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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE ON RELIABILITY AND RISK ASSESSMENT

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MEETING

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FRIDAY

MARCH 27, 2009

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The Subcommittee convened in Room T2B3 in the Headquarters of the Nuclear Regulatory Commission, Two White Flint North, 11545 Rockville Pike, Rockville, Maryland, at 1:00 p.m., Dr George Apostolakis, Chair, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

GEORGE APOSTOLAKIS, Chair

DENNIS C. BLEY

SAID ABDEL-KHALIK

WILLIAM J. SHACK

NRC STAFF PRESENT:

HAROLD VANDERMOLEN, Designated Federal Official

GARY DeMOSS

MARY DROUIN

CHRISTIANA LUI

GARETH PARRY

ALSO PRESENT:

KEN CANAVAN

DOUG TRUE

DON VANOVER

A-G-E-N-D-A

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

12:59 p.m.

CHAIR APOSTOLAKIS: The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Subcommittee on Reliability and Risk Assessment.

I am George Apostolakis, Chairman of the Subcommittee.

Subcommittee members in attendance are Said Abdel-Khalik, Dennis Bley, and William Shack.

The purpose of this meeting is to discuss example uses of the guidance and performance of sensitivity and uncertainty analysis as described draft NUREG-1855, guidance on the treatment of uncertainties associated with PRAs and risk informed decision making. And the latest version of the companion EPRI report, treatment of parameter and modern uncertainty for probable risk of risk assessments, dated April 2008.

The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full committee.

Harold VanderMolen is the designated federal official for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the *Federal Register* on March 13, 2009.

A transcript of the meeting is being kept and will be made available as stated in the *Federal Register* notice.

It is requested that the speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily recorded.

We have not received any requests from members of the public to make oral statements or written comments.

We will now proceed with the meeting. And I call upon Ms. Mary Drouin of the NRC staff to begin.

MS. DROUIN: Okay. Thank you, George.

We're delighted to be here today.

(Laughter.)

We are. We are.

CHAIR APOSTOLAKIS: That's a good start.

MS. DROUIN: At the table with me is Gareth Parry from NRR, Ken Canavan from EPRI, Doug True, and Don Vanover from ERIN Engineering.

I want to reiterate that this was a collaborative effort between NRC and EPRI. And from a

personal perspective a a a tremendous success in the collaboration here. I look forward to future ones of this kind.

We were here in front of the full committee the 1st of February. Yes.

MR. SHACK: Time flies when you're having fun, yes.

MS. DROUIN: Yes. And at that time -- this is the word document.

PARTICIPANT: Oh, it's a word document.

MS. DROUIN: A word document.

There were comments that were raised by the Subcommittee in terms of the Appendix, to 1855. And we agreed to come back to go through the Appendix, in particular, and try to address, well address, not try to, to address how we have dealt with the comments that, in my perspective, what we heard from the full committee. I hope that we've addressed them appropriately and you'll be happy with our addressment.

So the way we're going to do the presentation is, I'm going to quickly, quickly, quickly, quickly walk through, here's were the comments that we heard. And then we're going to go through and you'll see part of your package is the

actual pages from the document. And highlighted in yellow we're going to walk through exactly how we addressed the comments.

So our goal is that, at the end of the day, is that, you know, you're happy with what we've done to the Appendix. Because our intent, you know, when we get to the future work, as you know, we need to make this publically available in preparation for the workshop on May 5th and 6th.

So starting with that. There were three sets of comments that we thought we heard.

The first set of comments was that in looking at the Appendix it was felt that the results were presented in such in a way that they could be misinterpreted as as as being general conclusions. And that someone using it for a particular application could just take what was in the Appendix and use it kind of, almost like a template. And say okay, now this is acceptable for this application. And that was not the intent.

So we have gone through the document. And in numerous places added caveats to keep reminding the user that that's not, this is just an illustration of how you apply the guidance. And it's not meant to be interpreted as a generic template. So we're going to

walk you through all of those.

The next set was on the particular example when it came to the seismic is that the feeling is that the seismic dependencies were not described in a clear enough manner so that the user would understand that he needs to, both, identify and model them.

And in several places we've gone through the report and expanded our discussion to try and clarify that dependency. And once again, you know, we're going to go through and show you where we had particularly added discussion and, you know, what we did.

The last comment was the concern with the, with the apparent arbitrary use of sensitivity analysis to evaluate model uncertainties. And this was a particular area in the HRA. And again we've added more discussion to try and clarify that.

Then the last thing that we've done, which was on our own initiative, is that, in going through we've thought there was some places where, you know, could still warrant some clarification. And so we have made four areas in particular we've added some more.

And that is in regards to the definition of application, clarifying the screening of lower

power and shutdown contribution, an evaluation that a fire LERF is needed, and the basis for consuming fire PRA results are conservative.

So just a quick summary of the comments that, how how we understood them. We're now going to walk you through page by page. And that is why this is in a Word file because I could not figure out a way how to do this in a PowerPoint file. This is just all the pages but we can skip right to this one which is how I couldn't figure out how to do this in a PowerPoint file. I can probably increase that. There we go.

So, Gareth, do you want to --

MR. PARRY: Okay. I'll I'll stop at -- and Don will correct me if I say things wrong.

Basically, what we decided to do here is that we decided to tighten up the definition of the application to be specifically what's written here. Because that's the way the calculation is done, in fact.

And what we're saying is that the technical specification change that we're proposing in this one is to transfer something that is a routine preventive maintenance that's currently performed at shutdown and transform it into into the at-power.

And you'll see some of the changes in the document. I don't think we actually highlighted them, but there's some other changes in the document that make that clearer.

There is one change you will see later on that explains that, basically, when we're dealing with risk we're not going to, we're not going to credit the decrease in risk from the shutdown that's associated with this. Which would be the, a valid way of doing it. And that's in the sense of a conservative estimate in the change in risk. So you'll see that we've added that as a as a caveat. So that's the reason we made this change.

We if we go on now --

CHAIR APOSTOLAKIS: Let me understand this one.

MR. PARRY: Okay.

CHAIR APOSTOLAKIS: This reduction associated with moving this maintenance on availability from shutdown will be conservatively omitted.

MR. PARRY: The risk reduction for the shutdown phase is going to be conservatively omitted.

MR. SHACK: Because now it's available.

MR. PARRY: Because now it's, it's it's

not, it's not dealt with in in shutdown.

MR. BLEY: I don't think in the package you gave us you don't have the next page. But in the old page, A-2 --

MR. PARRY: Yes.

MR. BLEY: Under the scope --

MR. PARRY: Right.

MR. BLEY: -- you talked about shutdown modes of operation not relevant. And it just struck me that that was kind of bad phrasing. It doesn't add any, the change adds no shutdown risk. And then you go on to say, but you might need to consider the shutdown risk is reduced because of this. Is that still in there given you have this sentence up front?

PARTICIPANT: No.

MR. PARRY: Actually it is. We we can fix that sentence.

MR. BLEY: Okay.

MR. PARRY: But there's another sentence later on that explains that we're not going to factor in the decrease in risk --

MR. BLEY: Okay.

MR. PARRY: -- from not doing it at shutdown.

MS. DROUIN: I'm sorry, Dennis. What

sentence are you reading?

MR. PARRY: It's on A.2.

MR. TRUE: A.3.1.

MR. PARRY: A.3.1. It's in the middle of it.

MR. TRUE: The third line down. Or third and second line.

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: Why why did you decide to do this?

MR. PARRY: Because that's a, that's, in fact, what we've calculated. That is what this particular --

CHAIR APOSTOLAKIS: No. No. I mean --

MR. BLEY: I think they're saying in in practice as you might want to do that, but this example does not do that.

MR. PARRY: Correct.

MR. BLEY: Yes.

CHAIR APOSTOLAKIS: Does not what? Does not --

MR. TRUE: Account for the decrease in risk --

PARTICIPANT: Account for the decrease in risk.

MR. TRUE: -- associated with reducing the unavailability of RHR during shutdown. But we're going to increase --

CHAIR APOSTOLAKIS: I don't understand why?

MR. TRUE: Why what?

CHAIR APOSTOLAKIS: If it's a decrease, it's a decrease.

MR. PARRY: Yes, but we'd we'd have to have a low power shutdown model to calculate it.

CHAIR APOSTOLAKIS: Well that's the reason.

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: Okay.

MR. VANOVER: A simplification if you will.

MR. PARRY: Yes. Okay. I'll let Don carry on with the next one. All right, Don.

MR. VANOVER: On page A-4, Table A-3 was the assessment of the relevant external hazard groups. And we just added some footnotes, cautions to make sure that they weren't interpreted as generically applicable for this type of hazard group for all plants. Added a couple of clarifying footnotes.

MS. DROUIN: Now this this is the approach

we've taken throughout the document. So when you see these words here, you will see this kind of footnote showing up all the way through the Appendix. So I don't know if we, you know, need to go through every single one. But we can show you the places, you know, we're prepared to show you the places where we've added these footnotes. And it's kind of the similar footnote everywhere.

MR. BLEY: Yes. I think this takes care of one thing that was in our comment. Something that I probably didn't state too well the last time. When I read through that Table --

MR. PARRY: Table A-3?

MR. BLEY: Table A-2, 3. Oh, it's now A-3.

PARTICIPANT: Yes, the numbers have changed.

MR. BLEY: The numbers have changed, yes.

When I read through this Table there are a number of these hazard groups which essentially say the same thing. And they say, you know, it could decrease reliability, but the frequency of the damage from this kind of group is small compared to the other things.

Now, the thing that I didn't say well

before, but I'll try to say it better this time. And it could be a footnote or maybe you don't even need to consider it. But it just struck me, if this came to staff, if the submittal came like this is, I think it would generate RAIs on these, how can you be sure of that? Because, you know, if you hadn't done some of the internal events you might be able to argue the same kind of way.

So somewhere behind this has to be something that shows a basis for saying the frequency is small compared to the other things. And it just struck me that if I were using this as a guideline even though we're saying it's -- I figure I could say words like these to cover the case.

When really, if you want to include in your document or you'll be forced to later come up with a justification for the claims that the frequencies of these hazard groups were small compared to the things that were already concluded.

MR. PARRY: And I think your your question is a good one. But I think the way this would probably be handled is that the the analysis that would be underlying this would be in some, it would be archival documentation. It wouldn't be necessarily in the submittal. So when RAI, if it came in, I think

you could go back and refer to the archival documentation that would support these statements.

MR. BLEY: That's kind of what I assumed would happen. I was I was wondering if it would be why as to one people, but that's probably what will happen to them. Although, but they probably all know that anyway.

MS. DROUIN: I mean, are you looking for an additional count, an additional caveat of a different kind here that you think would be helpful?

MR. BLEY: Yes. You know, I think the last time when we were saying, well, there was nothing to justify this stuff here. And and and part of that was because we were worried it could be interpreted more broadly.

MR. SHACK: The question is whether this is a justification or a conclusion. I'm reading it as a conclusion of an analysis.

MR. PARRY: But that's not documented here.

MR. SHACK: Yes. Right.

MR. BLEY: And it's documented as a conclusion, but, I guess, rather than saying, "I want you to include something." I'm wondering I'm wondering if a footnote saying, you know, "These kind

of responses will almost surely generate request for justification of these conclusions." It would be worthwhile.

CHAIR APOSTOLAKIS: Are you talking about the second one --

MR. BLEY: No. There's about six of them, George, that have essentially the same --

MR. SHACK: Small compared to the internal events.

MR. BLEY: Yes.

CHAIR APOSTOLAKIS: How about a footnote along the lines that Gareth mentioned that during similar analysis some place that justifies this conclusion. I mean, there has to be something somewhere.

MR. SHACK: Well maybe it's the heading that says, "Basis". Maybe it will be better just to change that to, "Conclusion".

MR. BLEY: Well even it were conclusion you would want to --

MR. SHACK: Yes, but, basis makes it sound as though that's the reason. Conclusion says that that's a conclusion of something else.

MR. BLEY: That somewhere else is this information.

MR. SHACK: Right.

CHAIR APOSTOLAKIS: So you need two things then. Change the heading to, "Conclusions". And then have some footnote that says or justification go somewhere else.

MR. PARRY: I think "basis" is the right word here. For, in the sense that what we're doing is applying screening criteria here. So it's the basis for, it's it's the basis for which screening criteria we're using. Right?

MR. VANOVER: Yes. I think it sounds like we need a --

PARTICIPANT: Oh, yes.

MR. VANOVER: -- clarifying footnote on the approach column. The specific items that were screened based on threat induced. The likelihood of threat induced challenge. We could probably reference, you know, supporting information for this, the basis for this conclusion can be found in the archival --

PARTICIPANT: Yes.

MR. BLEY: I think something like that would be useful. They have they have to have done something more than just make a judgement here that it's small.

PARTICIPANT: Right.

MR. BLEY: I know for seismic there is a lot more, but seismic didn't say these this little pat phrase.

PARTICIPANT: No.

MS. DROUIN: So I just want to make sure that we're real clear here. What we're proposing is that right here on the approach column that we're going to be adding another footnote. And this footnote will say something to the fact that, you have to go to your archival documentation in terms of the justification of some the screening.

PARTICIPANT: Yes.

MR. BLEY: I guess I would put it under "basis". As another footnote under basis.

CHAIR APOSTOLAKIS: Why do you have to refer to it as a guide? I mean the PRA or the baseline PRA. Whatever that is.

MR. SHACK: Well, Don had said IPEEE which is probably where it really is.

PARTICIPANT: Yes.

CHAIR APOSTOLAKIS: The what?

MR. PARRY: It would be in IPEEE a lot of it.

PARTICIPANT: Right.

MR. BLEY: If you hadn't found it there you might have it somewhere else. That seems reasonable to me. We've got it. You want to see it. Come and look.

MR. TRUE: I think other term we used elsewhere is Tier 2. So we could just refer to it as being contained in the Tier 2 documentation.

MR. CANAVAN: I might --

MR. BLEY: I missed that.

MR. TRUE: This is below the --

MR. CANAVAN: -- yes, I might --

PARTICIPANT: It mixes --

MR. CANAVAN: -- just limit it to reference. Because in some cases plants located near airports for example have it in there FSAR. So they might actually be using a number in their FSAR.

MR. BLEY: It could be in a lot of places.

MR. CANAVAN: Yes. I'd just say, "reference material or other reference material," or leave it sort of as that. You might have calculated it. You might --

MR. VANOVER: So I think the footnote is applicable to the last four groups of approaches.

MR. PARRY: Right.

MR. VANOVER: But not the first two. So I

wouldn't want to put it on the header to column.

MR. BLEY: Oh, okay. It looked to me like it applied to aircraft impacts, extreme winds, turbine generated missiles.

MR. VANOVER: Yes. Everything in that group. Everything in that group on the approach column. I think the last four groups in the approach column.

CHAIR APOSTOLAKIS: The first, the first row --

MR. TRUE: The ones that are extreme because --

CHAIR APOSTOLAKIS: -- the first row refers to a plant specific PRA.

MR. PARRY: Yes.

MR. TRUE: Yes.

PARTICIPANT: Yes.

CHAIR APOSTOLAKIS: Which is somewhere.

MR. PARRY: Yes. Not in the submittal. It's in the documentation --

CHAIR APOSTOLAKIS: So shouldn't the others then refer to that?

MR. PARRY: It might not be, well the plant specific PRA is probably the PRA model as it exists.

CHAIR APOSTOLAKIS: Right.

MR. PARRY: This other stuff would probably be in documentation that's more related to IPEEE. And it would be in their screening analysis.

MR. BLEY: And in this example these were things that weren't modeled explicitly in the PRA.

MR. PARRY: That's right. They would not be in the PRA.

MR. SHACK: But it's just a footnote on that screen from --

MR. PARRY: Okay.

MR. SHACK: -- consideration based on likelihood. So you just put a footnote there. And --

MR. PARRY: Yes. Okay.

MR. SHACK: -- deal with it.

MR. VANOVER: Yes. And what I propose, we put the same footnote to the last three --

MR. PARRY: Right.

MR. VANOVER: -- rows in the approach column as well on the second page of that Table.

MR. PARRY: Yes. They would be the same thing.

PARTICIPANT: Okay.

MR. PARRY: Yes.

MR. BLEY: Is this the whole Table now?

It says it all?

MR. SHACK: A slightly different set of documentation.

PARTICIPANT: Oh, okay. You're not seeing the --

MR. BLEY: I'm looking at I'm looking at the rest of it on the old --

PARTICIPANT: Okay.

MS. DROUIN: It has it has, if all goes to the next page.

PARTICIPANT: Yes.

MR. VANOVER: Okay.

MS. DROUIN: So I I just, we're putting the footnote not on the actual column heading --

PARTICIPANT: No.

MS. DROUIN: -- of approach, but we're putting it on the rows on particular rows under the approach column heading --

PARTICIPANT: Where it's applicable.

MS. DROUIN: -- where it's applicable.

PARTICIPANT: Yes.

PARTICIPANT: I think that's applicable.

CHAIR APOSTOLAKIS: Under the approach or under the basis?

MS. DROUIN: No. Not under the basis.

PARTICIPANT: Under the approach.

MS. DROUIN: Under the approach.

MR. TRUE: And we don't have to repeat it on every single one of them. It applies across.

PARTICIPANT: Yes.

MS. DROUIN: Okay.

MR. VANOVER: Okay. Good. The next page in the handout, A-6, is just further clarification of the first issue that Gareth brought up about the --

CHAIR APOSTOLAKIS: Before you go to the --

MR. VANOVER: -- the power shutdown --

CHAIR APOSTOLAKIS: -- the page starts, the out power PRA and what is used in this analysis include; an internal events, an internal floods. Model you mean? An internal events model?

MR. VANOVER: Yes. We can add that.

PARTICIPANT: Well, it says model up --

CHAIR APOSTOLAKIS: Yes. But include an internal events.

MR. VANOVER: Oh, okay. The English is a little awkward, you know.

CHAIR APOSTOLAKIS: But a little model there.

MR. BLEY: If you just said the out power

PRA includes --

MR. PARRY: Internal events and internal floods, and fire.

CHAIR APOSTOLAKIS: And models for internal events.

MR. BLEY: It's like a sentence here. It's at the end.

PARTICIPANT: In bullet form you kind of lose it.

PARTICIPANT: Yes, you do. It falls off.

MR. VANOVER: What do we want to say here?

MR. PARRY: Say internal events, and internal floods, and fire. Internal fire.

MR. VANOVER: Okay. Good. Yes. The highlighted, at the bottom paragraph just reiterates again the same clarifier as the initial page that we're ignoring the shutdown reduction and risk.

CHAIR APOSTOLAKIS: Again, the message though, I mean, I had to ask you three times until you told me the reason we're doing this is because we don't want to deal with a shutdown PRA. I'm an innocent reviewer of this. And I'm trying to do my own thing. The analysis will conservatively omit. The message that you're sending is that you're doing

it because it's a conservative thing to do. And that's not your motivation. The motivation is that you don't have the PRA.

MR. VANOVER : Yes, but --

CHAIR APOSTOLAKIS: Can you rephrase this to make it clear?

MR. SHACK: But if it wasn't conservative you wouldn't let them do it.

CHAIR APOSTOLAKIS: That's true. That's but if I'm a user of this I may get the wrong impression. I may even have my lower power and shutdown PRA but these guys are telling me that conservatively I shouldn't --

MR. BLEY: You might even get somebody at your shop who looks at one where they did look at the shutdown PRAs. Oh, you shouldn't be doing that --

CHAIR APOSTOLAKIS: Yes you should be --

MR. BLEY: -- in the conservative way.

CHAIR APOSTOLAKIS: But --

MR. BLEY: This example, for convenience this example doesn't --

CHAIR APOSTOLAKIS: Yes. But you're not getting to the low power shutdown.

MR. BLEY: You can have --

CHAIR APOSTOLAKIS: -- low shutdown --

MR. BLEY: -- you know --

CHAIR APOSTOLAKIS: -- shutdown PRA evaluations. We chose to do this conservative approximation or whatever.

MR. BLEY: That's an example. But it can be looked at in practice.

CHAIR APOSTOLAKIS: Yes but still, exactly. Exactly.

MS. DROUIN: I mean, I agree. I think if we went in and put words like for the convenience of this example we did this, that would also further emphasize the fact that you can't come in and just take this example and apply it blindly.

MR. BLEY: Exactly.

CHAIR APOSTOLAKIS: You may put the words like, you know, in order not to have to deal with the low power shutdown PRA. Something like that.

MR. VANOVER: Yes. And some think that was a specific motivation. It was just that we had a comment that, we could have reduced the risk and we just said, "Well, we didn't do that."

PARTICIPANT: Yes.

MR. BLEY: Well, when we left last time we kind of agreed with you. You didn't have time to redo calculations or add new calcs. So this was a way to

get around it. But I think a little clarity that it was more convenient to the example would help.

MS. DROUIN: Right.

MR. PARRY: Okay. We can --

MS. DROUIN: I agree. Not a problem.

MR. BLEY: Which would to not misinterpreting it on --

MS. DROUIN: Yes.

MR. VANOVER: Okay. Page A-9. We had an internal comment to reiterate that we weren't calculating LERF explicitly for internal fires because it was not available. We had said that previously, but when someone looked at the Table they missed that connection. So we added that.

I guess that goes to A-11.

CHAIR APOSTOLAKIS: Let me understand this. Note that only fire CDF available and as such a qualitative evaluation will need to be provided for fire LERF. What is a qualitative evaluation of a fire LERF?

MR. PARRY: I think it's an assessment of the sequences that come out of the fire and the discussions that they do not contribute to LERF. I think that's correct. I think --

PARTICIPANT: For the separation.

CHAIR APOSTOLAKIS: Why is that qualitative?

MR. PARRY: Because there's no particular calculation on on on, there's no calculation for LERF.

PARTICIPANT: Are you just saying we don't think these --

CHAIR APOSTOLAKIS: Is it here somewhere?

MR. BLEY: It's discussed in the text. Right?

MR. PARRY: Yes. It's in the text.

MS. DROUIN: I mean, but the the page before it comes in and says, "Additional note that only fire CDF is available. And as such, a qualitative evaluation will needed to be provided for fire LERF." So that's just reiterating and reminding them that.

MR. PARRY: But there's a discussion, I think, of the of the contributors.

MR. VANOVER: Yes. I think when we get in to the contributors there's a discussion somewhere about the LERF not dominating the assessment because of the type of exit sequences that were involved in that --

CHAIR APOSTOLAKIS: Where is that?

MR. VANOVER: -- RHR. I'm looking for

that.

MR. PARRY: It's way way down --

PARTICIPANT: It's way back.

MR. PARRY: It's way back. It's where we start talking about the fires. So it's somewhere on that page -- it starts on page A-26, I think.

MS. DROUIN: Yes. Internal fire scenarios and contributors.

CHAIR APOSTOLAKIS: A-26?

MS. DROUIN: It may not be you're A-26.

CHAIR APOSTOLAKIS: We don't have -- mine jumps from A-25.

MR. SHACK: You have to go back to the original document.

MS. DROUIN: No. You have to go with the one that we gave you.

MR. BLEY: Yes. On page A-26. The original document.

PARTICIPANT: I don't see it.

MR. VANOVER: Not right there, but --

MR. PARRY: It's somewhere.

MR. BLEY: I don't even remember that, but that doesn't mean it's not here.

PARTICIPANT: It's near the Table that summarizes --

MR. BLEY: Oh, that's on page A-8 of the original document. "Officially note that only fire CDF is available and as such a qualitative evaluation will need to be --

MR. SHACK: Where is that qualitative evaluation is what we're looking for?

MS. DROUIN: That's what I just read you, Dennis.

MR. BLEY: I know.

MR. VANOVER: Mary, move move that page up to the bottom of page, the Table A-5. The footnote on Table A-5 that's in your handout. On page A-9. Right right there. We didn't highlight that because that was there before.

MS. DROUIN: Oh, yes. There it is.

CHAIR APOSTOLAKIS: So what does that say?

MR. VANOVER: It says that, it's a qualitative assessment that says, we don't think LERF matters for this particular application due to the reasons stated.

MR. PARRY: Because they're all long term decay heat removal sequences.

MR. SHACK: -- an early release.

MR. PARRY: Yes.

MR. BLEY: If it actually said that. I

mean it, if it, in said in 705, that you can't make an early release because it's long term cooling, that --

MR. SHACK: It might be helpful.

CHAIR APOSTOLAKIS: I think if you deleted "as is indicative from internal from the internal events results" it would be clearer.

MR. VANOVER: Okay. There it is.

CHAIR APOSTOLAKIS: Because then you're really focusing on the long term containment giving more function.

Due to the nature of this function --

MR. TRUE: I think what we're really saying in this is, if you look at the delta CDF for internal events and internal floods. That 1.26E-7. And internal fires at 7.85E-7. Internal fires is larger by a factor of 6 or so. If you look at the delta LERF for internal events, it's 2.67 times 10 to the minus 10. Far below the threshold. Even if and, we believe that the characteristics of the internal fire scenarios are about the same, we wouldn't expect that the delta LERF for a fire will ever been close to our threshold. Maybe seven, maybe six times the the internal events, but we don't expect it to be --

CHAIR APOSTOLAKIS: If you deleted those words would distort the meaning?

PARTICIPANT: You mean the phrase?

MR. PARRY: Well, "as it is indicative from the --

CHAIR APOSTOLAKIS: "It is a very limited impact on LERF," period.

MR. PARRY: Yes. I think it might be good.

MR. TRUE: Well, we we could do that. I think it actually decreases the value of the statement because the way we did it was, we looked at the internal events and said, it's the same, the nature of the scenarios are the same. Internal events was --

MR. BLEY: If you wrote the sentence, and said out loud, and put it in here instead of that short phrase, it would be a whole lot clearer.

CHAIR APOSTOLAKIS: What did you say, Dennis?

MR. BLEY: That is up to him to remember.

PARTICIPANT: Get the transcript.

MR. BLEY: It's on the transcript.

MR. TRUE: Yes. When will that transcript be ready?

(Laughter.)

MS. DROUIN: -- talked about the fact that we got this factor on the internal.

PARTICIPANT: Mm-hmm.

MS. DROUIN: And then to come in and explain the fire, we don't have that same difference.

PARTICIPANT: Yes, I --

MS. DROUIN: This is, this, the way it's written now requires the reader to make that leap by looking at the numbers versus coming right out and pointing to him and telling that you'll do this. And he'll have to figure it out on his own by looking at the numbers.

PARTICIPANT: Right.

MR. BLEY: And one little bitty nit, back to Table A-4 and footnote 2. If instead of just saying, "It will need to be provided." If you have said, "See the footnote for Table A-5 for a qualitative discussion."

MR. PARRY: Yes. I think that's --

MR. BLEY: You wouldn't get the questions we just got.

MR. PARRY: -- yes. I --

MR. TRUE: And then we had to go back and change --

MR. PARRY: Yes. Yes.

MR. SHACK: Or else put that footnote in the text.

PARTICIPANT: That sounds good.

MR. PARRY: Yes, we might --

MR. CANAVAN: That's sort of what I was just thinking. Do the qualitative right there.

MR. TRUE: Well you need to see the numbers in front of you, I think.

MR. CANAVAN: Well, I wasn't so much going to the numbers as so much the first part of the bullet which just says --

MR. TRUE: Oh, well, the nature of the --

MR. CANAVAN -- charged --

MR. TRUE: -- that's --

MR. CANAVAN: -- the function --

CHAIR APOSTOLAKIS: But what would you say to somebody, this is outside your current subject, that we keep screaming about uncertainties and all that and we still make decisions based on numbers like 1.28 10 to the minus 7, 6.49 10 to the minus 8, what kind of credibility does this decision have?

PARTICIPANT: I'm only --

CHAIR APOSTOLAKIS: Can we really trust such 10 to the minus 10? Are we playing games here or what?

MR. BLEY: Well, there's an uncertainty coming up in a few pages. I mean, the uncertainty

analysis is --

PARTICIPANT: Yes.

MR. BLEY: -- toward the end --

MS. DROUIN: Well my recommendation, and I I agree with you. This is this is ridiculous. And we should slap our hands that we created a Table that has something like 3.86E-6.

PARTICIPANT: I agree with that.

MS. DROUIN: And we need to go, and I agree, clean that kind of stuff up.

MR. TRUE: I thought George's plan was broader than that.

PARTICIPANT: Yes.

MR. TRUE: 3 times 10 to the minus 10 --

CHAIR APOSTOLAKIS: But this is a little broader --

PARTICIPANT: Yes.

CHAIR APOSTOLAKIS: -- because I --

(Laughter.)

MR. PARRY: But I also think though that, in defense of putting these, these are the numbers that come out of the calcs.

MR. BLEY: Actually they had even more decimal points on them.

(Laughter.)

MR. PARRY: You know, if you wanted to check back though, and if you want to do the independent calculation, you can you can check. I don't think that's, but yes, your plan is a little different. Can you really believe 10 to the minus 10? Well if --

CHAIR APOSTOLAKIS: Or six.

MR. PARRY: Well, hopefully we can believe six. But I mean, if if --

CHAIR APOSTOLAKIS: Well --

MR. PARRY: -- if you calculate the delta at 10 to the minus 7, then if what you're really saying is that the likelihood of getting early release from that is really extremely low. That's the context in which you have to take that 10 to the minus 10.

PARTICIPANT: The --

MR. PARRY: Yes. You really don't believe the number, but you do believe that the value is extremely low.

MR. CANAVAN: But maybe you start with low, then if there's there's small and there's very small, and then there's very, very small, and then there's not worth talking about which is the numbers that we're looking at now.

MR. BLEY: But let's got in to this

argument about particular numbers. Way back in WASH-1400 and the testimony before the Congress, they dealt with it, was the only way I know to deal with it. And say, you're supposed to model, you believe. It's composed of pieces whose numbers you believe. And just because they get been multiplied together doesn't mean they're completely meaningless anymore.

PARTICIPANT: Right.

MR. BLEY: There might be something else you've left out of course.

PARTICIPANT: Right.

MS. DROUIN: Right.

MR. BLEY: But for that thing you modeled --

MR. PARRY: And we discussed that.

PARTICIPANT: It's there.

MR. CANAVAN: Good question.

MR. VANOVER: We can certainly reduce the number of significant digits.

CHAIR APOSTOLAKIS: The expression --

MS. DROUIN: Yes. I mean, I just always think that when you do that, it's implying a precision that we ourselves don't believe.

MR. TRUE: So we'll just drop the third significant digit?

MS. DROUIN: I would.

MR. BLEY: I mean, there's argument -- and then the pieces don't add up. If you got the other Table --

MS. DROUIN: I --

MR. BLEY: -- with the percentages --

PARTICIPANT: Right.

MR. TRUE: Because some places say the delta --

PARTICIPANT: You got to put --

PARTICIPANT: Then you are going to write, how come they don't add up?

PARTICIPANT: I read a comment like that. These numbers don't add to a hundred percent.

PARTICIPANT: Right.

MS. DROUIN: Okay.

MR. CANAVAN: You got to put plus or minus.

MR. VANOVER: Okay. On the top of page A-11. Mary, the next, I think you went too far.

CHAIR APOSTOLAKIS: Let me ask something else. Is this work going to continue or this is it?

PARTICIPANT: It's --

CHAIR APOSTOLAKIS: The issue of uncertainty, and sensitivity, and all that. After the

Appendix with the NUREG got published. Finito?

MS. DROUIN: No. As as we said at the full committee, we have plans to continue this work on this NUREG. Exactly what we're going to do next year is what we're going to have to, there's more than we can do next year. So we're going to have to start prioritizing what is it we're going to try and do in the short term versus the long term. And our plan is to use a lot of the insights to, from the workshop to help us decide in our our our program offices what should we be going after next.

CHAIR APOSTOLAKIS: And you're, at some point in the future, you're also going to get in to physical models with uncertainties like thermal hydraulic codes and all that. Because this is really PRA level 1 essentially.

MS. DROUIN: Right.

PARTICIPANT: Yes.

MS. DROUIN: Right.

CHAIR APOSTOLAKIS: So this is not the final word.

MS. DROUIN: Absolutely not.

MR. CANAVAN: I think the particular part that you're talking about, at least from EPRI's perspective, that's a, probably a little further out

than what our next steps are which are for other hazard groups, other, maybe other levels of PRA. But also in tandem looking at other types of uncertainty like the codes uncertainty.

CHAIR APOSTOLAKIS: But if you get in to fire analysis scan --

PARTICIPANT: Oh yes --

CHAIR APOSTOLAKIS: You have codes.

MR. CANAVAN: Sure. Sure.

CHAIR APOSTOLAKIS: You don't necessarily, when I say thermal hydraulic, I don't mean real applied.

PARTICIPANT: Right.

CHAIR APOSTOLAKIS: But any code that models physical phenomenon you have uncertainties. I think you need some guidance. So that's something that will happen.

MS. DROUIN: Yes.

CHAIR APOSTOLAKIS: Okay.

MS. DROUIN: But I I, what I'm trying to say is, I don't know when it will happen.

CHAIR APOSTOLAKIS: Yes.

MS. DROUIN: But, you know, we have plans to try and address, you know, level two stuff, level three. Expand this past just internal events and

internal fire. Expand this to not just support operating reactors, but new reactors.

But we're going to have to try and stand back and say, you know, what should be the priority of how we take these things on?

CHAIR APOSTOLAKIS: So you're going to meet with us when you decided those things?

MS. DROUIN: Absolutely not. We always come and we always value you your input.

CHAIR APOSTOLAKIS: And we appreciate your cooperation.

MS. DROUIN: Thank you.

CHAIR APOSTOLAKIS: Did you take all that down?

PARTICIPANT: That's the second time you got him to laugh.

CHAIR APOSTOLAKIS: What?

PARTICIPANT: That's the second time she's got you to laugh this afternoon.

PARTICIPANT: Is this a bet? I mean --

(Laughter.)

MS. DROUIN: Okay. Let's see, where are we? We're on page A-11.

MR. VANOVER: Yes. Top of A-11. We added a clarification of why we're doing a bounding seismic

risk assessment since we don't have a full seismic PRA to utilize for this site. And then, added a footnote clarification that, to make sure this wasn't construed as generic, a way to generically disposition seismic contributors.

MS. DROUIN: Right. And this was also getting in to clarifying your concern with regard to the dependencies.

PARTICIPANT: Right.

MR. VANOVER: Yes. It gets a couple of the specific examples with the dependencies.

MR. PARRY: But the first sentence here too is that, I think it wasn't obvious from the tree of the way it was written, that loss of offsite power was assumed as a condition. I know John Stetkar was worried about that.

MR. VANOVER: Right. So then when we get in to the details of the discussion of the bounding seismic assessment, we added some clarification to the LOOP section on the top of page A-14.

CHAIR APOSTOLAKIS: So so far we've been addressing the the question of generalizability of the results. Right? You're making sure by excepting the yellow stuff, that this case study what it, what we're doing is meaningful. But don't generalize.

MS. DROUIN: Right.

MR. VANOVER: Right.

CHAIR APOSTOLAKIS: That's really what we've been doing so far.

MS. DROUIN: Except for here now.

MR. PARRY: Except for here.

CHAIR APOSTOLAKIS: Okay. So we start something else now. Okay.

MS. DROUIN: Right. We're going to be coming back and forth because, instead of trying to do all the ones, for example, that dealt with generalization, we're going through page by page and showing you where, which ones. And and this particular one gets in to both. It's the applicability, the generalization. But also now you're starting to see now what we've done to clarify your concern on the dependencies.

CHAIR APOSTOLAKIS: So where are we?

MR. VANOVER: So we're at the top of page A-14 --

PARTICIPANT: Yes.

MR. VANOVER: -- in the discussion of loss of offsite power events for the seismic assessment. So we hadn't really addressed the issue of dependencies and seismic capabilities of components.

So we tried to add that, what we're doing here works, given the situation where the other alternate containment heat removal mechanism, the vent capability is higher than the RHR loops themself. So we added that clarification to provide further justification that the bounding, that it was truly a bounding calculation.

CHAIR APOSTOLAKIS: Again, you're referring now to other studies somewhere else.

MR. TRUE: Yes.

MR. PARRY: Yes.

MR. TRUE: This would be the --

MR. PARRY: The seismic margin study.

MR. TRUE: Right.

CHAIR APOSTOLAKIS: So that exists somewhere else.

MR. PARRY: That exists somewhere else.

CHAIR APOSTOLAKIS: Okay.

MS. DROUIN: So on this same page as you see at the bottom --

CHAIR APOSTOLAKIS: Yes.

MS. DROUIN: -- are those typical footnote for the clarification on the generalization.

CHAIR APOSTOLAKIS: I think you're overdoing it with the footnotes, by the way. You

could have combined them and say, that the originals are going through the relevance of seismic induced transient events and seismic induced LOOP events. I mean, you really would cover --

MS. DROUIN: We were trying to make you guys happy.

CHAIR APOSTOLAKIS: Happiness is oozing out of my ears here. But --

MR. PARRY: Well obviously weren't not happy enough with the, you know, the government health warnings that we put on the front which said basically the same thing. Because I think you raised the question last time. So we thought, it's to remind people.

CHAIR APOSTOLAKIS: It seems to me this is childish. I mean the conclusion, it's exactly the same. Seismic induced transient. Seismic induced LOOP events. That's the only difference. One could combine the two. If you don't want to do that, that's fine.

MS. DROUIN: You know, I don't have a problem with providing a -- it so happened because they ended up --

CHAIR APOSTOLAKIS: You mean to tell me a footnotes --

MS. DROUIN: -- they ended up on the same page.

PARTICIPANT: we can combine this.

MS. DROUIN: I mean, we weren't trying to go overboard. But we really were trying to be --

CHAIR APOSTOLAKIS: I know you are. I know you are.

MS. DROUIN: -- responsive to John Stetkar's comment that he wanted to see, in his words, "Lots of caveats". So we've given you lots of caveats.

MR. PARRY: We'll combine them. And make the --

MS. DROUIN: But --

MR. VANOVER: I mean, they're not, they showed up on the same page, but they're three quarters of a page apart.

PARTICIPANT: I know --

MR. VANOVER: If we go to tack that they may not send us, show up on the same page.

MR. PARRY: Oh, that's a good point.

MS. DROUIN: So I will take your comment.

CHAIR APOSTOLAKIS: If you don't want to do it, don't do it.

MS. DROUIN: No. I would like to do it.

I just don't want to come back later and be criticized that we don't have enough again.

CHAIR APOSTOLAKIS: This is, this comment is made from the point of view of English only. So if, you know, if, by saying seismic inducted transient events and LOOP events, than the rest is the same.

MR. CANAVAN: Just use the same number twice.

CHAIR APOSTOLAKIS: Let's not make a big deal of it.

MS. DROUIN: Yes. Okay.

CHAIR APOSTOLAKIS: It's up to you. Eventually, will be a letter of this. What are you guys asking?

MS. DROUIN: No. You all sent a letter. We have your letter.

CHAIR APOSTOLAKIS: But we don't like A. I thought you --

MR. CANAVAN: You love it now.

CHAIR APOSTOLAKIS: What?

MR. CANAVAN: You love it now.

CHAIR APOSTOLAKIS: Well --

MR. SHACK: We can always write to letter them.

CHAIR APOSTOLAKIS: It's not that I want

to write a letter. I'm just asking the staff.

MR. BLEY: Well, I want to say that, now that we've looked at the revision we're --

MS. DROUIN: Okay. I can just tell you, my understanding, when we were at the full committee, what the understanding was, is that, we would come back to the subcommittee and go over these concerns that you had to see if you were happy with those concerns --

CHAIR APOSTOLAKIS: Right.

MS. DROUIN: -- with how we've addressed them. And we were then going to make this appendix publically available for the workshop. We were going to take lessons learned from the workshop to see if we needed to still refine the example. And then we were going to publication. So we were not coming back to you again for a letter on publication for this appendix.

MR. BLEY: If I remember our recommendation, we said, "Revise this before you publish it."

MS. DROUIN: That's right. And that's the next point.

MR. BLEY: I think that's the way we stated it.

MS. DROUIN: Your letter, you know, said --

CHAIR APOSTOLAKIS: If if the changes that you make after the workshop are substantive, will we see it again? I mean, we can not approve something that is subject to change. Somehow we have to be informed of what happened. Maybe a briefing to the full committee that, as a result of the workshop this is what we did. They are not a big deal. Blah blah blah. So the letter stands.

MS. DROUIN: Yes. I I I would agree, George, that if the comments or what comes out of the workshop is, you got to go back to the drawing board. But I'll be honest, I just don't see this happening.

PARTICIPANT: No.

MS. DROUIN: I don't see that the comments coming back from the workshop are going to be substantive.

CHAIR APOSTOLAKIS: Would it help you to brief the full committee maybe for an hour? As a--

MS. LUI: I mean, if you're interested we can definitely come back and brief you. And meanwhile, we understand that you also have workload. You have lots of letters to write. So I guess, you know, it comes down to, at this point in time, we

don't anticipate on going to have significant comments coming up on the workshop that would put us on a different path. Meanwhile we would be happy to come back and give you information briefing.

And in the event that there are significant comments that we are going to go on different path and if you want to weigh in again, you will certainly have that opportunity.

CHAIR APOSTOLAKIS: It's not that I want to weigh in again. It's just that --

MR. BLEY: It strikes me that it would be useful to us to hear how the workshop --

CHAIR APOSTOLAKIS: Yes. Exactly.

MR. BLEY: -- but --

CHAIR APOSTOLAKIS: In general --

MS. DROUIN: And that's what I was going to, what our intent was. Maybe coming back later on in the July time frame or later on where we can come back and say, "Okay. Here is what we learned from the workshop. Here's here's our initial ideas of what we want to do in the future in terms --

CHAIR APOSTOLAKIS: Yes.

MS. DROUIN: -- of the next version of this document." Not in terms of the little things we've cleaned up on the example. But, you know,

"Here's the plan we're laying out now on this work. And we're looking to do this in the next six months. This in the next year." You know, to give us time on the staff part to digest what came out of the workshop. And us laying out, you know, a path forward --

CHAIR APOSTOLAKIS: Yes. That's all I'm asking for.

MS. DROUIN: -- of what we might do next. And that we had intended, yes, to come back.

CHAIR APOSTOLAKIS: It doesn't have to be a briefing just on the workshop. I mean, if you wanted to talk about your future plans, that's fine too. But, if you could brief us as to what happened at the workshop. Were people ecstatic? Or were there a lot of objections? Or what?

MS. DROUIN: Well I'm hoping that members of the ACRS will come to the workshop.

CHAIR APOSTOLAKIS: Well --

MS. DROUIN: Seriously.

CHAIR APOSTOLAKIS: When is it?

MS. DROUIN: May 5th and 6th.

CHAIR APOSTOLAKIS: I'm out.

MR. BLEY: That's when we're having bunches of meetings. That's our only problem.

CHAIR APOSTOLAKIS: There's a workshop in Brookhaven those days.

MR. BLEY: There is a workshop at Brookhaven. There is four, I think, subcommittee meetings, those two days. So it's going to be --

CHAIR APOSTOLAKIS: How about, next time you come here to talk about whatever you want to talk about, spend ten minutes telling us what happened at the workshop?

MS. DROUIN: Absolutely.

CHAIR APOSTOLAKIS: So you don't have to spend much time preparing for it and we don't have to have a special subcommittee for that. There is no reason.

MS. DROUIN: All right.

CHAIR APOSTOLAKIS: That's all.

MS. DROUIN: Okay.

CHAIR APOSTOLAKIS: It takes us ten minutes to finally agree. But --

MR. BLEY: From what we've heard you would expect people to be coming to the workshop to learn how to use this approach or that's the main --

MS. DROUIN: That's that's the main purpose of the workshop.

And we were talking about it over lunch

today. And based on Ken's knowledge, etcetera, we're we're anticipating a good 75 people showing up at this workshop.

CHAIR APOSTOLAKIS: These would be all utility people. Right?

MR. CANAVAN: Mostly. Yes.

MR. PARRY: Well, we'll have some NRC people too.

MS. DROUIN: We're hoping to get good NRC attendance. Because this document is not just a document for industry. It's a document also for, you know, I mean, for the NRC of how to use this in our decision making.

MR. CANAVAN: And there will be some vendors and consultants.

We have 35, I think, early registers. That's a lot.

CHAIR APOSTOLAKIS: Where will it be?

MR. CANAVAN: In the auditorium here.

MS. DROUIN: In the auditorium.

MR. SHACK: You have 35 what?

MR. CANAVAN: 35 early registrants.

MR. SHACK: Oh.

MS. DROUIN: And that doesn't include the NRC people.

MR. CANAVAN: And utility people are notoriously late at signing up.

MS. DROUIN: And we'll be sending out a second notice week after next.

CHAIR APOSTOLAKIS: Very good.

MR. TRUE: George, we have six people coming from our company. Just so that we make sure that everyone understands the document and the ramifications. Because we think this will be important as we go forward. And --

CHAIR APOSTOLAKIS: So a year from now everybody will talking in terms of model uncertainty, incompleteness uncertainty and everything. Right? We will not be --

MR. VANOVER: Nope.

CHAIR APOSTOLAKIS: Given the fact though that these were very nicely described in the original regulatory guide 1174, I'm not holding my hopes very high. But progress has been made.

MR. PARRY: Well, I think there wasn't really that much guide, I mean are people confused over what to do about it.

CHAIR APOSTOLAKIS: Yes.

MR. PARRY: I think this document should really help them.

PARTICIPANT: Confused about --

CHAIR APOSTOLAKIS: Well we're going to account for some model uncertainty somewhere here. Since it --

MS. DROUIN: Okay.

MR. VANOVER: Okay. Top of page A-15. It's another example of the, addressing the issue related to the dependencies and the seismic bounding assessment. Based on re-looking at that calculation and considering the assessment. We actually redid the calculation from what it was before. And made sure all the LOOP boundary conditions were appropriately applied. And basically rewrote that whole section there to discuss the new bounding analysis to address the dependencies and so forth.

MS. DROUIN: Let me ask you something, George. Going back to your comment about, we've gone, maybe did an overkill with our footnotes. And what we tried to do is that, as you see here we had a footnote associated with LOCA events, a footnote associated with reactor pressure vessel rupture one with LOOP and the one before with the transient events. So, you know, we were doing it every step. If I understand you correctly, you would be perfectly happy if we removed all of those and put one footnote, for

example, on this whole section under conclusions versus one under each --

MR. BLEY: A little suggestion. You may not like it. What if there were a header that just said, across each page, "Plant specific AOT example."

MS. DROUIN: That was just an example. That to me wasn't what the concern was.

PARTICIPANT: No.

CHAIR APOSTOLAKIS: No. My comment specifically referred to footnotes 4 and 5.

MR. BLEY: Because there were two on the same page.

MR. TRUE: They were.

CHAIR APOSTOLAKIS: These two are identical except for "transient events and LOOP events."

MR. PARRY: Okay.

MS. DROUIN: Okay.

CHAIR APOSTOLAKIS: Seems to me, those two can be combined.

MS. DROUIN: Right. But my point is, is that, when you go to footnotes 6 and 7 they're almost the same, but now instead of having seismic induced transient events for 4. 5 would have seismic induced LOOP events. We're now seismic induced LOCA events.

And then number 7, which is kind of the catch all of all of those.

MR. CANAVAN: We can look --

MS. DROUIN: I'm not trying to beat this to death. But it's --

MR. PARRY: It doesn't hurt --

CHAIR APOSTOLAKIS: 6 and 7 are going to be separate. I mean --

MR. PARRY: -- it doesn't do any harm to have them separate.

CHAIR APOSTOLAKIS: The other two w I thought was --

MR. TRUE: I'll cop to this because it wasn't Mary's fault that it's all in there. I was the one who went through it. What I did was, everywhere that I thought we were drawing a conclusion, I tried to put a footnote to say, "This conclusion is specific to this thing." We came up some with some sort of generic way of phrasing that which is quite repetitive. We admit to that. But -- so that was the philosophy that went in to this. We could roll it back up to a higher level and in certain sections say, "We're drawing these general conclusions. They should not be construed as generic for other applications." But you can do it either way. I think the footnote

way keeps the flow of the text there and keeps you from being disrupted by all these caveats in the text. So that's why we went the footnote path.

MR. BLEY: Nobody can say they didn't see it.

(Laughter.)

MR. TRUE: A further note, this was an example.

MR. CANAVAN: Yes. I will note, we can also flip it. We can say, start with the bottom and say, "This example should not be construed as generic. This is the position of this contributor including seismic induced LOCA events are applicable specific." So you can make one footnote with two things in it. Reference it twice, same number, but one footnote that applies multiple spots. That's a way of collapsing them and still -- that's what a tech editor would do. So, collapsing them and --

MS. DROUIN: I wasn't trying to beat this to death. But it may be -- but I thought it was a good comment because it's kind of irritating to see that footnote 20 million times. But --

CHAIR APOSTOLAKIS: But if your people at the workshop complain we can go to the ACRS.

(Laughter.)

MS. DROUIN: Well that that that may be in and it of itself why we may leave it in there.

MR. BLEY: We have tried putting a watermark across tables and figures so people wouldn't disconnect them from the text and they still do. So.

MS. DROUIN: Oh, I know. And the --

PARTICIPANT: Sure. However you do it --

CHAIR APOSTOLAKIS: It's okay.

MS. DROUIN: Okay.

CHAIR APOSTOLAKIS: So we're expecting now to absorb this yellow long paragraph right now. Right? Can you explain what it says?

MR. VANOVER: Sure. We looked at the delta --

CHAIR APOSTOLAKIS: This is on page A-15. Right?

MR. BLEY: It's almost the same paragraph as before.

PARTICIPANT: The numbers are a little --

MR. TRUE: Well, the numbers are --

PARTICIPANT: Yes.

MR. TRUE: -- I'll jump in if you want.

MR. PARRY: Go ahead.

MR. TRUE: And we changed the, quite a bit I think in the first, you know, paragraph.

PARTICIPANT: Yes.

MR. TRUE: So the basic idea was to say, "The worse this could be is that everything else failed seismically and RHR never failed seismically, and you look just at the differential reliability of that remaining available RHR system. And as it, as the maximum delta risk you could calculate." So basically the calculation we did we, said, everything else was failing. And we looked at what the seismic LOCA risk with both trains and loops of RHR available and with only one loop of RHR available. And we calculated that delta. And we calculated that it was only .3 percent of the acceptance criteria, and therefore small. We felt like it was a definitely a bounding characterization.

MR. PARRY: And particularly, if you think about when you have seismic failures, if there were any seismic failures, typically they'd fail the whole system. And that's the way we modeled it. So it really cancels out. The unavailability doesn't even doesn't even show up.

MR. TRUE: The piece which we didn't account for which was seismic failures of RHR --

MR. PARRY: Doesn't show up.

MR. TRUE: -- because of the correlation

effect and the and the risk, seismic risk calculation would only make that delta go down actually.

MR. CANAVAN: Yes. It would only decrease the .3 percent.

CHAIR APOSTOLAKIS: Just a minor comment. On the second yellow. From Table A-9 it can be seen that the frequency of seismic can induce small, medium, or large LOCA. Not "and". "Or". And that was any one of them.

PARTICIPANT: Yes.

CHAIR APOSTOLAKIS: And then frequencies.

You can just agree, Gareth. That's what you mean. Small or medium or large.

MR. PARRY: You managed the sum. But I, excuse me --

MR. CANAVAN: You mean the spectrum.

CHAIR APOSTOLAKIS: Yes.

MR. VANOVER: Yes. We added them up so that's an or gate.

PARTICIPANT: Okay. Okay.

MR. CANAVAN: I always write the spectrum of LOCA.

MR. PARRY: Make sure you capitalize LOCA.

MR. VANOVER: Okay.

PARTICIPANT: Medium too.

PARTICIPANT: Yes.

MR. VANOVER: Moving forward to the model uncertainty section now.

CHAIR APOSTOLAKIS: Where are you now?

MR. VANOVER: A-25 is the next. It's a footnote for the identification of potential sources of uncertainty in Table A-19.

CHAIR APOSTOLAKIS: So 8, footnote 8. What is it in the tables?

MR. VANOVER: It's at the title to the table.

CHAIR APOSTOLAKIS: Oh, it's at the title. You're right. Of Table 19.

Internal events and internal floods contributors that are potential sources of uncertainty.

MR. VANOVER: Right. So we just wanted to again emphasize that we didn't want to, for people to use this as a template for their application with those specific contributors. It's just --

MR. PARRY: Because this is a function of the results that are driving the decision.

MR. VANOVER: Yes. That's one of the focuses we talked about at lunchtime about the

workshop. We want, You know, the intent of the workshop is to make sure people understand that they have to understand the contributors first. And and that's part of the process to get to identify the source, the potential sources of uncertainty.

CHAIR APOSTOLAKIS: Is the general approach the following? Forget about -- something that we discussed I think with Doug a few years back. I have a PAR model or a sub-model for whatever I want to do. And I know I have model uncertainty and human error, for example. I thought a clever way of handling it, if it works, because it doesn't always work, is to say how how high should that particular probability be to change my decision? Because I'm about to make a decision. Right? And then you find that it has to be say higher by a factor of a hundred. And then you say, but that's unreasonable. It can not be greater, as great as, you know, as a hundred times more. Is that spirit still there? I thought it was a good idea to do that. Because, then you are avoiding the issue of, gee, the model uncertainty is a factor of three. No. It's a factor of five. Well maybe it's two and a half. In other words, you are focusing on the decision itself. Now that doesn't mean it always work. But many times it does. Is it

clear what I'm saying?

MR. PARRY: Yes. Yes. You want to back out the --

CHAIR APOSTOLAKIS: How high does this have to be to change the decision? And then you make a judgement. If it, if by increasing by a factor of two you change the decision, you say wait a minute now. I'm not on solid ground here. But if it takes a factor of a hundred, obviously, that's not validated more.

MR. TRUE: No, I think it's in there. I think that, but it's not, I wouldn't say that that's necessarily emphasized. There's a there's a first pass, I think section 5 --

MR. PARRY: Yes.

MR. TRUE: -- talks about using this raw MACCS process where you you just assume something has failed. See how large it is. If that exceeds your acceptance criteria, then if it doesn't exceed your acceptance criteria you can stop. When you're gain the picking sensitivity studies, we tended to emphasize, well 1174 emphasizes which is reasonable alternative hypothesis. Looking at what's what you've assumed your analysis. Look at what a reasonable alternative is. And adopt that reasonable

alternative. Rather than the way you're talking about which is working backwards from the decision.

CHAIR APOSTOLAKIS: But the problem that, with that is that, there may be endless discussions as to what is a reasonable alternative.

Whereas, if you focus on the decision first, the disadvantage of that is that you may not always get a clear cut answer. In other words, it's not always a factor of a hundred.

Maybe a combination of the two. I don't know. But but --

MR. TRUE: I know from personal experience I've I've done what you've said. And actually in previous LARS. Where I've said, you know, "This can't be a problem because it would have to be this big. And there's no way it will ever be that big." But I will, I don't believe we actually did that --

MR. VANOVER: No. We did that -- it's the difficulties that we've entered with the incorporation of more hazard groups and more quantifiable models. Is that, unless we have an integrated model that combines them all, we'd have to figure it out on the side somehow, what the maximum increase would could be. And then there's, for this example, there's several calculations that have to be done. It's not

just CDF related. It's delta CDF. It's a function of the outage time. And you have the A loop out, the B loop out. Those are separate calcs. So, even for this one example, there's four separate case runs for the base case. And then to integrate them with what -- we could do it, but it's not as trivial as one calculation. Figure it out.

CHAIR APOSTOLAKIS: Well, it doesn't have to be trivial. I mean, it doesn't have to be one calculation.

The question is, I think it is easier, in general, to focus on how, what would it take to change the decision, then argue that this is a reasonable alternative model. In general, that's my impression. That it is easier --

MS. DROUIN: Well, and I think that's in there. Because you're doing it, you know, against your acceptance guidelines. And to challenge your acceptance guidelines where you're now would be changing your decision, you know, it may take a factor of a thousand or in some cases it may be just a little bit. So, it's always going to be in the context of looking at, what that change would need to be to challenge your acceptance guidelines that you're using for that decision.

CHAIR APOSTOLAKIS: The question is, is that message here somewhere?

MS. DROUIN: Oh, I think it is.

MR. PARRY: It is in Chapter 5. I think it's less obvious in this.

MR. TRUE: Yes.

CHAIR APOSTOLAKIS: In the example I don't think it is. In the main report -

MR. PARRY: In the main report, it is. Yes. Yes.

CHAIR APOSTOLAKIS: -- you do talk about it.

MR. TRUE: I think qualitatively Don has it going places where he made arguments along those lines. But never quantitatively.

CHAIR APOSTOLAKIS: Maybe that's something you revisit in the future. Because I don't think it's something we're going to settle today.

MS. DROUIN: But I think that's --

CHAIR APOSTOLAKIS: It's something that requires some thinking.

And I'll tell you where else it appears, in future reactors, in your technology neutral framework. There is some guidance that says that, "Sequences that have a point estimate less than 10 to

the minus 8 or the 95th percentile less than 10 to the minus 7." You didn't use those words. But they're really below concern. You did use those words. I I - -

That's where, again, with model uncertainties and all that, you may want to argue. You know, I have this sequence, it is already down there. But somebody questions the model you use, then you say, "Well, gee, it would have to be a factor of a hundred to reach that level." It makes a hell of a difference, you know, whether you include it in the licensing basis events or not. So it's something that is long term.

I I I I agree that it's in the main body. I don't think it's explicitly stated in the example in the appendix. But I don't think this is the time to worry too much about it.

But I think in the future we have to go back and revisit that. In other words, make all these sensitivity analyses focused on the actual decision.

MR. PARRY: I actually think it's a not feasible approach for things like SDP calculations because they're very limited. And you have limited number of uncertainties. And I think it can be very valuable there.

CHAIR APOSTOLAKIS: Yes. And and and my point here is that, it's something that will require some thinking. That's why I don't want you to come up with something right now.

MR. SHACK: Well, it may be that what you finally, when you finally have identified your key sources of uncertainty, you now limited it down to a small number.

CHAIR APOSTOLAKIS: Yes.

MR. SHACK: And you can begin to apply arguments like that.

MR. TRUE: That's --

MR. SHACK: I think Don's argument before that you have all this stuff together --

MR. PARRY: Yes.

MR. SHACK: -- and it's hard to do, if you've got a lot of uncertainties it's hard to make that kind of argument with a large number. You can make a different set of arguments to get down as they do in this in this example when they're down to two key sources of uncertainty then you can begin to ask yourself --

PARTICIPANT: Right.

MR. SHACK: -- that kind of a question.

PARTICIPANT: Yes.

CHAIR APOSTOLAKIS: Not only that, but that's why I'm saying that it really has to go through some serious thinking. There was a table, I remember, or two tables. But one came from Doug, I believe. Where there was a generic list of model uncertainties.

MS. DROUIN: Right.

MR. TRUE: We still have that.

CHAIR APOSTOLAKIS: That can be expanded, say, you know, this is a model uncertainty could be as high as this. And then by combining the two, the specific analysis with the generic table, you may reach a conclusion.

MR. PARRY: You can only do that though if you can directly relate it to a parameter. Some of these things are not.

CHAIR APOSTOLAKIS: Not necessarily. Not necessarily. Not necessarily.

MR. PARRY: I don't know how you can do that with say --

CHAIR APOSTOLAKIS: I don't want to settle the issue now, guys.

MS. DROUIN: Yes.

CHAIR APOSTOLAKIS: I mean, I don't think it's something that we can start speculating. All I'm saying is, this is something that, at least I think is

worth some thinking, you know, in the privacy of your offices. Not in the public forum.

MS. DROUIN: No, I, one of the things that I have as part of the workshop is that at the end of the workshop to set aside an hour with the participants and get their feedback, you know, in real time. You know, what are their ideas in terms of where we should go.

And preparing for that outward discussion at the workshop, our intent is to include a list of questions. You know, instead of just this discussion being a free-for-all. You know, there's specific things that we would like to get their input on. And, so, we would have that list of questions that we would want them to think about during the course of the workshop.

So when we get to the tallying, you know, well what about maybe pursuing something like that. We don't have all these questions formulated yet. But I think this is --

MR. BLEY: That idea of having those questions to focus in a discussions, that worked very well on --

CHAIR APOSTOLAKIS: You do --

MR. BLEY: -- the initial framework.

MS. DROUIN: Yes.

CHAIR APOSTOLAKIS: -- you do touch upon it in Chapter 5. I can not go, become more explicit.

MS. DROUIN: No, it's --

CHAIR APOSTOLAKIS: -- the federal laws.

MR. PARRY: Would you like us to explain? To mention the paper?

CHAIR APOSTOLAKIS: That's exactly what it does.

MR. PARRY: Yes. I know exactly what it does. And and and that is discussed in Chapter 5.

CHAIR APOSTOLAKIS: I know.

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: I know. All I'm saying is --

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: -- I'd like to see growth perspective in how far this argument is going to be pushed.

MR. PARRY: Okay.

CHAIR APOSTOLAKIS: Which is, by the way, Doug's approach was very, very similar.

MR. PARRY: Right.

MS. DROUIN: Okay.

MR. BLEY: Before we leave this I have a

point of clarification. Because I've been back through this again this morning. I haven't been at it awhile. And now something that I don't remember from the main report. This table has all together about six items.

MS. DROUIN: Are you talking about Table A-19?

MR. BLEY: Yes.

MS. DROUIN: Okay.

MR. BLEY: The whole table has some more items that were culled from --

MS. DROUIN: Right.

MR. BLEY: -- looking through the contributors and deciding what is --

MR. PARRY: Right.

MR. BLEY: -- important. It looks to me, and I don't remember if there is guidance on this, and I'm wondering what the argument is, it looks to me like the top ten cut-sets for each of the two cases pick up about ten percent core damage frequency. And it looks, I can't say anything like that about the next table, that looks at the contributors in terms of their importance.

PARTICIPANT: Yes.

MR. BLEY: I don't have a clue how much

how much of the core damage frequency we have there. So two parts to this question. One is, is that a reasonable number to be confident in the, why is that a reasonable number to be confident that our collection of items in to this Table is pretty good? And two, would it have been helpful to also have a sort based on risk achievement or if to see if there was something hiding out that could really kick this? And if there was uncertainty associated with that that might be important.

MR. VANOVER: I I I can try to answer that question. The the insights were mostly obtained from the Fussil-Vasily contribution. The percent contribution to the risk metrics.

MR. BLEY: Mm-hmm.

MR. VANOVER: We we provided the ten cut-sets just as example. But --

MR. BLEY: Okay.

MR. VANOVER: -- because we didn't want to put a whole --

MR. BLEY: Do you have a clue as to how much of the core damage frequency we get with that group?

MR. VANOVER: The group --

MR. BLEY: That are --

MR. VANOVER: -- well each are --

MR. BLEY: -- that are listed by their Fussil-Vasily importance. You can't add up those importance.

MR. VANOVER: You can't add them up. But they're they're all, you know, at least above five percent. Some of them are in the 30 percent range, I think.

MR. BLEY: Yes. Well, yes.

MR. PARRY: Yes.

MR. VANOVER: So we're picking up a large contribution. The the risk achievement worth, we could look at, but that's going to be the same type of stuff that always shows up. The the rare event.

CHAIR APOSTOLAKIS: Fussil-Vasily doesn't use percentage, does it?

MR. BLEY: It tells you the contribution that cut-sets to core damage frequency.

MR. PARRY: A basic event. I'm sorry. Not a basic event.

MR. BLEY: Whatever the event. Yes. If it's a basic event.

MR. TRUE: I think there's another aspect of this which is probably more, a little bit implicit, but we also looked at the results in terms of action

classes that contributed.

PARTICIPANT: Mm-hmm.

MR TRUE: And initiators that contributed, you know. To make sure that we had sliced and diced the results in different ways. Because if you get too myopically focused on either importance majors or just down in the cut-sets, you can miss the forest for the trees.

MR. BLEY: Yes. So looking at the forest that would help. I didn't see any texts that talked about, that you did that. Is that in there?

MR. TRUE: That's up in the front. It's actually before that. You know, our characterization of, where are the risk from having RHR out of service comes from. And then the most --

MR. BLEY: Oh, that was in the very beginning.

MR. TRUE: The very beginning. Yes.

PARTICIPANT: When you're looking at the --

MR. TRUE: Yes. And these all logically fall from that. Now don't -- we didn't do an accounting what fraction of we got from that. But these are, the logical differences.

MR. BLEY: That's helpful to me to to

thinking taking that larger look kind of confirms that we've picked up the important things.

MR. TRUE: And that's --

MR. BLEY: It would be nice. I don't remember if the main report gives you much guidance on how thorough you ought to be.

MR. PARRY: Maybe not on how thorough you ought to be.

MR. DROUIN: No.

MR. PARRY: But it does discuss that that's what you need to do.

PARTICIPANT: Yes.

MR. PARRY: Is you need to break it down by contributors and then look at the cut-sets, the individual contributors.

MR. BLEY: There is at least to me as I read this, the impression I got reading this last part that finally generated the Table, implied to me that it all came from the ten cut-sets or the twenty cut-sets, the top twenty in cut-sets. Ten in each case. And this importance thing.

MR. TRUE: -- more the importance --

PARTICIPANT: Yes.

MR. BLEY: So that's the impression I got. And I'm wondering if other people get that and if

it's worth a --

MR. PARRY: Okay.

MR. BLEY: -- a note in the text to clarify something along the lines that you guys just talked.

MR. PARRY: I can see where you get that sense.

MR. TRUE: You can see where you get that.

MR. PARRY: Yes. No, there's a sentence there that is misleading. You're right. On A-22 it says, "The review of the top level contributors in these Tables."

MR. BLEY: Yes. That's what --

MR. PARRY: No. We need to we need to fix that.

MR. BLEY: I would like you to fix that.

MR. PARRY: We will fix that. That's a good that's a good catch because that's not what was done. Yes. These --

MR. BLEY: Because then I started counting things up. And I wasn't convinced.

MR. PARRY: You wouldn't even you wouldn't even see a lot of the contributors in these texts.

PARTICIPANT: You don't?

MR. PARRY: You don't actually. No. We

only intended these as examples. We'll need to beef that up.

CHAIR APOSTOLAKIS: So where are we now gentleman and ladies?

MR. BLEY: I've asked them to make a little fix to that.

CHAIR APOSTOLAKIS: I understand that. But which page are we on?

MR. VANOVER: I think we can move to page A-33, Mary. The next --

MS. DROUIN: Yes. I agree.

CHAIR APOSTOLAKIS: A-33.

MR. BLEY: And we're skipping those very long Tables.

MR. PARRY: Yes.

MS. DROUIN: Yes.

MR. PARRY: Well nothing changed.

MR. BLEY: Those are all the same.

MR. VANOVER: Some minor internal changes, but --

MR. PARRY: Right. Yes.

MR. VANOVER: -- nothing to address the ACRS comments. Okay.

The middle of page A-33, we tried to add clarification, you know, not to construe this as a

generic disposition for everybody. The conservatives and the fire modeling.

MR. TRUE: I think there was a specific ACRS reference to fire modeling and it's not being acknowledged as a source of model uncertainty. What we didn't say was that when you looked at the scenarios that were driving the LOOP risks, we actually didn't use any fire modeling in those analysis of those scenarios. So we --

MR. BLEY: And that's what you're trying to cover.

MR. TRUE: Yes. That's what we were trying to cover in the text. And then as Don said, the footnotes say, "You can't generically conclude that."

MR. BLEY: Yes. Because there's two things in the Table. You didn't get the convincing part about that. So I think this helps.

CHAIR APOSTOLAKIS: And this is where, in the future, you really want to worry about the physical models.

PARTICIPANT: Mm-hmm.

MS. DROUIN: Right.

MR. PARRY: Yes. You've done some work on that. Right, Ken? On fire model --

MS. DROUIN: Unless we want to go through more of these footnote type of Tables. We can jump all the way to page A-46.

MR. PARRY: No. No. Go to A-34.

MR. VANOVER: A-34. Yes. We just got rid of that footnote.

MR. BLEY: That's a different footnote.

MR. VANOVER: This was the parametric uncertainty evaluations.

MS. DROUIN: Yes.

MR. VANOVER: It was noted that there was not much difference. And we just, that that's what happened in this case. That may not be the case in all applications. The epistemic correlation.

MR. SHACK: That's the belt and the suspenders. Could you say that in the first paragraph too? I mean --

MR. VANOVER: Yes.

MR. PARRY: Yes.

MS. DROUIN: And I want to point out that we quit using the term "state of knowledge".

CHAIR APOSTOLAKIS: You did what?

MS. DROUIN: We quit using the term "state of knowledge".

PARTICIPANT: Oh and that funny acronym --

PARTICIPANT: Thank you. Thank you.

CHAIR APOSTOLAKIS: Which, for these kinds of calculations, which codes does the industry use?

MR. TRUE: CAFTA.

MR. CANAVAN: UNCERT.

PARTICIPANT: It's a module in --

MR. CANAVAN: In the module. It's UNCERT. It's a module in CAFTA.

CHAIR APOSTOLAKIS: It's CAFTA.

MS. DROUIN: CAFTA.

MR. TRUE: I would also say --

MS. DROUIN: He's long dead.

MR. TRUE: -- at my own peril. I think that what, actually found pragmatically in doing an analysis of plant PRAs and applications, is that, this result is actually not all that uncommon.

PARTICIPANT: No.

MS. TRUE: That that the, what the standards, the requirements for gathering plant specific data which we've now brought in to end up with different distributions for different the parameters. Better treatment of common cause. All those these, that the epidemic correlation is not as significant at the CDF level. There may be slices of it like ice mocha and some other ones where some are

very important. But at the CDF level, delta CDF --

CHAIR APOSTOLAKIS: How much time does that save Doug?

MR. TRUE: I'm not I'm not arguing, I already know it saves time. I'm just saying that just for your thing.

CHAIR APOSTOLAKIS: I know I know I know what you're saying is --

MR. TRUE: But this plant model will probably be there with almost every application. Because this is literally this is what we see pragmatically when we when we do this. I'm not arguing against doing the calculation. I gave that up a long time ago. Despite the fact that it's a waste of time.

(Laughter.)

MS. DROUIN: Okay. Moving on.

MR. VANOVER: Okay. The presentation of the sensitivity study results to address the third ACS comment --

CHAIR APOSTOLAKIS: Page?

MR. VANOVER: A-45.

CHAIR APOSTOLAKIS: 45.

MR. VANOVER: And this sort of addresses George's earlier comment that we, you know, we, you,

sometimes you can do a conservative screening study and and use a maximum bounding increase. And in other cases you need to do a more reasonable alternative assessment in presenting the results. So we added that footnote to the title of the Table.

CHAIR APOSTOLAKIS: This 95th percentile, guys, I mean, it bothers me.

MR. PARRY: Which Table are you on?

MR. TRUE: 46.

CHAIR APOSTOLAKIS: 46. In this example application, "All HEP events are set to their 95th percentile value." I don't know what that means.

MR. PARRY: Well, okay. That that's just the way this was done. Okay. So, okay.

But the next paragraph, the remainder of that paragraph explains why we think in this case that that's okay. Because of the way we used it. Essentially, what we're saying is that, if the PRA has, and this PRA has been done and peer reviewed against the standard, and we do believe that the relative ranking of the HEPs is is acceptable and wasn't incorrect, because who knows, but it's it's consistent with the way the standard will be done. What we're really worried about is is maybe the overall level of the HEPs.

And this is a, I think this is a way that we've dealt with this issue in lots of other examples like in NEI 00-04, for example.

Now in the main body of the text, yes, we do say that, "You should look at the variability between methods as well as well as within the method." In this case though, what we said was, "Just by even looking at these, the range that it, the factor that it increases is in the range of 2 to 4 for all the HEPs in this particular model." And it's sufficient really to show that some of these human actions are significant. And therefore, they are candidates for compensatory measures. And that's the way we are using it in this context.

CHAIR APOSTOLAKIS: Okay. They are significant. Now what?

MR. PARRY: Then you identify the compensatory measures for these.

CHAIR APOSTOLAKIS: So let let me understand the Table.

MR. PARRY: Okay.

CHAIR APOSTOLAKIS: Because it's been a long time.

MR. PARRY: Okay.

CHAIR APOSTOLAKIS: That's page 46.

Right?

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: So the first column says, "Human error probability development, note one. Total delta CDF." Is that after you have used the 95th percentile or before?

MR. VANOVER: That's after. It does this this whole Table is the result of the sensitivity studies.

CHAIR APOSTOLAKIS: Okay. So I have raised -- so what was delta CDF before you did that?

MR. VANOVER: Right, like it's presented in the beginning of that Table. The base case assessment.

CHAIR APOSTOLAKIS: So it was 2.7 10 to the minus 7.

MR. VANOVER: Right.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: So it increased by roughly a factor of five, less than five.

MR. PARRY: Four four pretty much. Just under four.

CHAIR APOSTOLAKIS: And it's now 10 to the minus 6.

PARTICIPANT: Mm-hmm.

CHAIR APOSTOLAKIS: And what was the regulatory limit?

MR. PARRY: 10 to the minus 6.

CHAIR APOSTOLAKIS: For CDF?

MR. PARRY: Delta CDF.

MR. TRUE: Right. We are staying in a very small range.

MR. PARRY: Region 3.

MR. TRUE: Region 3.

MR. SHACK: He doesn't want to go --

CHAIR APOSTOLAKIS: But you can go to 10 to the minus 5. Can't you?

MR. SHACK: -- he doesn't want to go there.

MR. PARRY: You can but --

CHAIR APOSTOLAKIS: Why don't you want to go there?

MR. TRUE: Because then we would have to quantify the base, we'd have to quantify base everything.

MR. PARRY: Including low power shutdown, seismic --

MR. TRUE: To demonstrate that we're below 10 to the minus 4.

MR. SHACK: Region 3 spreads out. Region

5 steps it 10 to the minus 4.

CHAIR APOSTOLAKIS: Let's just say for the moment that we ignore that.

By increasing this human error probability by a factor of 2 to 4, I go to 10 to the minus 6. By how much would I have to increase it to go to 10 to the minus 5?

MR. VANOVER: If we scaled it, than a lot.

MR. TRUE: You can't do that.

CHAIR APOSTOLAKIS: Why can't --

MR. TRUE: Well because it --

CHAIR APOSTOLAKIS: -- I do that?

MR. PARRY: No. You can't do it. Yes, because --

MR. TRUE: They're synergies. Because some cut-sets have more than one basic --

CHAIR APOSTOLAKIS: That's right. That's right.

MR. TRUE: So --

CHAIR APOSTOLAKIS: So it would be a significant increase then. Would it not?

MR. TRUE: No. It might, it went up by a factor of 4. And we needed it to go by a factor of 40. It could be as small --

MR. VANOVER: Well we we --

MR. TRUE: -- as a factor of 10.

MR. VANOVER: -- also the model also includes a dependency analysis.

CHAIR APOSTOLAKIS: I'm sorry. What?

MR. VANOVER: A human error dependency analysis. So there's already a lot of, where human events appear in the same cut-set, we've already made a single event to model the combined failure. And those got adjusted in this sensitivity as well.

MR. PARRY: Let me try to get to George's point. Are you asking, George, how much would you have to increase the HEPs to trigger 10 to the minus 5?

CHAIR APOSTOLAKIS: Right.

MR. PARRY: Yes. We can't answer that. I mean, these factors of 2 to 4, they're different for the different HEPs. Okay. Some of them go up by a factor of about 4. Some of them go up by a factor of 2 depending on where they are. So it's not an easy question, it's certainly not a question we can answer here.

CHAIR APOSTOLAKIS: It's not a question to be answered here, but it can't be that difficult.

MR. VANOVER: Trial and error.

MR. PARRY: Trial and error. Yes.

MR. TRUE: You'd have to just pick some numbers and --

CHAIR APOSTOLAKIS: But is it a factor of six?

MR. TRUE: No.

MR. PARRY: No. Smaller than that.

MR. TRUE: Probably over ten, I would guess.

MR. PARRY: Probably over ten. Yes.

MS. DROUIN: But since you're trying to stay in the low region I'm not sure what would be the exercise, what would be the benefit of doing that or knowing that?

CHAIR APOSTOLAKIS: Oh it would be --

MS. DROUIN: The whole point is to stay in the low region.

CHAIR APOSTOLAKIS: -- because a factor of ten is a pretty significant factor. And if I'm still below the 1174 limit --

MR. PARRY: Well, except that we don't have a complete, we'd have to be sure that the CDF was less than 10 to the minus 4.

CHAIR APOSTOLAKIS: In this case, it's not?

MR. PARRY: We don't know. I mean, we

just don't know. I mean, my feeling is, yes. But almost certainly. But we don't have the numbers.

CHAIR APOSTOLAKIS: I mean, again, the spirit of all these comments is not change this particular example.

MS. DROUIN: Right. I understand.

MR. PARRY: Right. No. No.

CHAIR APOSTOLAKIS: I'm trying to find the way of injecting this kind of thinking in to this kind of argument. Because if it's more than a factor of 10, that clearly tells me something.

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: That maybe I should worry about it.

MR. PARRY: That maybe you should about it. Yes.

MR. CANAVAN: This is the old argument about, for example, if you make a decision and the base decision comes out to 80 to the minus 7, and you run an uncertainty, and when you're running that case a factor of 67 on a HEP brings you to brings you in to the next category, you might argue that that 67 is too high to get.

CHAIR APOSTOLAKIS: It's an unreasonably --

MR. CANAVAN: It's an unreasonably high number.

CHAIR APOSTOLAKIS: -- yes.

MR. CANAVAN: So therefore, I'm confident that --

MR. TRUE: An unreasonable alternative --

MR. CANAVAN: -- the unreasonable alternative hypothesis, but it remains in the small category. Not in the unacceptable range. So you might argue that your's is small --

CHAIR APOSTOLAKIS: It's a very useful insight it seems to me.

MR. CANAVAN: -- category.

MR. PARRY: It is when it's applicable. But in this case --

CHAIR APOSTOLAKIS: In this case --

MR. PARRY: -- it's not that.

MR. BLEY: And if you start making that argument, you got to start thinking about what are the things that could drive those human error probabilities. And it's it's not multiplying by a number. It's something going on probably --

PARTICIPANT: Right.

MR. BLEY: -- in the way the plant's operated or people are trained and --

CHAIR APOSTOLAKIS: Presumably you have already done that. That's why you were reporting HEPs. I mean, it's not like you were pulling a number out of --

MR. SHACK: I mean, after you've done that you still have to quantify it then. That's really what he's really arguing about. That final numerical --

PARTICIPANT: Yes.

MR. CANAVAN: There's some insight that can be gained from that number, but --

CHAIR APOSTOLAKIS: I mean, it was a common cause failure too. In an example we did some years ago people say, well, common cause failures are models and all that. But then if you see that, you know, the beta, gamma, and all that stuff, you really have to go almost close to one for the decision to be reversed. Then you say, "Wait a minute now."

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: I mean, that that's that's unreasonable.

MR. PARRY: Yes.

CHAIR APOSTOLAKIS: We don't see that in practice.

MR. BLEY: But is it unreasonable to say

to apply those across systems which we don't usually do? That might make a really big difference.

MR. PARRY: That could make, that would make a really big difference.

CHAIR APOSTOLAKIS: It might.

MR. PARRY: I think it would.

MR. BLEY: When you start on these grand conclusions you got to start thinking about lots of breakers and factors.

MS. DROUIN: But the fact is --

CHAIR APOSTOLAKIS: all I'm saying is, this is another way of attacking or giving insights in to the model uncertainty issue.

MR. PARRY: Right.

MR. VANOVER: Right. In a in a different example where --

CHAIR APOSTOLAKIS: By the way, it's one way that gives additional insight.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: That's all.

MR. VANOVER: If the example were presented that was far away from the acceptance guidelines, then it would be a little bit easier to do that kind of calculation --

MR. PARRY: Yes.

MR. VANOVER: -- and and have confidence there. In this example we're close to the acceptance guidelines.

CHAIR APOSTOLAKIS: Well, you're 10 to the minus 6.

MR. PARRY: Yes.

MR. VANOVER: Well, even if, we're before the --

PARTICIPANT: The base --

MR. VANOVER: -- the base case.

CHAIR APOSTOLAKIS: Yes.

MR. VANOVER: So what we're, the the point at that point is, okay, what's, I'm I'm close. Granted, I'm close, but I think I'm okay. And therefore, what's important to the decision being made. And that, and this sensitivity case reconfirms that the list of actions that I've already identified important didn't change.

MR. PARRY: Right.

MR. VANOVER: When I -- by looking at the results of the sensitivity case.

MR. PARRY: Right. I think also to add to that, I think this is a, and somewhat of a more instructive example, because we are close to the to the limit. Because if we were really low and all we

did was show that you can multiply these by a factor of ten, we think that's unreasonable, I I don't think it's very helpful. Because then, so what? I mean, we knew that anyway. But if if your decision is insensitive to these uncertainties, you're really in a very good place.

So now I think what we're showing here is that by understanding the results and understanding what's driving the uncertainty to towards the limit, you can, at least, focus on things you might be able to do something about. Which in this case is is doing some compensatory measures on important human actions.

MS. DROUIN: Right. By my understanding, George, your comment is not so much on this example.

CHAIR APOSTOLAKIS: No.

MS. DROUIN: But if we go back to the main body and look at the guidance we have in there. And if we start looking at, you know, get to the point where we're starting to make a decision. There is some additional insights by looking at it from this perspective that could help us in making a decision. Now, that may not be applicable for this particular example. But in terms of the guidance that we have provided to look and see, you know, what would it take to get there. And getting there, would that be

unreasonable. I agree that could add, that could that could provide some very useful information in to your decision making process. And I agree that down the road we ought to look at what would that take in terms of providing guidance from that perspective.

MR. PARRY: Right. I actually think that's in Chapter 5. I think that's already in Chapter 5. That guide.

CHAIR APOSTOLAKIS: It's in the potential measures. Shouldn't one ideally go back and redo the numbers assuming these are in place? Or take on faith that if you do these things everything will be okay?

MR. PARRY: If we knew how to do that --

CHAIR APOSTOLAKIS: Well --

MR. PARRY: -- without human reliability methods.

CHAIR APOSTOLAKIS: -- well, I don't know.

MR. SHACK: And what credit do you give them for the pre-shift brief?

MR. PARRY: Then you do the best you can.

I mean, in a sense, we do think that the values that are in here, the base values are, in fact, good representative values.

Incidentally, just as a matter of interest I went back and checked the SPAR models for this for

this particular plant. They're not very different. In fact, I think in some cases, the numbers in this model are higher than a lot. You can't make a direct one-to-one comparison because they define the HFEs a little differently. But I think the HEPs that I saw, quite a lot of them, were considerably higher than what you would see in the SPAR model.

CHAIR APOSTOLAKIS: So you are saying that you have to take it on faith that these compensatory measures --

MR. TRUE: Compensatory measures get us back to what we assumed is the base model without those compensatory measures.

MR. PARRY: Right.

MR. TRUE: That keeps us below the threshold. Right. Okay. Without the compensatory, without without --

(Laughter.)

-- the base model the base model the base model was okay. All right. We came in below the threshold with the base assumptions. When we increased the values, they went went went above. We're putting in place those compensatory measures to make sure we're down where we were to begin with.

MR. PARRY: At least.

MR. TRUE: At least.

MR. PARRY: Yes.

MR. TRUE: And the those values that are in the base value did not assume we had taken these additional actions.

CHAIR APOSTOLAKIS: So the applicant then, the licensee will tell the staff --

MR. PARRY: Right.

CHAIR APOSTOLAKIS: -- here is our application. And we promised to do these things as well.

MR. TRUE: Mm-hmm.

MR. PARRY: Yes.

MS. DROUIN: To offset the change we've done over here to keep our risk down at the original place.

MR. TRUE: This is not a new thing for the staff or for LARs. We've done this since --

MR. PARRY: Right.

PARTICIPANT: Right.

MR. TRUE: -- late, early 2000 kind of time frame when the first wave of things came through. Where we would include compensatory measures based on our insights from the results.

CHAIR APOSTOLAKIS: So you see, again, one

way or another ultimately comes to a decision.

MR. PARRY: Yes.

PARTICIPANT: Yes.

PARTICIPANT: Right.

MR. TRUE: Providing confidence in that decision.

PARTICIPANT: Yes.

MR. PARRY: Yes.

MS. DROUIN: Okay.

CHAIR APOSTOLAKIS: Well let's see now. Where are we? How long do you need?

MR. VANOVER: The there's only one more --

MS. DROUIN: There's only one more.

MR. VANOVER: -- highlighted section and it's one of the generic footnotes at the end.

CHAIR APOSTOLAKIS: 45?

MR. VANOVER: 48.

CHAIR APOSTOLAKIS: Okay.

MS. DROUIN: So then we're at the very last slide of --

CHAIR APOSTOLAKIS: Future work.

MS. DROUIN: -- future work. As we talked earlier in the briefing, you know, early April, we plan to make this appendix, you know, which is coming up next week.

MR. BLEY: Did you already send out the main document? You made that available?

MS. DROUIN: The main document is in the publication process. And what that means is, it's it's it's waiting. We sent a letter to the Program Office saying, "We intend to publish." And we give them two week notification. So we're at that part. So, the end of next week, it will go to the printer and be, will be publically available.

And at that time, is, I will, has been planning on issuing a second public notice. And the second, the public notice would have the ADAMS number for the appendix in it with a detailed agenda of the workshop.

CHAIR APOSTOLAKIS: Very good.

MS. DROUIN: So I don't see, except maybe a few places, you know, that we agreed to today that we will go back and make some, and these are minor, not any major things that we have to, you know, fix on this appendix to make it public from today's meeting.

Then in the July/August -- and those are tentative dates. Based on the workshop and any additional needed changes to formally to formally publish this appendix as Volume 2. And the reason I say July/August is just the process you have to go

through, it's not going to happen overnight. So, to me, it will probably be published in the July/August time frame.

And then again, based on insights from the workshop, from our users need, you know, identify what our future work's going to be. You know, what will be our short term and long term things, you know. What additional examples we want to take on. Where we need to expand the scope. You know, right there I just have internal fire, new reactors. Things we will consider, also, of course is level 2, level 3. I mean, there's a whole slew of the things we need to think about and what order, you know, we will we will do them.

And, of course, we will continue back with the ACRS on this.

CHAIR APOSTOLAKIS: The, is the NGNP still in the works? It was in the law. I don't know -- are they still going ahead?

MS. DROUIN: Well, there's the NGNP licensing strategy that went to Congress.

CHAIR APOSTOLAKIS: Right.

MS. DROUIN: And they're having meetings right now for the pre-application review.

CHAIR APOSTOLAKIS: Right.

MS. DROUIN: And I believe the the license review is supposed to start in 2013.

CHAIR APOSTOLAKIS: And it's supposed to have a good dose of risk information. Correct? That's what we recommended at least. And I hadn't heard otherwise.

MS. DROUIN: It doesn't -- let me try and answer it a different way. If you use as a point of departure for comparison, they are not going to the level of what is in the framework document.

CHAIR APOSTOLAKIS: Absolutely not. Yes. But they are bringing a lot of risk information I think in the in the --

MS. DROUIN: I think they would argue with that. Their view is that it is, it is primarily deterministic, with some insights, with some risk insights factored on to it. But most of the decisions are deterministic.

CHAIR APOSTOLAKIS: So it would be the same like design certification or the PRA is just a new kid in the block and we'd look at it in case we find something. But essentially, the decision is --

MS. DROUIN: Well, I I --

CHAIR APOSTOLAKIS: What is the status of the TNF within the agency now? Is it just a NUREG

somewhere?

MS. DROUIN: It is a NUREG that has been published. There is a second paper going forward that will talk about a recommendation in terms of testing the framework document. I don't know if you want to--

CHAIR APOSTOLAKIS: Testing it in the NGNP or separately?

MS. DROUIN: There are different approaches upon which you can test it. I I I don't want to say too much because it's still pre-decisional right now.

CHAIR APOSTOLAKIS: Okay.

MS. DROUIN: But you know, the fact there is a second paper going forward that does talk about. Because the Commission came back, you know, that's all public, did come back and say, "Test the framework."

CHAIR APOSTOLAKIS: Yes.

MS. DROUIN: And so there is a second paper going forward with a recommendation of what it would take to test the framework.

CHAIR APOSTOLAKIS: A test is a piece information. There are a lot of people out there who do like that. Who like the TNF.

MS. DROUIN: I'm aware of that.

CHAIR APOSTOLAKIS: They think that's a way to go.

MS. DROUIN: They may like it, but they aren't stepping up as a volunteer.

CHAIR APOSTOLAKIS: To do what? To have to reevaluate it. No. I think the NGNPs are not sure of counting it. This would be a real real case. Now we are getting out of the --

MS. DROUIN: But that's all we have.

CHAIR APOSTOLAKIS: Yes. Are there any comments from the members? No? Said it?

MR. ABDEL-KHALIK: No.

CHAIR APOSTOLAKIS: Bill?

MR. SHACK: No.

CHAIR APOSTOLAKIS: Public?

MR. SHACK: I think the the the notes do help clarify things. It may be a little overkill, but --

PARTICIPANT: Yes.

MS. DROUIN: And and and I want to apologize. Ken, I don't know if Ken wanted to add anything.

MR. CANAVAN: There was only one item for the record. George, in the beginning mentioned the EPRI report and he mentioned the April version. But I

just want to be clear that the the title was correct, but the report number is 1016737 and the final report is December 2008. Just so you have it.

CHAIR APOSTOLAKIS: We have that. Right?

MR. CANAVAN: Yes. You do.

CHAIR APOSTOLAKIS: Okay. Thank you. All right. Thank you very much. This was very informative. Appreciate it. Thanks.

(Whereupon, the above-entitled matter was concluded at 2:40 p.m.)

Treatment of PRA Uncertainties in Risk-Informed Decision Making

Advisory Committee on Reactor Safeguards
Subcommittee on PRA

March 27, 2009

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

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Objective of Meeting

- Discuss staff resolution of ACRS comments on Appendix A to NUREG-1855
  - Overview of major comments
  - Walk-through of the revised document
- Future work

OVERVIEW OF MAJOR COMMENTS

ACRS Comment (1)

- ACRS Comment: Results are presented in ways that may be misinterpreted as general conclusions, when they are applicable only to the specific situation modeled.

- Staff Resolution: Added numerous statements, in footnotes, to highlight that the conclusions drawn are not to be interpreted as generic, but must be derived for each application independently.

ACRS Comment (2)

- ACRS Comment: Important seismic dependencies are not described in ways that make it clear that the user will need to identify and model them properly.

- Staff Resolution: Expanded the discussion of the seismic analysis to address the dependencies between seismically induced failures.

ACRS Comment (3)

- ACRS Comment: Concern with an apparent use of arbitrary sensitivity analyses to evaluate model uncertainties.

- Staff Resolution: Enhanced discussion to highlight the adequacy of the sensitivity analyses to identify the key sources of model uncertainty and to identify appropriate compensatory measures.

Additional Changes

- Several changes made to the report to clarify:
  - The definition of the application
  - The screening of low power and shutdown contribution
  - An evaluation of fire LERF is needed
  - The basis for considering fire PRA results conservative

WALK-THROUGH OF THE REVISED DOCUMENT

Changes on Pages --

A-1 .....Clarification
A-4 .....Applicability
A-6 .....Clarification
A-9 .....Clarification
A-11 .....Applicability, Dependencies
A-14 .....Applicability, Dependencies
A-15 .....Applicability, Dependencies
A-25 .....Applicability
A-33 .....Applicability, Clarification
A-34 .....Applicability
A-39 .....Applicability
A-45 .....Applicability
A-46 .....Sensitivity
A-48 .....Applicability

APPENDIX A

EXAMPLE IMPLEMENTATION OF THE PROCESS FOR THE TREATMENT OF PRA UNCERTAINTY IN A RISK-INFORMED REGULATORY APPLICATION

The license amendment request (LAR) discussed here is a hypothetical example developed to illustrate the process described in this document and in EPRI 1016737. While a realistic PRA model has been used in the example, it has been modified to ensure that there are some sources of uncertainty that exercise all aspects of the process (i.e., result in challenging the acceptance guidelines). The approach discussed for addressing these sources of uncertainty is provided as one example of a spectrum of possible approaches and is provided for discussion and illustrative purposes. Its inclusion should not be construed to imply that this is the only approach or that the illustrative example would be sufficient in all cases.

A.1 Introduction

This appendix provides an example of the implementation of the guidance given in this report. The example risk-informed regulatory application is a hypothetical License Amendment Request (LAR) to revise the Technical Specification Allowed Outage Time (AOT) from 3 days to 7 days for the RHR/SPC system at a representative BWR, Mark II plant. The PRA model for the plant is consistent with the PRA technical adequacy requirements outlined in Regulatory Guide 1.200 [Ref. A.1]. The purpose of the technical specification change is to allow routine preventive maintenance currently performed at shutdown to be performed with the unit at power. As discussed in Section A.3, the risk reduction associated with moving this maintenance unavailability from shutdown will be conservatively omitted from the calculation of ΔCDF and ΔLERF.

Following the guidance in Section 3.1 of this report, the first step is to identify the risk assessment results required to support the LAR using the application specific guidance documents. For this risk informed AOT Extension, the application specific guidance documents are Regulatory Guide 1.174 [Ref. A.2] and Regulatory Guide 1.177 [Ref. A.3]. The risk assessment or PRA results required for this application and the associated acceptance guidelines are summarized in Section A.1.

The remaining sections follow the guidance in Section 7 to document the analysis performed to assess the risk implications of the proposed LAR. Section A.3 provides a description of the PRA model used to support the analysis and summarizes how the PRA is used to generate the results required for comparison with the acceptance guidelines, and follows the guidance in Section 7.2. Section A.4 presents the comparison of the PRA results with the acceptance guidelines, following the guidance in Section 7.3 to address the PRA uncertainties. This in turn relies on the detailed guidance in Sections 4, 5, and 6. Finally, the presentation of the results is discussed in Section A.5, using the guidance of Section 7.4.

The example is not intended to be comprehensive in the treatment of completeness uncertainty. However, some examples are provided to illustrate the approaches that can be used.

These insights indicate the following when considering the scope of the PRA required to assess the risk significance of the RHR Loop AOT[1]:

- Both the functions of Containment Heat Removal and RPV Makeup are relevant to the risk significance of the RHR Loops.

- LOCA, LOOP, and Transient initiators all have the potential to create a demand for the RHR Loops

Assessment of Relevant Hazard Groups

With an understanding of the role that the RHR system plays in mitigating risk an assessment of the relevant hazard groups can be completed. Section 6.3.3 provides a list of hazard groups that should be considered in a risk assessment. Table A-3 summarizes how those hazard groups were dispositioned for this hypothetical plant. The majority of the hazard groups were screened from consideration, using the screening approaches discussed in Section 6.

Table A-3
HAZARD GROUPS CONSIDERED IN THE RISK ASSESSMENT

Approach	Hazard Group	Basis[2]
Addressed quantitatively	• Internal Events • Internal Floods • Internal Fires	Plant-specific PRA reflecting the as-built, as-operated plant is used to quantitatively estimate the risk impacts.
Addressed using a conservative approach	• Seismic Events	Using a simplified conservative analysis, the contribution of seismic risk to total risk can be shown to be minimal.
Screened from consideration based on likelihood of threat-induced challenge	• Accidental Aircraft Impacts	Removal of RHR Loop may decrease reliability of heat removal function, but the frequency of damage from accidental aircraft impacts is very small compared to other events already considered (e.g., LOOP, Loss of Condenser)
	• External Floods	A slow developing event which would allow restoration of out of service RHR Loops prior to presenting a significant challenge.
	• Extreme Winds and Tornados (including generated missiles)	Plant is designed for extreme winds and tornadoes. Removal of RHR Loop may decrease reliability of heat removal function, but the frequency of wind/tornado-induced damage is very small compared to other events already considered (e.g., LOOP, Loss of Condenser)

[1] The conclusions related to the relevance of RHR to plant risk are specific to the plant and change being evaluated and are not be construed as generic dispositions.

[2] The conclusions related to the relevance of these hazard groups to the application are specific to the plant and change being evaluated and are not be construed as generic dispositions of the hazard group.

The at-power PRA models used for this analysis therefore include:

- an internal events,
- an internal floods, and
- a fire PRA model.

In addition, the seismic hazard group was addressed quantitatively with a conservative analysis as discussed in Section A.3.4. The other hazard groups were demonstrated not to be relevant based on a screening analysis. The at-power ΔCDF and ΔLERF for this application are such that the results lie in Region III of the RG 1.174 acceptance guidelines (see section A.3.3), and therefore, it is unnecessary to evaluate the low-power and shutdown contribution to the base CDF and LERF. Furthermore, the change being proposed involves moving unavailability of the RHR loops from shutdown to power conditions. The analysis will conservatively omit this risk reduction, which could be used under RG 1.174 to offset the increase in at power risk in the ΔCDF and ΔLERF calculations.

As part of the development of the internal events and internal floods PRA model, the major sources of uncertainty for the representative plant were previously identified and characterized (refer to Appendix B of EPRI 1016737). For the Fire PRA model, such an assessment has not yet been performed, but for the purposes of this illustrative example it will be assumed that the major sources of uncertainty include all of those identified for the internal events model plus the fire scenario frequencies and the associated impact vectors (i.e. failed components may be conservatively treated for some scenarios). It is also noted that in many cases the impact of the fire scenarios on SSCs has been conservatively assessed. The quantitative impact for this assessment will include an explicit treatment from these two portions of the PRA model.

A.3.2.2 Level of Detail

To support an application, a PRA model has to have sufficient level of detail to model the cause-effect relationship associated with the LAR. Since this PRA is a detailed PRA, and, in particular, models the RHR loops in detail, it has the level of detail necessary to support this application.

A.3.3 Using the PRA Model

(This section is developed per the guidance in Section 7.2.3.)

This section describes how the internal events and internal floods PRA model and the fire PRA model were used to support the application. The proposed technical specification change involves simultaneous unavailability of several RHR and RHRSW components. The revised CDF and LERF values for the AOT configurations are obtained by re-quantifying the base PRA model with all of the identified events set to TRUE compared to their base-case probability values.

The evaluation of ΔCDF and ICCDP (or ΔLERF and ICLERP) for the AOT change for a plant that has a fuel cycle length of T_{CYCLE} is determined as shown below.

The new annual average CDF due to the change in the AOT, CDF_{NEW}, is given by the following equation:

Table A-4
INITIAL RISK ASSESSMENT INPUT VALUES

Input Parameter	Internal Events and Internal Floods	Internal Fires [2]	Total
$LERF_B$	8.18E-08/yr	N/A	N/A
T_A	7 Days	7 Days	7 Days
T_B	7 Days	7 Days	7 Days
T_{CYCLE}	700 Days	700 Days	700 Days
AOT_{NEW}	7 Days	7 Days	7 Days

[1] For simplicity and since it does not significantly impact the results, $CDF_{base'}$ is assumed to be equal to CDF_{BASE} for this assessment.

[2] Note that only fire CDF is available and as such a qualitative evaluation will need to be provided for fire LERF.

Table A-5
INITIAL RISK ASSESSMENT OUTPUT VALUES

Output Parameter	Internal Events and Internal Floods	Internal Fires	Total
CDF_{NEW}	3.86E-06/yr	1.35E-05/yr	1.73E-05/yr
ΔCDF	1.26E-07/yr	7.58E-07/yr	8.84E-07/yr
$ICCDP_A$	1.13E-07	3.76E-07	4.89E-07
$ICCDP_B$	1.28E-07	1.08E-06	1.21E-06
$LERF_{NEW}$	6.49E-08/yr	N/A	<1.0E-05/yr [1]
ΔLERF	2.67E-10/yr	N/A	<1.0E-07/yr [1]
$ICLERP_A$	1.52E-10	N/A	<5.0E-08 [1]
$ICLERP_B$	3.61E-10	N/A	<5.0E-08 [1]

[1] Due to the nature of the RHR/RHRSW function in mostly providing a long term containment heat removal function, there is a very limited impact on LERF as is indicative from the internal events results. Although not explicitly quantified, a significant increase in the LERF related risk metrics is not expected from the fire analysis either.

From the results in Table A-5, the RHR B case will likely lead to exceeding the acceptance guidelines and as a result the fire PRA model was reviewed and further refinement was performed. The refinement included the removal of demonstrated conservatisms and credit for compensatory measures in reducing the fire risk for the analyzed configurations. This

A.3.4 Seismic Risk Implications

This section provides information regarding a bounding assessment of the seismic risk implications of having an RHR Loop out of service for the representative plant. In this example, the hypothetical plant does not have a full seismic PRA. In order to evaluate the potential seismic risk implications, a focused, bounding seismic risk assessment is provided to evaluate the role of the RHR loops in mitigating seismic-induced events[3].

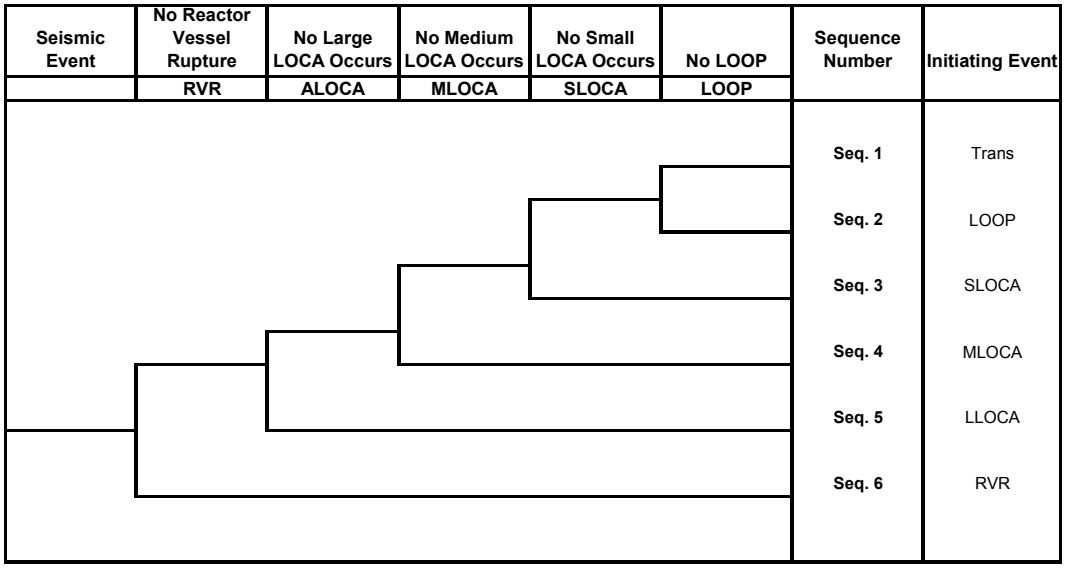
A.3.4.1 Methodology

A simplified seismic initiator event tree is provided to partition the effects of a seismic event into the following initiator categories:

- Reactor Vessel Rupture (RVR)
- Large LOCA
- Medium LOCA
- Small LOCA
- Loss of Offsite Power (LOOP)
- Transients

The basic approach and structure for the partitioning of seismically-induced initiating events from the seismic PRA described in NUREG/CR-4550, Volume 4, Part 3 is used [Ref. A.4]. The event tree structure is shown below in Figure A-1.

Figure A-1 Simplified Seismic Initiator Event Tree



Consistent with Ref. A.4, a LOOP condition is assumed to exist for all sequences except Sequence 1. The latest NRC data on seismic hazards, NUREG-1488 [Ref. A.5] is used to

[3] The ability to assess seismic contributors to an application is specific to the plant and change being evaluated. This example is not to be construed as providing generic dispositions of the seismic risks.

In the internal events PRA, the loss of condenser initiators during the removal of the RHR loop from service contributed only about 5% to the change in risk. Thus, it is concluded that the risk contribution from seismically-induced transients is negligible.[4]

LOOP Events

In the internal events PRA, LOOP events are relatively important contributors to the risk associated with the RHR loop out of service condition. This is due to the loss of condenser condition caused by the loss of offsite power. Given a loss of condenser event, the RHR system and the containment vent are the only two means of containment heat removal available. For the plant being evaluated, the containment vent capability has been seismically evaluated and found to have a significantly higher seismic capacity than the RHR loops. This means that the vent would be expected to be available to mitigate the seismic LOOP condition. Therefore, it can be assumed that seismic-induced LOOP events present a challenge similar to a traditional LOOP, except offsite power recovery is assumed to be precluded, i.e., unrecoverable in the timeframe considered by the PRA.

The risk implications of seismically-induced LOOPs is assessed by comparing the frequency of seismic-induced LOOP events to the frequency of unrecovered LOOP events that are due to other causes (i.e., grid, plant centered, and weather), as treated in the internal events PRA.

The internal events PRA utilizes LOOP occurrence and recovery data from NUREG/CR-6890 [Ref. A.7]. Based on this data, the site-specific frequency of long term losses of offsite power (i.e., those >24 hours in duration) is approximately 5E-4/yr. This compares to the frequency of seismically-induced LOOP events from Table A-9 of 1.06E-4/yr. So, the seismically-induced LOOP events are roughly 20% of the internal events frequency.

Additionally, LOOP events contribute roughly 20% of the total delta risk from internal events (refer to Section A.3.1.2). Conservatively assuming that ***all*** LOOP contribution to the delta risk comes from long-term losses of offsite power means that the seismically-induced events might increase the delta risk by approximately 4% (20% of 20%).

Based on the internal events results above for ΔCDF, $ICCDP_A$, and $ICCDP_B$, a 4% increase to each of those figures of merit can be approximated as shown below. These bounding values are all less than within 1% of the corresponding acceptance guidelines. Given the bounding nature of this assessment, this is judged to be insignificant.[5]

Output Parameter	**Internal Events**	**Bounding Seismic LOOP Estimate (4%)**
ΔCDF	6.30E-08/yr	6.30E-08/yr * 0.04 = 2.5E-09/yr
$ICCDP_A$	5.37E-08	5.37E-08 * 0.04 = 2.1E-09
$ICCDP_B$	6.71E-08	6.71E-08 * 0.04 = 2.7E-09

[4] The conclusions related to the relevance of seismic-induced transient events to the application are specific to the plant and change being evaluated and are not be construed as generic dispositions of the contributor.

[5] The conclusions related to the relevance of seismic-induced LOOP events to the application are specific to the plant and change being evaluated and are not be construed as generic dispositions of the contributor.

LOCA Events

RHR loops support more than one function in the mitigation of LOCA events, i.e., both containment heat removal and RPV makeup. The risk from seismically-induced LOCAs will be bounded by evaluating the change in overall RHR reliability that occurs when one loop is out of service and using that as an indicator of the change in LOCA risk.

Based on the RHR model from the representative site PRA, the overall reliability of RHR with both loops available assuming an unrecoverable loss of offsite power scenarios is 7.1E-04 and is 8.4E-03 with one loop out of service. Thus, the overall reliability of RHR changes by approximately a factor of 10 (due to the redundant nature of the design of the system and supporting emergency diesel generators). By assuming that the RHR reliability will have a direct impact on ***all*** LOCA risk (i.e. the remaining loop of RHR during the AOT would not be impacted by the seismic event and would be required to mitigate all LOCA events), the change in seismic risk can be conservatively approximated. (In a typical PRA, seismic failures of RHR would be correlated so that both loops would be failed. Therefore, there would be no impact on the seismic risk of a loop being out of service.)

From Table A-9, it can be seen that the frequency of seismically-induced Small, Medium and Large LOCAs is 8.55E-6/yr (i.e., 5.20E-06/yr + 6.46E-07/yr + 2.70E-06/yr). Assuming that the change in risk can be reflected by the remaining RHR loop reliability, the risk change is bounded as 8.55E-6/yr * 8.4E-03 = 7.2E-8/yr. Over a 7 day AOT, this contributes only approximately 1.4E-9 to the ICDP (7.2E-8/yr * 7 days / 365 days/yr), or roughly 0.3% of the acceptance guidelines. Given the bounding nature of this assessment, this is judged to be insignificant.[6]

Reactor Vessel Rupture

Reactor vessel rupture (RVR) events cannot be mitigated. Thus, the unavailability of an RHR loop has no impact on the risk associated with seismically-induced RVR events.

Conclusion

Bounding analyses were performed to consider the potential seismic contribution for the RHR/SPC loop out of service during the AOT configuration. This included an evaluation of six separate initiating event consequences from the gamut of potential seismic events. One of the categories was determined to be un-impacted by the RHR/SPC loop out of service configuration (reactor vessel rupture), and the other five initiating event categories were determined to have no more than a few percent impact compared to the acceptance guidelines. Given the results of these bounding assessments, they are not carried further in the analysis.[7]

[6] The conclusions related to the relevance of seismic-induced LOCA events to the application are specific to the plant and the change being evaluated and are not be construed as generic dispositions of the contributor.

[7] The relevance of the seismic risk contribution to the application and to the decision being considered are specific to the plant and the change being evaluated. This example is not be construed as a generic disposition of the contributor.

Table A-18
SIGNIFICANT CONTRIBUTORS TO THE INTERNAL EVENTS AND INTERNAL FLOODS EVALUATION (RHR "B" LOOP CASE)

Event Name	Probability	Fussell-Vesely	Risk Achievement Worth	Description
BHU8ABDXI	6.90E-03	5.96E-02	9.58	FAILURE TO RESTART RUNNING PUMP OR START STANDBY PUMP
ECB505DNI	2.57E-04	4.62E-02	180.85	D114 BUS XFRMR BREAKER 152-11505 FAILS TO RE-CLOSE
ZHULVCDXI	5.60E-04	4.46E-02	80.51	OP FAILS TO CNTRL LVL IN A TRANS WITH LP INJECTION
AHUBCIDXI	1.80E-02	3.71E-02	3.02	OPERATOR FAILS TO BYPASS DIV 1 AND II CONTAINMENT ISOL.
EHUTIEDXI	6.70E-03	3.41E-02	6.05	OPERATOR ACTION TO CROSSTIE TO 4KV BUSES FAILS
ZHUCSTDXI	1.85E-03	3.41E-02	19.4	JOINT HEP FOR REFILLING CST VIA ANY MEANS
NODG2E	8.20E-01	3.21E-02	1.01	FAILURE TO RECOVER EDG IN 2.5 HRS / NO RECOVERY IN 0.5 HRS
NODGE	1.00E+00	3.21E-02	1	FAILURE TO RECOVER DIESEL EARLY (30 MINUTES)
BPMAFACTOR	5.00E-01	3.11E-02	1.03	FRACTION OF RUNNING TIME FOR CRD PUMP 1AP158

Table A-19
INTERNAL EVENTS AND INTERNAL FLOODS CONTRIBUTORS THAT ARE POTENTIAL SOURCES OF UNCERTAINTY[8]

Contributor	Reason for Importance
Viability of CRD injection post containment failure	CRD is one of the only systems available for RPV makeup following containment failure. While the flow path for CRD to the RPV traverses through the Reactor Building, it is sufficiently low in the structure and protected that only certain containment failure modes and locations would impact it.
Various Human Errors: - Failure to depressurize RPV - Failure to bypass containment isolation - Failure to cross-tie IA to PCIG - Failure to utilize CRD for RPV Makeup	The human actions are important to avoiding the long-term loss of containment heat removal condition or providing RPV makeup after containment challenge that eventually lead to core damage.

[8] The specific sources of model uncertainty relevant to the decision are specific to the plant and change being evaluated. This table is not be construed as providing generic dispositions of the potential sources of uncertainty.

Table A-26
UNIQUE INTERNAL FIRE CONTRIBUTORS THAT ARE POTENTIAL SOURCES OF UNCERTAINTY[9]

Contributor	Reason for Importance
Scenario initiating event frequencies	Recent fire PRAs performed for NFPA-805 have identified that the fire ignition frequencies derived from EPRI TR-1011989 have a conservative bias. Recent EPRI work has found that improvements in industry performance over the past 20 years have reduced fire ignition frequencies by roughly a factor of two.
General conservatism of fire scenario treatment	The fire PRA performed for this plant contains a general conservative bias in the definition of the fire damage scenarios and human actions. This bias tends to overstate the fire CDF contributions. If the analysis identified that the RHR Loop condition was excessive, then these conservative biases could be eliminated, but since the results appear to support the AOT extension, they are tolerated in this analysis.

The modeling of fire effects is generally considered to be a source of model uncertainty. However, in this hypothetical case, the scenarios contributing to the increased fire risk due to the RHR Loops being out of service did not rely on fire modeling. Bounding assumptions were made regarding fire impacts. This is one of the reasons for characterizing the fire PRA results as generally conservative for this evaluation.[10]

A.4.2 Assessment of Uncertainty

As discussed in Chapter 3, epistemic uncertainty is generally categorized into three types — parameter, model, and completeness uncertainty. Because they are characterized in different ways, the approaches to addressing them are different as discussed below. The analysis of uncertainty is best carried out sequentially, dealing first with parameter uncertainty, and then addressing model uncertainty. This needs to be done both for the hazard groups separately and in combination.

[9] The specific sources of model uncertainty related to fire contributors that are relevant to the decision are specific to the plant and change being evaluated. This table is not be construed as providing generic dispositions of the potential sources of uncertainty.
[10] The specific sources of model uncertainty related to fire modeling are specific to the plant and change being evaluated. In other cases, where detailed fire modeling is relied upon, this would be likely to be considered a source of model uncertainty. This statement is not be construed as providing generic dispositions of the fire modeling as a source of model uncertainty.

A.4.2.1 Parameter Uncertainty

(This section is developed per the guidance in Section 7.3.3.1.)

The cutset results for the four different delta-CDF assessments were reviewed to determine if the epistemic correlation could influence the mean value determination. From the review of the cutsets, it was determined that the dominant contributor cutsets do not involve basic events with epistemic correlations (i.e. the probabilities of multiple basic events within the same cutset for the dominant contributors are not determined from a common parameter value). Per Guideline 2b from EPRI 1016737, then it is acceptable to use the point estimate directly in the risk assessment.

To verify that the use of the point estimate is acceptable in these four cases, a detailed Monte Carlo calculation was performed to compare the mean value determined from the Monte Carlo simulation as compared to the point estimate. The results of those assessments are provided in Table A-27 below. Figures displaying the probability density function for each of the cases appear after the table. Based on the minimal difference in the comparison of the mean value with the point estimate values provided, the use of the point estimate for this assessment is deemed acceptable.[11]

Table A-27
PARAMETRIC UNCERTAINTY EVALUATIONS AND COMPARISON TO POINT ESTIMATE RESULTS

Result	**Internal Events and Internal Floods**		**Internal Fires**	
	RHR "A" Case	**RHR "B" Case**	**RHR "A" Case**	**RHR "B" Case**
Propagated Mean Values[(1)]				
CDF_X[(1)]	6.56E-06/yr	7.31E-06/yr	1.57E-05/yr	3.05E-05/yr
CDF_{BASE}[(1)]	3.80E-06/yr		1.25E-05/yr	
ΔCDF[(1)] = CDF_X - CDF_{BASE}	**2.76E-06/yr**	**3.51E-06/yr**	**3.20E-06/yr**	**1.80E-05/yr**
Point Estimate Mean Values[(2)]				
CDF_X[(2)]	6.53E-06/yr	7.23E-06/yr	1.57E-05/yr	3.03E-05/yr
CDF_{BASE}[(2)]	3.73E-06/yr		1.25E-05/yr	
ΔCDF[(2)] = CDF_X - CDF_{BASE}	**2.80E-06/yr**	**3.50E-06/yr**	**3.20E-06/yr**	**1.78E-05/yr**

(1) Developed based on the parametric mean value for each case from a Monte Carlo simulation with 10,000 samples.

(2) Developed based on the point estimate value for each case.

[11] For this case, the epistemic correlation had little influence on the mean results. This may not be the case in all instances.

Table A-28
IDENTIFICATION OF POTENTIAL KEY SOURCES UNCERTAINTY[12]

Source of Uncertainty	Base Model	Application Important Contributor	Source of Model Uncertainty Assessment	Potential Key Source of Uncertainty
HEPs for utilizing CRD injection	Yes	Yes	There are three CRD-related HEPs that influence both the internal events and internal fire events evaluations (BHU8ABDXI,BHUMX2DXI, and ZHUCSTDXI). The credited actions are procedurally directed with the calculated HEP values derived from an accepted methodology. Although variations to the HEP values may lead to changes in the risk assessment results, only very bounding assumptions regarding the appropriate HEP values for these individual actions would lead to exceeding the risk metric acceptance guidelines. In any event, the HEPs for utilizing CRD injection are identified as a potential key source of uncertainty for this application as part of the HEP development as a global source of uncertainty.	Yes – included as part of HEP development as a class
HEP values for operator fails to depressurize	Yes	Yes	The credited actions (AHUXTRDXI and ZHUAAXDXI) influence both the internal events and internal fire events results. They are procedurally directed with the calculated HEP values derived from an accepted methodology. Although variations to the HEP values may lead to slight changes in the risk assessment results, only very bounding assumptions regarding the appropriate individual HEP values for these actions would lead to exceeding the risk metric acceptance guidelines. In any event, the HEPs for depressurizing the RPV are identified as a potential key source of uncertainty for this application as part of the HEP development as a global source of uncertainty.	Yes – included as part of HEP development as a class

[12] The identification and disposition of the potential sources of uncertainty are specific to this plant, this model, and this application and are not to be considered generic dispositions.

an evaluation of the maximum Risk Achievement Worth approach as is described in Section 5.4 to screen certain items, but for the remaining items realistic sensitivity cases are performed. Based on the analysis of the results of this assessment with one loop of RHR known to be unavailable, there were no identified logical combination sensitivity cases to explore. Additionally, two sources of model uncertainty (i.e. assumptions related to viability of non-CRD systems following containment venting or containment failure, and the Fire PRA model assumption that all scenarios with credit for FW/PCS always require bypass of the containment isolation signal and cross-tie of instrument air to instrument gas to maintain air supply to inboard MSIVs) are not explored with sensitivity studies since they are most likely to reduce the relevant risk measures and therefore could only improve the margin compared to the acceptance guidelines.

Table A-29 is a sample presentation format for the sensitivity case results for this hypothetical LAR example with acceptance guidelines of 1.E-6/yr for ΔCDF and 5.0E-7 for ICCDP, respectively. Note that the results of each sensitivity case are presented for the total risk metrics (i.e. the combined impact from the internal events and internal fire events assessments), and for ICCDP for the cases with either loop A or loop B unavailable. Insights regarding potential compensatory measures that would reduce the risk metrics associated with the source of uncertainty are also identified.

Table A-29
PRESENTATION OF SENSITIVITY STUDY RESULTS[13]

	Total ΔCDF	**Total ICCDP**	**Above ΔCDF Limit?**	**Above ICCDP Limit?**	**Potential Compensatory Measures**
Base Case Assessment (R_o Values)	2.7E-7	A: 1.2E-7 B: 4.1E-7	No	No No	Base case compensatory measures include no maintenance on selected components. This compensatory measure will be enforced during the RHR/SPC AOT.
Source of Uncertainty and Individual Sensitivity Study Results (R_S Values)					

[13] The specific sensitivity studies presented here are only applicable to this example. In some cases, where the impact can be shown to be minimal, a conservative screening study is performed. In other cases, a more measured approach is taken based on reasonable alternatives derived from an understanding of the bases for the base case analysis.

Table A-29
PRESENTATION OF SENSITIVITY STUDY RESULTS[13]

	Total ΔCDF	Total ICCDP	Above ΔCDF Limit?	Above ICCDP Limit?	Potential Compensatory Measures
1. Human Error Probability (HEP) development (Note 1)	1.0E-6	A: 7.1E-7 B: 1.2E-6	Yes	Yes Yes	Perform pre-shift briefs on potentially important actions: • Maximize CRD flow for RPV injection • Depressurize RPV for low pressure injection • Bypass containment isolation for PCIG • Cross-tie IA to PCIG to maintain inboard MSIVs open for use of FW/PCS
Note 1: In this example application, all HEP events are set to their 95th percentile values. This resulted in HEPs that were multiplied by factors in the range of 2 to 4. While this range is smaller than that which could be obtained by using a totally different HRA approach, it is sufficient, in this case, to demonstrate that the HEP values are a potentially key source of uncertainty. Further, the HRA was performed using a systematic approach that is consistent with the ASME PRA standard and has been peer reviewed. One of the requirements of the standard is that the HEPs be compared as a set to ensure that the ranking is appropriate to the context within which HEP is evaluated. The identification of significant contributors discussed in Section A.4.1.2 resulted in the identification of the most significant human failure events, and these are the ones identified for potential compensatory measures above.					
2. Total frequency of medium LOCAs that are too big for CRD makeup capabilities (Note 2)	3.0E-7	A: 1.4E-7 B: 4.3E-7	No	No No	N/A – Bounding sensitivity case still leads to results within the acceptance guidelines.
Note 2: Current MLOCA frequency of 3.9E-4/yr is greater than alternative hypothesis of 1.1E-4/yr from NUREG/CR-6928. Therefore, sensitivity case provides a conservative screening assessment by setting all of the current MLOCA frequency to be greater than CRD makeup capability.					

Based on these results, the following two items are identified as ***key*** sources of uncertainty for this application[14]:

- Human Error Probability (HEP) development as a class
- The basis for determining CRD survivability following containment failure scenarios

Following the guidance in Section 5, it is incumbent upon the analyst to characterize the degree of confidence in the assumptions associated with the sources of uncertainty listed above that lead to the base case results (with compensatory measures incorporated) being within the acceptance guidelines. It is not the intent of this process to say that the results of any one or more sensitivity case being above the acceptance guidelines should automatically lead to a negative outcome by the decision maker. On the contrary, the intent of the process is to clearly identify those sources of uncertainty that are key to the decision (and therefore by definition will challenge the acceptance guidelines), and that appropriate compensatory measures have been identified to implement or otherwise deal with the key sources of uncertainty.

Additionally, it should be noted that one of the main points of the HEP development sensitivity as a class is to confirm that a systematic bias in the HRA process is not suppressing an important insight. The purpose of setting all of the HEPs to the 95th percentile value at the same time is to see if some additional actions should be separately identified as important. An examination of the important contributors from sensitivity case did not identify any new insights or indicate that there any more compensatory measures that might want to be considered.

A.4.2.3 Completeness Uncertainty

(This section is developed per the guidance in Section 7.3.3.3.)

Table A-3 in Section A.2.2.2 presents a summary of the disposition of those hazard groups not included in the PRA. As discussed there, the majority of those hazard groups were screened based on qualitative or quantitative considerations. The seismic hazard group was demonstrated to be an insignificant contributor based on a simple, but conservative model as discussed above.[15]

A.5 Summary of Results of the Risk Assessment

Table A-30 shows a comparison of the individual hazard group core damage risk metrics to the acceptance guidelines. As stated previously, the focus is on the core damage risk metrics since the large early risk metrics were determined not to be significant contributors for this hypothetical LAR. The base case results with compensatory measures in place to avoid maintenance on selected components and trains show that the threshold acceptance values are met for ΔCDF and ICCDP when the A RHR loop is out of service and when the RHR B loop is out of service for the extended AOT.

The results of a structured process for identifying potential key sources of uncertainty led to the performance of four sensitivity studies. The sensitivity studies were performed to identify the key sources of uncertainty and related assumptions for this PRA application. The results and

[14] The specific key uncertainties identified here are only applicable to this example and are not to be construed as generically applicable.
[15] This conclusion applies only for this application for this plant and is not to be construed as generically applicable.

Future Work

- Staff's plans on Appendix A:
  - Early April -- make Appendix A publicly available for May 5,6 workshop (with the current changes and any additional ones from today's meeting)
  - July/August -- based on workshop, make any additional needed changes and formally publish Appendix A (Volume 2 to NUREG-1855)
- Based on insights from workshop and user needs, identify future work; for example:
  - Short and long term needs
  - Additional examples
  - Expanded scope with regard to guidance (e.g., internal fire, new reactors)
- Will continue to interact with ACRS