER CORRADINI: Okay. Fine.

DR. JONES: Exactly.

MEMBER SKILLMAN: Dr. Jones, your previous slide four please. You mentioned Hurricane Sandy verified.

DR. JONES: Yes.

MEMBER SKILLMAN: Would that be Salem Hope Creek, Oyster Creek, Indian Point?

DR. JONES: Actually, the surge came in under what they were designed for. What is unique in this and what we've been saying to applicants is that NWS-23 when you use the PMH we see that a lot of times the radius of the storm are smaller than what we've seen with the recent storms.

And we tell them that you have account for this. You have to start putting in larger radius beyond what the NWS-23 gives you. You have to put in different speeds than what you've seen before because it doesn't reflect what we've seen.

Typhoon Tip was about 1340 mile radius of winds and Sandy was 1180. I mean it's like the second largest radius of winds recorded. Now central pressure Typhoon Tip was 870. Sandy was 943. NWS-23 the lowest it goes is 882 way beyond the low what Sandy was.

But the key point is that they have to modify they can't just accept it as a cookie cutter that this is what I have and this is what it shows and this is good enough. You have to have subject matter experts to look at what your site specific characteristics, climatology. The region, what's happened since 1979. And you have to adapt accordingly.

Sandy proved that here's a storm no one expected to be that huge. And we've been telling the storm are larger and you're going to have to put that into your analysis.

MEMBER RAY: Your reference to site specific experts, of course, raises in my mind the

issue of a consensus process.

DR. JONES: Well, not consensus. If you hire a meteorologist or a firm with a meteorologist or a civil engineer who does storm surge in current practice, all of them will be able to come to the same conclusion that the Staff usually has. If you try not to use someone as the subject matter expert, you're going to have a disaster.

So what I'm saying it's not a consensus. I think all the oceanographers and meteorologists were on the same page. And civil engineers who deal with the surge were on the same page.

MEMBER RAY: Thank you.

DR. JONES: Okay. For the enclosure one, the storm surge process. I'm going to talk about that it includes the hurricanes, tropical cyclones, extratropical cyclones. That's your mid latitude, the ones we get hit with all the time during the winter.

And then you have the hybrid storms. That's Sandy. That's the type that recur at the end of the season comes up and produces the perfect storm.

What is the relationship to our current practice is that ISG, we try to get rid of the probable maximum terminology. You've heard that years. And I try to attempt to get rid of that

terminology in this guide.

And what we did is come up with nomenclature that gets rid of the probable maximum such as design basis flood, simulated. Since we don't have a history of a lot of these observations, we have to develop synthetic observations through simulation of numerical models. So we use simulated hurricane, simulated wind storm and that's your mid latitude storm.

And what the goal is to have your simulated storm surge and then the storm surge that is the maximum of that is your design basis storm surge. So we don't use probable maximum storm surge of the design basis storm surge.

MEMBER CORRADINI: So you've changed the nomenclature, but in essence it's the same thing.

DR. JONES: Yes because before in the meetings and like we've mentioned here, the probable has nothing to do with probability. We're trying to stop the conclusion with that.

MEMBER STETKAR: Naturally I was going to ask now that you've changed the nomenclature that if you run 100 different simulated wind storms is there any effort to assess a likelihood for the occurrence frequency of each of those simulations?

DR. JONES: We plan to do that now.

MEMBER STETKAR: Okay.

DR. JONES: Under the NWS-23 method, you couldn't.

MEMBER STETKAR: That's right.

DR. JONES: It was fixed. I mean you had to do strictly deterministic. And we're going to get to that, but you'll see that the Corps and remember the Corps and NOAA were the ones who designed our NWS-23. And they moved on. So we're trying to catch up with them.

Here it is I put in the first bullet that our current practice is consistent with the other Federal agencies especially the Corps. We had Don Rizio from the Corps who had performed some studies. You've seen that in STP and also on Turkey Point and Levy County where we've added some of his findings to that.

And the current practice is to use a two-dimensional coupled storm surge model sometimes with another wave model. Of course, they're great offshore. It's not mandatory, but the best practice is to use that.

And what we're doing right now we're using the deterministic method that we say, for example,

NWS-23 but here for the review we actually want to try to go through the JPM EST that probabilistic type of surge modeling that the Corps does.

MEMBER CORRADINI: What's the Corps? You mentioned that a few times.

DR. JONES: The Army Corps of Engineers.

MEMBER CORRADINI: Okay. Fine.

DR. JONES: Yes.

MEMBER CORRADINI: Thank you. I thought it was the Reactor core. I wasn't sure if it was the reactor core, the Marine Corps. I guess there is rotten to the core.

DR. JONES: I've worked with all of them.

MEMBER CORRADINI: So the Army Corps of Engineers.

MEMBER POWERS: My heartfelt sympathies to you.

(Off the record comments.)

DR. JONES: Well, then we have also which I didn't mention FEMA. FEMA, actually NOAA, FEMA and then the Corps are all on the same page. Actually, NOAA they use SLOSH because that was the model they had. But they turned over to ADCERC for the higher accuracy, better physics. And so when you're looking at the Federal agencies, what I'm describing here is

to say except that we're going out to a farther exceedance probability than they are doing.

MEMBER CORRADINI: So maybe this isn't a pervious subcommittee meeting and I'm just catching up. When you go with further exceedance you modify certain parameters in the model that essentially changes the intensity of the storm.

DR. JONES: Actually, even in NWS-23, you change. Actually, you can go in there and change the intensity of the storm. But what we do now is the systematic, numerical way to do it Monte Carlo that you get all types of variables and run it.

MEMBER CORRADINI: Okay.

DR. JONES: That's all we're doing.

MEMBER CORRADINI: More data collection.

DR. JONES: And now we can get actually the risk informed information that we couldn't get from NWS-23. And one of the big changes and this is not really a change because in our current, the last bullet, when they first came in, of course, no one had done this in 30 years. So they went to our guidance.

In the guidance we had maps that were 30 years old. And 1D models, of course, from the 1970s. And we said, "Well, that's fine and good. But, no, you can't use that. You need to use the standard."

And that's when we worked with NOAA and got the SLOSH code. And we started working with the Corps and this ADCERC. So that's when the things came that you cannot use the maps. You cannot use the 1D models from 30 years ago.

MEMBER POWERS: Can I just -- A little bit of philosophy if you don't mind. The nice thing about 1D models is you can understand them.

DR. JONES: We do when we get tsunami. We actually do -- We can get to that when we get to the tsunami.

MEMBER POWERS: The prohibition against using something that's from 30 years ago, I mean there are two possibilities. It's wrong or it does not give you the kind of detail you're now looking for. It is the latter because as you just said you don't use it. They're 30 years old. Exactly. So sacrificing understandability for increased detail.

DR. JONES: Well, not exactly. On the new 2D models, actually you have the full physics which you didn't have in the 1D. So oceanography we know the physics of the waves. We know how everything interacts.

MEMBER POWERS: There's nobody in the world that understands everything from 2D models.

DR. JONES: But the 2D models because we know that they have radiational dissipation and stuff like that. So that actually adds something that you couldn't have through the 1D model. And also it assumes that the 1D models with imagery was smooth which is not the case for a lot of the sites. It's not smooth or unchanging. A lot of that went into that.

So on slide eight, we have a NUREG/CR-7134 and I have to emphasize this is not guidance for site specific evaluations. This was a study done for the industry to be able to do the most extreme part of an HHA, a hazard assessment.

So if you go in here and throw everything in the kitchen sink in you come up with this surge at your site. If your site was still dry, you can say you were done.

On the other hand, if your site was wet, then what you would do is go through a site specific type of analysis. So a lot of feedback and I get to that later is that some of the stakeholders think that this is a guidance for a site specific surge. It's not.

MEMBER CORRADINI: So what you just described is this box? Which is they just do a box to see if they're dry and they're okay. I can see your

words and looking at the words.

DR. JONES: It can lead to that. This is one approach in which they can do that. One approach for this type of flooding analysis which they can do that for surge and for which they can be so very conservative that at the end of it there's no question that if their site is dry nothing is going to be higher. It's not going to reach the site.

MEMBER CORRADINI: But they don't need to go any further.

DR. CHOKSHI: To answer your question fully, that box contains more than the surge. Everything.

MEMBER CORRADINI: Okay.

DR. JONES: There's that one flooding subpart.

Essentially, what this graph is describing it just fixes a narrow range of a narrow of factors affecting the surges and tries to reach these asymptotic limits. And we have seen those. There are some cases where you get the storm, it doesn't matter how big you get it at. At a certain point the surge will not increase.

We've seen that in South Texas. We've seen that in Levy. We haven't seen that at Turkey

Point because that's facing the Atlantic Ocean different. But we've seen that.

So this gives them an option. But we do not stop them from doing the probabilistic method. And so the method that is described in 7134 can be extended if you look at other references for probabilistic assessment of surge. And the research did go to NIST, the National Institute of Standards, back in 2002 and they actually conducted a probabilistic surge hazard analysis for Tampa Bay. That's been done before.

Page nine, the key technical positions for the NRC is that we want them to use the state-of-the-art surge models driven by state-of-the-art meteorological models. For their flood hazard evaluation, we intend on the NRC Staff to use the probabilistic method that's available through JPM EST.

And from prior ACRS meetings we gather that it's probably best that sometimes the applicant and the NRC come through by two different methods instead of us just reevaluating what they've done. We have our method. They have their method. And actually you cover the whole spectrum much more completely than just using one model for everything by applicant and also by Staff.

And so for a meteorological input, once again NWS-23 is acceptable except that on a site specific basis they have to justify the use of it based on their climatology and the changes that we've seen in the meteorology and the storm since 1979. And we've done that. It's been in our STP, Levy. All the ones that we've come before the ACRS we've done that. And the applicant has been willing to do that.

And once again the last bullet, they have the option of doing deterministic or probabilistic. We do not prohibit them. It's their choice.

MEMBER CORRADINI: And if they do deterministic, they use your DBSS.

DR. JONES: DBSS is the final result no matter if you use probabilistic or deterministic. If you want to get what is your maximum surge at the site except when you do probabilistic they don't have what? They don't have a return period or we won't have a return period.

Actually, it's to the benefit of the applicant to go probabilistic if you think you're going to be flooded by the surge because actually NWS-23 we don't know exactly how extreme those storms are. I think we do now. It's 10^{-7} to 10^{-13}. And so --

MEMBER CORRADINI: Say it again.

DR. JONES: They could be up to from what Research says 10^{-7} to 10^{-13}. So I'm saying if they get surge from that with all our conservatisms on top of that and then they get flooded, under the current practice of deterministic they're stuck.

MEMBER CORRADINI: I heard what you said, but I was stuck on the scientific notation. Again, 10 to the what?

MEMBER ARMIJO: 10^{-7}.

MEMBER CORRADINI: 10^{-7}. I thought you said $10^{7}.10^{7}$ to 10^{-13}.

DR. JONES: No, no. 10^{-7}. So that's just on the storm side.

MEMBER SHACK: But what's your acceptable level for them to --

DR. JONES: That's another that's going to come up.

DR. CHOKSHI: There's a question.

MEMBER SHACK: That is a question.

DR. CHOKSHI: We will get into that why.

DR. JONES: Okay. I'm going to move onto the tsunami section. Any other questions on the surge side?

MEMBER ARMIJO: 10^{-7} per year?

DR. JONES: Yes.

MEMBER SHACK: 10^{-13}.

MEMBER ARMIJO: Does that end it right there?

DR. CHOKSHI: I think maybe let's clear that we don't want to leave this under a misimpression. It's not that when you use NWS-23 you are always conservative because there are other things.

DR. JONES: That's right.

DR. CHOKSHI: So you have to be careful about this to draw any conclusion from that.

MEMBER SHACK: Okay. If you do a lot of replications of that model you get those numbers.

DR. CHOKSHI: Exactly. And that's one of the things that in this kind of why they talk about this hybrid approach for that very reason.

DR. JONES: And actually, too, what you see is that you can have storms that have a lower recurrence or a higher recurrence and they might produce the same surge depending on what the parameters are. You can vary the size, the forward speed and intensity. So one storm that may be extreme in one case may have the same surge as another one which is not so --

DR. CHOKSHI: You know the simple things

like initial -- How do you -- because that changes the volume.

DR. COOK: So the recurrence for the storm does not necessarily relate to the recurrence of the water height at a site.

DR. JONES: And that's why in this study by Research back in 2002 they actually had a joint probability where you saw the parameters of the hurricane or the storm and you saw the surge related. And you had the exceedance probabilities with that. So you could go in the table and some at this end had the same surge as something at this end depending on which parameter and the return.

That's what we were trying to tell the applicants, too. It's not just always using these extreme variables. Sometimes there is something that will show up on a more frequent basis that may have the same or exceed the storm surge. And you have to do it on a site specific basis.

MEMBER SHACK: What you do is you take the deterministic storm model and you supply a distribution of parameters to it.

DR. JONES: Well, actually it's a -- What they actually do is the joint probability method they take the history. It's still based on the history of

the site or region. But it takes that and it matches it. It does a distribution. And it makes synthetic storms based on that. And you can get a recurrence frequency for the storm.

The surge is purely probabilistic because you take that one storm and you put in the model, run and get a surge. Take the next synthetic, run, put it in there and put it in there. And then what you get now is a synthetic historical database to do your work.

MEMBER CORRADINI: You're doing your Monto Carlo calculation and you compute whatever you did from the input distribution.

DR. JONES: Exactly.

MEMBER CORRADINI: I'm sorry, Bill. Go ahead.

MEMBER SHACK: When you said you used the NWS-23 as your storm model.

DR. JONES: No, NWS-23 is a separate.

MEMBER SHACK: Yes, that's what I thought.

DR. JONES: It could be something that's done all the time and it's fixed.

MEMBER SHACK: There's VICTORY which you guys did for the hurricane wind speed.

DR. JONES: Exactly. And that's what

we're talking about.

MEMBER SHACK: What I thought when you said you did the surge you did with NWS-23 and you varied parameters with that.

DR. JONES: You can, but you get no return. You don't get any risk information because it's fixed. It's all based on a common --

MEMBER SHACK: So your 10^{-7} is somebody's -- That's the VICTORY type model.

DR. JONES: Exactly.

DR. CHOKSHI: All of the parameters are variables, the pressures and the --

DR. JONES: Central pressure or pressure difference, forward speed, track, direction, latitude and longitude. It's all of those in there.

MEMBER SHACK: But again you're doing 10^{7} replications over his history and his distribution.

DR. JONES: Exactly. And it's all going to be site specific varying from site to site.

DR. CHOKSHI: And I think as you pointed out --

MEMBER SHACK: But the telling those to return periods is a very -- No, no.

DR. CHOKSHI: Exactly. You have to be very careful what the -- How you treat into the

classical seismic type.

MEMBER CORRADINI: So can I ask I simpler question since I thought I understood? But now that you lost me there's no point in trying to replicate. If I was at Dresden, interesting but not relevant. But I was D.C. Cook, relevant. If I'm way inland, surge doesn't matter. Okay. But at D.C. Cook after Sandy, people will washing up dead fish and all sorts of interesting stuff on the eastside of Lake Michigan and the southside. So a surge is possible or necessary to calculate there.

DR. JONES: Yes.

MEMBER CORRADINI: Okay. I just wanted to check.

DR. JONES: Any other questions?

(No verbal response.)

On slide 11, this is on tsunami relationship to current practices. Once again in a nutshell, the Regulatory Guide 1.59 (1977) didn't even try to attempt to address tsunamis and that's with the other guidance.

Thanks to research, Annie Kammerer and them at Research, what they did after the Sumatra tsunami they had a research program they put together which was joint effort of NOAA and also NRS and USGS.

And some of the people, the experts, at USGS are actually helping with our site evaluations.

And what they came up with there was first two technical manuals that came out of the 2007 workshop. One was on standards and criteria for evaluating tsunami models. The other one was the issues for tsunami hazard assessment.

The latter one eventually morphed into what we have as a NUREG/CR-6966 which was produced in conjunction with NOAA's Pacific Marine Environmental Laboratory and Pacific Northwest Laboratory as guidance for tsunami. It actually also morphed into a revision of 2007 revision to NUREG-0800 our standard review process.

Now the one of the standard criteria for models actually that's the last deliverable. It's been completed, but it's still in review right now with NOAA. And I should receive that probably next year.

On the second page, what we have here, this is the most significant one here, the first one. This is the one that used by all our applicants including the USGS. What they did in this study they looked at all the sources, earthquake, volcano, tsunami, everything for the Gulf of Mexico and the

Atlantic and they came up and actually ran models of them and got amplitudes. And for the applicants they could go in there and they could look at the volumes, the slides, everything here to do a tsunami analysis.

And then in 2010, the second one, for free, they provided us with a guide on the paleotsunami deposits. And they can use that in the review.

All this has been used by the current applicants and it's been successful when you have subject matter experts who actually apply it. In cases where it didn't work is where they didn't have subject matter experts. And they tried to do with obscure papers and it was a nightmare at one site. It took three teams before they got it right. And when you get the right people it works very well.

And most of these people know each other. I mean USGS expert they know the people who did Katrina. They know the people who the applicants have hired. They've all published papers together. So as far as consensus --

MEMBER POWERS: That means that they are incapable of critiquing each other.

DR. JONES: Because coming to consensus is going to be easy. What's that?

MEMBER POWERS: Does that mean they're incapable of critiquing each other?

DR. JONES: No, they have no problem with that. Actually, that's not a problem at all. They jump on each other very quickly. And they know it's professional. But they jump. They have no problem with that.

DR. CHOKSHI: I think this is sort of a reflection of a small community.

MEMBER STETKAR: Community and actually dysfunctional family.

DR. JONES: In the terms of what we're talking about like PTHA. It's my opinion based on my relationship with these people and seeing the applicants that, yes, the other guy says it would be ugly going into one room and trying to come up just like in seismic. But I have a feeling that they will come up with it quicker. And there will be a consensus on that.

I don't think it's going to be the same issue. I think oceanographers, civil engineers doing the oceans and stuff, I think we're on the same page.

They've actually done an assessment of peer review. Eric Geiss was on that for Diablo Canyon. They have some issues with it, but we'll

review that in time. We have no prohibition from any plant submitting a PTHA even though there's really not a consensus. But we have no problem and we wouldn't have any problem evaluating it if it comes into the NRC. So that's not an issue either.

So if they want to do that as long as they use the science, current practice, justify what they're doing and tell the story, I think they can do that if they choose to do that. So that's not an issue with us.

What you see here on surge and tsunami, surge is mature. Tsunami is almost there. We just have to do a few extra steps. People are doing it. In the case of Diablo Canyon, they did it on their own. And we will review that as part of this process if they submit this for their reevaluation.

Also Seaside Oregon there on this, Eric Geiss did this for FEMA. They usually go 100 to 500 years based on the data. Of course, they have the cascade. So they have a different issue there. They actually will have a probability of earthquake induced tsunami there. But we have no nuclear power sites there.

But he did that as a study which with Annie Kammerer who actually sponsored a great workshop

with MIT, Woods Hole in 2011. All these people were there. It uses the same methodology. He actually refers to the Japanese methods.

Sometimes we have disagreement but we're working that out. But generally we're moving forward with that. The bottom line is nothing prohibits anyone from doing a PTHA and submitting it to the NRC.

MEMBER STETKAR: But these are earthquake induced tsunami, right?

DR. JONES: Let me take Diablo Canyon's findings for example. They actually are consistent with what we found for the other plants in that they have the submarine landslide that they determined is going to be the bound. Okay.

The United States, most of your data is far field tsunami from Japan, Chile, Alaska. Most not exceeding nine feet. And the Gulf and the Atlantic, we really don't have any history of any recorded and those have been put in the suspect on the United States. And then 1929 Grand Banks, there's really no associated run-up in the United States.

So essentially we have zero for that. So totally different than Japan. Thousands of years they have tsunami but they had a Fukushima in their record. Totally different. So we're looking at far afield.

Now Diablo Canyon looked at storm surge not exactly using the models I would recommend. But they looked at it. So for waves three meters and below far afield tsunami. From anything probably up to three or five meters, storm surge. Then from about 10 meters and beyond, submarine landslide.

DR. CHOKSHI: But answer the question.

MEMBER SHACK: -- probabilistic model of the submarine landslide surge.

DR. JONES: Yes, they attempted -- When you do probabilistic it's not just the landslide, you have to look at all of the sources. So it's even more complicated. If you're at a site, you have to look if you have far afield tsunami. You've got to put that in there. Volcanos you have to put that in there. If it's submarine landslide, you've got to put that in there.

And then one you have to do subsets like how much is the fault, doing this, put a probability uncertainty to that. Submarine landslide how many seconds with volume. Divide that up into several segments.

DR. CHOKSHI: Given what you have in seismic, different sources. You have to characterize sources. You have transmission. And then the what

exactly.

DR. JONES: But they didn't get into the ocean part. That was just the source. Then you can get something from far away that will affect you at your plant right there. And then you have the symmetry and everything you have to deal with on top of that.

MEMBER SHACK: It's easier to calculate stuff going through water than ground.

DR. CHOKSHI: For sure.

DR. JONES: And then we have the issue if a site is flooded that we really don't have any literature or methods yet to address how structures are impacted by tsunami. We do for surge. But still they're just now looking at that even at the international level.

Because the tsunami wave, long period wave, long wave, 70 percent of them don't break. Then storm surge you always have them breaking. A total different something going on. So you see that in the Sumatra and this thing just comes barreling through and it keeps going.

And there is totally different effect. And they found out in Japan they had structures that were built for safe havens for tsunami. Two of them collapsed. And they were going like why. So it is

different.

And then remember your source is already generated. So it's freeway. It's already generated with the surge. There is your source that's moving in to where you are. You know it's still there. And it can change directions and do other things that make it complicated.

So that's what we're looking at, but it can be done. And we don't prohibit the applicants from using PTHA.

MEMBER CORRADINI: So, in this case, for the tsunami, the PTHA would then give you again a design basis.

DR. JONES: Exactly, except now you have a return period. The only difference is in our deterministic one that you could do things that are unphysical that you can't do with the probabilistic one. What I'm saying is once again when you address the 1D models we may use the 1D part of a 2D model to see how outrageous we can get. Because without that dispersion, that radiation there, what you do is this thing is going to build up to tremendous. But we know that the role is in that 1D.

We can also take out friction. You won't do that in probabilistic space. You won't take out --

MEMBER CORRADINI: We already talked about that in the past.

DR. JONES: That's right. We talked about that previously. So we won't take out friction in the probabilistic one. So the deterministic one you can be out here somewhere. But unfortunately you don't have risk information.

DR. CHOKSHI: But I want to remind everybody we have this HHA concept.

DR. JONES: Exactly.

DR. CHOKSHI: And tsunami has for most sites in the U.S. falls into that category. They want to fully assure that something else governs and tsunami doesn't affect. So actual application of somebody doing a probabilistic tsunami has an analysis, I think you see one example and maybe some others. But I think it's a concept we approve. But I just wanted to put in the perspective that natural use is not going to be exercised in my view as much because you do that type of approach to show that it doesn't impact your site.

There are some seacoast site, Atlantic coast, where they may have to do more.

MEMBER STETKAR: Florida sites because the Caribbean, there are collapses and things. They've

modeled all of that.

DR. CHOKSHI: Right. But I think because some of our vulnerability of the information that some of the USGS reports. This is my feeling that you see will see a full-grown prediction on the caliber of analysis. Diablo is maybe one example. More likely that that caliber of analysis you will see.

MEMBER CORRADINI: And it's just that -- I'm sorry. I didn't mean to interrupt you.

DR. JONES: No problem. Like I said, the surge and tsunami too once again we don't know what's going to happen next year with this storm surge. We could get something like a Sandy or something like that. With the tsunami these sources are not going to -- Unless we find data that contradicts or something new, it's there. We've modeled it for all these sites, the same thing over and over again.

MEMBER CORRADINI: But maybe it's my impression that's confused. It is my impression that at least in Fukushima's case the earthquake occurred at a large rectangular area and it occurred in the southern part of the trench which nobody saw historically. So it wasn't just the size. It was also the location that took out that site versus on the -- At least that's what has been explained to me

by folks in Japan. So am I misunderstanding something?

DR. JONES: They also talked about how they had coherence of two waves coming together. But our guys -- I mean if we were asked to do a probabilistic one we would have to take into account I mean all those other -- I mean you can't ignore some of those towns were at 60 foot tsunami in recent history.

And then it goes into how much do you weigh that. They just chose not to weigh that heavily in their final assessment.

DR. CHOKSHI: But I think to answer your question, the tsunami is going by the length of the force and the uplift, right?

DR. JONES: Right. But it's still its objective of what source you have.

DR. CHOKSHI: I think in that prediction whether there are those two occurred and I think Eric could shed light, but whether they knew that that southern part also would rupture at the same time probably was not known.

MEMBER CORRADINI: I guess I just wanted to make sure I wasn't getting a misimpression. Because what was told to me was they never consider it that far south. They consider it but further north.

DR. CHOKSHI: It was considered but not likely.

DR. JONES: So again that was subjective.

MEMBER CORRADINI: Right.

DR. JONES: Do you see what I mean?

MEMBER CORRADINI: But historically there is nothing there. And they chose to look at the sites that had seen them before and replicated that calculation.

DR. JONES: But one of the things we go by is that because we haven't seen anything at your site doesn't mean that it can't happen at your site. And one of the things why you look outside your region of your site is to see what else is out there because that means it's probably a chance that can happen.

In our case, we haven't seen anything like that. It doesn't mean it can't happen. But historically we haven't. But in their case historically they've actually seen it. Do you see what I mean?

So it makes a big difference in when you do your analysis. If we'd actually seen that, do you think that you would accept it if we didn't put it into the analysis?

MS. KAMMERER: Hi. I'm Annie Kammerer,

currently at NRO DSCI working on Fukushima work. But in my previous life I was coordinating with tsunami research as you've heard.

And so just to answer your question, there's a fundamental role, philosophical difference, between the seismic community in Japan and the U.S. in terms of segmentation of faults. In Japan, they still treat different segments as essentially different faults and they don't really believe in the theory that these segments will actually rupture together.

Whereas that changed in the United States in the 1970s with the Landers earthquake. So we now officially segment faults. We will look at joint ruptures routinely. And so if you have multiple segments like that in the U.S. the way that we do it.

And in fact we're doing it or the community is doing it right now with the Shack level threes that are going on in the west. And we just had the long conversation in terms of Diablo Canyon and segmentation.

So we don't do segmentation. We don't accept segmentation like that. So I think if that was a coastal plant on the U.S. we would look at the potential for multiple rupture. But it's just something that we've seen in Fukushima Kashwazaki the

same problem. It's a difference of philosophy of the two seismic communities.

DR. CHOKSHI: And I think that issue of segmentation has been around for a long time. I remember initially Diablo licensing we were talking about is this a segment for it or should we treat it as continuous.

MS. KAMMERER: Yes, it's a big challenge and it's not an easy one. I mean if you look at the entire San Andreas theoretically it could all rupture together. But we know that that doesn't happen. So it's still a work in progress, but in the U.S. we account for that through a lot of treating the uncertainty in the Shack process. But they don't really have that process.

MEMBER CORRADINI: That helps a lot. Thank you.

MS. KAMMERER: Thank you.

MEMBER CORRADINI: Because the only comeback that I heard is that there was a separate group called HERP in Japan that strongly suggested the possibility of that. But it was never analyzed.

MS. KAMMERER: I think that that's true. I think there was a segment of the technical community there which was saying that it was unrealistic. I

think people did see it.

MEMBER CORRADINI: Okay. Thank you.

DR. JONES: Yes, I think Professor Namura who I worked with, he might have one of those who was leading. And that's the whole thing. If it's plausible and under HHA, why not try it so see what's going to happen?

So I'm just saying that's another philosophy. You don't lose anything by it by trying that. So thank you, Annie. Okay. On slide --

MEMBER RAY: Just one question as I think about this and we talk about segmentation or not and so on. I'm trying to think whether there's a needed or a required, I should say, correlation between the seismic event that's the design basis and the event that you model or that you would use in modeling a tsunami.

It almost sounds like the seismic event that's used in the design could be smaller than the rupture that would be assumed in tsunami modeling if I followed you correctly.

DR. JONES: Remember you have an offshore earthquake, but then you have a lot of what they're looking at the faults onshore won't generate.

MEMBER RAY: That's right. But I'm

talking about an offshore.

DR. CHOKSHI: You are absolutely right because the vibratory ground motion is going to depend magnitude and distance. In tsunami the major parameter, one of the things, is how big a rupture volume is going to be displaced. So it could be two different events.

MEMBER RAY: -- strikes like a tsunami.

DR. CHOKSHI: The same thing. The strong surge and the wind speed. If you're designing for wind the storms you will consider it will be different than for the surge.

DR. JONES: Exactly. Because you could have something in a valley where the hurricane may not get to with the hurricane winds. But the surge can sure get up there with a different type of storm.

And actually in submarine landslides what Eric Geiss is trying to do from the USGS is actually use seismic events as a trigger through the submarine landslides and try to get a correlation so that we can get some return. Try to build up the database there because it's so small. Like you said, hardly any history whatsoever.

So we can tie it to seismic events. At least we can say this one might initiate this type of

summary landslide. And actually they've done studies on that and it's mostly within 100 kilometers of the shelf is the only way you can have underwater earthquake with 100 kilometers off the Atlantic that you would have a submarine landslide issue.

MEMBER RAY: One other thing. The survey is required to assess the seismic hazard is pretty well I guess understood or accepted. It's not clear to me that the surveys for underwater landslide potential are required. I mean if somebody just doesn't do any, that I guess wouldn't be acceptable.

DR. JONES: Are you talking about for the applicant actually paying for underwater?

MEMBER RAY: Yes. What assessment of the landslide potential and for what distance from a coastal site issue?

DR. JONES: We do have that and that's what the resource like Annie helped with this one here that actually with the site scan -- Well, I'll let Annie address that.

MS. KAMMERER: Yes. So the two coastal Pacific sites have both done multibeam bathymetry right of shore to look at landslides and it's detailed pretty well. Diablo Canyon is in there. PTHA report which is publicly available through the Pacific

Earthquake Injury Research Center.

But there really wasn't that information for the Atlantic and the Gulf. And so what we did, RAS and NRO worked together and supported this USGS work where they used brand new state-of-the-art multibeam which actually done by NOAA actually for a different purpose for law of the seas.

But it was of such high quality that we were able to use that. USGS was able to use that to map the landslides all along the Atlantic and that's available in -- Henry, I think one of your slides. I'm lost track of where that was.

DR. JONES: Yes.

MS. KAMMERER: But that USGS it's an updated landslide report. That was basically for that purpose. And that's what NRO has been using. They've been modeling sort of the largest -- I don't have my glasses. Yeah.

DR. JONES: It's 2009 USGS.

MS. KAMMERER: It's on page 12. It's 2009 USGS evaluation of tsunami sources.

DR. CHOKSHI: And one of the things also we still haven't, but we have talked with the Mexican government in the Gulf area as to when it has come up. So maybe that similar type of investigation.

MS. KAMMERER: Right. What NRA did was they worked with the USGS and the time UT, but now USC to model the largest of the slides that were mapped offshore to get sort of a deterministic upper bound on what kind of runups those might be produce.

DR. JONES: And then they also looked at all the other sources, too. You know the Azores, the Caldera. They looked at the whole gambit. So I don't want you to get an impression that it's just submarine landslides.

MS. KAMMERER: Right. That report, the objection of it, and I think they did a great job of reaching it was to look at all possible sources in the Atlantic and the Gulf. So it's near field/far afield landslide and seismic. This is something then that the NRC Staff and licensees can use to gain an understanding of what the Atlantic and the Gulf sources are.

DR. JONES: And, Dr. Ray, the thing is that you notice that she said that Diablo, I mean, the company has paid. I looked at reports $20 to $60 million for seismic and tsunami. We had to leverage off of NOAA. It's very expensive. Unless NOAA or Navy or one of the companies go for it it's kind of hard to get the data.

One site they wouldn't be able to -- I mean they would have be a company. It has to be a joint venture because it's that expensive.

Let me move forward. Let me see. Okay. What we're asking the stakeholders that they use the state-of-the-art tsunami models. There are several out there. We don't tell them which one to use. They do everything from the model from NOAA to these other models that other universities use.

We use the deterministic methodology. But they are free to do the PTHA approach. And we will review that. And as we stated before, Nilesh stated before, that we're having the conference in January. We're going to have Eric Geiss and several of the tsunami experts here along with Rizio who is the storm surge expert. And we're going to look at the probabilistic over again.

And the PTHA we're going to address those issues. And once again the option is open for the applicant to use either deterministic or probabilistic methods.

Now for the public comments, most of them were editorial. Actually they had very few on the tsunami side, only about eight. Most of them were editorial. And on the next slide I'll show you some

of the comments.

On the surge side, most of them were also editorial. NEI had the most. And we're addressing those as we speak.

The public comments on 16, some felt that we were prejudice against NWS-23. We actually funded NWS-23. We're not prejudice. It's just that 30 years later some things are just not applicable. But if you want to use it, you're free to use it. We just have caveats that you have to justify it based on the climatology and we have to do a few things in view of the storms that we've seen. Justify it.

Probabilistic/deterministic. We will not prescribe which one it is for the applicant. That's up to the applicant to decide on their needs and which method they want to use. And that's always been the case.

The time and expense, once again that's up to the applicant. They have to make that decision. It's not an NRC decision.

Software. We tried to put examples on the surge side of the state-of-the-art is and the Federal agencies use. But applicants are free to use other software as long as they have documentation to justify why that software is applicable for that site and what

it's capable of doing.

And then the last bullet, that's where I'll let Nilesh address that one. What are we going to set as the standard if we do a probabilistic either for surge or for tsunami? What are we going to set? So if they come and they're flooded. So they go back. They go "Maybe I was wrong. Maybe I should do a probabilistic one now."

They go back and do a probabilistic one and they get all these return probabilities and frequencies and stuff. Which one is acceptable to say that that's their design basis storm surge or design basis tsunami.

DR. CHOKSHI: I think there are couple of reasons why we did not include explicitly. First of all, this is all in the framework of current practice. And current practice in a flood, except for combined events, does not have accident probability. So in order to put through, we probably have to go through a better process with the stakeholder.

And I think when we go to Reg Guide 1.59 that's where it's to introduce something new in a property. So I don't think it was inherent. But we haven't gone through that process and have it looked at by everybody whether that is the --

The other thing is that I think this requires a little bit more thought. In the seismic we have directly related to a performance target. And what is I think missing here is the center part, the flood protection part. What are condition probabilities?

For us to decide, if I define an acceptable target, if I had a better sense which I do in seismic. And if you talk about internal assessment the qualities of the protection is a totally different animal.

So do I want to meet my target by placing all the probabilistic weight on to the hazard side or is there a mixture of that? I think those kinds of questions need to be thought through before we set a target. That's one of the reasons to -- The thought is that when the people come up we'll have to look at it basically case-by-case. Is there something here coupled with some --

MEMBER SHACK: And practical guide. I can design to a 10^{-6} flood. I can't design to a 10^{-6} earthquake.

DR. CHOKSHI: Exactly.

MEMBER STETKAR: You can design to a 10^{-7} high wind though, can't you?

MEMBER SHACK: Yes.

DR. CHOKSHI: And it's again how the practices evolve. Like in the seismic people will still have inherent conservatisms. That's the community. That's how it designs. We want to give it whatever design basis you give it. Then we'll have a certain mindset.

In the flood I think there is not that community practice there on the protection side. Because it's very, very unique, plant specific, site specific. So we need to think through that process and say "that makes sense." Because the next question will be why seismic is 10^{-4} and flood is 10^{-6}.

I need to better answer that question. Yes, I can do it. That's one answer, but. So that's sort of in a very broad sense.

MEMBER SHACK: It's better if it's possible.

DR. CHOKSHI: It's to you need to face this problem. And I think we want to face it in the right framework. So that's basically not to include a --

DR. JONES: And my last slide is a schedule. We're on track. We're going to finish up today actually the public comments and revisions to

the ISG. The NSW passed on OGC and go through the process. But we're on track so far.

Any other questions?

(No verbal response.)

CHAIRMAN SCHULTZ: Thank you.

MEMBER SHACK: You're not going to ask that question now, Nilesh. But if somebody comes in you're going to have to make a decision.

DR. CHOKSHI: We'll have to make a decision. And I think we can come back because there are many other factors which you have to consider particularly. The two parties very different and I think he said that we were adequate seismic. The conceptual framework is there, actual application and how you look at results may be quite different because of the margins and other issues.

Shall we move on?

CHAIRMAN SCHULTZ: I would like to take a break now.

DR. CHOKSHI: Okay. I was hoping you would say that.

CHAIRMAN SCHULTZ: A break is good. The break is 15 minutes please. Off the record.

(Whereupon, the proceedings in the foregoing matter went off the record at

3:05 p.m. and went back on the record at 3:22 p.m.)

CHAIRMAN SCHULTZ: We're back in session.

And with that, we are going to resume with a presentation by Michelle Bensi associated with the Interim Staff Guidance for the integrated assessment of external flooding, which we have been anticipating for the afternoon. So, welcome.

DR. BENSI: The much-hyped integrated assessment.

CHAIRMAN SCHULTZ: Yes. We look forward to the presentation. Thank you.

DR. BENSI: Okay. Thank you very much. All right. So, as mentioned, we are going to get rolling here with the integrated assessment.

Just to remind ourselves where we are within sort of the bigger picture here, some context, this comes after the performance of the hazard reevaluation. So it's sort of why we structured the presentations as they have been, where Henry went first talking about the hazard, because chronologically that comes before where we are at this point, which is the integrated assessment.

And in a moment or two, I'll talk about, when is an integrated assessment needed? What is the

trigger for this particular activity? So this is where we fall in terms of the chronology of it.

So what is the purpose of the integrated assessment? This question, what is the integrated assessment? And the integrated assessment is what we have defined it to be. It is an evaluation of the total plant response to external flood hazards, so this considers both the protection and mitigation capabilities of the plant under flood hazards.

And I want to take a moment here and sort of, you know, get our terminology right, what we mean by "protection and mitigation," because in the context of this ISG, you know, there is often some confusion about -- until you read the ISG -- what we are talking about here.

So protection is keeping water out of where you don't want it, so flood walls, seals, sandbag barriers. And even the stuff that goes along with it can be considered protection, active components that are used to handle leakage that is coming through barriers. This is flood protection -- keeping water out of where you don't want it.

Mitigation is, how can you respond when you have water where you don't want it? So it's the ability to maintain key safety functions in the event

that a flood protection feature fails or you don't have flood protection.

So just so we understand sort of the paradigm under which we are working, protection and mitigation. And the integrated assessment uses all available resources that can be leveraged with appropriate justification.

So the goal of the integrated assessment is to evaluate the effectiveness of the current licensing basis against the new hazard based on -- that was calculated based on current regulatory guidance. And what we want to do is identify plant-specific vulnerabilities and other important risk insights, and that is defense in depth, available margin, cliff edge, those sorts of concepts. We want to identify those.

And then, we want to assess the effectiveness of any new or planned flood protection to provide -- or, excuse me, protection or mitigation equipment that may be put in place in response to the reevaluated hazard.

So a word about the scope of the integrated assessment. It considers full power operations and other plant configurations that could be susceptible due to the impairment of flood

protection features. It includes the flood-induced loss of ultimate heat sink, "flood-induced" being key there. We are not talking about other losses of ultimate heat sink. This is just something that is caused by the flood.

The integrated assessment is intended to evaluate the effectiveness of flood protection and mitigation for the plant modes of operation that the plant is expected to be in the entire flood event duration.

And this is a good point for me to just take a moment to say, what do we mean by the "flood event duration"? This is actually something that is quite important in the integrated assessment.

The flood event begins when you have sort of a condition that requires entry into a procedure at the site. So, you know, forecast that a storm is coming, notification of a dam failure, or potentially it could be arrival of water onsite if there is no warning.

So this is the initiation of a flood event, and the flood event -- and it carries through, all of the preparation, the period of inundation, and does not end until two conditions are met. That is, the flood waters have receded from the site, and the

plant is in a safe and stable plant state. And the reason we did that is to capture both Fukushima and Fort Calhoun.

So Fukushima, the water came, the water went, and the plant was still not stable. So we want to make sure we capture that. And Fort Calhoun, the water came and stayed, and so the event does not end until that water is gone. So just a note there about what we're talking about. This is looking at the entire flood event duration.

Did you have a question?

MEMBER STETKAR: I did. Back up to the first -- no, on this slide, the third sub-bullet under the first bullet.

DR. BENSI: Yeah.

MEMBER STETKAR: You're talking about floods, and everybody likes to think of floods being more water than I need or want.

(Laughter.)

DR. BENSI: Yes.

MEMBER STETKAR: We talk about the evaluation -- analysis of dam failures, for example, that can lead to more water than I need or want. Dam failures can also lead to a lot less water than I need. So where in the whole context of this

evaluation do I look at failures of impoundment dams, downstream dams, and things like that that, for example, remove my ultimate heat sink?

DR. BENSI: In the context of the integrated assessment, if it was induced by flood, so a flood --

MEMBER STETKAR: Oh, no, no, no, no. I didn't say that, did I?

DR. BENSI: Then, we're -- that's in this.

MEMBER STETKAR: I didn't say that.

DR. BENSI: Other activities that are not related to a flood event are not within scope, and they are a Tier 3 activity.

MEMBER STETKAR: Why are they not in scope, if I need to do the same evaluation of very similar dams? Suppose along the same riverine system that could lead to either too much water or too little water. I really don't understand why this disconnect exists.

DR. CHOKSHI: I think there are different pieces, you know, for -- here, for the flooding, you need to keep it. Otherwise, you are not analyzing proper sequence. You may have both flooding and the loss of ultimate heat sink.

MEMBER STETKAR: I understand about the

wall of water coming down the river that takes out all of the dams, but --

DR. CHOKSHI: Now, the other way of losing ultimate heat sink, accident sequences that are being addressed in the other part of the Fukushima activities. There is a whole --

MEMBER STETKAR: My big question is: why?

CHAIRMAN SCHULTZ: Right. Just in terms of the mechanics, if nothing else.

DR. CHOKSHI: Yeah. I mean, because of, you know, the -- it's not only a flood problem. It is -- you know, you can lose UHS in several other ways. And then, and the thing you would analyze with the loss of UHS, you know, as it -- because this one is only looking that the flooding is induced accident sequences.

MR. WIDMAYER: John, I think it kind of had to do with when they needed some stuff to get done.

MEMBER STETKAR: Yeah.

DR. CHOKSHI: But that's between --

MEMBER STETKAR: I understand that, but in some sense I'm trying to understand why the industry is being asked to jump through, in many cases, the same hoop twice.

MR. WIDMAYER: Well, in this case, it's sort of self-induced. I mean, they are really the ones that limited it, if I'm saying it correctly, to --

DR. CHOKSHI: The Fukushima program was defined, you know, that was the -- so we had started with that, there is a loss of ultimate heat sink, I don't remember of which number, and then, in fact, the argument was from industry, why at all you are including here? And we said not to include flood-induced loss of UHS in the flood analysis doesn't make sense. So we got that -- it was negotiated position.

MEMBER STETKAR: Okay.

DR. BENSI: Okay. So we are sort of -- we are still here on this, what the integrated assessment is supposed to do, and it is supposed to look at, you know, the plant response under the modes of operation that the plant is expected to be in for the flood event duration.

So this may include notification of the impending flood and then the subsequent shutdown of the plant before the arrival of flood water. So it is not limited to sort of this at-power condition because of the nature of the flood events.

We do ask for, you know, descriptions of

the expected plant response under other modes and configurations, and whether or not vulnerabilities arise under these conditions. So this would be our flood features bypassed or defeated due to maintenance or refueling -- during a refueling outage. Are you opening things up such that, you know, flood barriers are defeated, for example?

So while we are focusing on what you are expected to be in for the flood event duration, we do also look at some of these other modes or configurations that could present vulnerabilities during a flood event.

All right. This is the trigger, so we have -- we have shown these flowcharts where the integrated assessment comes after the hazard reevaluations, but not all sites need to do an integrated assessment. So up there at the top box you see the entry of the hazard information.

And then, what is necessary is a comparison of the new hazard versus the old hazard, and looking at whether or not the new hazard is bounded by the old hazard. And by "old hazard," I mean the design basis hazard for the site. And they compare these two things. And if the new hazard is bounded by the old hazard, they don't need to do an

integrated assessment.

And we are not talking just about flood evaluation. So the intuitive thing is, okay, if the old flood is bigger than the new flood, okay, you know, that's clearly bounded. But we are also talking about what we call associated effects, and these are wind, waves, and runup, the hydrodynamic forces, including debris, sediment deposition and erosion, concurrent weather conditions, groundwater egress. All of these associated effects have to be bounded by the design basis. And if they are not, then you move forward into doing the integrated assessment or --

MEMBER ARMIJO: Have all of those same effects that you just mentioned been addressed or included in the old design -- in the original design?

DR. BENSI: Not necessarily. It could be comparison against the null set.

DR. CHOKSHI: Or, for example, like dynamically reject mineral travel. But depending on what level they are resumed, it may still --

MEMBER ARMIJO: But they are part of new reactor reviews.

DR. BENSI: So if there is no bounded, we have a couple of special cases where we said, "Okay. You can do something, you know, an abbreviated review,

not a full integrated assessment, an abbreviated review."

So moving from the second decision box down to the -- excuse me, the first decision box down to the second decision box, it asks, "Is the only thing that you haven't considered before site drainage or local intense precipitation?" Many sites did not consider this. Older sites did not consider this memo.

So if this is the only thing that is not bounded by a current design basis, you can go to this abbreviated review where you evaluate just your site drainage using some guidance that is in the integrated assessment ISG, as well as the existing standard review plan. You can submit this evaluation with the hazard report, and you don't need to go into the "full integrated assessment."

You always have the option to take the full two years under the integrated assessment, but this is -- it's out, it's a little easier. If that is not the case, we ask one more question, which is, "Is all of the flood protection permanent and passive?" as in, it doesn't involve closing of doors, any sort of manual actions to implement, no temporary barriers. It is all in place and passive equipment.

If that is the case, the flood protection can be evaluated using certain pieces of the integrated assessment ISG as part of an abbreviated review. Likewise, that review is submitted with the hazard report of -- the hazard evaluation and does not require going into the integrated assessment in full as we are talking about today.

And I should caveat that there with the fourth decision box, in which case they have to demonstrate that flood protection is reliable and has margin, and that is going -- that is a term that is going to have some meaning as we step through the ISG.

So I guess the big picture here is, generally, new hazard bound, old hazard -- or old hazard bound, new hazard, so old is bounding of the new. No integrated assessment required. Everybody else has to do an integrated assessment, except for these couple of special cases where we allowed for an abbreviated review as opposed to a full-blown integrated assessment that we will be talking about today.

So this is a graphic sort of showing -- to show a high-level overview of the integrated assessment process. The hazard evaluation information done under the Recommendation 2.1 hazard reevaluations

enters at the top there into the processes as an input to the process.

Most sites, or many sites, have flood protection that they have onsite, and so sites that have flood protection would need to evaluate that flood protection, so they would do an evaluation consistent with the guidance that we have provided.

Two things can happen as a result of that evaluation. First, they can demonstrate, based on performance criteria, that the flood protection systems are reliable and have margin, in which case they need to document and justify this, and they are going down the left-most arrow there in this figure, and they're done.

The sites that have flood protection may find that under the new hazard information that the flood protection is not reliable or does not have margin, and that there is the potential for water to effect SSCs important to safety. If that is the case, then they proceed to something -- to evaluation of their mitigation capability.

Once again, mitigation is the capability to maintain key safety functions, given the failure or lack of flood protection. And then, after the evaluation or mitigation capability, we roll right

into the results there.

On the far right-most arrow there are some sites that do not have flood protection, and they allow water to enter buildings that house SSCs, either by procedure or design. You guys have probably heard of some of those sites.

And if that is the case, obviously, there is no flood protection to evaluate, so the red box is not applicable, and they move directly into the evaluation of their ability to maintain key safety functions given that that water is now onsite and potentially inside these buildings. So --

MEMBER SKILLMAN: Where is the definition of the hazard evaluation? Where is that term and its extent defined?

DR. BENSI: The hazard evaluation is the hazard report or the hazard reevaluation that is performed in response to Recommendation 2.1.

DR. COOK: In Recommendation 2.1, if I may, you know, there was a figure that I showed at the very beginning. There are boxes, and there are also due dates. It is a very well-defined metric. Each licensee was prioritized into one of three year bins -- March 2013, March 2014, March 2015. And that is the hazard review. And so they are going to be

submitting to that.

And so it was very clear in the 50.54(f) letter that there is a hazard review, and then, based on the results of that hazard review, you then would also provide some interaction actions that you may want to, you know, tell us about. And then, also, based on those results, you would then need to go in and do an integrated assessment. So that is drawn directly from the language that is there in the 50.54(f) letter.

MEMBER SKILLMAN: Just to calm my beating heart, let me give you, say, three examples.

DR. COOK: Sure.

MEMBER SKILLMAN: I understand Bonneville, and I understand the plants in the northwest. B&W tried to build a plant up there, and loss of Bonneville was one of our design basis tests. I understand Joe Cassie and its, if you will, threat to the --

DR. COOK: This was right outside of Portland.

MEMBER SKILLMAN: It's up on the Columbia River.

DR. COOK: Oh. Yeah, yeah, yeah. I was out at Hanford and PNL for eight years.

MEMBER SKILLMAN: And so failure of Bonneville in so many hours to the plants that are up there.

DR. COOK: Okay.

MEMBER SKILLMAN: Joe Cassie the same, to Oconee.

DR. COOK: Right.

MEMBER SKILLMAN: You probably saw The Fugitive. That's Nantahala, and Teleco is right next to it. And those feed Tennessee, that ultimately find their way to Browns Ferry.

DR. COOK: Yeah.

MEMBER SKILLMAN: And so how should we think about subsequent dam failures, particularly subsequent, where you've got a couple of large impounds that are several hours away, but those are large, large reservoirs? So how do we get up to the blue box --

DR. BENSI: Those would --

MEMBER SKILLMAN: -- when we think --

DR. BENSI: -- be part of the hazard reevaluation performed under the Recommendation 2.1 reevaluation.

DR. CHOKSHI: The dam white paper we talked about --

MEMBER SKILLMAN: That's why I asked the question about the dam white paper.

DR. CHOKSHI: According to this cascading failure and how do you define how far you have to go out, how -- you know, what -- it is cascading. Again, it depends -- you know, you have to look at the different sequences, and Chris can tell you. So you have to look at all of the permutations --

MEMBER SKILLMAN: The quick answer is, "Hey, it's in the dam failure white paper."

DR. CHOKSHI: It is part of it.

DR. COOK: Well, but the quick answer, too, is it's part of our standard review plan, Section 2.4.

DR. CHOKSHI: It's a combination of --

DR. COOK: It is part of our review that we do when we look at it is the cascading or domino failure as it comes down, because some dam -- a dam that is upstream could fail, but the reservoir downstream, given the conditions, could handle that additional volume.

You could have Grand Coulee, and Grand Coulee then takes out Chief Joseph, and it goes all the way down the stream, and eventually takes out Bonneville perhaps, you know, as that goes all the way

down. And so you can have that as well.

So it all depends on which ones you are looking at, how much time you have.

DR. CHOKSHI: I think in this -- I am familiar with one of the cases in Europe, that they were planning a downstream dam and the worst condition is that one upstream dam fails and downstream dams are wide and it floods back the site. So you need to look at all kind of back area, you know, so -- so, yeah, I think -- but it's part of the process. Short answer.

DR. COOK: And it is part of the hazard review.

MEMBER RAY: I've got two questions as long as we're stopped here for a second. We've been talking about dam failure leading to flooding. It is not what you are doing, I know, but dam failure, in and of itself, can lead to loss of heat sink as well. Is that part of the work that is being done, or is it separate, or is it --

DR. COOK: Well, I sort of wanted to go back -- Dr. Stetkar was also talking about the same thing. I mean, we had had sort of the thing -- and I want to try -- I mean, there were lots of discussions within the Steering Committee about what we were looking at, and there are some situations where you

have a nuclear powerplant and you have a dam close by. That dam that is close by impounds a reservoir, and that reservoir serves as the ultimate heat sink for that plant.

One of the situations when they were deciding whether it was in or not was, as a hydrologist looking at it, if we are looking at this cascade of failures coming down this river, and suddenly it comes into that reservoir, to not look at that reservoir that impounds a UHS doesn't make any sense.

You have to look at that situation as well. You can't just ignore it, whether it's the UHS or not, because if that dam fails, you end up with one water level at the site. It may be negative because you use the UHS, but it is positive because you don't flood the site. If the dam stays --

MEMBER RAY: Well, I'm asking a much more narrow question, and that is, I assumed looking at dam failures that there was a set of ones that we were examining, and so on. And flood of the site is the principal reason we would do that. I was just asking a simple question: are we also looking at failures that would result in loss of heat sink?

DR. COOK: Yes.

MEMBER RAY: Okay. So the answer is yes.

DR. COOK: Yes.

MEMBER RAY: I understood the answer before, but I just wanted to affirm that simple thing.

DR. COOK: If the UHS is lost because of a flood, it's part of this.

MEMBER RAY: Yeah. And that may be the only risk to the plant. There may not be any upstream failure that would be threatening.

MEMBER STETKAR: Harold, in clarity, they are not looking at only failure of the downstream dam taking away the UHS. They are not doing that.

MEMBER RAY: I assumed that there was somebody looking at dam failures for either purpose, and that's all I wanted to affirm to be the case. For either reason, since dam failure is a dam failure regardless of why.

DR. BENSI: There's activities going on under the -- post Fukushima. There is also a proposed Generic Issue on --

DR. CHOKSHI: But the plant is a real question. Okay? This comes into play, too. What is the flood we talked about here? Now, in some cases, the flood -- you know, the ultimate heat sink is a Category 1 facility, whatever it is.

So if you are -- during the seismic review, the seismic failure is going -- is in there. You have to look at that.

DR. COOK: It is in the seismic part of Recommendation 2.1, because it's a seismic Category 1 structure. And so seismic 2.1 picks -- it's complicated.

MEMBER RAY: I wish that were true, but let me go on to another subject. Watts Bar is a wet site. Is there any consideration given to criteria -- in other words, it will flood, but they take protective action ahead of time, as you tell us now. Is there any idea that that might be done at other sites subject to flooding?

DR. BENSI: Do other sites take those types of -- take actions, is that what you're --

MEMBER RAY: Well --

DR. BENSI: -- to the temporary barriers, for example?

MEMBER RAY: Well, actually, shutdown and --

DR. COOK: Yes. Oh, yes.

DR. BENSI: Oh, yes. That's not an anomaly.

MEMBER RAY: That's not unique, in other

words.

DR. COOK: Oh, no. And that's part of the integrated assessment, which hopefully we are answering your question on.

MEMBER RAY: Okay.

DR. COOK: And you know what it is, you know, is -- as you go through is to look at all of those things. It's not just to shut it down. It is also to maintain shutdown.

MEMBER RAY: Yes, right.

DR. COOK: And so that whole process is looked at through this integrated assessment.

DR. BENSI: And we'll go into more detail on that.

MEMBER RAY: The way the discussion had gone earlier, it sounded like flood level being above the design flood level that was maybe -- one solution to that might be to implement a Watts Bar-type strategy --

DR. COOK: Oh, yes.

MEMBER RAY: -- at least in principle.

DR. COOK: Oh, yeah.

DR. BENSI: I don't know what you're --

DR. COOK: The integrated assessment allows you a framework to analyze it and to look at it

and to see how reliable it is.

MEMBER RAY: All right.

DR. BENSI: All right.

MEMBER SHACK: My curiosity is killing me. Who lets the flood waters into the building? Is this Turkey Point and it's open deck or --

DR. CHOKSHI: There are --

(Laughter.)

MEMBER SHACK: Do they have a drain at the bottom or something, or they -- okay.

DR. BENSI: All right. So this is just a moment -- and this is just a stop here real quickly. It's sort of a broad-level overview of the content of the IHG when we talk -- you know, there information about framework and peer review and the hazard definition and flood protection and mitigation, and then we have appendices on protection and manual actions.

And the reason I stop here is actually to point out sort of the interdisciplinary nature of the integrated assessment, and also have a moment to talk about the interoffice team that worked on this. We had people from -- PRA experts. I know Jeff and Fernando are back there. We had human factors and HRA, Undine, et al. Jake Phillip worked on some flood

protection stuff. Tom Nicholson was involved. And Dave is here, who is also a human factors person.

So we had a lot of expertise coming together, because the nature of this assessment is extraordinarily interdisciplinary. You know, it really draws upon a lot of different areas of expertise. So I guess that was the point of the slide was just to sort of give an overview of how diverse these assessments really are. And if I missed anybody, sorry.

All right. So to set the stage for -- before we start going through the details of the framework itself, just stop here to talk about some of the key assumptions of the integrated assessment. These are rather important.

So we talked about -- I talked about before our overall philosophy being sort of arrive at risk-informed insights, and of course this is to facilitate our eventual Phase 2 decision-making in terms of if additional regulatory actions are necessary.

So sort of a -- in that sense, the integrated assessment allows the use of all available resources for both protection and mitigation. So credit can be taken for onsite and offsite resources.

This includes systems -- using systems, equipment, and personnel in non-traditional ways, using temporary protective features and mitigation equipment, using non-safety-related, SSCs.

So these -- with appropriate justification, these can be credited as part of the integrated assessment. However, it is necessary to account for the potentially reduced reliability of these types of equipment or measures relative to in-place safety-related equipment.

We have also recognized, as you guys all know, the parallel activities that are going on related to Fukushima lessons learned. And we recognize that some of this equipment and the analyses that have been done could likely be utilized to respond to the reevaluated flood hazard.

What is important -- we make the important distinction that in crediting these resources it is necessary to demonstrate that having these resources and meeting any associated guidance that goes with them meets the intent of this ISG, because there are different purposes.

We are looking at, you know, the appropriateness of something for responding to design -- beyond design basis event versus the acceptability

of the design basis itself. These are two very different questions. So we recognize these things are ongoing. We allowed the, you know, things to be leveraged, but with the caveat that it has to meet the intent of this ISG.

The second key assumption is -- and this rolls right out of the -- of Henry's talk, that we recognize that for many flood mechanisms that widely accepted and well established methodologies were not available for assigning initiating event frequencies to severe floods. And these are the floods that we're talking about in terms of the design basis of nuclear powerplants.

So while these widely accepted methods are certainly available for, you know, shorter return period flood events, that for the types of events we're talking about there is not really a community of practice for many flood mechanisms. And as a result of that, the integrated assessment does not require the computation of initiating event frequencies.

We also do not allow the use of initiating event frequencies to screen out hazards in lieu of an evaluation as part of the integrated assessment.

You know, that being said, with appropriate justification, we do allow use of

initiating event frequencies as part of a PRA. If that -- if an external event PRA option is exercised, we don't require that. But we do not want to preclude the use of PRA as part of the integrated assessment, and hopefully that will come out when we start talking more about the actual guidance.

And then, the other importance of that last bullet there is that we want -- you know, as the community -- as the state of practice evolves and matures, we want to make sure that this guidance remains durable and can leverage those changes and improvements to the state of practice, if and when and as they happen.

And this would be, you know, a good place to plug that workshop that is coming up here in January on flood, you know, frequencies, and as things come out of those types of exercises, that they can be leveraged in the integrated assessment.

The last major key assumption is the importance of human performance within the context of flood events. They take on a great deal of importance in flooding events. You know, in response to flooding, you know, there is the establishment of flood protection features, you know, constructing sandbag barriers, deploying pumps, you know, moving

equipment. These all rely heavily on manual actions.

It can also be associated with event mitigation, you know, taking averages, taking action that leverages equipment, portable pumps, et cetera, and maintaining key safety functions.

There is also things that are probably a little more analogous to what you may have seen in fire in the sense that, you know, there could be failed or degraded instrumentation and controls that affect operators in the control room, or local panels may be affected as well.

So manual actions become very, very important from the context of flooding, and that is a key assumption and a driving factor in a lot of the guidance that we have provided. And --

MEMBER STETKAR: Are you going to talk a little bit more this afternoon about that guidance?

DR. BENSI: Yes.

MEMBER STETKAR: Okay.

DR. BENSI: That's what this -- yeah. That's where we're rolling right now.

MEMBER STETKAR: Good.

DR. BENSI: Appendix C, yes, we can -- yeah. And we've got some -- we've also got some folks in the audience that -- if we need additional help

that we can rely on.

So now we are actually getting into the guts of the integrated assessment ISG. What we are going to be talking about today reflects the ISG as issued, not the ISG pre-public comment. So this already reflects our resolution to the public comments that we received.

So at the end of the presentation, we will talk about some of the comments we received, but we have already implemented our resolutions to those in what you are going to be seeing here.

So the integrated assessment consists of up to five possible steps, depending on site characteristics. Some things are either not applicable or not necessary for some sites. All sites, though, start with a definition, establishment of an initial peer review scope, an initial peer review team. This is something we will talk about a little bit later. We have an appendix on peer review.

All sites must define the controlling flood parameters. If they have flood protection, they need to evaluate that flood protection. If flood protection is either inexistent or not reliable or does not have margin, if necessary, to evaluate mitigation capability, and then of course there is the

1 documentation of results.

2 So we consider peer review to be an

3 important component of ensuring technical adequacy.

4 It will help increase our confidence in the results of

5 the assessment and help us know that we have a sound

6 basis for any subsequent regulatory actions.

7 We use a graded peer review approach as

8 part of the integrated assessment where the scope of

9 the peer review is dictated by what actually has to be

10 done as part of the integrated assessment. There is

11 a lot of diversity -- site-to-site diversity, so the

12 integrated assessment needs to be very, very flexible

13 to accommodate this diversity. And, correspondingly,

14 the scope of the peer review needs to change with the

15 scope of the assessment itself.

16 The number of peer reviewers that are

17 necessary is dictated by this scope. We do allow the

18 selection of peer reviewers from within the licensee's

19 organization, if they have the appropriate attributes

20 that we have outlined in the ISG. Otherwise, we do

21 say that external peer reviewers are required.

22 And though we do encourage an in-process

23 review, it is not required. So --

24 MEMBER BROWN: "In process" means you all?

25 DR. BENSI: "In process" meaning that the

peer reviewers are involved from beginning to end.

MEMBER BROWN: Oh, okay.

DR. BENSI: Contemporaneous. So instead of waiting 'til the end and looking at the final product, yeah. So we encourage that, but we do not require that.

MEMBER POWERS: Yeah. But it's -- the problem with these analyses is post facto review is too superficial. And you really -- the only way to do it right is to have an in-process peer review panel looking at it as you go through it. I mean, it really -- these things -- they are so superficial, the reviews, otherwise.

DR. CHOKSHI: Exactly. And I think that the lessons we learn from IPEEE and everything else, at that point nobody has the time or resources to go back and redo something, you know.

MEMBER POWERS: That's right. That's right. Nothing insightful really emerges. I mean, you find out that you made some typographical errors at most and --

DR. CHOKSHI: Something, yes.

MEMBER POWERS: Yeah. I mean, if there's anything that comes out of these things it's in-process peer review is really the most valuable thing

you can possibly have. The other thing that is nearly always a problem in these is picking the peer reviewers. You don't get -- you tend to take people from the same club, and you don't get the guy with the wild-ass idea that might be right.

DR. BENSI: So Step 2 is the identification of flood scenario parameters. And what this is is taking that information that came out of the Recommendation 2 on hazard reevaluation and distilling it down into the parameters that define the flood hazards. So flood height and these associated effects you talked about -- wind, waves, and runup -- and dynamic forces such as debris, sedimentation, and erosion, et cetera, and defining these sets of parameters that need to be considered as part of the integrated assessment.

For some sites it is actually going to be necessary to consider multiple sets of these parameters to capture the different hazard effects associated with different hazard mechanisms. If we can imagine one particular -- you know, a site could be subject to just a PMP event where you have -- you know, slowly evolving where the water, you know, sort of comes up in a slower manner, maybe associated with more warning time, but the water gets really high, for

example.

On the other hand, that same site could be subject to potential dam failure. Where the warning time may be significantly reduced, the resulting flood may be more energetic with larger dynamic forces. And the duration could be very different. That water could come and go versus an event where the water sticks around longer.

So these events, while one may have higher water level, for example, one may be associated with larger dynamic forces. So it may be necessary to consider these things separately and evaluate -- perform the evaluation under these different sets of parameters. And we specified that in the ISG.

Alternatively, we do a lot of the option of selecting an enveloping scenario, where you take the highest water level, the shortest warning time, the longest duration, the worst dynamic forces, and create a single scenario that is considered as part of the integrated assessment.

The other thing that is probably also important to note, it's not just the hazard characteristics but also the plant response. For some of these hazards that -- you know, if you had a flood with very short warning time, the plant may be in a

very different plant mode or state or configuration relative to an event that had a lot of warning time such that the plant could comfortably shut down at a very normal cooldown rate and get to a more safer state before the arrival of flood waters onsite.

So those sorts of things may need to be considered separately as part of the integrated assessment.

All right. So we come next to this decision box here. And this is very similar to what we had talked about previously on that figure that had the colorful boxes where we said some sites do not have flood protection, so, obviously, they have nothing to evaluate if they don't have it.

So this asked the question: does water enter buildings by procedure or design? The answer is no. In that sense, you have flood protection. One moves on to evaluating that flood protection. Otherwise, moves on to evaluating mitigation capability.

So the flood protection evaluation is performed to evaluate the capability of the site flood protection to protect SSCs important to safety from flood height and associated effects. So those other things in addition to the water surface elevation for

each set of those flood parameters that were defined in the previous step.

This is done by evaluation against qualitative and quantitative performance criteria that we have laid out as part of the integrated assessment ISG, things like evaluating the structural integrity of a barrier using present day codes and standards, for example.

And then we asked -- is for justification of the flood protection, the robustness of the flood protection. And we also asked for documentation of available margin. So if the flood protection is shown to be reliable or justifiably reliable and have margin, we ask, for what is that margin? And we ask it with respect to physical barrier dimensions, which is probably the most intuitive margin that one would think of with flooding.

But we also ask for it with respect to structural or other performance capacity. And also, with respect to time and staffing associated with performance of manual actions. So we ask for this margin in a lot of different ways as part of the integrated assessment.

MEMBER REMPE: Just out of curiosity, I mean, you've got a very detailed process here for

people who go through the integrated assessment. For the people who -- and maybe you interacted enough with the plants to already know that no one is going to try and say I don't need to do it, but for those folks, do they have such a well-established process on how they will try and justify to say they don't need to go through the process?

DR. BENSI: As it is set up, if the site's current design basis bounds the reevaluated hazard --

MEMBER REMPE: But we already talked about --

DR. BENSI: -- they're done.

MEMBER REMPE: -- your earlier thing saying that, well, they may not have considered everything, and they are going to try and justify that what they considered -- if they didn't consider some things, still covers the other things. And do they have to justify that the -- like right now with all of the --

DR. BENSI: Yeah.

MEMBER REMPE: -- you talked about the dimensions of the barrier and its capability with sand and --

DR. BENSI: Yeah.

MEMBER REMPE: -- are you going to go

through that level of detail with the folks who try and get out of it?

DR. BENSI: And I rolled back to this one, because there is only those two special cases in which if the new hazard -- if the old hazard doesn't bound the new hazard that you don't have to form -- perform a full integrated assessment. And in both of those cases, we have specified that you still need to use parts of this ISG.

MEMBER REMPE: So they will still have to go through that level of detail if they are trying to --

DR. BENSI: Yes.

MEMBER REMPE: -- flood protection is permanent --

DR. BENSI: Yes. So in this third diamond down here where they say, yes, they have flood protection that is permanent and passive, so they are going to try and do an abbreviated review, we asked this question, is the flood protection reliable and have margin --

MEMBER REMPE: Per the same thing.

DR. BENSI: -- per the ISG.

MEMBER REMPE: They will have to go through that same process.

DR. BENSI: Per the ISG.

MEMBER REMPE: Okay.

DR. BENSI: And they are only going through part of the ISG.

DR. CHOKSHI: I think the --

DR. BENSI: Specifically, the section which relates to flood protection, so they evaluate it.

DR. CHOKSHI: The distinction here is that that -- let me give a physical example. If I had a wall which protects my site from the flood, it's 10 feet high. I calculate new and the flood design was eight feet originally. I still get, say, seven or eight feet from the new, but now I have a two-feet dynamic effects.

My wall very well may be capable of taking the additional load. And if that's all you need to show, that comes into this process. There is no reason time-wise to do -- go through this -- all of the steps of integrated assessment. But you can supply that analysis to say that you have a capability. that's the --

DR. COOK: And it also allows it to come in -- instead of also waiting for two years, a licensee may decide that, you know, if we -- if it's

just a wall that we are evaluating, we already have our wall pretty much done. We are going to submit it. We are going to get done, and we are going to step out of the --

DR. CHOKSHI: -- definitions.

DR. BENSI: Yeah. But --

DR. COOK: It was in no way to abbreviate it to the point where they didn't have to do all the parts that they would need to do.

DR. BENSI: And actually -- and it is actually -- we did pull this out, but in many ways we look at this figure. This is almost what they would be doing as part of the integrated assessment anyway. If they were counting on that same wall, they would enter the process, they would evaluate, and they would be done anyway.

So in some ways it is -- it does facilitate not having to enter the integrated assessment process, but by specifying down here that they have to use the appropriate parts of the ISG anyway, we still -- you'd still ensure sort of a systematic and rigorous look at it.

DR. CHOKSHI: Following the simple elements of your question, for some cases plants -- this integrated assessment is this much work, for some

this much work. So, but the guide defines all of the scope.

MEMBER REMPE: Okay.

DR. CHOKSHI: Right.

MEMBER REMPE: Okay. Thanks.

DR. BENSI: So, yes.

MEMBER REMPE: Sorry to sidetrack you.

DR. BENSI: Yes. So the answer in the end was yes.

MEMBER REMPE: Okay.

DR. BENSI: Okay. So based on the results of that evaluation, we asked the question, you know, have you demonstrated that the site flood protection is reliable and has margin? And if that is the case based on comparison against this performance criteria we have laid out, then, you know, you're done. You go to the documentation of flood parameters, and of course you have to perform, you know, the peer review.

If it is not, it is necessary to go to the -- move on to the evaluation of mitigation capability. There is also a step in here I want to point out, that when flood protection is -- cannot be shown to be reliable and have margin, we don't just stop at saying, "No, it doesn't."

We ask, "Well, what flood elevation and

under what associated effects do you have -- or are you reliable?" so that at least we have some idea of what is the sort of inherent capacity of your flood protection systems as they stand.

So, you know, and just saying, "Oh, they weren't any good" is not enough. We want to know -- we want to know when they are good. So that is specified as part of the process.

DR. COOK: And that is sort of -- to sort of add on to the -- the response from the integrated assessment leads into that Phase 2, the regulatory decision. So having that information all together will then, however it comes out, will then help us to make a better decision at the end with Phase 2, and that was the thinking behind it.

DR. BENSI: Okay. So moving on to this evaluation of mitigation capability, so -- I said it a couple of times. Mitigation capability is this capability to maintain key safety functions in the event that the flood protection system fails or is a result of the fact that it cannot be shown to be reliable and have margin, or in the event that the flood protection system -- or the site does not have flood protection system under the flood conditions that we're thinking about here.

Mitigation capability needs to be evaluated for credible flood protection failure modes, including concurrent failure. So if flood protection in Building 1 is jeopardized, as well as Building 2, those flood protection failures -- simultaneous or concurrent flood protection failures -- have to be considered, and the loss of the equipment need to be considered concurrently in terms of evaluating the plant's capability to mitigate that.

We lay out three potential methods for demonstrating or evaluating mitigation capability depending on site characteristics and the information that is needed for the decision-making. They are referred to as the scenario-based evaluation or margins-type evaluation, and then there is a full PRA action.

One can think of this as sort of an HHA kind of approach here where there is an increasing level of realism, decreasing level of conservatism associated with moving from a scenario-based evaluation to the full PRA. So scenario-based is intended to be the most conservative and full PRA intended to be the most realistic options for performing this evaluation.

So the scenario-based evaluation --

MEMBER CORRADINI: Can I ask a question?

DR. BENSI: Yeah. Absolutely.

MEMBER CORRADINI: So do you have an anticipation of how many are going to get to the diamond number five with a no?

DR. BENSI: As in they have to go into this evaluation and mitigation capability? I don't know if we have an estimate on that. Judging --

MEMBER CORRADINI: If the answer is you don't, you don't. That's fine.

DR. BENSI: But it was something that we interacted with industry a lot on developing, so there is definitely an interest in this particular step. So --

MEMBER CORRADINI: Thank you.

MEMBER SHACK: You know, there are plants, right?

DR. BENSI: Absolutely.

MEMBER SHACK: There is at least one.

DR. BENSI: I don't -- yes. Yeah.

DR. CHOKSHI: There are more than a few.

DR. BENSI: Yes.

MEMBER REMPE: In your interactions with industry, did most of them seem to indicate they would be going through some, if not all, parts of this

integrated assessment, should they get out scot-free? I mean --

DR. CHOKSHI: I think --

DR. COOK: Well, there will be some --

DR. CHOKSHI: Right.

DR. COOK: -- you know, that are there. I mean, if you look at a number of sites, you know, and in historical parlance we would say "dry." You know, we know rain falls on every site, but they call them "dry" because they didn't have flood protection or mitigation and they are way above.

Unless something has radically changed, a lot of those will remain dry. And this isn't going to --

MEMBER REMPE: But would it be like 20 percent? Or you have no idea?

DR. COOK: I don't have particular numbers right off the top to give you that could come in. I mean, there will be a number that will be using, you know, the integrated assessment, so we're not doing this for nothing.

MEMBER REMPE: Right. Oh, yeah, I imagine that's true. I was wondering if almost all of them would except -- unless they are a very, very dry site.

DR. COOK: I would, you know --

MEMBER POWERS: It never rains there.

DR. COOK: That's why we allowed some of the things. If it's just, you know --

DR. BENSI: Yeah. I don't mean to keep pulling back to this one, but that's why the -- we want -- because we have to -- the important thing is is that this trigger, the initial trigger, is the new to old comparison. And if the site is high and dry against, you know, flooding or surge, it is up on the bluff so to speak and it still has rain on the site, we wanted to facilitate them doing a more abbreviated review commensurate with the site hazard.

And so that's why we put some of these options for the abbreviated review was to make sure that we are not dumping everybody into the integrated assessment unnecessarily. So we want to make sure we do things commensurate with the hazard.

DR. COOK: And so far some of our predictions -- I mean, you can somewhat tell, too, with the walkdowns, because, remember, the walkdowns go through, and a lot of those have to deal with it. And we have a large number, and, you know, they are just coming in, so I don't have all of the statistics. I mean, we are starting to get into the 90 percent range of having most of them in.

When you look at those, there is a vast majority where the walkdown reports are short, on the order of 15, 20 pages. However, there are a few -- and I can just tell because I was on travel last week and my email box -- there are a few that are a couple hundred megabytes. So they are going to be --

MEMBER POWERS: Lots of colored pictures, that's all.

DR. COOK: Well, maybe that's it. Maybe that's it.

(Laughter.)

MEMBER CORRADINI: You can set additional assurance.

DR. WIDMAYER: Hey, Joy, there was a part real early in the negotiations where I think industry was interested in whether NRC had a little secret list of the ones they wanted to have the full-blown analysis. So there was a lot tension I think as far as whether there was this secret list, and, you know, the staff made sure they knew there wasn't a secret list, that they wanted to go through this process and develop this carefully and technically and --

DR. CHOKSHI: I think based on the interest on our discussions and calling a number of people, this particular flood has a lot of attention.

So I have people that are anticipating -- you know, first of all, the hazard part itself, you know, not all of this thing was very different.

And my feeling is that industry thinks they will have to -- you know, a sizeable number would have to do that, just gauging on the engagement, you know, the -- with the questions you get from the individual EJT member on the task force.

MEMBER CORRADINI: Can I go back a slide? You don't have to go back back, but on the last -- at the end of the last one you said scenario-based, margin-type, or full PRA. Is there an accepted procedure for a margin?

DR. BENSI: Yes. We are going to go into --

MEMBER CORRADINI: Okay. I'm sorry.

DR. BENSI: -- this right here. Yeah.

MEMBER CORRADINI: Okay. All right.

DR. BENSI: Yeah. That was my key-up for the next three slides.

MEMBER BROWN: Can I ask --

DR. BENSI: Definitely.

MEMBER BROWN: -- you talked about not knowing, yet on your overview slide you listed 66 plants over three years where licensees submit

results, and then 24 licensees submit results, and then 20 --

DR. COOK: That is the hazard. That is the very -- you know, the blue box, the flowchart.

MEMBER BROWN: But what about the other plants?

DR. COOK: I should have explained.

MEMBER BROWN: No, no, there's 66 out of 100 and --

DR. BENSI: Oh, 66 sites.

MEMBER BROWN: Sites. All right. I didn't get that out of it.

DR. COOK: Well, and because of time, I jumped through, and the IA afterwards, integrated assessment, if needed.

MEMBER BROWN: Okay.

DR. BENSI: Yes. So those are when they have to submit those reports.

All right. So now we have mentioned these three types of -- these three options for the evaluation and mitigation capability. So the scenario-based evaluation is systematic, rigorous, and intended to be conservative, although this is primarily a qualitative evaluation used to demonstrate that there is high confidence that key safety

functions can be maintained.

And we have some guidance that we believe, you know, facilitates the systematic evaluation that is also conservative, even though it is a primarily qualitative evaluation.

And just to note, it is the licensee's responsibility to demonstrate that this type of evaluation is enough to demonstrate to us -- remember, this is part of a 50.54(f) letter, request for information, so we are asking for the information.

So the onus is on the licensee to demonstrate to us that this type of evaluation is sufficient to demonstrate that key safety functions can be maintained under this reevaluated hazard, and remembering in the -- under the scenario in which the flood protection is not reliable or doesn't exist. So that's where we stand with this.

And our intent was -- to have this type of option was there are situations one could imagine where, for example, just one part of their flood protection is not robust, and one pump, for example, is lost. It's a simple evaluation to perform.

Conversely, at the other end of the spectrum, everything is gone. It is also, analogously, a relatively simple evaluation to

perform. So we wanted to make sure we had a way to facilitate that type of evaluation.

DR. CHOKSHI: Let me expand on that, why, you know, we -- we recognize that number of things -- it is very hard to put number on that, you know, for example, some of the manual actions. But you need to have some level of confidence that these are highly reliable in the scenario.

Okay. So other thing is that when you deal with qualitative, unless you have a systematic and rigorous framework, it can become, you know, very, very loose. So we wanted to find this ground where there is a systematic process, which, you know, can be firmly applied. So everybody looking at this says, "Yes, I understand the steps in this."

You know, the other part of the question is that in many cases the -- and if you look at the flood scenarios, something like Fukushima, this really essentially wiped out all of the things you needed, and the scenario boundary conditions and things were very straightforward.

You know, that you had all loss of, you know, for -- you were, you know, in that case plant was still operating, but in some cases time warning you will know what your decay heat you need to remove,

what kind of, you know, capacity you need, and you may be dealing with a very, very few equipment and actions. But actions might be not usual actions. You may want to bring some things over here.

So it's -- so how do I capture these in a reasonable way? But I know that if I start putting number, you know, it may be false sense of security that I have some number.

MEMBER STETKAR: But you throw around terms like very confident that things are highly reliable.

DR. CHOKSHI: I know.

MEMBER STETKAR: What is "highly reliable"? I'm asking.

DR. CHOKSHI: It's a very good question, and that's the reason we went through a lot of discussion, and part of it --

MEMBER STETKAR: We have it.

DR. CHOKSHI: -- Appendix C, which --

MEMBER STETKAR: I read that. I'm asking you now, as the group who put this together, what is your concept of high confidence of high reliability? Is that 60 percent success and 40 percent failure? Is it 90 percent success and 10 percent? Is it succeeding 999,999 times out of a million? What is a

highly reliable action?

DR. BENSI: What we intended to do for here, we thought, you know, high confidence, what do we mean? How do we demonstrate high confidence?

MEMBER STETKAR: Don't -- because I'll get to uncertainty later. I'm still trying to get to what you consider highly reliable.

DR. BENSI: Well, I was going to -- can I say one thing and then spin it over to you?

MEMBER STETKAR: No, because I want to get an answer to highly reliable first, because --

DR. BENSI: That's what I was -- okay.

MEMBER STETKAR: -- I don't want to mix confidence with reliability.

MR. MITMAN: Jeff Mitman with NRR. One percent failure probability.

MEMBER STETKAR: One percent. Thank you. Ninety-nine percent reliability. Now, what confidence should I have in that?

DR. BENSI: Well, the other thing is I --

MEMBER STETKAR: What confidence should I have in that? I'm not going to let you bounce around here. Should -- is that a mean reliability? Am I 95 percent confident that the reliability is 99 percent or better?

MR. MITMAN: It's a mean or a median. We don't -- we do not have --

MEMBER STETKAR: Okay.

MR. MITMAN: -- a confidence interval on it.

MEMBER STETKAR: But we just said it's highly confident.

DR. BENSI: So what we --

MEMBER STETKAR: No. We just said it's highly confident.

DR. BENSI: Yes. And --

MEMBER STETKAR: We just said it's highly confident. So if it's a mean or a median, there is a 50 percent probability that it could be worse than that. How much worse? Factor of 10? Factor of 100?

MR. MITMAN: We didn't go that deep. This is not a probabilistic analysis.

MEMBER STETKAR: But don't throw around terms that say high confidence of high reliability if you can't defend what those mean.

DR. BENSI: We actually didn't -- we tried here -- they don't -- this doesn't combine the two terms. We used the phrase -- "reliable" is a term that is used with respect to flood protection, and reliable is shown by -- and we don't compute

reliability. That is something that I should note.

It is not a quantification of reliability. It is showing that something is reliable against -- using comparison against both qualitative and quantitative performance criteria. For example, present day codes and standards, which should, in a sense -- and some codes being tied to a target reliability, others not be.

But by demonstrating that you meet those performance criteria, you demonstrate -- you know, you show that you have -- that flood protection is reliable. We don't tie it to a reliability. We do allow the -- you know, if you want to compute the reliability of it in the -- you know, quantifying the reliability, we don't preclude that, but we say -- we use it in the sense that it is reliable.

Here in the scenario-based evaluation, we are not -- it is not quantified. There is no quantification of the reliability of these things. What we are trying to do is provide high confidence that key safety functions can be maintained? And, once again, by "high confidence" we do this by comparing against performance criteria, doing a rigorous and conservative evaluation of whether or not manual actions are reliable -- feasible and reliable,

once again, using this in the notion of feasible and reliable as opposed to the quantification of reliability.

So this is what we mean here. We don't mean confidence and reliability. We are using it in a sense that you are providing high confidence via performance criteria.

MEMBER STETKAR: I understand "feasible." You use the term "reliable." Reliable --

DR. BENSI: Yes.

MEMBER STETKAR: -- implies a measurement of success probability.

DR. BENSI: Well, yes. But it -- we're saying that -- we are making the -- you know, it's -- agreed, it's not tied to a strict number in the ISG. But we're saying that we have -- we think that this is reliable because it meets present day codes and standards, and that there is an inherent level or inherent robustness associated with meeting those criteria, such that we now say that that flood protection is reliable, or perhaps reliable enough might be a better way to think about it. Reliable enough for our purpose.

MEMBER STETKAR: What I'm trying to get a sense of is, what is reliable enough, and what

confidence do we have in that "enough"? What margin is --

DR. BENSI: And to be honest, the state of knowledge in terms of the calculation of the reliability of flood protection is not such that we could say, you know, this type of wall --

MEMBER STETKAR: It is --

DR. BENSI: -- has this fragility function. So we have to --

MEMBER STETKAR: It is interesting that in risk assessment we seem to be able to do that for a broad variety of things, evaluate estimates of reliability, perhaps with rather large uncertainties, but we seem to be able to do that. And I don't understand why we can't do that here.

DR. BENSI: You could. You could. And we say in the guidance that if you choose to, you know, perform a -- do structural reliability -- that's something that I have done in the past -- you could do it. But we have to think about what our goal here is, which is to determine if the flood protection is a robust flood protection system.

And perhaps we accomplish our goal more effectively by doing this rigorous evaluation against present day codes and standards versus, you know,

really worrying about what is the limit state function of that wall.

DR. CHOKSHI: There are two aspects. You know, as you move forward, move toward the next step, margin, they become more and more quantitative --

DR. BENSI: Yes.

DR. CHOKSHI: -- and exactly go to what you are saying. The thought here was that for certain situations, I only make use of, you know, my most robust means available to me. I may have other means to accomplish that same function, but I ignore them.

So I have already sort of building conservatism that I am not looking at all the possibility. And if I can show that I have -- and the performance criteria has to, you know -- shall be discussed. But it is very exhausting, not only in terms of whether the function is accomplished at that time, but for the availability, the maintenance, all of the programmatic aspects which will go in a PRA. You will look at it to establish continuity.

All of those factors are part of it. Only thing is that you -- also, we have a set of -- way to judge each particular element. There is three categories -- used to -- high, low, and, you know, medium. So you -- so it's a fairly disciplined

process. That's what I was trying to, you know -- and that was the goal, that, you know, how can we, where possible --

MEMBER STETKAR: You know, my experience dealing with a lot of people and doing a lot of those qualitative evaluations is very similar to Lake Woebegone.

DR. BENSI: Pardon?

MEMBER STETKAR: Lake Woebegone. All of the men are good -- all of the women are strong, all the men are good-looking, and all of the children are above average. Nothing is ever evaluated. Everybody is above average. I have never been able to find people who keep average average. And that's the problem of doing these types of qualitative evaluations.

DR. BENSI: Yes. And --

MEMBER STETKAR: If I could find the one who is average --

MEMBER SIEBER: I'm the one.

(Laughter.)

MEMBER STETKAR: I'm curious how the staff will now assess those evaluations in terms of their reasonableness, because if everybody does the qualitative analyses, and everybody is average or

better, that's not correct, because not everybody is average or better.

DR. BENSI: Yes. And we have actually tried to lay out -- for example, we have an appendix on the evaluation of manual actions.

MEMBER STETKAR: Okay.

DR. BENSI: And we have intended that to be conservative, such that --

MEMBER STETKAR: I went through the appendix. And if I'm -- I check all of the nominal or better than average in that appendix.

DR. BENSI: And then, well, if --

MEMBER STETKAR: Because I know I'm better than average. And this is serious. People will be submitting these things to the staff and saying, "Please accept my evaluation." And what criteria are the staff going to be using and saying, "Well, how did you reach this conclusion that you are better than average?" At least if people quantify things, you know, you can -- you have that sort of metric.

DR. BENSI: I think I understand your point. What we have tried to do, though, is that even though this was a qualitative evaluation in its core is to lay out a structured approach that involves logic structures, for example, so that there is

transparency to the staff about, what is the sequence of events you have looked at?

So looking at timelines for manual actions, looking at, you know, requiring that these things -- that event trees be drawn out and documented to us, so at least -- at the very least, in terms of what your concern is, is that we require these things to be documented to us, so that it's transparent and we can be, you know, rigorous in our review of what they have done.

So down here on the --

MEMBER REMPE: Before you go on --

MEMBER SIEBER: Let me --

DR. BENSI: Yeah.

MEMBER SIEBER: My interpretation of what you have presented so far is that you are trying to determine whether the plant meets codes and standards that encompass the challenges presented against it. So to me that is a deterministic as opposed to a probabilistic assessment. It either meets it or it doesn't. Is that the case?

DR. BENSI: In much of -- for example, the flood protection evaluation is very deterministic in the sense that you meet the standards, you have certain characteristics, yes.

MEMBER SIEBER: Now, the --

DR. BENSI: The mitigation, the line is not quite so clear.

MEMBER SIEBER: The only probabilistic part of it, as I see it, is whether it's a flawed approach or not, and at what level it occurs.

DR. CHOKSHI: No.

MEMBER SIEBER: The way you are analyzing it, though, looks like if it occurs and it's at this level, then we have to meet these yes or no standards. And if the plant has the components and the capabilities and the design to meet the standards, then it's successful. Otherwise, it is not.

DR. BENSI: Yeah. But what protection -- it is the case that we -- either you come in with the hazard, which is the flood height and all of these other things, and you either have -- you either can demonstrate that the flood protection is reliable based on these performance criteria, which is -- I just want to say, it's beyond the present day codes and standards. I use that term a lot, because it is sort of intuitive and easy to say --

MEMBER SIEBER: Right.

DR. BENSI: -- what our performance criteria are. But there is more to that than the

performance criteria.

MEMBER SIEBER: Well --

DR. BENSI: But when you get into this mitigation evaluation, it is not the case that it is a go/no-go.

MEMBER SIEBER: Now, the problem that you run into there is the codes and standards, in some cases, do not embody performance in terms of operating outside of design conditions, nor does it consider failure rates that either are there because equipment fails sometimes or because the environment is harsh enough that it will cause a failure.

So you have an opportunity to go from a -- to a deterministic determination, which makes for a short and sweet evaluation and a yes or no answer, or you can do it, you know, in a probabilistic way. And I think that's what John is saying. He is expecting enough rigor to have a probabilistic answer, and it's not clear to me.

DR. CHOKSHI: Yeah. We have sort of greater options. Ultimately, the option of -- ultimate option is the probabilistic -- total probabilistic analysis.

MEMBER SIEBER: Yeah. That's --

DR. BENSI: And we do -- for example, for

active components we do lay out criteria that -- we ask for quantification of reliability, for example. In some cases, that -- you know, there might be -- that might not be feasible for some components. We also lay out qualification criteria that looks at -- and it actually -- do you want me to -- I can show -- I can put it up as an example here. Here?

It's hard to see, exceptionally hard to see, but we have a table in the ISG that talks about, for example, active components. And some of these -- it talks about quantification, but it also talks about some of these other things like unavailability, and whether or not it is covered by Appendix B, or is it covered by a fire protection QA program, and that sort of thing. So it's --

MEMBER SIEBER: Well, my conclusion out of all of this is that that side, whether you want enough rigor to be able to determine what's the chances that I am going to survive this in a probabilistic sense, the information to provide that answer, or you are going to go back and say all of the nameplates say that I can -- that this equipment will operate under these conditions, and be satisfied with that, and that's a deterministic answer. And you have to decide which is good enough to provide protection of the

public health and safety. And so I think that's an issue you may want to think about.

DR. BENSI: Jeff?

MR. MITMAN: If I could add something, please? I've got about seven years working with the reactor oversight program.

DR. CHOKSHI: Name, please.

MR. MITMAN: I've got about seven years --

DR. CHOKSHI: Your name.

MR. MITMAN: Jeff Mitman with NRR. And we often run into these scenarios where in PRA space we are trying to credit non-ECCS systems to address issues. You know, you evaluate what the ECCS is going to do, and then there are scenarios where you add -- especially flooding where, for lack of a better term, a B.5.b pump that is written into the procedures that says, "If you get this flood, we bring to bear this pump."

And these are not traditional ECCS equipment. It is commercial grade equipment that is not built -- we are not talking about nuclear standards here. We are talking about commercial grade standards, and that's important to remember when we talk about these scenarios, because there are lots of scenarios where the flood protection, the walls fail,

the ECCS goes under water, and they bring to bear these commercial grade pumps to put water into an isolation condenser or to put water into a steam generator.

And we are not talking anymore about what most of us are used to dealing with. These are beyond the typical mitigation strategies, and it's important to keep that in mind.

DR. CHOKSHI: And I want to --

MR. MITMAN: Now, as a PRA guy, to address the question about reliability, what I had -- when I gave my input into this writing process, what I was thinking in the back of my mind is I'll be comfortable if I can get a one percent failure probability out of that. And so when I think about, you know, the operator's failure probability, the equipment failure probability, that is the kind of thing that I'm going for. Okay?

If I can write criteria, qualitative criteria, that get us to that about a one percent failure probability, you know, assuming that the initiating event frequency is low enough, I'm going to have a reasonable degree of confidence. And so that was my criteria when I worked my way through the writing process.

MEMBER CORRADINI: Can I just ask -- John is going to ask a much more instantiated question. I am still struggling with they can choose between the three. Is that correct?

DR. BENSI: Yes. But --

MEMBER CORRADINI: So the answer to that is yes.

DR. BENSI: Kind of. Kind of. And I actually do want to caveat that, because we have set this up so that there is going to be cases where the scenario basis is just not going to cut it. You can try it, but you're not going to be able to meet what we have laid out.

MEMBER CORRADINI: Okay.

DR. BENSI: So --

MEMBER CORRADINI: So they know that going in, right?

DR. BENSI: Yes.

MEMBER CORRADINI: Yes. Okay. So there are certain characteristics of them failing diamond five, or answering yes to diamond three, that they would know going in that the scenario base isn't going to cut it.

DR. BENSI: I would say not related to diamond three and five, because diamond three and --

particularly diamond five is related to the flood -- the characteristics of the flood protection. Whether or not scenario base is going to cut it in mitigation will have to do with how they are -- in many ways how they are mitigating it, what they are doing, and what is available to mitigate it.

MEMBER CORRADINI: Okay.

MEMBER SHACK: So if you have permanent barriers versus sandbags --

DR. BENSI: Well, that would make it more likely that you would enter mitigation. But if you had in-place safety-related equipment that you could still rely on versus your all manual actions, and things are very, very complex, and it's hard to model, and things are going all -- then, you know -- then, that's the line. So does that help --

MEMBER CORRADINI: Well, I'm kind of going somewhere. What I'm -- in my mind is I'm trying to understand you gave them three options. You told me they're going in. They would have some indication a scenario base would either cut it or not cut it. Do these build on each other such that if you started with scenario based and they didn't get it, and they thought they could make it with scenario based, and then you looked at it and they said no, reject, that

at least builds on the next step?

DR. BENSI: Yes.

MEMBER CORRADINI: And if they try the next step and it doesn't cut it, reject. And they essentially -- so what I guess I'm saying is they are essentially building up to a more complex --

DR. BENSI: Yes.

MEMBER CORRADINI: -- and one builds on the other?

DR. BENSI: Yes. And so you are -- you know, for example, you -- in all cases, it's required to have -- to use logic structures to model the problem at hand, so that you start with simple, but you start noting this thing is getting out of hand. So then you move on to something that is more capable of handling those complex situations. So yes. The answer to the question is yes.

MEMBER CORRADINI: Okay. Thank you.

MR. MITMAN: Jeff Mitman again. One of the things that became clear with our interactions with the industry, it's going to be an interim process on their part, too. And if they see that a certain pump is very important and not very reliable, they certainly have the option of committing to add a second or a third pump to increase reliability. And

it was clear that they were contemplating doing those kind of things.

DR. CHOKSHI: Actually, I wanted to pick up on that and the question you had raised. But I think the process, it will be able -- you know, remember that at the end of this process we have to make some decisions. And I think the process will identify if there are key procedures or equipment where you need to focus on, which controls this, you know, qualitative/quantitative.

And I think the -- and then, as a part of the decision, that, okay, your protection depends on this equipment. You want now to have a certain pedigree going forward.

MEMBER STETKAR: And I understand all of that. And, you know, differentiation between safety grade versus non-safety grade, commercial off-the-shelf equipment, quite honestly, the failure rates, as long as they are maintained, aren't all that much different. What I'm mostly concerned about is the human intensive aspects of this.

And just because I have good procedures -- we know that just because I have good procedures does not ensure high human reliability, especially under stressful and perhaps situations that divert people's

attention among competing concerns.

What I wanted to ask Jeff -- he escaped, so I can ask him again -- have you done -- you know, and I went through all of sort of the systematic process in Appendix C -- I know we are getting a little bit ahead here, but we've kind of gotten onto this -- is a good checklist and sort of bins to throw different performance shaping factors that affect human performance, kind of -- and three or four different categories -- nominal, better than average, worse than average, and so forth.

If the presumption -- if people check off all of the right boxes, you know, and the criteria that you use, if the presumption is that that will provide something on the order of 99 percent reliability, have you tried to use this process for a series of operator actions?

In other words, taking a set of scenarios and look at performing a human reliability analysis, quantitative human reliability analysis, and see whether or not indeed that would satisfy, you know, kind of your nominal objectives, even though you are not doing a quantitative analysis. In other words, that --

DR. BENSI: You mean put these things in

a series that have to happen.

MEMBER STETKAR: Well, no. If people -- given the fact that everybody qualitatively is better than average, so they are all going to check off all of those boxes, can you look at a number of different scenarios that would apply different stresses, not comprehensively, but a few, and, say, perform a quantitative human reliability analysis as you would in a PRA and see whether or not this gives you reasonable assurance that you would sort of hit that target, that the operators kind of are comparable to what you might expect the equipment to be.

MR. MITMAN: Jeff Mitman again. A couple of things. The starting point for the checklist was fire H. And then it was informed with a lot of excellent insight with a fire PRH/fire human factors that was added by the human factors community.

We haven't tried to actually take an actual human error event and actually calculate it. But it is certainly in the back of our minds as we went through this, because we've got a lot of significance determination process. And I come out of the shutdown area where it is all human factors driven.

And so certainly that is right there in

front of the -- front of my mind when we work through this, thinking about what kind of procedures they have, what kind of environmental conditions they have, you know, and it wasn't just the checklist. It was this is -- you know, this is what we mean by "nominal." And so, you know, you can't just check "nominal." You have to defend the nominal and then --

DR. BENSI: We need to define what "nominal" is.

MR. MITMAN: We defined what "nominal" is. We defined what "degraded" was. And so the intent was you can't just check off; you've got to defend it. And we want the information, so that we can look at this and say, you know, we're talking about a thousand-year flood, it has never happened. It has been raining for four days. There is three foot of water on the site. And you say you can just stroll out into the plant and do this?

MEMBER STETKAR: I'm not so much worried about the three or four days. I'm worried about the dam failing. It has never happened before, and there is a wall of water coming down the river and somebody says, "Hey, there's a wall of water coming down the river."

MR. MITMAN: And we've got three hours --

MEMBER STETKAR: That's a much different type -- but I'm talking about, you know, if you've looked at a couple of those different types of scenarios --

MR. MITMAN: We have looked at flooding scenarios during the SDP process. We continue to look at some SDPs that are coming in on some plants in the significance determination process. We are well aware of these issues, the timing issues, the amount of water, the very significant decisions that need to be made, things like putting river water into perfectly adequate, perfectly good steam generators, before you have a problem, and how that -- the stresses that that will raise.

We are thinking about that. Now, whether it all got adequately reflected in the procedure or not we will see when we get the first responses.

DR. BENSI: I wanted to add one thing. We talked about this checklist, the nominal checklist of these performance shaping factors. But there is more than that that we have added, particularly since the public comment period, with regard to timing analysis. You had talked a lot, you know --

MEMBER STETKAR: That part -- the feasibility part of this is actually quite good in

here.

DR. BENSI: So what -- so --

MEMBER STETKAR: You know, it's -- and the discussion of that, the timelines, you know, that is -- you haven't heard me say anything about that. I'm focusing on reliability, expectations of what that reliability might be, and the staff's ability to independently provide a degree of assurance that that reliability is what the licensee is claiming it is.

DR. BENSI: And that was actually something that we thought about a lot when we were developing this particular guidance. So I think I can say that particularly with the documentation requirements, they are very explicit about the documentation of the -- and the justification for the things that are said.

So it's not just check that it's nominal. Check that it's nominal and defend it in terms of the justification, provision of the narrative that -- you know, for the manual actions is --

DR. CHOKSHI: And that --

DR. BENSI: -- the detailed timing analysis, including having an appropriate margin to even justify feasibility, and then also to justify that it is also reliable, admittedly, not in a

quantified sense in Appendix C, just given our timelines on this.

DR. CHOKSHI: Again, going back is, okay, this is the information they provided. Now, when I need to make a decision, what -- I may need to pursue something further, or I just say, if everything is manual actions, I think we need to again focus on that and go back to look for that if need be, and how to make sure that it is there, but it's highly reliable, you know.

So, I mean, that was the sort of thinking that, given the conditions, you know, can we get to that point?

DR. BENSI: It was something that we thought about a lot, which is exactly what you're talking about.

CHAIRMAN SCHULTZ: Undine?

MS. SHOOP: Undine Shoop from NRR. I'm sure many licensing actions have manual actions. So this is not something new. We have been doing this for many years. And so we would look at this and they would have to justify this to the same level that they have to justify the manual actions that they have with our licensing action today, which means run operators through, not just the young 20-year-olds but people

over the range of ages, basically show me that it works. And so that would be the expectation, just like it is for normal actions that they are asking for in their licensing actions today.

MEMBER STETKAR: What we found, however, from PRA is that because there has not been rigor applied to the reliability of human performance in the licensing area, and from our own experience from events that have happened in plants, complicated events, fires, equipment failures, that indeed people don't perform according to the licensing criteria.

Thirty minutes is not a magical pass-fail in terms of if you have more than 30 minutes available, the operators are guaranteed to be successful, which condition we have, then, used in licensing.

MS. SHOOP: Well, and licensing -- they actually have to run some teams, and they have to show us that they can meet that time. They have to show us that they can meet that time under those conditions.

MEMBER STETKAR: I never failed doing a single thing on the simulator.

MS. SHOOP: You know, humans are unpredictable and fallible --

MEMBER STETKAR: That's --

MS. SHOOP: -- you know, and they want to make sure, to the best of the abilities of what we can test that they can demonstrate that they can do this. I mean, obviously --

MEMBER STETKAR: We're not going to flood this place, though, you know, a thousand times to make sure that they only fail 10 out of those thousand.

MS. SHOOP: Well, you have to do what's reasonable.

DR. BENSI: And we're talking about these mitigation actions. I mean, these are things that are being done out in the plant in many cases. I mean, you know, these -- they are challenging. I mean, you said you looked through Appendix C. It talks about the fact that some of the conventional methods for looking at these things in terms of running things on the simulator are not going to be a viable --

MEMBER STETKAR: That's exactly right.

DR. BENSI: So our goal -- and we'll get -- I have a slide on Appendix C there. So in Appendix C, though, is to definitely -- is to lay out an evaluation that is systematic and that is transparent, so, admittedly, we can't flood the plant, we can't pop the top on things and -- but --

MEMBER STETKAR: We should go on, because

of the time. I wasn't arguing with the structure that you have. I was trying to get a handle on --

DR. CHOKSHI: It's a good --

MEMBER STETKAR: -- the concept of reliability and confidence in that and how the staff would review submittals that claim that the actions are reliable with high confidence, without doing any type of quantitative analysis. And I've gotten the answers.

DR. BENSI: Yeah. And it's something that we have struggled with ourselves internally.

So, okay, I'm going to get back rolling into this. So we're sitting here at this first type of -- this first option for performing the mitigation evaluation, the scenario base, which we said was systematic, rigorous, and conservative.

It consists of the key elements listed there, obvious things like a description of the scenario that you are dealing with here, and the approaches that are used for doing the mitigation. But in terms of the systematic approach that is transparent, looking at timelines, qualitative evaluation of manual -- of active components as well as available quantification of active components and reporting of that, the evaluation of manual actions

using this Appendix C. I have a slide on that later.

The requirement that logic structures be used --

DR. COOK: Quantitative?

DR. BENSI: No. It's supposed to be qualitative there.

DR. COOK: For active component?

DR. BENSI: Yes. It is both, but it's possible that they won't do quantification. Yeah. So, yes, it's qualitative.

The requirement for development of logic structures, and that even if failure branches are not fully developed that they be shown, so that things are transparent and we can see, and then of course a conclusion of the overall reliability of the approach.

Option 2 -- one thing I didn't get to mention is, just as a note, this assumes flood protection fails with probability one. So if there are credible flood protection failure modes identified in that step 3 or box 4 of that flowchart there, they are assumed to happen under the scenario-based evaluation.

So we had talked about some things where how are you going to find out that scenario-based isn't good enough? Well, if assuming that the flood

protection failures that all could be credible occur, is not something that can be adequately handled, then you're going to fall out of this one.

The margins-type evaluation is a quantitative evaluation. It uses CCDP and CLERP as the output, so now we are into quantification, differentiating it from a PRA of course in terms of consideration of the full hazard curve and the initiating event frequencies.

It is intended to be more realistic than scenario-based and more conservative than a PRA. It also uses logic structures that are more complex than scenario-based evaluation.

In order to compute CCDP and CLERP, plant system models need to be updated or adapted from internal event models, for example, or developed specifically for the purpose of performing the integrated assessment.

In the context of the margins-type evaluation, it is admissible to -- or allowed -- they are allowed to credit the probability of flood protection failure under the condition that all flood protection failure modes are included or to consider bounding failure modes but with failure probability of one. And there is a technical reason for that if we

feel like people want to discuss it.

So this is getting into the full quantification, you know, the event trees quantifying the sequences and computing CCDP and CLERP as the output of the evaluation. So this is the margins-type evaluation.

And then, we have the full PRA-based -- yeah?

MEMBER STETKAR: And just to keep my theme going up here, in the margins analysis it says here you would like them to quantify the human reliability, but, if they can't do that, use .1, right?

DR. BENSI: That's old. That no longer appears in the version of the --

DR. CHOKSHI: I think in one of the --

DR. BENSI: That was in the draft that went out for public comment. That has been removed from the ISG.

DR. WIDMAYER: I'm doing the best I can.

(Laughter.)

DR. BENSI: But you weren't reading Appendix C that had a timing analysis, so you were looking, I assume, at the -- were you looking at one that had a detailed analysis of timing?

MEMBER STETKAR: Well, you know, the word

"detailed" is --

(Laughter.)

DR. BENSI: The version that went out for public comment had a short discussion of the timing analysis on --

MEMBER STETKAR: Yes, it does.

DR. BENSI: -- whatever page. The version that is -- that was issued has a much more detailed timing analysis --

MEMBER STETKAR: Oh.

DR. BENSI: -- discussion. It is -- but Appendix C has --

MEMBER POWERS: As usual, Stetkar, you are out of date.

DR. BENSI: In fact, the Appendix C that has been issued is, I would say, more robust than what went out for public comment initially.

MEMBER STETKAR: Oh, because -- yeah, I mean, I have something that says timing -- it's about a page. It discusses references --

DR. BENSI: What we are doing now is much more detailed in terms of the level of rigor that we require.

MEMBER STETKAR: Up in the margins -- I mean, the thing I was reading from here just says

basically, "We'd like you to quantify it. But if it's -- if you make the determination, licensee, that it's infeasible, stick on point 1." Go through the checklist in Appendix C and --

DR. BENSI: Yeah.

MEMBER STETKAR: -- stick on point 1 if it's feasible.

DR. BENSI: Just an FYI, in the scenario-based evaluation, that has become significantly more rigorous than what is appearing in the version that you are reading as well. So when we --

MEMBER STETKAR: Okay. I'll be quiet.

DR. BENSI: Some of the things that we have been discussing --

CHAIRMAN SCHULTZ: In the interest of time, we can't describe what is now in place. We're going to have to move forward. I think --

DR. BENSI: Yeah. That's what -- so I was going to -- so answering the question, that doesn't appear anymore. We ask for quantification.

CHAIRMAN SCHULTZ: We are running along -- the 5:00 time is already an hour over our schedule.

DR. BENSI: Yes, yes. Have to move onward. Okay. So that's the margins-type evaluation.

The full PRA-based evaluation is what you

think of as full PRA. We do reference the ASME/ANS PRA Standard and Reg Guide 1.200 as references, particularly Section 8 of that standard as references. We recognize that that is an at-power PRA, and that some of these sites may be not at power when the -- at the onset of flood conditions, so that there may be some modifications needed with respect to that standard.

We do add some references to what has been used by the staff for advanced reactor reviews with respect to shutdown and low power PRAs that may provide some useful insights. But, in essence, this is PRA as one would think of PRA.

MEMBER SIEBER: This is the other side of our deterministic versus PRA discussion --

DR. BENSI: Yeah.

MEMBER SIEBER: -- from before.

DR. BENSI: Yeah. So we -- but we don't require a PRA. We allow it as an option that can be exercised and --

MEMBER ARMIJO: Do you think anyone will actually try a PRA approach unless -- well, if they're in a desperate situation they probably will, but do you expect someone will do this?

DR. CHOKSHI: I think, for example, if you

had -- all of your flooding is controlled by such type of -- somebody may be tempted to try and go through that exercise. You know, we --

MEMBER ARMIJO: Because of the nature of that.

DR. CHOKSHI: Because of the nature of that.

MEMBER ARMIJO: Okay.

DR. COOK: We haven't had anybody stand up and commit, but we have had quite a number that have mentioned in our public meetings that they are very interested.

DR. CHOKSHI: They definitely wanted that option.

DR. COOK: Yes.

DR. BENSI: Yes. Documentation requirements -- we have a section in the ISG that specifies documentation. What is listed here on the slide is what appeared in the original 50.54(f) letter, and then we expand upon that in the ISG and say what you need to document in order to show each of these particular items that were requested.

We have four appendices to support the assessments that were discussed throughout. Appendix A provides guidance on the evaluation of

flood protection. Appendix B lays out the expectations of the peer review. Appendix C is the evaluation of manual actions. And Appendix D provides some references and resources.

I'll walk through those real quickly here. So Appendix A provides some guidance references and points of consideration with respect to different types of flood protection features for exterior and incorporated barriers, provides some points of consideration, look at this, these particular items we lay out. We also offer references, particularly to documents done by the Army Corps of Engineers that can be used, for example, for looking at flood walls and sea walls.

We have some guidance for looking at active features associated with flood protection or active features in general. This is where you will see a discussion of the fact that -- our preferences for quantification in the cases where quantification -- and also, we request quantification and qualification.

The guidelines for qualification were developed based on industry provided them the initial draft of the qualification criteria, and then we ran it by some of the folks here at NRC, particularly

those working in the parallel actions under post Fukushima, so that there would be some consistency.

There is guidance on temporary features, the equipment necessary for performance of manual actions, and then looking at flood protection at the system level, instead of looking at just individual components but looking at how these things form a complete flood protection system and just evaluating it at that level.

MEMBER SKILLMAN: Where do you include the surprise components of a flood such as an ice dam that is compounded by debris that yields an even greater ice dam downstream that backs up onto the site?

DR. BENSI: That would be captured under the hazard reevaluation, the hazard report that is done chronologically prior to the entry of the integrated assessment. So that the possibility of an ice dam and what the characteristics of that would be would be done prior to the -- before the entry into the integrated assessment.

MEMBER SKILLMAN: Thank you.

MEMBER SIEBER: You're neglecting global warming.

DR. BENSI: Appendix B talks about peer review. We lay out the -- both the reviewer

attributes and the attributes of the review with respect to independent number of reviewers and in process versus a one-time peer review. We lay out what we expect with respect to the documentation of the peer review in Appendix B. It is pretty --

This was actually a major point of discussion in our interactions with industry, and so we can talk about that later, time permitting.

Appendix C is this evaluation of manual actions. We have been sort of alluding to this throughout our discussion, where it provides guidance for evaluating manual actions using concepts from human factors engineering and human reliability analysis. It lays out a rigorous -- what I believe to be a pretty rigorous process with respect to the identification definition of human actions including guidance on the level of detail and how to break up human actions.

There is an evaluation of whether manual actions are feasible based on evaluation of performance shaping factors and categorization of those factors as nominal or degraded. There is also a timing analysis that is necessary that is laid out as well as the calculation of time margin.

There is the determination of whether or

not manual actions are reliable based on the available margin. And then, there is guidance with respect to the documentation that should be provided of this evaluation, so that we ensure that we have the information we need to perform our review and critically evaluate what comes in.

Appendix D -- we call it existing references and resources. It provides some descriptions of some evaluations that have been performed previously with respect to external flood risks, including under the Task Action Plan A-45, NUREG-5042, the IPEEE program.

We provided these strictly to show that this has been done before, that we aren't -- you know, that -- we had heard some comments that said that, you know, no one has ever looked at external event risks for flooding and --

CHAIRMAN SCHULTZ: We're all familiar with it.

DR. BENSI: Yeah. So we put this in there just to show that they exist and to provide insights that -- you know, to -- as references that may provide insights. It is not to provide examples of what we are doing.

So sort of wrapping up here with where we

stand and what kind of comments we received, if you're interested, we did interact with external stakeholders in numerous public meetings, and we -- it was quite an iterative process. We issued the guide for public comment on the 28th and had a 30-day public comment period which ended October 29th.

We received 61 comments from four different submissions. The comments were related to the evaluation/mitigation capability, particularly the version of scenario-based that went out for public comment, which has been revised significantly. Comments were received with respect to peer review examples. The rest of those listed there I have some more details.

We did issue it this past Friday, November 30th, in its final form. We did make significant revisions based on the public comments and the iterations in the meeting.

If we have some time, I could run through a summary of the key comments we received. Two slides.

DR. CHOKSHI: I think it may be better --

DR. BENSI: So we can roll through that and leave it at that.

CHAIRMAN SCHULTZ: I don't see any

surprises here with regard to the questions. I would like to ask, since it is just 5:00, or thereabouts, if there are any public comments. I don't believe there is anyone still on the bridge line, but, Derek, could you check? And while he's doing that, if there's any comments that anyone would like to make from the room?

DR. COOK: While that's going on, one comment just myself. When we were here before you with the walkdowns, one of the comments that had come out with the walkdowns was recommending NUREG-1852, which is looking at fire actions and going in.

That pushed us and got us into a place that really helped us with the integrated assessment and looking through. So I guess I just wanted to say thank you in that sense, because that was --

MEMBER STETKAR: Even the short version I read was --

DR. COOK: Yeah. So anyway, I --

DR. BENSI: Yes. But the short --

DR. COOK: -- since we've got a minute --

DR. BENSI: The version that went out for public comment was very based on 1852. You see flavors of 1921 that appear in the version that went out for the final issuance. It really had a heavy influence on the final product through Appendix C.

MEMBER STETKAR: I would be interested to see what it looks like now.

DR. COOK: We'll see what we can do about making sure you get that.

CHAIRMAN SCHULTZ: The bridge line is open. If there was any members of the public who would like to make a comment at this time, please identify yourselves and do so.

DR. WIDMAYER: I think Bob Budnitz and Dennis Bley are both on the line. Bob was trying to talk to you a minute ago.

CHAIRMAN SCHULTZ: Okay.

MR. BUDNITZ: Can you hear me?

CHAIRMAN SCHULTZ: Yes, Bob. Please go ahead.

MR. BUDNITZ: This is just to go back to something that is a couple hours old.

(Laughter.)

CHAIRMAN SCHULTZ: We're ready.

MR. BUDNITZ: I still am puzzled at resistance to the best state of knowledge about the flooding hazard at a site using probabilistic method. I just think that -- well, it might answer the --

MEMBER STETKAR: Bob? You're breaking up really badly, Bob.

MR. BUDNITZ: Well, I'm -- maybe it doesn't work.

PARTICIPANT: Is he on a cell phone or --

MR. BUDNITZ: No, I'm on a landline.

CHAIRMAN SCHULTZ: Okay. Go ahead, try it again. You were breaking up for a minute. Try it again, Bob.

MR. BUDNITZ: Just wanting to go back to being puzzled about why anything would think that without a probabilistic assessment of a hazard -- state of knowledge -- don't know how much -- by these measures, especially at the sites where -- hazard is high. That is --

CHAIRMAN SCHULTZ: Bob, you're still breaking up. I think we got it, but you're still breaking up quite a bit.

MR. BUDNITZ: I'm going to --

CHAIRMAN SCHULTZ: Bob, did you leave? If you haven't left, please let us know.

MR. BUDNITZ: I'm going to call in on another line.

CHAIRMAN SCHULTZ: Okay. Dennis?

MR. BUDNITZ: Another landline.

CHAIRMAN SCHULTZ: Okay. We'll wait until you do so. Dennis, do you have any comments? We'll

start with you. Dennis, are you there?

MEMBER BLEY: Yes, I am. I had it muted again. I'm sorry.

MR. BUDNITZ: Okay. I'm back. Can you hear? Is that okay?

CHAIRMAN SCHULTZ: Go ahead, Bob.

MR. BUDNITZ: Go ahead, Dennis.

(Laughter.)

CHAIRMAN SCHULTZ: I would like to try with you. Please go ahead.

MR. BUDNITZ: Okay. So I'm sorry, but I just called on a different landline. Just the point that I tried to make a while back, but it still puzzles me at the end of this, and that is we really want to understand the flooding hazard at a site for a given flooding type -- maybe it's a dam or maybe it's a river or whatever.

I don't see how you can do it without a probabilistic assessment. And the fact that that probabilistic assessment is going to have a lot of uncertainty really reflects the state of knowledge today. And not doing it says I'm going to stick my head in that sand and be like the ostrich.

So it seems to me that although we can't do that in time for these assessments right now, I

don't understand how anybody can come to a judgment that something is adequate, especially if it's -- except if it's really high and dry. Something is adequate without that.

And, therefore, I don't understand what supports a judgment by anybody that it's adequate if -- with the sort of guesswork that they have on the "deterministic method." Enough said.

MEMBER POWERS: Well, Bob, let me ask a question.

MR. BUDNITZ: Go ahead, Dana.

MEMBER POWERS: Suppose I don't think I'm really interested in what the flooding hazard is. I'm interested in making sure the plant can respond in case there is a flood.

MR. BUDNITZ: Well, yeah. But, Dana, there is always -- not quite, but there is usually always some flood bigger than what you've said. And I don't know whether that is a one in 500 years or one in 50,000.

MEMBER POWERS: Well, suppose I just say, "Okay. The biggest flood I have ever heard of around here or any place else is so big, and my plant can stand up through it."

MR. BUDNITZ: That's fine. There are

sites like that. But I'm thinking about the ones that aren't like that. Sure, there are sites where you don't have to worry. But we're not worried about them, are we?

MEMBER POWERS: What I'm saying, Bob, is having details on the risk I face probably is secondary to knowing that I can withstand a flood with really some reliability.

MR. BUDNITZ: Dana? Dana, but the flood you have just talked about, do you know whether it's a 1,000-year flood or a 50,000-year flood?

MEMBER SIEBER: How are you going to tell?

MR. BUDNITZ: Well, no, no, no. The way you tell is you ask the experts to do a probabilistic assessment. And with their true uncertainties in mind, that is the best state of knowledge you've got. And at least we ought to have the benefit of that. You are no worse off with that, but you are usually, in fact almost always, a heck of a lot better off.

MEMBER POWERS: But I get those experts in and say, okay, what is the 50,000-year flood here? Or 1,000-year flood? What they will give me an answer to, really, is the limit. And it's probably that 500-year flood is the only one they are going to answer me --

MR. BUDNITZ: I actually don't believe that, but keep going.

MEMBER POWERS: Okay. They tell me it's this big a flood. That's all I need. Now I go focus on my plant. I don't need a PRA.

MR. BUDNITZ: I don't think you need a PRA, a full PRA either. But I sure would like to know what the recurrence is of the flood that they are protecting against, and I would sure like to know what the recurrence is of the flood they can't protect against.

MEMBER POWERS: Define design basis flood.

MR. BUDNITZ: Right.

MEMBER POWERS: I mean, it's exactly right.

MR. BUDNITZ: But I want the probabilistic analysis to --

MEMBER POWERS: That's all I want is five experts --

MEMBER SIEBER: I don't know how you do that.

MEMBER POWERS: -- and, you know, especially if I get to choose the experts, I'll probably come up with my -- they will tell me that there's a 99.9 percent probability that any flood

you'll have will be less than this design basis flood. I don't need a PRA. I just need some expert opinions here.

MR. BUDNITZ: Well, I'm not arguing that that is what you need. I agree that's what you need. But most of these sites are arguing -- in fact, the staff seemed to agree with them -- that that is not a simple question to answer. Hence, let's not ask it.

I don't agree with that. I think it's a feasible question to answer, even though it has large uncertainty, and that you will cope with the uncertainty after you ask and answer it, not by not asking and answering it.

MEMBER STETKAR: I think you're both saying the same thing. Dana is saying some confidence that it is no greater than X. You don't need to know the full distribution.

MR. BUDNITZ: I'm not arguing with that for a minute. Maybe Dana and I are saying the same thing. It seems to me that without asking the probabilistic question somewhere along the line, you don't have any idea where you are.

MEMBER BLEY: This is Dennis. I want to join in this one.

MR. BUDNITZ: Go ahead, Dennis.

MEMBER BLEY: You know, I -- when we try to solve it on the fly here, we probably don't do a good job of it. For the idea that you get one answer, you go talk to experts and say that it's a probability distribution. Well, maybe you do, or maybe you have to build some kind of a model that looks deeper.

If one looks at the long-term seismic study that was done out for Diablo Canyon, I would have said 15 years ago, but it's probably longer ago than that, they went much deeper and looked at all of the possible mechanisms, all of the possible faults that could continue, and built models. And at the deeper level in those models they were able to do elicitation and look at data and build up a model that lead you to some confidence.

We haven't tried it here yet. I don't know how to do that because we haven't done it. If we start looking, I think it's well worth the effort. And getting a better feel for the likelihood is important.

It is probably not, based on two things that were said earlier, a recurrence rate. It is really a probability based on mechanisms that can occur. You know, rivers do change over the kind of timeframes we might even be talking about. And at the

course level, these may be, as Dana said, probability distributions, in which case the statistics just don't work for you. But if you put in the effort to dig deeper, I think we can probably do a lot better.

Just in closing, so I don't stay on the phone too long, I really appreciated the discussions today and thought they were very useful. And I will drop off now.

DR. CHOKSHI: Yeah. I think, Dennis, that the whole purpose for us, you know, at this workshop is to get to that stage, that that is where we can look at -- you know, I think one would think -- you know, seismic, as you said, there are a lot of mechanistic models.

You can do simulations and things, you know, which the community -- either because they did not have a bill to answer this questions, or other reason. They haven't developed such models or even thought about that. So we need to get to that first base and start the process. I think it is not going to happen overnight.

MEMBER BLEY: I agree with you, and I think we have just heard a little too much "It can't be done." And I think you're right, going ahead with the workshop is the next step, and let's see where

that goes. And if it's three years before we get it, we're better off starting it now than five years before that.

DR. CHOKSHI: Exactly.

DR. COOK: The workshop is January 29 through 31 here. Tom Nicholson is in the back. He can talk more about it. Multiple panels that are there, multiple different topics. Covers a lot of the things. It's --

CHAIRMAN SCHULTZ: Other comments, before we close, from members of the Committee? Jack? Sanjoy? Dennis? Dana?

MEMBER SHACK: Just a valiant presentation. That's all I can say.

CHAIRMAN SCHULTZ: We're pleased that we had the time available for you today. It was a very thorough presentation of a lot of work that has been done. Congratulate you, once again, on the development of the latest version of the documentation, and we will enjoy reading that when we get to it. Appreciate it very much.

We will like to get information from you, Nilesh, about the schedule for the seismic work.

DR. CHOKSHI: Yes.

CHAIRMAN SCHULTZ: As well as determining

when would be the best time to come back and find out how the program is going in this area, in a reasonable time. There is a lot going on here -- that's for sure -- with what is coming back.

So with the information that you are going to be gathering, especially with respect to the licensee's evaluations over the next month, we would like to figure out a time to look at the information that is gathered.

DR. CHOKSHI: We'll work with --

CHAIRMAN SCHULTZ: We'll be in touch.

DR. CHOKSHI: And I wanted to -- you know, this is -- you know, they're like integrated ISGs. It has been for I think some of the discussions. There is a second part to this, review part. And I think that was a very valuable insight, because you rely on the process of developing review guidance, so how we focus on -- you know, on certain aspects.

So I think it was some very valuable insight to the discussion, and so we can construct the review guidance, which goes to I think, you know, ultimate goal and also point to where we need to focus. So --

CHAIRMAN SCHULTZ: And we all agree with you that in the application much will be learned. So

we look forward to that as well.

With that, I will close the meeting.

(Whereupon, at 5:13 p.m., the proceedings in the foregoing matter were concluded.)

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

JAPAN LESSONS-LEARNED PROJECT DIRECTORATE

Overview of Interim Staff Guidance for R2.1 Flooding Evaluations

Advisory Committee on Reactor Safeguards Fukushima Subcommittee Meeting December 5, 2012

Dr. Christopher B. Cook

NRO/DSEA/RHMB, Ph: (301) 415-6397

Near-Term Task Force Recommendations 2.1 & 2.3

- NTTF 2.1: [Licensees are to…] reevaluate the seismic and flooding hazards at their sites against current NRC requirements and guidance, and if necessary, update the design basis and [structures, systems or components] important to safety to protect against the updated hazards.
- NTTF 2.3: [Licensees are to…] perform seismic and flood protection walkdowns to identify and address plant-specific vulnerabilities and verify the adequacy of monitoring and maintenance for protection features such as watertight barriers and seals in the interim period until longer term actions are completed to update the design basis for external events.

Overall Approach: 50.54(f) Letters on March 12, 2012

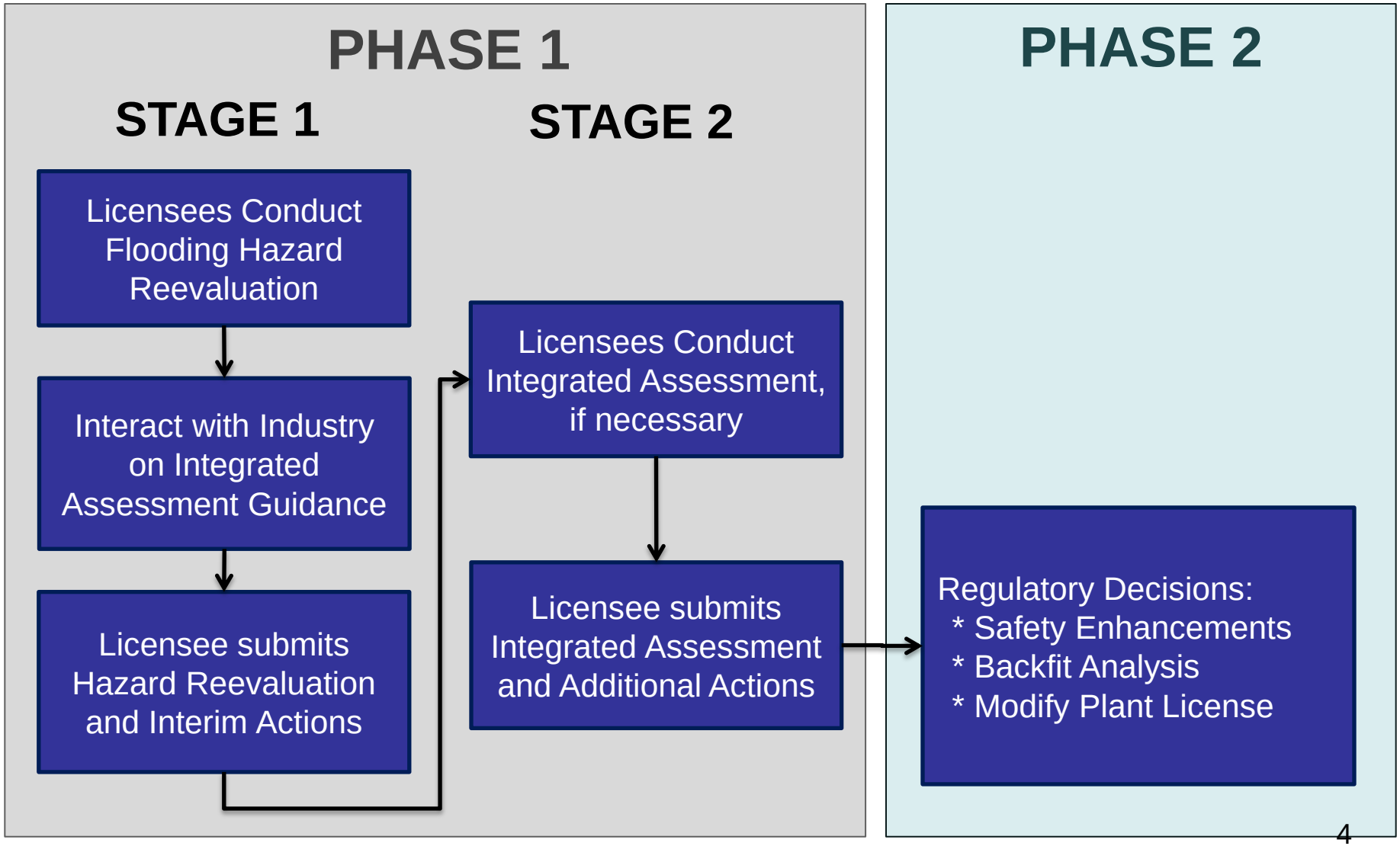
NTTF 2.3 - Walkdowns

NTTF 2.1 Flood Hazard Reevaluations and Interim Actions

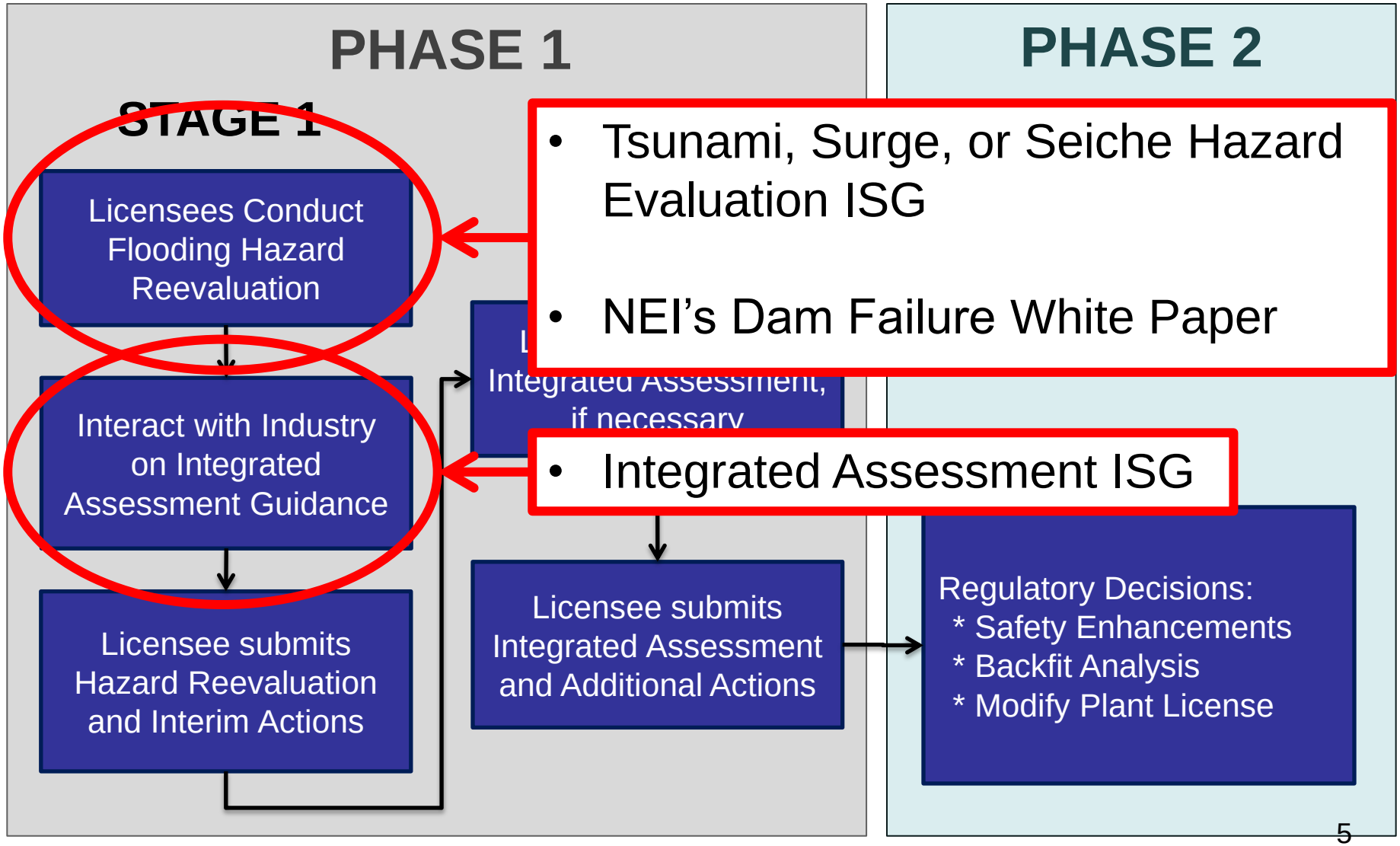
NTTF 2.1 Integrated Assessment (if required)

Regulatory Actions (if appropriate)

50.54(f) Flooding Reevaluation



50.54(f) Flooding Reevaluation



Motivations for developing ISGs and White Paper

- Why develop the Hazard ISG and Dam Failure WP?
  - SRP Section 2.4, ANSI/ANS-2.8, and RG1.59 provide the overall framework of what to evaluate.
  - However, ESP/COL reviews were only completed for a few sites, therefore only a limited number of ‘present-day’ examples.
  - Guidance summarizes ‘lessons learned’ from ESP/COL reviews.
  - Guidance discusses certain situations not encountered in completed ESP/COL reviews.
- Why develop the Integrated Assessment ISG?
  - Methodologies applied in the Integrated Assessment ISG were adapted from the seismic review area.
  - Results of the Integrated Assessment will facilitate regulatory decisions necessary during Phase 2.

Dam Failure

- NEI's White Paper on Dam Failure: Development Process
  - NEI-organized Flooding Task Force is leading development
  - Drafts are discussed at publically-noticed meetings. First-draft submitted early August. Next meeting is December 13-14.
  - All documents and written comments, including the NRC's and the public's, are preserved as part of the NRC meeting summary.

- NRC-Staff Activities related to Dam Failure
  - Presentation at Interagency Committee on Dam Failure (ICODS) on October 11
    - ICODS serves as the permanent forum for the coordination of federal activities in dam safety and security
    - Result was the formulation of small task group: POC's have been submitted from most agencies. First kick-off meeting is Dec 6.
  - NRC staff, via NRC's Dam Safety Officer, met individually with some federal agencies regarding specific dams and data needs regarding specific NPP hazard reevaluations

ISG Development Process and Status

- NRC-wide team collaborated and contributed to the ISG documents. Members from NRO, NRR, RES, Regions.
- Numerous public meetings held prior and during the Federal Register Notice (FRN) comment period.
- FRN Notice and Comment Period
  - Integrated Assessment ISG
    - **FRN Issued**: September 28, 2012
    - **Public Comment Period**: closed October 29, 2012
    - **Issuance Date**: Per the date stated in the 50.54(f) Letter, Enclosure 2, Footnote 2, the ISG was issued by Nov 30, 2012.
  - Tsunami, Surge, or Seiche Hazard ISG
    - **FRN Issued**: October 26, 2012
    - **Public Comment Period**: closed November 26, 2012
    - **Targeted Issuance Date**: December 21, 2012

Timeline

Date	Action
March 11, 2011	Earthquake and tsunami at Fukushima Dai-ichi site
March 12, 2012	NRC issued the 50.54(f) letters requesting information on flooding hazards & walkdowns
May 11, 2012	NRC issued a letter to all licensees prioritizing flooding hazard completion dates
May 31, 2012	NRC endorsed Walkdown Guidance (NEI 12-07)
November 27, 2012	Licensees submitted results of flooding walkdowns
November 30, 2012	NRC issued guidance on Integrated Assessment (JLD-ISG-2012-05)
December, 2012	NRC issues ISG on Tsunami, Surge, or Seiche
March, 2013	22 licensees submit results of hazard evaluations: Year 1 sites (IA, if needed, due 2-years later)
March, 2014	24 licensees submit results of hazard evaluations: Year 2 sites (IA, if needed, due 2-years later)
March, 2015	20 licensees submit results of hazard evaluation: Year 3 sites (IA, if needed, due 2-years later)

Major past actions

Future major actions

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

JAPAN LESSONS-LEARNED PROJECT DIRECTORATE

JLD-ISG-2012-05

Overview of Interim Staff Guidance for the Integrated Assessment for External Flooding

Advisory Committee on Reactor Safeguards
Fukushima Subcommittee Meeting
December 5, 2012

Dr. Michelle T. Bensi

NRO/DSEA/RHMB, Ph: (301) 415-0073

Overall Approach: 50.54(f) Letters on March 12, 2012

NTTF 2.3 - Walkdowns

NTTF 2.1 Hazard Reevaluations and Interim Actions

NTTF 2.1 Integrated Assessment (if required)

Regulatory Actions (if appropriate)

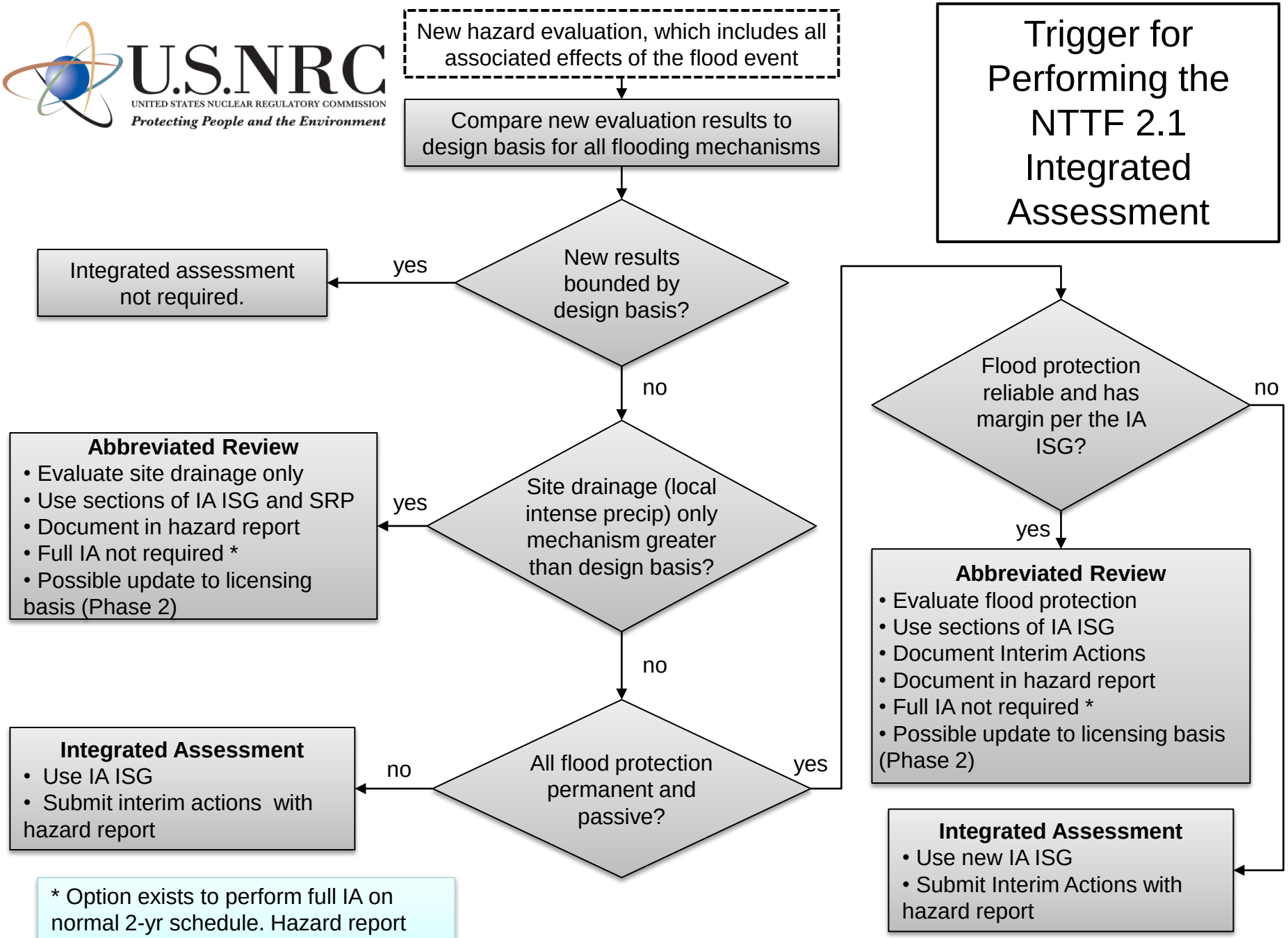
Purpose of Integrated Assessment

- The integrated assessment
  - evaluates the total plant response to external flood hazards
  - considers both the protection and mitigation capabilities of the plant
  - may use all available resources with appropriate justification
- The purpose of the integrated assessment is to
  - evaluate the effectiveness of the current licensing basis against the new hazard based on current regulatory guidance
  - identify plant-specific vulnerabilities due to external flood hazards and other important insights
  - assess the effectiveness of existing or planned protection for flood conditions and mitigation of flood consequences for the entire duration of a flooding event

Scope of Integrated Assessment

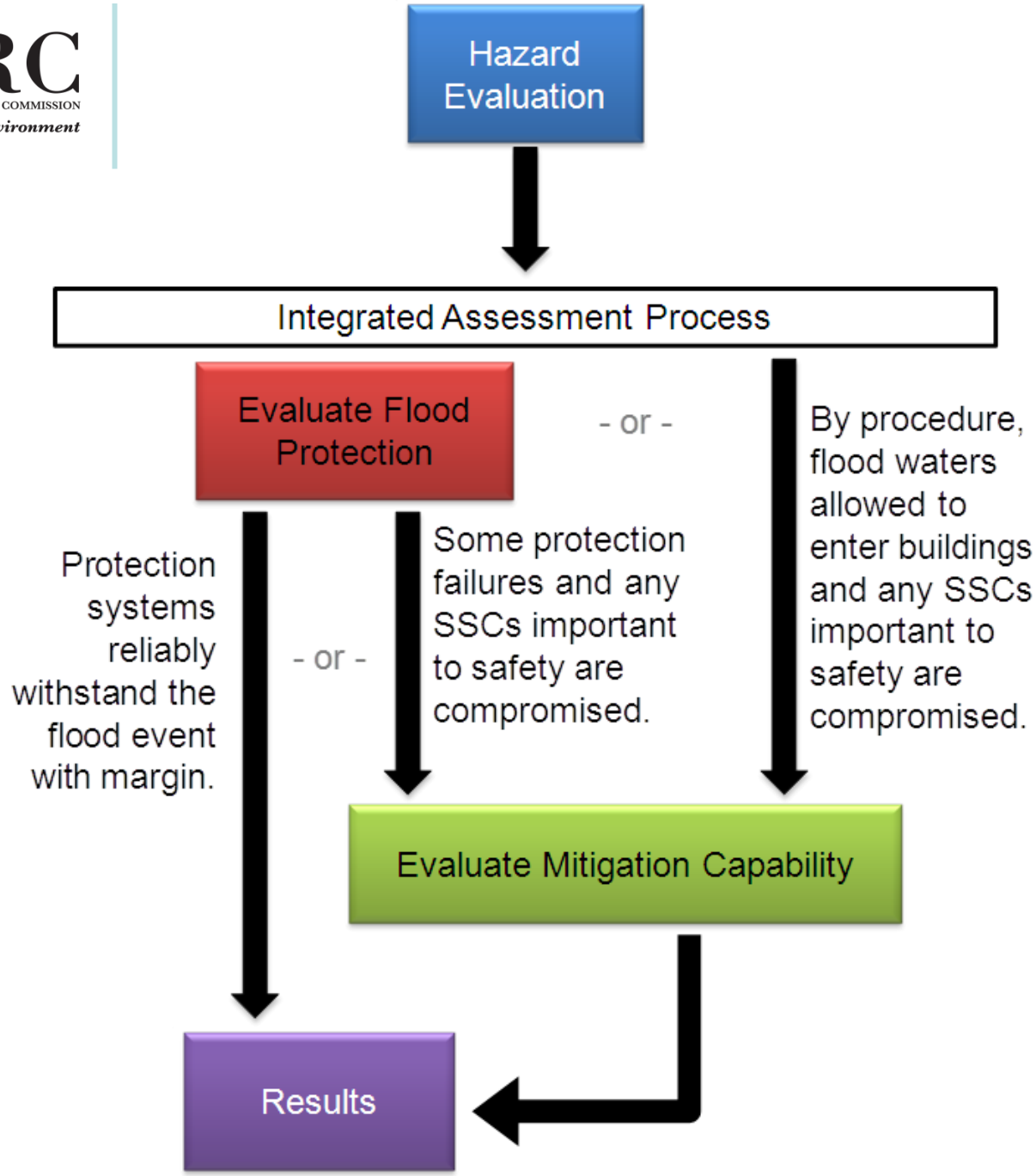
- The scope of the integrated assessment includes
  - full-power operations
  - other plant configurations that could be susceptible to damage due to impairment of flood protection features
  - flood-induced loss of an ultimate heat sink (UHS) water source
- The integrated assessment should
  - evaluate the effectiveness of flood protection and mitigation capability of the plant for the mode(s) of operation that the plant will be in for the entire flood event duration
  - describe the expected total plant response under other modes of operation, including a discussion of controls that are in place in the event that a flood occurs during any of these modes
  - consider whether specific vulnerabilities may arise during normal and full-power configurations and other modes of operation or configurations (e.g., conditions where flood protection features may be bypassed or defeated for maintenance or refueling activities)

Trigger for Performing the NTTF 2.1 Integrated Assessment



* Option exists to perform full IA on normal 2-yr schedule. Hazard report must state if IA is planned.

Interim Staff Guidance (ISG); Integrated assessment (IA); Standard Review Plan (SRP)


Hazard Evaluation
Integrated Assessment Process
Evaluate Flood Protection
- or -
By procedure, flood waters allowed to enter buildings and any SSCs important to safety are compromised.
Protection systems reliably withstand the flood event with margin.
- or -
Some protection failures and any SSCs important to safety are compromised.
Evaluate Mitigation Capability
Results

Content of ISG

1. Introduction
2. Background
3. Framework of integrated assessment (including key assumptions)
4. Peer review
5. Hazard definition
6. Evaluation of effectiveness of flood protection
7. Evaluation of mitigation capability
8. Documentation
9. Terms and definitions
10. References

Appendix A: Evaluation of flood protection
Appendix B: Peer review
Appendix C: Evaluation of manual actions
Appendix D: Existing references and resources

Key assumptions

1. Use of all available resources for protection and mitigation
   - In assessing the protection and mitigation capability of a plant, credit can be taken for all available (onsite and offsite) resources, including the following:
     - use of systems, equipment, and personnel in nontraditional ways
     - temporary protection and mitigation measures
     - nonsafety-related SSCs
   - The integrated assessment should account for the potentially reduced reliability of such resources in relation to permanent, safety-related equipment
   - Staff recognizes that other parallel activities related to Fukushima lessons learned are ongoing
     - Much of the analyses and evaluations done for these other activities can likely be utilized.
     - If crediting these resources, it is necessary to demonstrate that these resources also meet the intent of the integrated assessment ISG.

Key assumptions

2. Flood frequencies
   - For many flood mechanisms, widely accepted and well-established methodologies are not available for assigning initiating event frequencies to severe floods (i.e., floods as severe as those comprising the design basis for nuclear power plants).
   - The integrated assessment does not require the computation of initiating flood-hazard frequencies.
   - Using initiating event frequencies to screen out flood events in lieu of evaluation of flood protection features at the site is not acceptable.
   - Given appropriate justification, the use of the flood event frequency is acceptable as part of a PRA to evaluate total plant response.

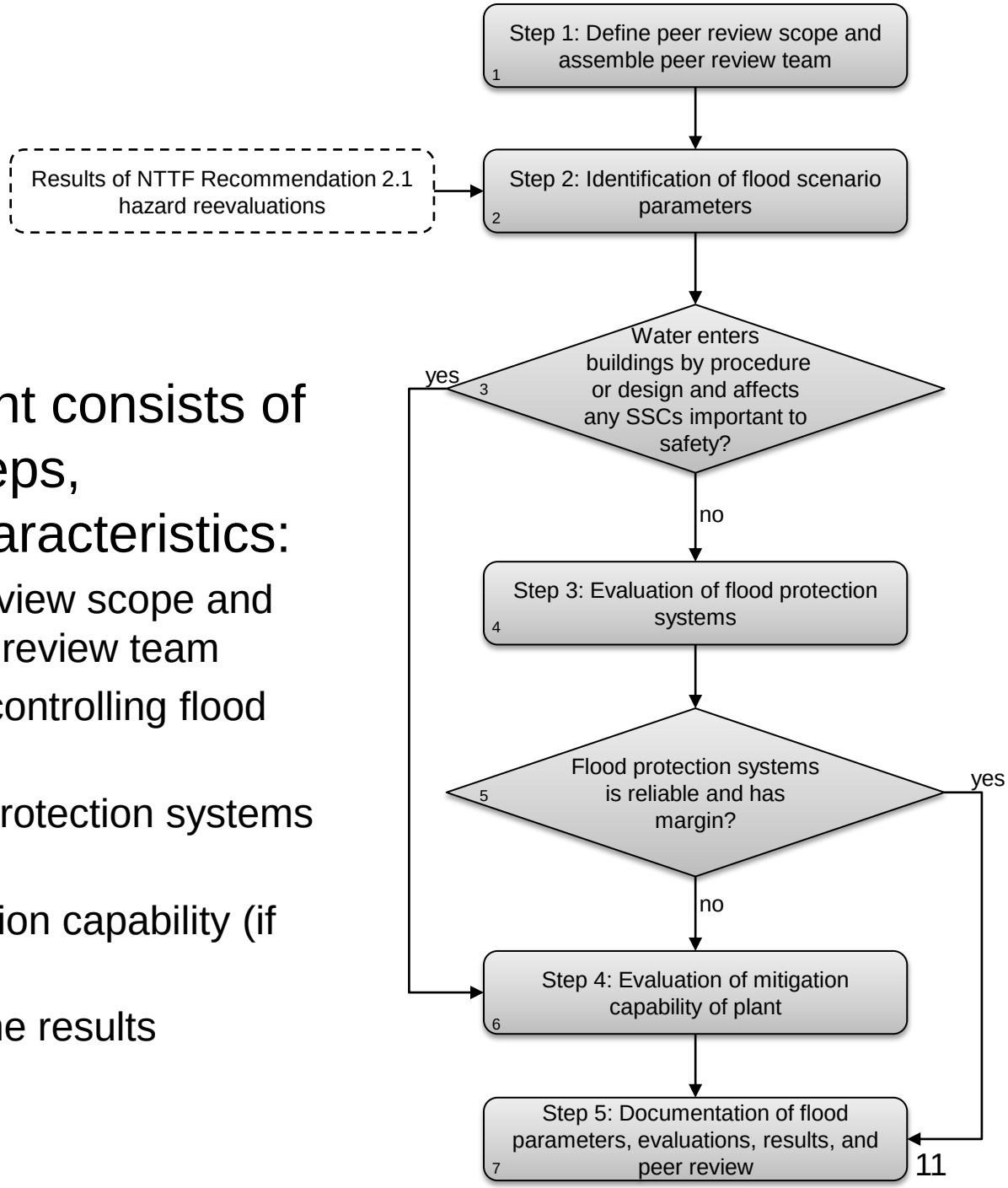
Key assumptions

3. Human performance
   - Human performance may take on added importance during flooding events compared to normal operations.
     - Establishment of flood protection features may rely heavily on manual actions (e.g., constructing sandbag barriers, deploying and operating portable pumps, or relocating equipment).
     - Manual actions may also be associated with mitigation, including actions that may leverage equipment, personnel, or other resources in nontraditional ways.
     - Failed or degraded instrumentation and controls in the main control room may affect operators.
     - Unavailability of equipment and systems may challenge the operating crew's ability to monitor and control the plant.
     - Access to and the functionality of local or remote control stations may be compromised.

Framework

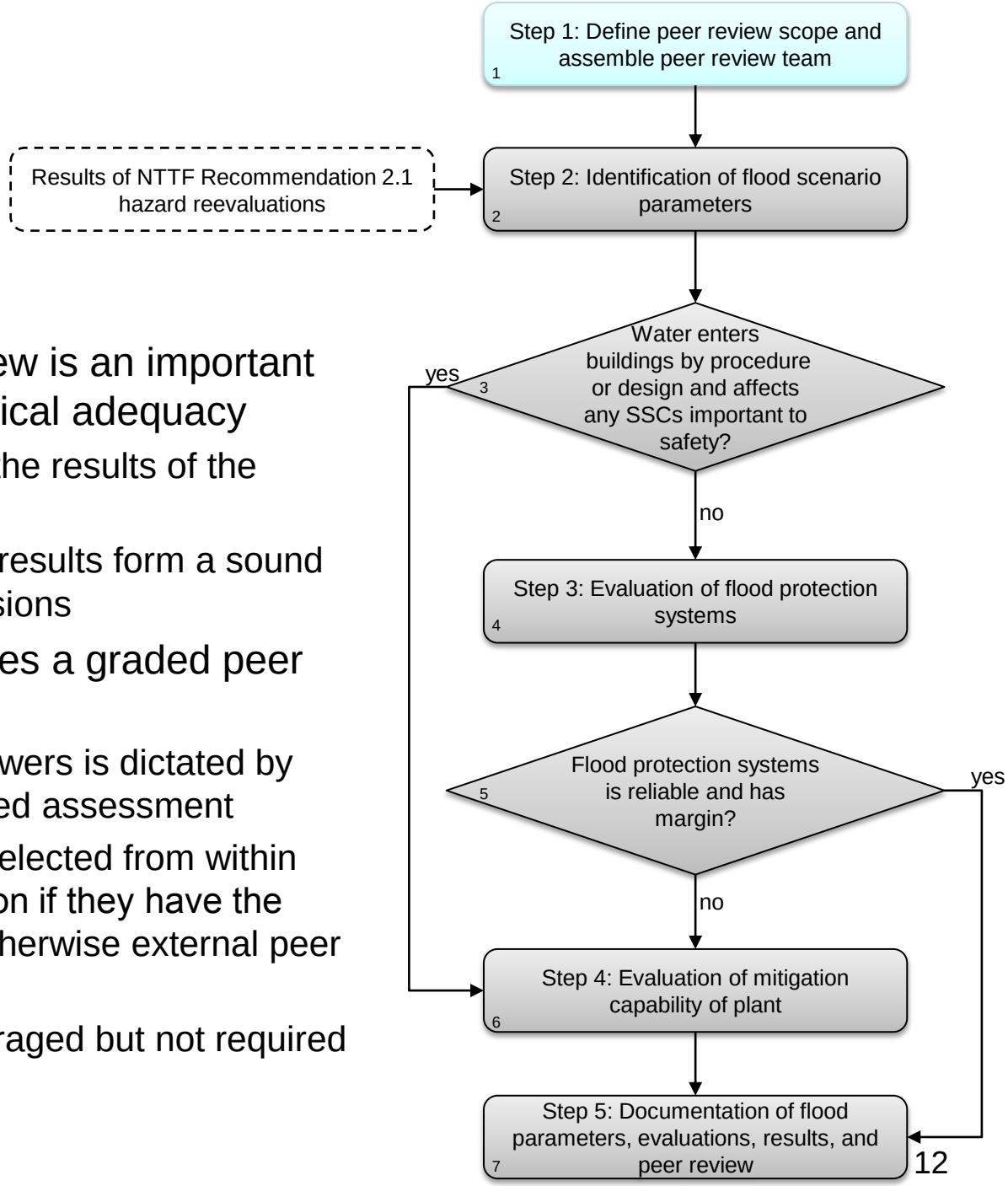
Integrated assessment consists of up to five possible steps, depending on site characteristics:

1. the definition of peer review scope and the assembly of a peer review team
2. a determination of the controlling flood parameters
3. an evaluation of flood protection systems (if applicable)
4. an evaluation of mitigation capability (if appropriate)
5. the documentation of the results



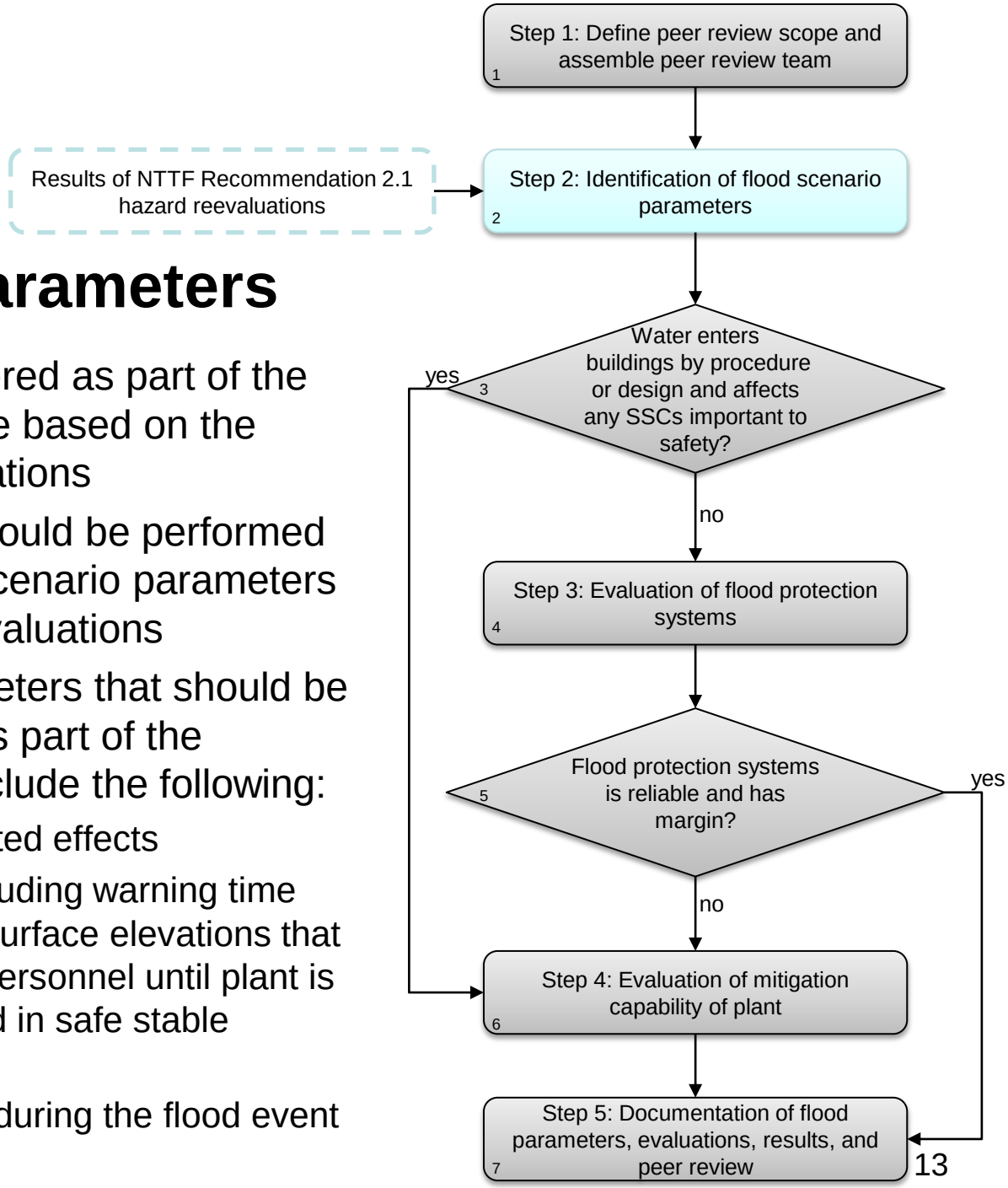
Peer review

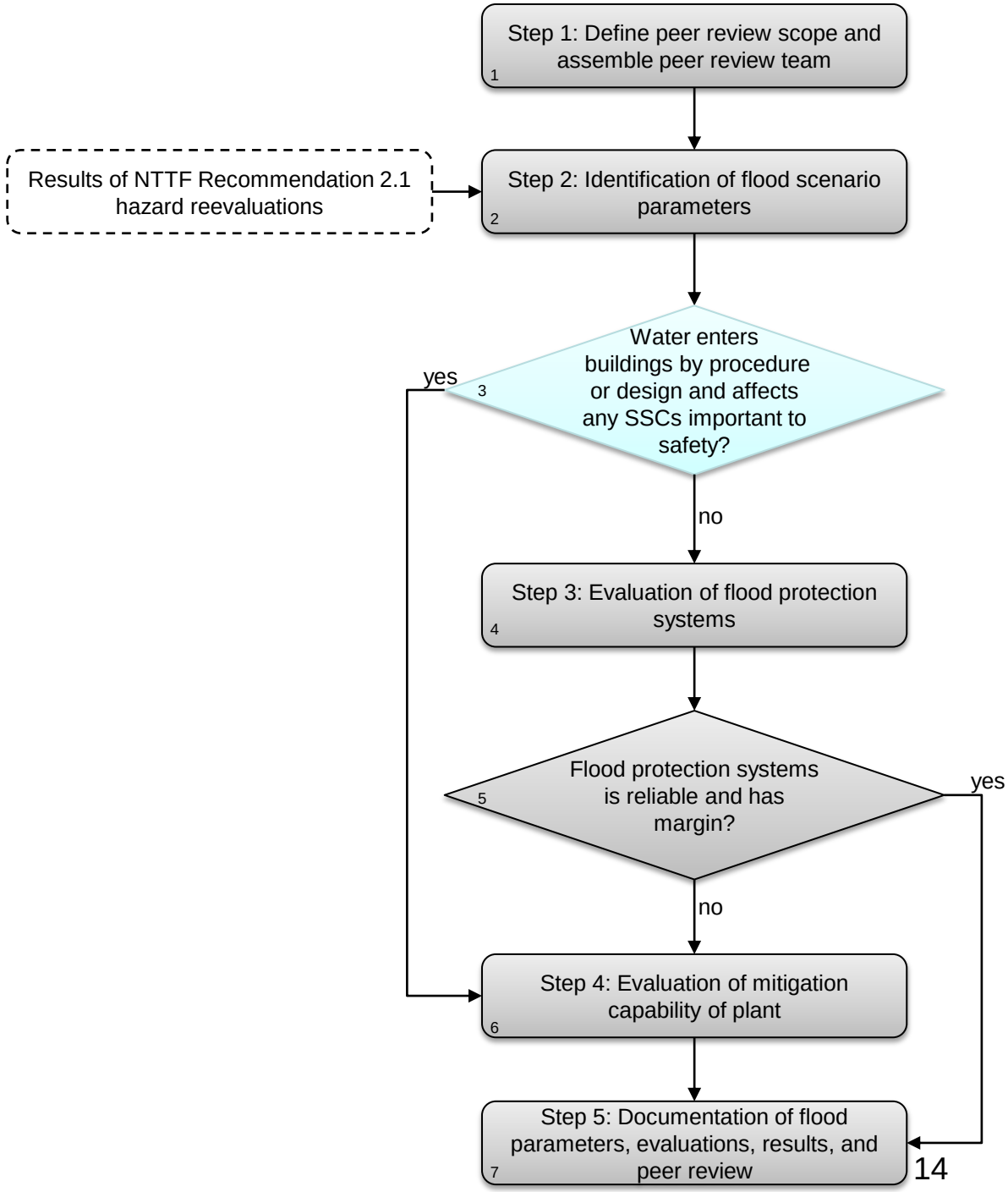
- An independent peer review is an important element of ensuring technical adequacy
  - increases confidence in the results of the integrated assessment
  - provides assurance that results form a sound basis for regulatory decisions
- Integrated assessment uses a graded peer review
  - the number of peer reviewers is dictated by the scope of the integrated assessment
  - peer reviewers may be selected from within the licensee's organization if they have the appropriate attributes (otherwise external peer reviewers are required)
  - in-process review encouraged but not required



Flood scenario parameters

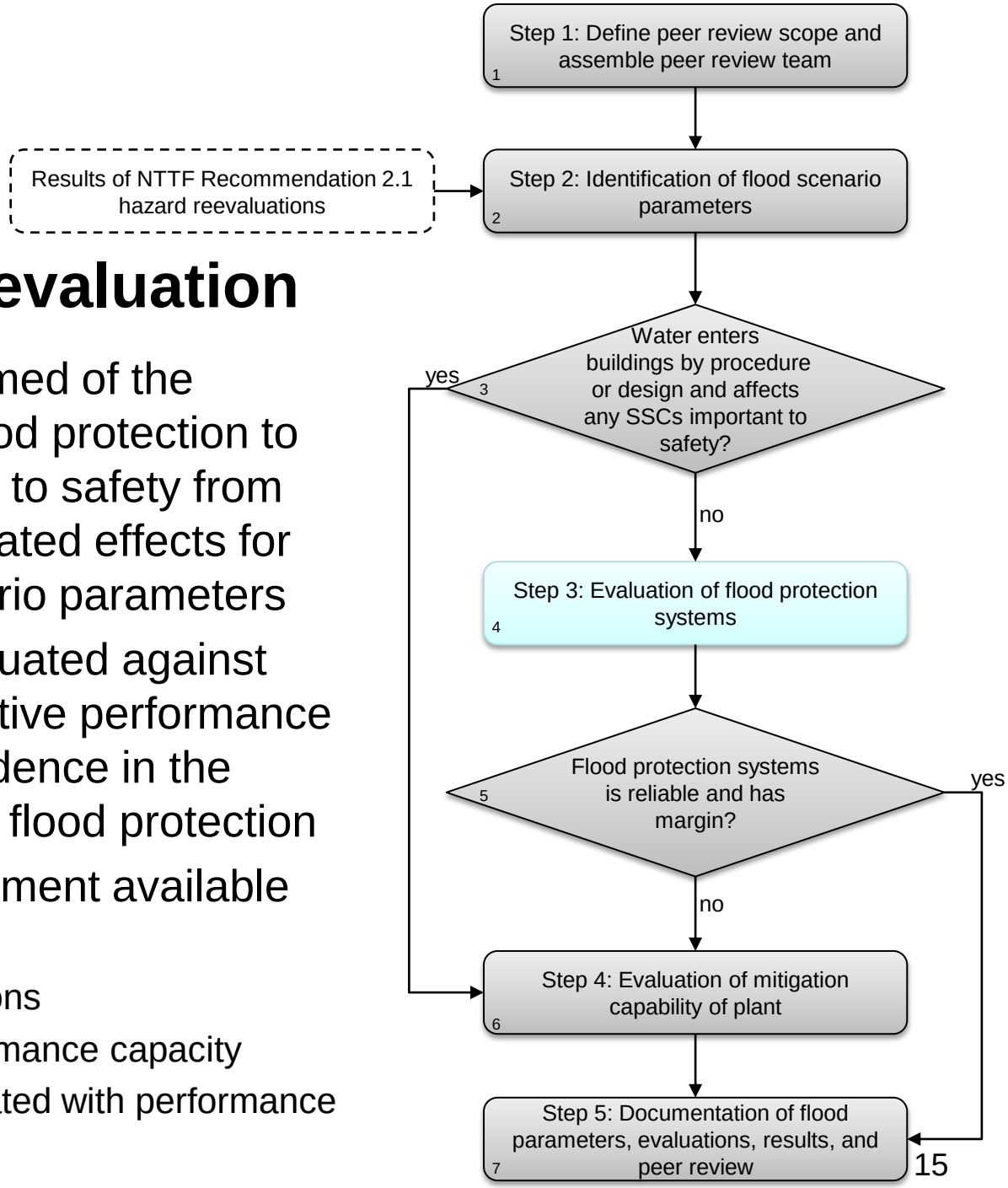
- Flood parameters considered as part of the integrated assessment are based on the NTTF 2.1 hazard reevaluations
- Integrated assessment should be performed for a set or sets of flood scenario parameters defined based on the reevaluations
- The flood scenario parameters that should be defined and considered as part of the integrated assessment include the following:
  - flood height and associated effects
  - flood event duration, including warning time and intermediate water surface elevations that trigger actions by plant personnel until plant is in and can be maintained in safe stable condition
  - evolution of plant status during the flood event

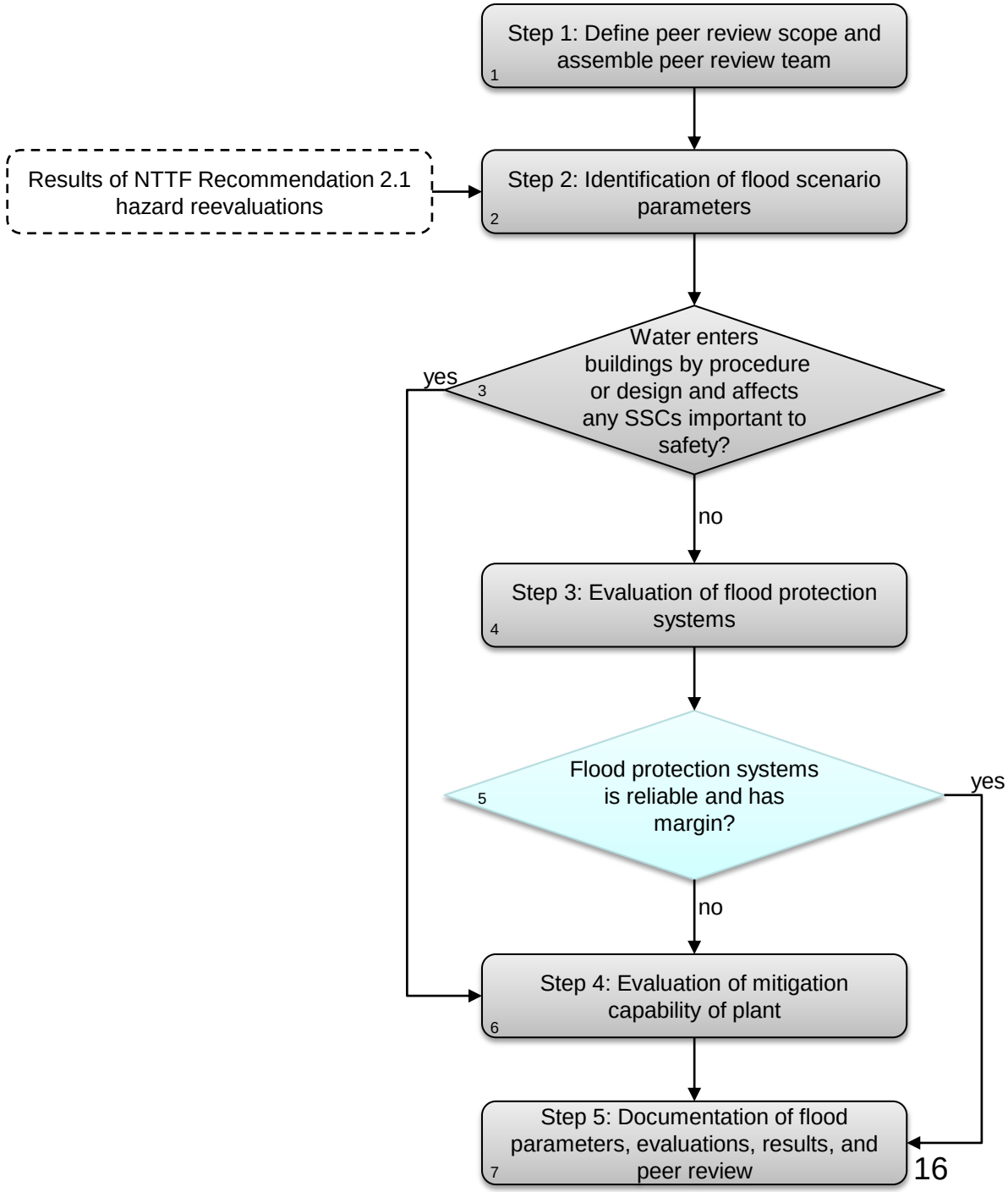



Step 1: Define peer review scope and assemble peer review team
1
Results of NTTF Recommendation 2.1 hazard reevaluations
Step 2: Identification of flood scenario parameters
2
Water enters buildings by procedure or design and affects any SSCs important to safety?
3
yes
no
Step 3: Evaluation of flood protection systems
4
Flood protection systems is reliable and has margin?
5
yes
no
Step 4: Evaluation of mitigation capability of plant
6
Step 5: Documentation of flood parameters, evaluations, results, and peer review
7

Flood protection evaluation

- An evaluation is performed of the capability of the site flood protection to protect SSCs important to safety from flood height and associated effects for each set of flood scenario parameters
- Flood protection is evaluated against qualitative and quantitative performance criteria to provide confidence in the reliability and margin of flood protection
- Evaluation should document available margin with respect to:
  - physical barrier dimensions
  - structural or other performance capacity
  - time and staffing associated with performance of manual actions

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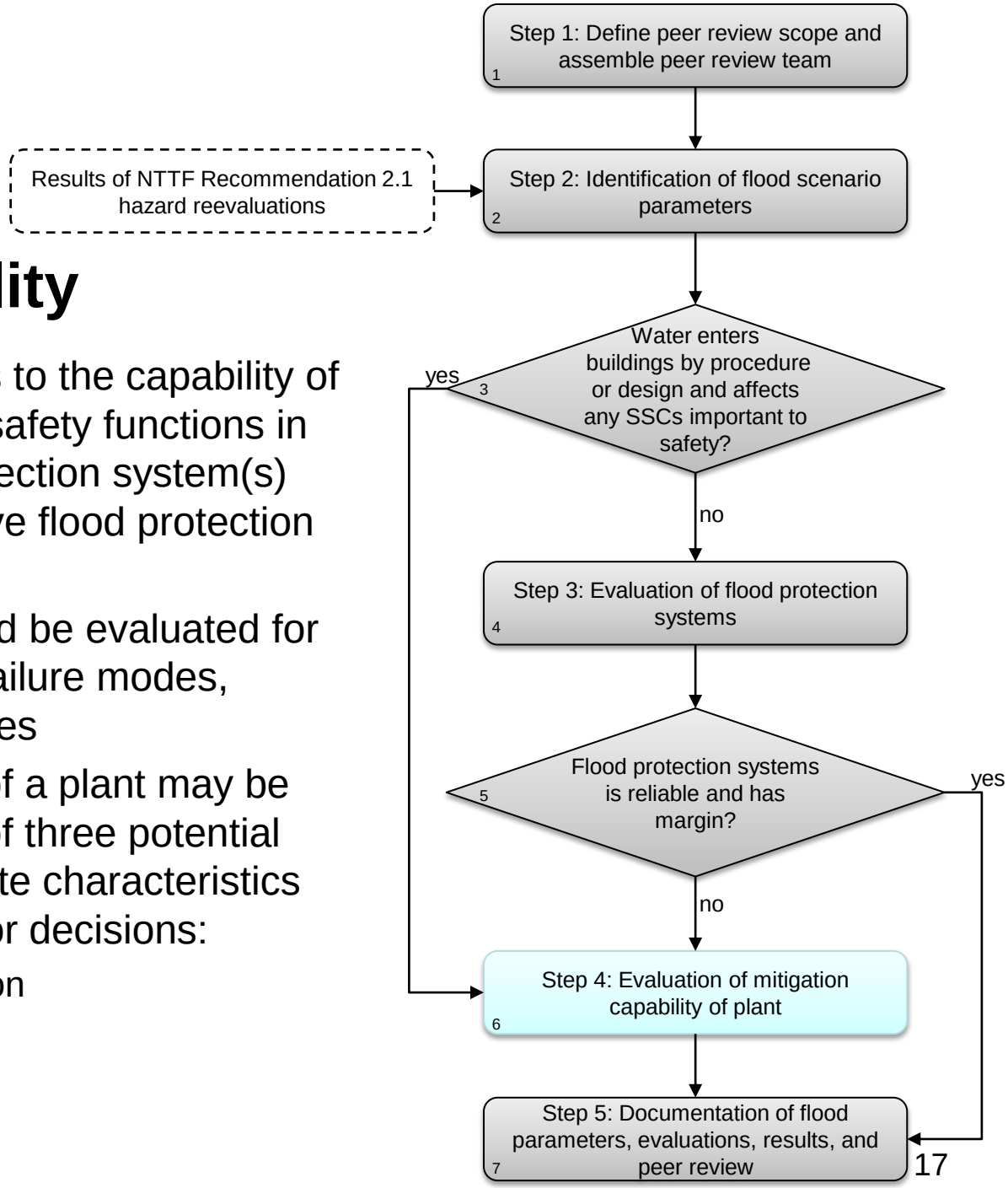
Flood protection systems is reliable and has margin?
5
yes
no
Step 4: Evaluation of mitigation capability of plant
6
Step 5: Documentation of flood parameters, evaluations, results, and peer review
7

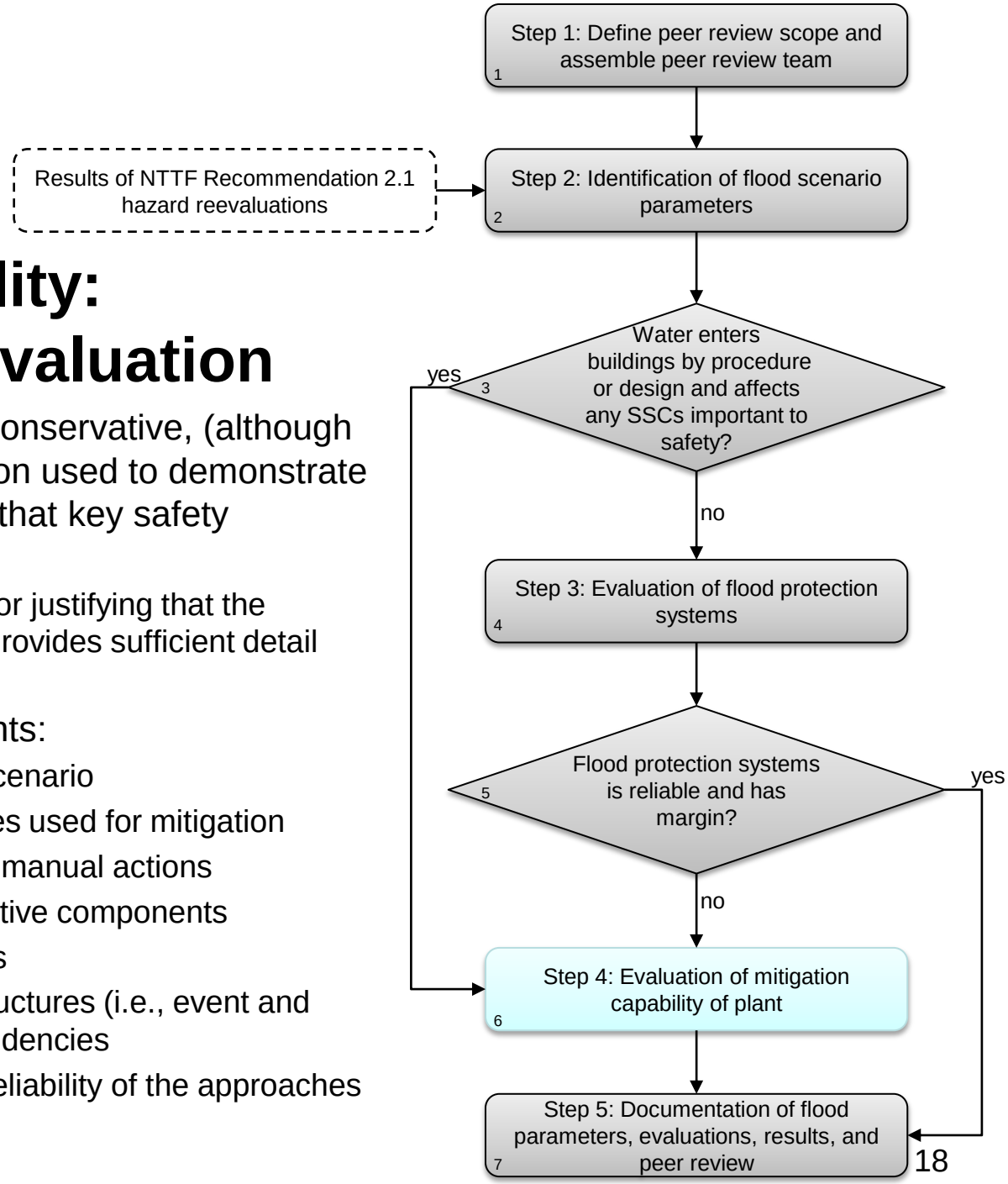
Mitigation capability

- Mitigation capability refers to the capability of the plant to maintain key safety functions in the event that a flood protection system(s) fails or a site does not have flood protection under the flood conditions
- Mitigation capability should be evaluated for credible flood protection failure modes, including concurrent failures
- The mitigation capability of a plant may be demonstrated using one of three potential methods, depending on site characteristics and information needed for decisions:
  - scenario-based evaluation
  - margins-type evaluation
  - full PRA



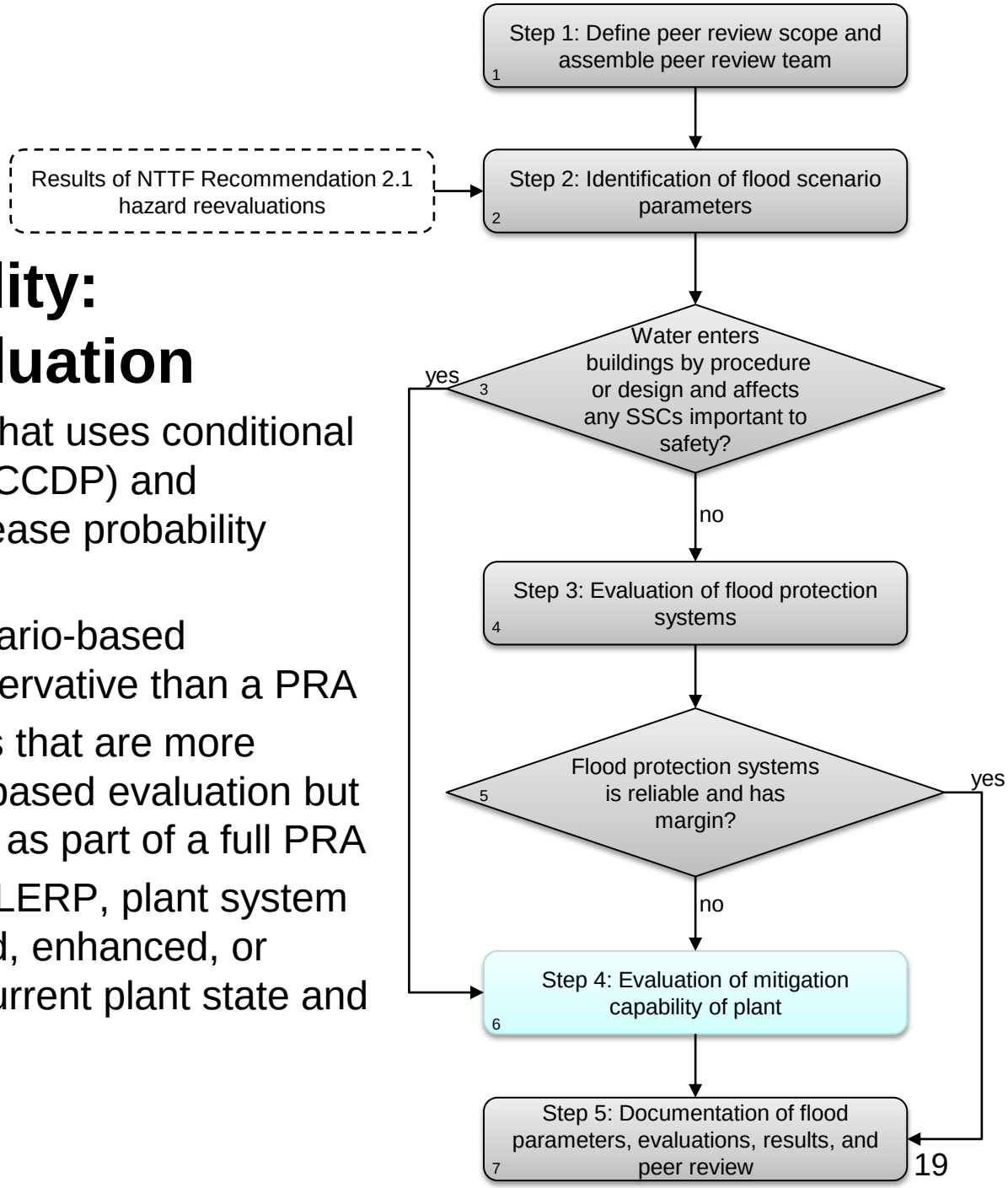
Mitigation capability: Scenario-based evaluation

- A systematic, rigorous, and conservative, (although primarily qualitative) evaluation used to demonstrate that there is high confidence that key safety functions can be maintained
  - the licensee is responsible for justifying that the scenario-based evaluation provides sufficient detail and supporting information
- Includes the following elements:
  - detailed description of the scenario
  - description of the approaches used for mitigation
  - timeline showing necessary manual actions
  - (qualitative) evaluation of active components
  - evaluation of manual actions
  - the development of logic structures (i.e., event and fault trees) to capture dependencies
  - a conclusion of the overall reliability of the approaches used for mitigation



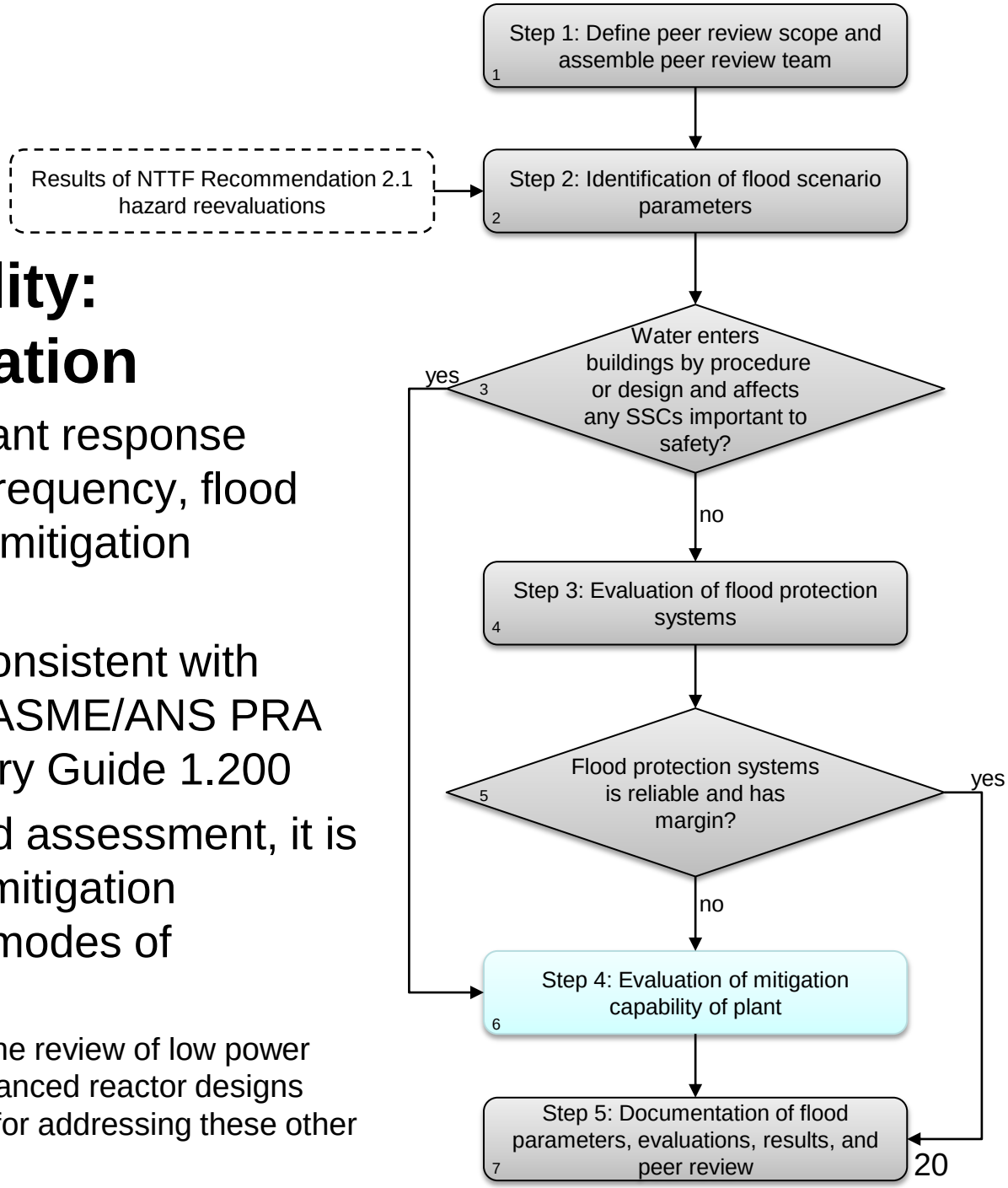
Mitigation capability: Margins-type evaluation

- A quantitative evaluation that uses conditional core damage probability (CCDP) and conditional large early release probability (CLERP) as output
- More realistic than a scenario-based evaluation, but more conservative than a PRA
- Typically use logic models that are more complex than a scenario-based evaluation but simpler than models used as part of a full PRA
- To compute CCDP and CLERP, plant system models should be updated, enhanced, or developed to reflect the current plant state and available equipment



Mitigation capability: PRA-based evaluation

- Used to assess total plant response accounting for hazard frequency, flood protection fragility, and mitigation capability
- Evaluation should be consistent with guidance contained in ASME/ANS PRA Standard and Regulatory Guide 1.200
- As part of the integrated assessment, it is necessary to consider mitigation capability during other modes of operation
  - references used by staff in the review of low power and shutdown PRAs for advanced reactor designs may provide useful insights for addressing these other modes of operation



Documentation

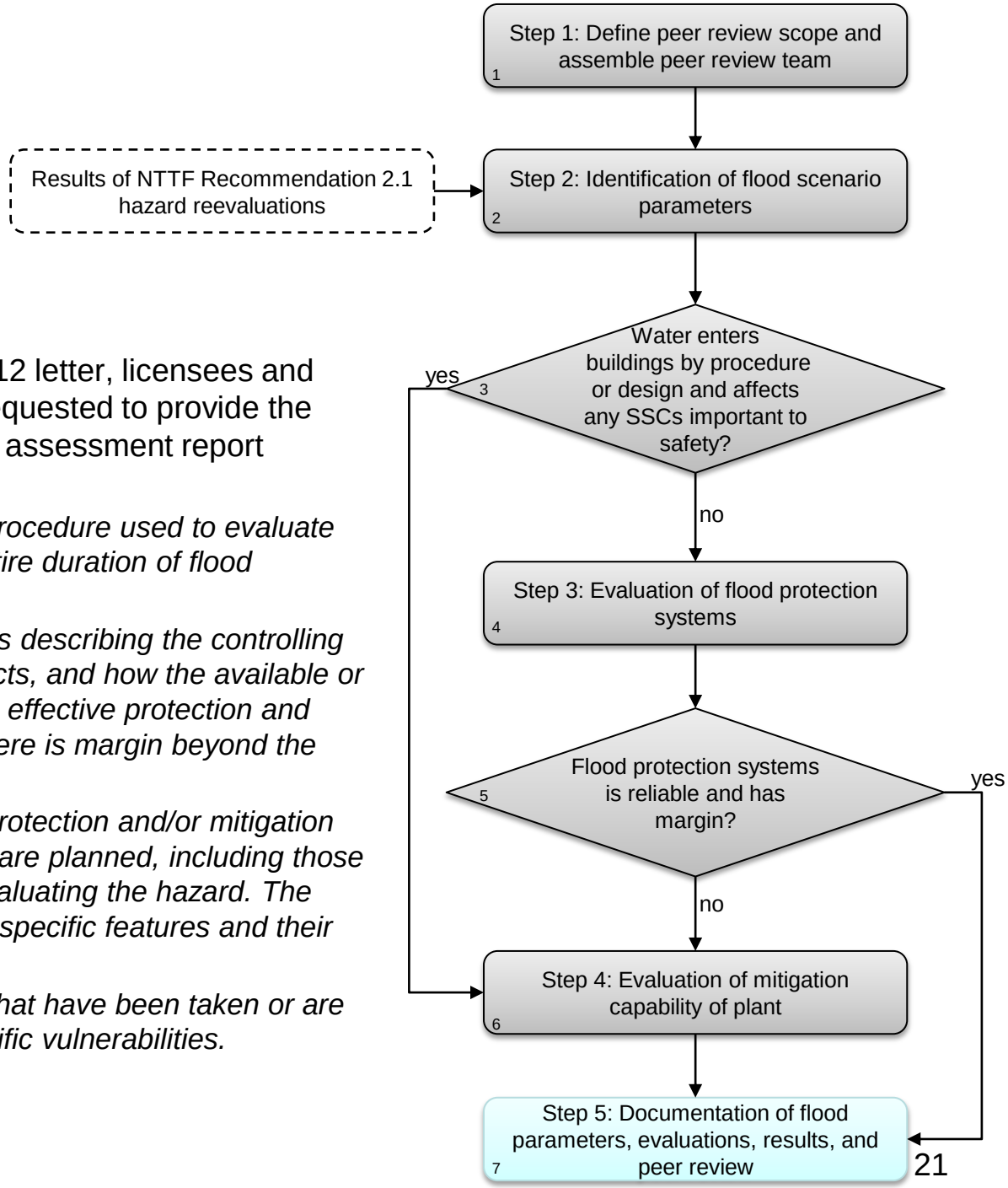
Consistent with the March 12, 2012 letter, licensees and construction permit holders are requested to provide the following as part of the integrated assessment report (Enclosure 2, pp. 8–9):

a) *Description of the integrated procedure used to evaluate integrity of the plant for the entire duration of flood conditions at the site.*

b) *Results of the plant evaluations describing the controlling flood mechanisms and its effects, and how the available or planned measures will provide effective protection and mitigation. Discuss whether there is margin beyond the postulated scenarios.*

c) *Description of any additional protection and/or mitigation features that were installed or are planned, including those installed during course of reevaluating the hazard. The description should include the specific features and their functions.*

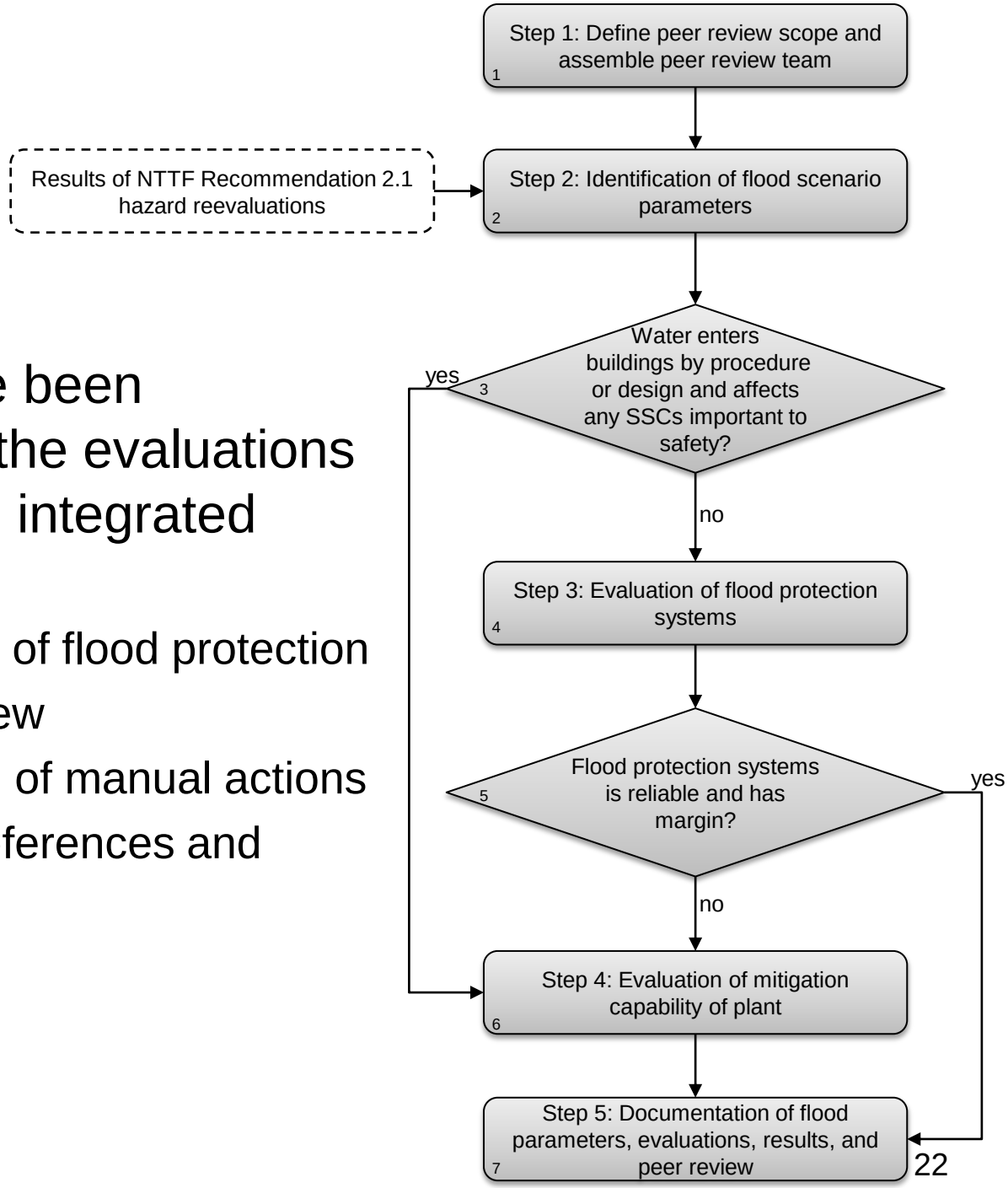
d) *Identification of other actions that have been taken or are planned to address plant-specific vulnerabilities.*



Appendices

Four appendices have been developed to support the evaluations required as part of the integrated assessment:

- Appendix A: Evaluation of flood protection
- Appendix B: Peer Review
- Appendix C: Evaluation of manual actions
- Appendix D: Existing references and resources



Appendix A: Evaluation of Flood Protection

- Appendix A provides guidance, references, and points of consideration related to:
  - Exterior and incorporated flood protection features:
    - earthen embankments (e.g., earth dams, levees and dikes)
    - floodwalls
    - seawalls
    - concrete barriers
    - plugs and penetration seals
    - storm drainage systems
  - Active features
    - Active components (e.g., pumps)
    - Flood doors and hatches
  - Temporary features
  - Equipment necessary for human actions
  - Evaluation of flood protection systems

Appendix B: Peer Review

- Appendix B provides guidance related to:
  - Peer reviewer attributes
    - independence
    - number of reviewers
    - peer review team leader
    - use of internal versus external reviewers
  - Peer review attributes
    - in-process versus one-time peer review
    - conduct of review as a team
    - areas of review and keys focus areas
    - scope of review
  - Peer review documentation
    - process
    - names and credentials of reviewers
    - description of how attributes were met
    - key findings and disposition of comments
    - review of report and main conclusions

Appendix C: Evaluation of Manual Actions

- Appendix C provides guidance for evaluating manual actions based on concepts and approaches used in human factors engineering and human reliability analyses
  - Process for identifying and defining important human actions (including narrative)
  - Evaluation of whether manual actions are feasible
    - Performance shaping factors

      - Cues and indications
      - Complexity
      - Human system interface
      - Special equipment
      - Accessibility
      - Training
      - Procedures
      - Staffing
      - Communications
      - Special fitness issues
      - Environmental factors
      - Perceived workload, pressure & stress
      - Scenario-specific PSFs
    - Timing analysis
    - Calculation of time margin
  - Evaluation of whether manual actions are reliable
  - Documentation

Appendix D: Existing References and Resources

- Appendix D provide brief descriptions and discussions of existing assessments of external flood risk at nuclear power plants
  - Evaluations Performed under Task Action Plan A-45
  - NUREG/CR-5042, “Evaluation of External Hazards to Nuclear Power Plant in the United States”
  - Individual Plant Examination of External Events (IPEEE) Program

ISG Development Summary

- NRC staff interacted with external stakeholders through multiple public meetings
- Issued ISG for public comment on September 28, 2012 (30-day public comment period ended October 29, 2012)
- Received 61 comments from four submissions
- Comments received related to:
  - evaluation of mitigation capability
  - expectations and attributes of the peer review
  - availability of illustrative examples
  - equipment redundancy and quantification of reliability
  - the evaluation of manual actions
  - the evaluation of flood protection and demonstration of reliability and margin using available performance criteria
  - general and miscellaneous other topics
- Integrated assessment ISG issued November 30, 2012

Summary of key comments

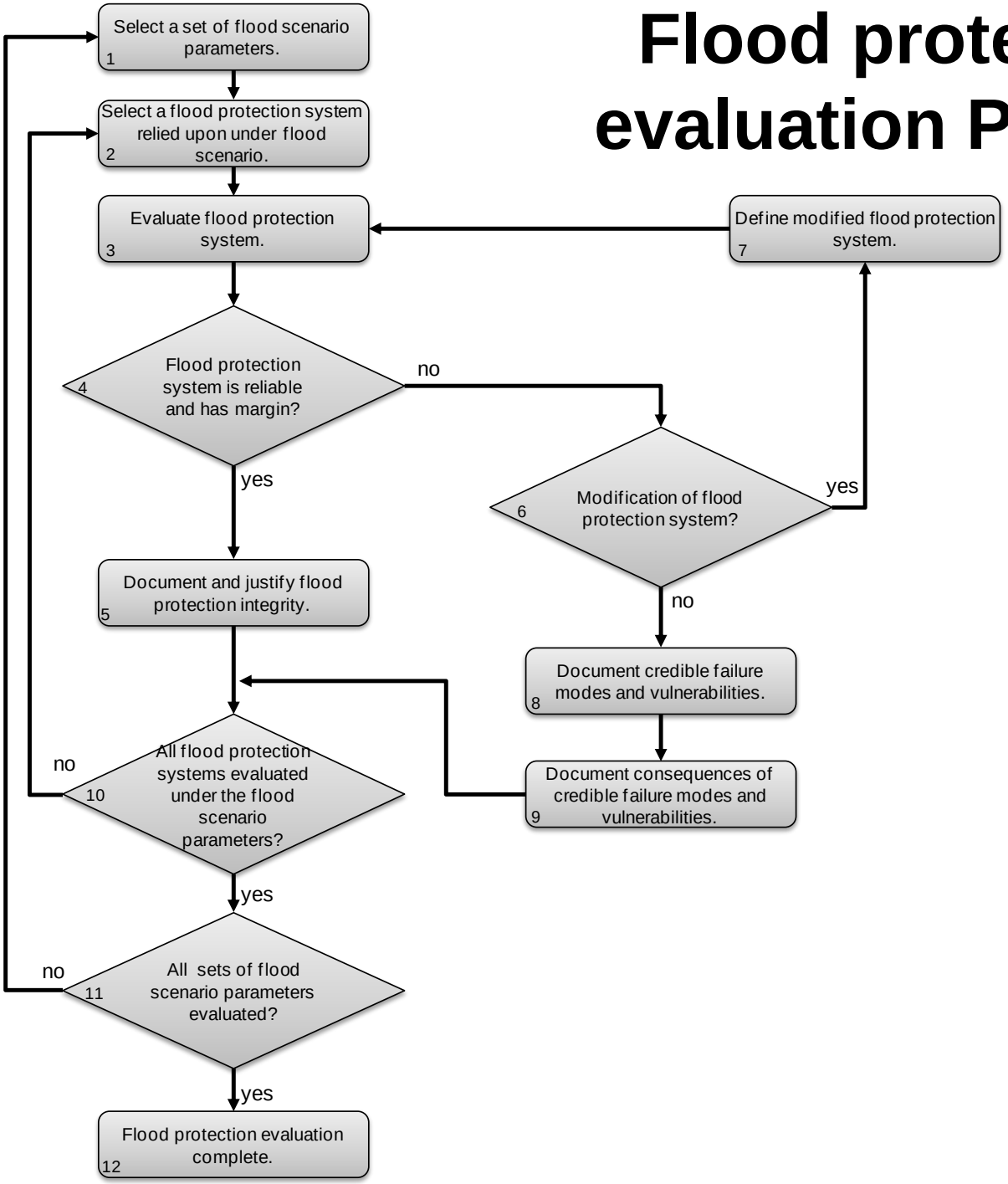
- Evaluation of mitigation capability (as originally proposed)
  - Concerns that scenario-based evaluation was too restrictive
  - Perceived bias towards margins-type assessment or PRA
  - Acceptability of crediting the probability of flood protection failure or consideration of bounding flood protection failure modes
- Expectations and attributes of the peer review
  - Considered unprecedented and an unnecessary burden
  - Concerns about requirements for a participatory review
- Availability of illustrative examples
  - Examples would be helpful
  - Industry proposes future interactions to develop examples through interactions at public meetings
  - Content of Appendix D considered unhelpful

Summary of key comments (con'd)

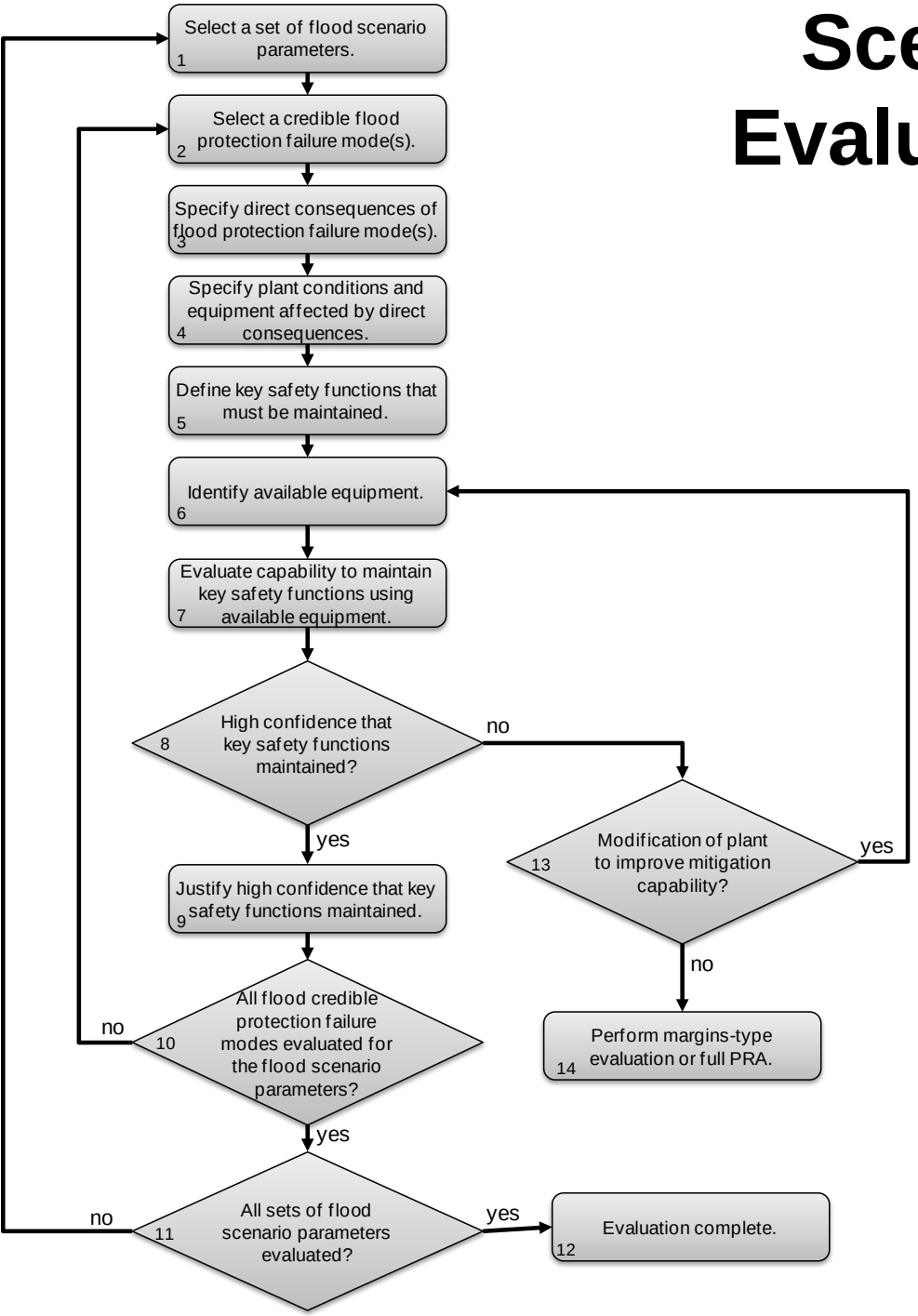
- Equipment redundancy and quantification of reliability
  - Quantification versus qualification
- The evaluation of manual actions
  - Lack of consensus methods for evaluating the feasibility and reliability of manual actions
  - Challenges to quantification
- The evaluation of flood protection and demonstration of reliability and margin using available performance criteria
  - Confusion of about overall relationship between Section 6 and Appendix A
  - Definition of "margin" and "reliable"
- General and miscellaneous other topics

Backup Slides

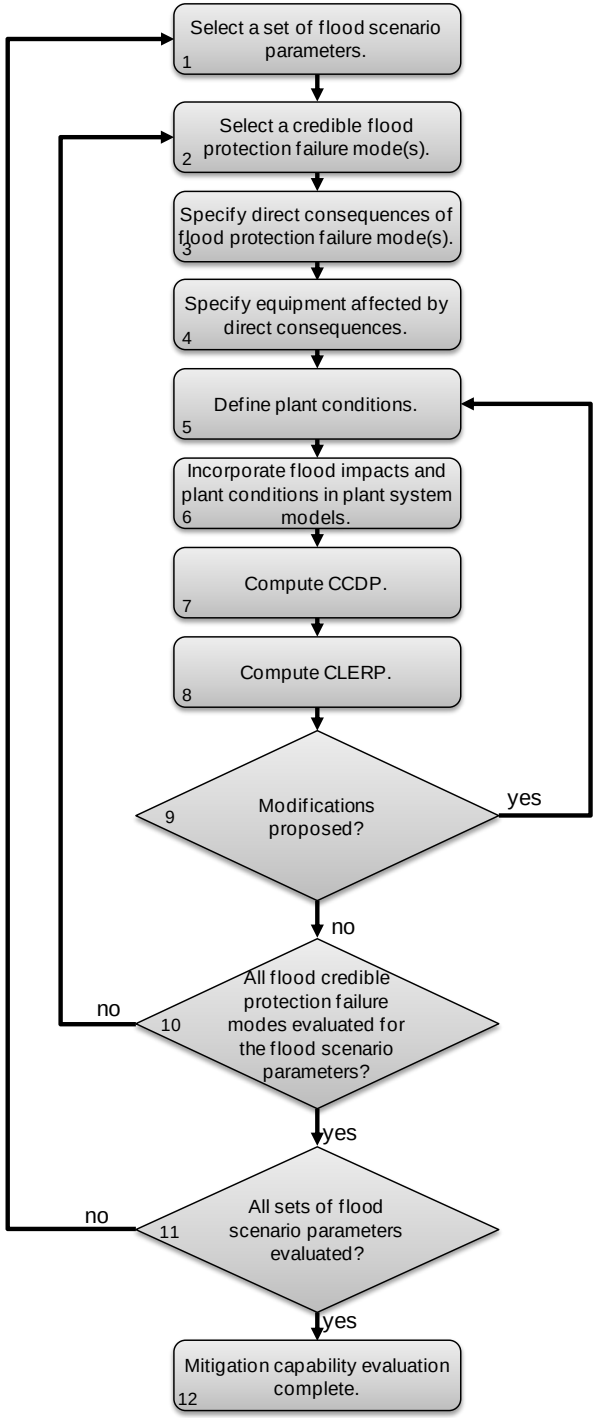
Flood protection evaluation Process



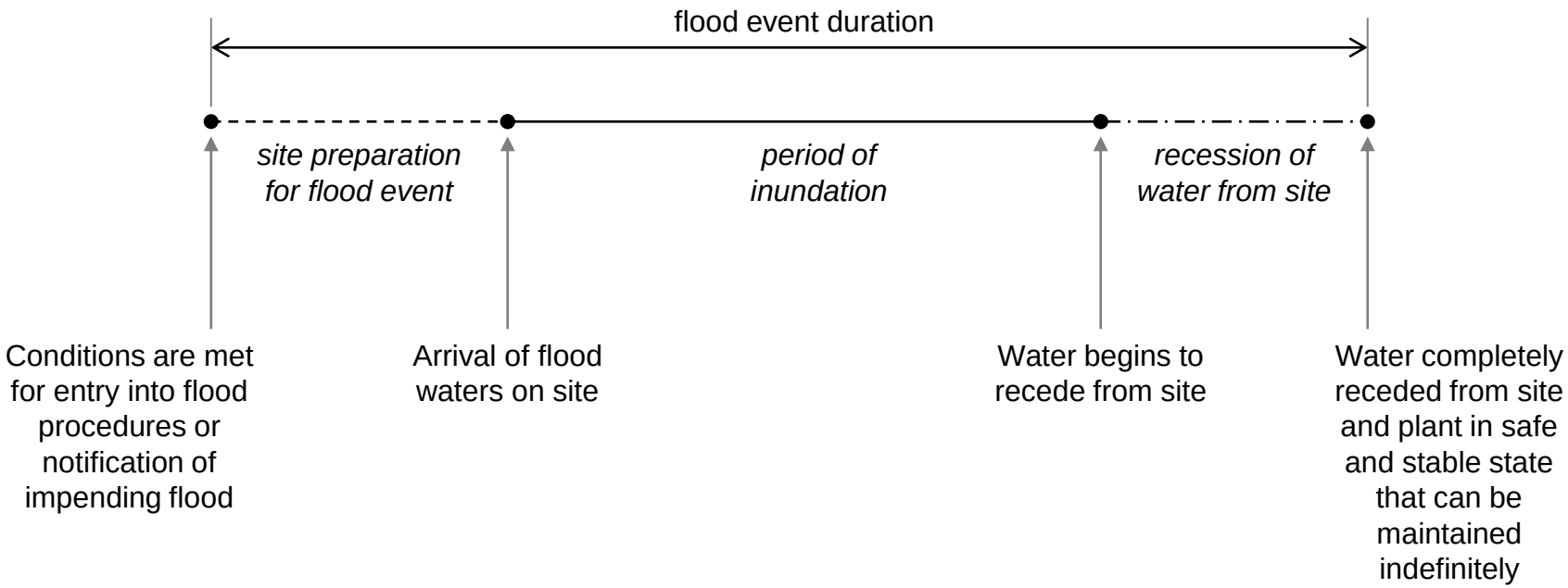
Scenario-based Evaluation Process



Margins-type Evaluation Process



Flood Event Duration



Criteria for Evaluating Active Components

Functional characteristics:	1. Equipment is capable of performing its required function (e.g., functional requirements such as pump flow rate, pump discharge pressure are met). 2. Equipment is in satisfactory condition. 3. Functionality of the equipment may be outside the manufacturer's specifications if a documented engineering evaluation justifies that the equipment will be functional when needed during the flood event duration. 4. There is an engineering basis for the functional requirements for the equipment which: a. is auditable and inspectable; b. is consistent with generally accepted engineering principles; c. defines incorporated functional margin; and d. is controlled within the configuration document control system.
Operational characteristics	1. Equipment is covered by one of the following: a. existing quality assurance (QA) requirements in Appendix B of 10 CFR Part 50; b. existing fire protection QA programs; or c. a separate program that provides assurance that equipment is tested, maintained, and operated so that it will function as intended and that equipment reliability is achieved. 2. Testing (including surveillances) a. Equipment is initially tested or other reasonable means should be used to verify that its performance conforms to the limiting performance requirements. b. Periodic tests and test frequency are determined based upon equipment type and expected use. Testing is done to verify design requirements and basis are met. The basis is documented and deviations from vendor recommendations and applicable standards should be justified. c. Periodic inspections address storage and standby conditions as well as in-service conditions (if applicable). d. Equipment issues identified through testing are incorporated into the corrective action program and failures are included in the operating history of the component. 3. Preventive maintenance (including inspections) a. Preventive maintenance (including tasks and task intervals) is determined based upon equipment type and expected use. The basis is documented and deviations from vendor recommendations and applicable standards should be justified. b. Periodic testing addresses storage and standby conditions as well as in-service conditions (if applicable). c. Equipment issues identified through inspections are incorporated into the corrective action program and failures are included in the operating history of the component.

Unavailability characteristics	1. The unavailability of equipment should be managed such that loss of capability is minimized. Appropriate and justifiable unavailability time limits are defined as well as remedial actions. A replacement would be for equipment that is expected to be unavailable in excess of this time limit or when a flood event is forecasted. 2. A spare parts strategy supports availability considerations. 3. The unavailability of installed plant equipment is controlled under existing plant processes such as technical specifications.
Equipment storage characteristics	1. Portable equipment is stored and maintained to ensure that it does not degrade while being stored and that it is accessible for maintenance and testing. 2. Credited active equipment is protected from flooding. It is accessible during a flooding event. Alternatively, credited active equipment may be stored in locations that are neither protected from flooding nor accessible during a flood if adequate warning of an impending flood is available and equipment can be relocated prior to inundation. a. Consideration should be given to the transport from the storage area recognizing that flooding can result in obstacles restricting normal pathways for movement. b. Manual actions associated with relocation of equipment should be evaluated as feasible and reliable (see Appendix C to this guidance). 3. A technical basis is developed for equipment storage that provides the inputs, assumptions, and documented basis that the equipment will be protected from flood scenario parameters such that the equipment could be operated in place, if applicable, or moved to its deployment locations. This basis is auditable, consistent with generally accepted engineering principles, and controlled within the configuration document control system.

United States Nuclear Regulatory Commission

Protecting People and the Environment

JAPAN LESSONS-LEARNED PROJECT DIRECTORATE

JLD-ISG-2012-06

Guidance for Performing a Tsunami, Surge, or Seiche Hazard Assessment

Advisory Committee on Reactor Safeguards

Fukushima Subcommittee Meeting

December 5, 2012

Dr. Henry Jones
NRO/DSEA/RHMB
(301) 415-1463

OUTLINE

- Introduction
- Surge
  - Relationship to current practice
  - Key technical positions
- Tsunami
  - Relationship to current practice
  - Key technical positions
- Public comments
- Status/schedule

PURPOSE

Describe to stakeholders methods acceptable to the NRC staff for performing tsunami, surge, or seiche hazard assessments in response to NRC's March 12, 2012 50.54(f) letter

Reflect current practice documented in the Final Safety Analysis Report (FSAR) and Safety Evaluation Reports (SER) for new reactors.

NEED FOR ISGs

- Evaluation of site hydrology characteristics performed over thirty years ago for the majority of operating nuclear plants.

- Advancements in meteorology and physical oceanography have contributed to a better understanding of natural phenomena.

- Significant advancements in computer resources and environmental sensor technology since the 1970s has reduced previous limitations in data collection and the numerical modeling of hurricanes, surge, seiche and tsunamis.

- Need to capture lessons learned from ongoing new reactor safety reviews, current best practices of other Federal agencies, and recent events
  - Indian Ocean tsunami (2004)
  - Hurricane Katrina (2005)
  - Japanese tsunami
  - Hurricane Sandy(2012).

STORM SURGE

- Hurricane (tropical cyclones)
- Extra-tropical cyclones
- Hybrid storms

RELATIONSHIP TO CURRENT PRACTICE

- In this ISG, the “probable maximum” terminology referenced in NUREG-0800, Regulatory Guide 1.59 Rev 2, Regulatory Guide 1.206 and ANSI/ANS-2.8-1992 is not used. Instead, the terms “simulated” and “design basis” are used as defined in the Appendix (Glossary):
  - Design Basis Flood (DBF)
  - Simulated Hurricane (SH)
  - Simulated Wind Storm (SWS)
  - Simulated Storm Surge (SSS)
  - Design Basis Storm Surge (DBSS)

RELATIONSHIP TO CURRENT PRACTICE (Cont'd)

- This ISG is consistent with practices by other federal agencies that conduct storm surge hazard assessments (e.g., NOAA, USACE, FEMA)
- Current practice in storm surge modeling is based on the use of coupled hydrodynamic ocean circulation and wave models, both driven by a planetary boundary layer (PBL) model that provides the atmospheric forcing (e.g.,NUREG/CR-7134).
- NRC currently uses the above modeling system with a deterministic meteorological input (e.g., NWS-23/PMH) in conjunction with the hierarchical hazard approach (HHA) for storm surge hazard assessments.
  - Hurricane parameters adjusted to reflect storm characteristics observed since NWS-23 was published (1979).
- Estimation of the storm surge using one-dimensional, bathystrophic models or using the associated simplified methods provided in Appendix C of RG-1.59, Rev 2 (1977) are not considered acceptable and are not currently used for storm surge hazard assessments.

RELATIONSHIP TO CURRENT PRACTICE (Cont'd)

- For reviewing flood hazard reevaluations, NRC intends to use a probabilistic-deterministic methodology (e.g., NUREG/CR-7134) combined with the HHA to provide an independent analysis of the site specific DBSS:
  - ➢ Fixed narrow range for factors affecting hurricane surges shown to have asymptotic upper limits
  - ➢ Vary other factors within a context that allows for natural uncertainty in estimating upper limit for surges at a specific site (e.g., probability distribution focused on extreme values)
- Licensees have the OPTION of using deterministic approaches, probabilistic approaches (e.g., joint probability method or empirical simulation technique) or probabilistic-deterministic approaches (e.g. NUREG/CR-7134)

SURGE: KEY TECHNICAL POSITIONS

- NRC and licensees will use state-of-the art storm surge and wave models, both driven by a planetary boundary layer (PBL) model that provides the atmospheric forcing.

- For flood hazard reevaluations, NRC intends to use a probabilistic-deterministic methodology (e.g., NUREG/CR-7134) combined with the HHA to provide an independent analysis of the site specific DBSS.

- The meteorological input for atmospheric forcing provided in NWS 23 is still acceptable for licensing decisions when coupled with validated storm surge models. Hurricane parameters should reflect storm characteristics observed since 1977.

- Operating nuclear plant licensee have the OPTION of using deterministic, probabilistic or probabilistic-deterministic methodologies.

TSUNAMI

RELATIONSHIP TO CURRENT PRACTICES

- NRC currently uses deterministic analysis in conjunction with the hierarchical hazard approach (HHA) for tsunami hazard assessments.
- **Regulatory Guide 1.59 (1977)** briefly mentions tsunami as a source of flooding but does not provide guidance on tsunami hazards. The draft revision to RG 1.59 (DG-1290) addresses tsunami hazards in more detail.

- Early cooperative efforts with NOAA, USGS and PNNL resulted in the publication of documents currently used for new application safety reviews of tsunami hazards:
  - **NOAA Technical Memorandum OAR PMEL-135** ("Standards, Criteria, and Procedures for NOAA Evaluation of Tsunami numerical Models") and **NOAA Technical Memorandum OAR PMEL-136** ("Scientific and Technical Issues in Tsunami Hazard Assessment of Nuclear Power Plant Sites") form the basis of the 2007 tsunami-related updates to NUREG-0800.

  - ***NUREG/CR-6966***, "Tsunami Hazard Assessment at Nuclear Power Plant Sites in the United States of America", provides present-day methodologies and technologies that can used to estimate design-basis floods at nuclear power plants for tsunami hazards **(2009).**

RELATIONSHIP TO CURRENT PRACTICES (Cont'd)

- USGS **(2009)**, "Evaluation of Tsunami Sources with the Potential to Impact the U.S. Atlantic and Gulf Coasts: an updated Report to the Nuclear Regulatory Commission," Atlantic and Gulf of Mexico Tsunami Hazard Assessment Group.

- USGS **(2010),** "Identification of Tsunami Deposits in the Geologic Record: Developing Criteria Using Recent Tsunami Deposits ", Robert Peters and Bruce Jaffe, USGS.

RELATIONSHIP TO CURRENT PRACTICES (Cont'd)

- **Probabilistic tsunami hazard analysis (PTHA)** is also feasible, but there is no widely accepted methodology or consensus standard for conducting PTHA for nuclear facilities that need to address low probability levels.
- No NRC regulatory guidance exists for describing the hazard level (return period, annual exceedance probability) that should be used for evaluating tsunami hazards at nuclear power plants.
  - PTHA is part of ongoing research (NRO/DSEA and RES/DE).
  - Probabilistic Flood Hazard Assessment Workshop will include session on PTHA (Jan 29-31, 2013 @NRC HQ).
- Operating nuclear plant licensees have the OPTION of using the PTHA methodology. Recent studies using PTHA:
  - Diablo Canyon (PG&E, 2010)
  - Seaside Oregon (USGS, 2009)

TSUNAMI: KEY TECHNICAL POSITIONS

- NRC and operating nuclear plant stakeholders will use state-of-the art tsunami models.

- The NRC staff considers that use of a deterministic methodologies in conjunction with the hierarchical hazard approach (HHA) and use of the PTHA approach are both acceptable for tsunami hazard assessments.

- As the PTHA methodology matures and regulatory guidance is established describing the hazard level (annual probability), NRC will apply deterministic and/or deterministic-probabilistic approaches as appropriate.

- Operating nuclear plant stakeholders have the OPTION of using the deterministic and/or PTHA methodology currently available.

PUBLIC COMMENTS

Total of thirty-seven (37) comments:

- **General Comments** (5) – NEI
- **Surge Comments** (24)
  - NEI (17)
  - Bechtel (6)
  - Unknown Affiliation (1)
- **Tsunami Comments** (8)
  - NEI (6)
  - Bechtel (2)

KEY PUBLIC COMMENTS

- (Surge) The language in the document implies a prejudice against the use of NWS 23 and methods that have been applied to the subject evaluations in current licensing bases.
- (Surge & Tsunami) Deterministic vs. Probabilistic Methodology – No firm position is presented in the ISG on acceptability of choice of analysis approach
- (Surge & Tsunami) Time and expense to complete Probabilistic Studies
- (Surge) Discussion of software and examples of its use can be interpreted as a preference for certain software
- (Surge) Previous versions of the ISG identified a target surge probability for the DBSS of $1x10^{-6}$ annual exceedance. Please confirm that this target is still valid when performing probability-based analyses in establishing the DBSS?

SCHEDULE FOR COMPLETION

- **December 06, 2012** - Begin internal concurrence on final ISG with public comments.

- **December 21, 2012** – Concurrence complete, issue final ISG and submit CRA forms to OCA.

- **ON TRACK-**