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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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RELIABILITY AND PRA SUBCOMMITTEE

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TUESDAY

MARCH 1, 2016

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear
Regulatory Commission, Two White Flint North, Room T2B1,
11545 Rockville Pike, at 8:30 a.m., John Stetkar,
Chairman, presiding.

COMMITTEE MEMBERS:

JOHN W. STETKAR, Chairman

DENNIS C. BLEY, Member

RONALD G. BALLINGER, Member

MICHAEL L. CORRADINI, Member

DANA A. POWERS, Member

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DESIGNATED FEDERAL OFFICIAL:

JOHN LAI

ALSO PRESENT:

KEVIN ANDERSON, PNNL

KEITH COMPTON, RES

KEVIN COYNE, RES

STACEY HENDRICKSON, SNL *

ALAN KURITZKY, RES

JOHN SCHROEDER, INL

STEVE SHORT, PNNL

JACK VECCHIARELLI, Ontario Power Generation *

*Present via telephone

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8:33 a.m.

CHAIR STETKAR: The meeting will now come to order. This is a meeting of the Reliability and PRA Subcommittee. I'm John Stetkar, Chairman of the Subcommittee meeting.

ACRS members in attendance are Ron Ballinger, Dana Powers, and Dennis Bley. John Lai of the ACRS staff is the Designated Federal Official for this meeting.

The Subcommittee will hear the staff's presentation on the progress of the Level 3 PRA project in the morning, and Dr. Jack Vecchiarelli of Ontario Power Generation will discuss nuclear plant site risk assessment and safety goals in this afternoon's session.

There will be a phone bridgeline. To preclude interruption of the meeting, the phone will be placed in a listen-in mode during the presentations and Committee discussions. A portion of the meeting may be closed in order to discuss and protect information designated as proprietary by the NRC pursuant to 5 USC 552(B)(c)(4), in case anybody wanted to look it up.

MEMBER POWERS: Could I get those numbers again?

CHAIR STETKAR: Yes, yes, you can. It's 5

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1 USC 552(B)(c)(4).

2 MEMBER POWERS: Not three?

3 CHAIR STETKAR: No, no, it says four right
4 here. We received no written comments or requests for
5 time to make oral statements from members of the public
6 regarding today's meeting. The Subcommittee will
7 gather information, analyze relevant issues and facts,
8 and formulate proposed positions and actions, as
9 appropriate, for deliberation by the full Committee.

10 The rules for participation in today's
11 meeting have been announced as part of the notice of
12 the meeting previously published in the Federal
13 Register. A transcript is being kept and will be made
14 available, as stated in the Federal Register notice.
15 Therefore, we request that participants in the meeting
16 use the microphones located throughout the meeting room
17 when addressing the Subcommittee. The participants
18 should first identify themselves and speak with
19 sufficient clarity and volume so that they may be readily
20 heard.

21 I know that we have material for, I think,
22 open and closed sessions. If, in the open session, we
23 stray too far toward proprietary information, just alert
24 us to that and we'll hold off on questions until we get
25 to the closed session.

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1 I'm a bit unprepared, so I have to look at
2 the agenda here. What we'll try to do is open the
3 bridgeline and ask for public comments at a convenient
4 time after the open session, the first part of the
5 morning, just in case there are any public comments and
6 then try to keep most of the closed session material
7 consolidated.

8 With that, I also remind everyone to check
9 your little electronic communication doodads and turn
10 them off, please, so they don't bother us. And we'll
11 now proceed with the meeting, and I'll ask Kevin Coyne,
12 Kevin, do you have opening remarks?

13 MR. COYNE: Yes, thank you. Kevin Coyne
14 from the Office of Nuclear Regulatory Research. Thank
15 you again to the Subcommittee for making time for us
16 today in the agenda. Our last meeting was about a year
17 ago, but since that time we've continued to benefit from
18 ACRS fact-finding activities, which have provided us
19 extremely valuable feedback on the Level 3 PRA project.
20 As a result of this feedback and other quality
21 activities, such as PWR Owners Group-led peer reviews
22 and other internal review processes, we have made
23 significant updates to our PRA model that have served
24 to improve the technical basis, consistency, and overall
25 quality of our model.

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1 We have also completed an expert
2 elicitation process on interfacing system LOCA, which
3 piloted our expert elicitation guidance developed
4 pursuant to SRM/SECY-11-0172. You'll hear more about
5 that this morning.

6 Alan will provide a more complete status
7 update, but 2016 is expected to be a very busy year for
8 us. We hope to complete revisions to the at-power
9 internal event Level 2 and 3 analyses, in addition to
10 completing other modules for fire, seismic, and shutdown
11 risk.

12 There are many challenges that remain, but
13 we continue to focus on pulling together a quality
14 product that will provide meaningful and useful
15 insights. We also continue to enjoy strong support for
16 the project from Southern Nuclear, the PWR Owners Group,
17 EPRI, and Westinghouse, and their substantial
18 contributions have made many of our accomplishments
19 possible.

20 With that, I'll look forward to today's
21 discussion, and we'll turn things over to Alan.

22 CHAIR STETKAR: If the green light is not
23 on, you're not on. Push right at the base of the -- keep
24 them off unless you're speaking because --

25 MR. SHORT: Too much noise?

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1 CHAIR STETKAR: Yes, and it bothers
2 transcripts.

3 MR. KURITZKY: Okay. As Kevin said, I'm
4 Alan Kuritzky with the Division of Risk Analysis in the
5 Office of Research, and I echo his sentiments. I
6 appreciate the time and the expertise of the
7 Subcommittee. I look forward to the opportunity to talk
8 to you about what we've accomplished in the last year
9 and what we hope to accomplish in the next year on this
10 project. And as Kevin also said, we've benefitted
11 greatly from our interactions to date with the
12 Subcommittee on this project and expect to continue to
13 do so.

14 With me also up here today is Steve Short
15 and Kevin Anderson from Pacific Northwest National Labs.
16 They were instrumental in running our expert elicitation
17 for ISLOCA, which will be the subject of the presentation
18 after mine. And there will be some other people that
19 will be coming up for the closed session on the Level
20 1 results.

21 Okay. Just to go over what we're going to
22 cover today. I'll start off with the overview, general
23 overview of the project status, what we've accomplished,
24 what we're planning to accomplish in the near future.
25 As I mentioned, we'll have the ISLOCA expert elicitation

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1 also in the open session. There might be some
2 information associated with the ISLOCA presentation
3 that will require discussion in the closed session.

4 Originally, I thought we would have
5 presentations both for the open and closed, but, after
6 looking at the presentation, we were able to check to
7 make sure it had no proprietary information. So we'll
8 make the whole presentation in the open session and only
9 if questions from the members lead us into a closed area
10 where we have to continue in the closed session. We may
11 be able to wrap it up in the open session.

12 Okay. And in the closed session, we'll
13 wrap up anything else on ISLOCA and then move on to our
14 Level 1 internal results. We'll go into the major
15 update that's occurred since the one that we briefed
16 you on probably a year and a half or so ago or two years
17 ago. And as Kevin mentioned, there was a lot of changes
18 based on feedback we got from the ACRS, as well as others.

19 CHAIR STETKAR: The ACRS Subcommittee.

20 MR. KURITZKY: Subcommittee.

21 CHAIR STETKAR: In all of these
22 discussions, remember you haven't received any formal
23 feedback from the ACRS here. It's only individual
24 subcommittee members.

25 MR. KURITZKY: Thank you for the

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1 clarification. Okay. The status of the project right
2 now will go over the different areas of the scope
3 elements. This is the general order that we'll follow,
4 going first with the reactor at-power Level 1 for the
5 various hazards, and then we'll move on to Level 2 and
6 3. We'll talk a little bit about the low-power shutdown
7 work we're doing and then move on to the spent fuel in
8 the pool and in dry cask storage. We'll wrap up
9 integrated site risk and the path forward.

10 I'm going to skip over this slide because
11 it really only applies to the path forward slides, and
12 it will be a little confusing to talk about now. So we'll
13 come back to those definitions later.

14 Okay. So the crux of our model, the core,
15 is the internal event and flood reactor at-power Level
16 1 model. And that one we initially completed and had
17 peer reviewed back in the summer of 2014. However, we
18 had substantial feedback from the PWR Owners Group on
19 that. We had a lot of feedback from members of the ACRS
20 Subcommittee on that model, as well as internal and
21 Technical Advisory Group feedback, etcetera. And so we
22 ended up having to do substantial changes to the Level
23 1 internal event and flood model or models.

24 We refer to them as the, that was the R01
25 model originally. We refer to it as the R02 model now,

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1 which is essentially complete. In the next couple of
2 days, we'll probably wrap that up.

3 We made substantial changes to the event
4 trees, a lot of changes to improve the accuracy and the
5 consistency to the event trees. We had to modify quite
6 a bit of the fault trees. The human reliability
7 analysis, we re-quantified quite a few human error
8 probabilities, as well as identified and incorporated
9 a few new human failure events into the models.

10 The dependency analysis, we've had to re-do
11 the human dependency analysis. And that actually is the
12 one thing that we're still wrapping up. Once that's
13 wrapped up in the next couple of days, we hopefully can
14 put a bow on what we call the R02 version of the internal
15 event model.

16 We've also made some substantial changes
17 to the internal flooding models. Based on a feedback
18 from the peer review, we've kind of re-interpreted, we
19 have a new interpretation of the requirements in the
20 standard for what flood scenarios should be considered
21 significant and, therefore, we've upped the number of
22 internal flood scenarios in the model from 10 to 23.
23 We also have adjusted our initiating event frequencies
24 for the floods to be more consistent with the EPRI
25 approach.

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1 We are currently revising those reports,
2 and they should be completed in the next couple of
3 months. But as I said, the actual model itself should
4 be done in the next couple of days.

5 MEMBER POWERS: I think there are double
6 the number of flooding scenarios. Why?

7 MR. KURITZKY: Not to get into the
8 technical jargon, but there's a definition in the
9 standard about what qualifies as a significant flood
10 scenario and we had a different interpretation of that
11 requirement, which led us to just retain 10 scenarios.
12 But when we had the peer review, they explained what
13 that really was intended to cover, and, using that
14 interpretation, another 13 scenarios met the
15 definition, even though they weren't big contributors.
16 But we now retain them also in the model.

17 MEMBER POWERS: So it didn't change your
18 flooding risk very much, but it made it a more robust
19 analysis?

20 MR. KURITZKY: Right. And the flooding
21 risk did change. I don't know specifically the
22 breakdown how many of those 13 scenarios added versus
23 the change in initiating event frequencies or changes
24 in the internal event model itself that it's based on.
25 But the risk from internal flood was low and it remains

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1 very low. So from an overall risk profile point of view,
2 it's not --

3 MEMBER POWERS: But that's just your idea
4 of the plant as you've got it configured?

5 MR. KURITZKY: Well, that internal flood
6 doesn't add much to the overall risk you mean?

7 MEMBER POWERS: Yes.

8 MR. KURITZKY: Yes, yes, it's just, it's
9 robust against internal flooding.

10 MEMBER POWERS: Yes. I mean, if it was,
11 I've had, like, Catawba units, one didn't have much of
12 a flood risk and one does. I mean --

13 MR. KURITZKY: Right.

14 MEMBER POWERS: -- subtle, subtle things
15 can get you into a lot of trouble with internal flooding.

16 MR. KURITZKY: Right.

17 MEMBER POWERS: So you really want a fairly
18 robust analysis there just because you're looking for
19 peculiarities in plants that might escape people's
20 attention.

21 MR. KURITZKY: Exactly.

22 MEMBER POWERS: Okay. I understand.

23 MR. KURITZKY: And Vogtle doesn't seem to
24 have those vulnerabilities.

25 MEMBER POWERS: Okay.

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1 MR. KURITZKY: Okay. And the last thing we
2 completed on the internal event model was the ISLOCA
3 expert elicitation, which will be the subject of the
4 next presentation.

5 Moving on to internal fires, this is an area
6 where, again, the whole premise of the project was to
7 leverage the peer-reviewed licensee models, like we did
8 with the internal event model. Internal fire, we also
9 had, Southern had prepared or had completed a fire PRA
10 that was peer reviewed, and we were able to make use
11 of it and mapping over their scenarios into our fire
12 event trees.

13 However, after we completed our new fire
14 model based on theirs, Southern had submitted, they had
15 gone through and re-did a lot of their fire model because
16 of feedback they had received on some of the approaches
17 and assumptions in their fire model, particularly
18 dealing with electrical cabinets. A lot of it came out
19 of the NFPA 805 reviews. And even though Vogtle wasn't
20 an NFPA 805 plant, they use a lot of the same techniques.
21 And so they had gone --

22 MEMBER BLEY: Their fire PRA pre-dated the
23 805, right? Or not?

24 MR. KURITZKY: It was the same, it was that
25 generation. Right. So it used those same, it had a lot

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1 of the same issues. So they had gone back, we were not
2 aware, but they had gone back and re-did their fire PRA
3 to get rid of that information. We were struggling with
4 how to adjust our model because we really didn't have
5 the access to the plant or the capability to do a fire
6 PRA from scratch. We were relying on theirs, and theirs
7 had relied on these suspect assumptions and modeling
8 techniques. But in the meantime, they went and re-did
9 it. They resubmitted to us after we had completed our
10 model, and that kind of left us in an uncomfortable
11 position of either going forward with the suspect
12 modeling assumptions and techniques on our own without
13 even the plant having that in theirs or re-doing our
14 whole fire PRA. So we've bitten the bullet, and we're
15 going to re-do the fire PRA to take advantage of the
16 changes that Southern has done in their Vogtle fire PRA.
17 As such, there's going to be a lot of changes, dealing
18 particularly with the electrical cabinet fires in terms
19 of fire growth and spread assumptions and whether or
20 not the fire gets out of the cabinet, how much of the
21 equipment in the room can be damaged, etcetera.

22 We actually went back to the plant in
23 November and had a walk down specifically to look at
24 some of these changes or how they would impact the model,
25 focusing again on the electrical cabinet fire scenarios.

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1 And so we'll determine whether or not we agree with the
2 changes they've made and then go ahead with the remapping
3 of all their fire scenarios into fire event trees in
4 our model.

5 We hope to have that updated fire model
6 completed by the end of the calendar year. That's kind
7 of the longest item that we have for the at-power, the
8 reactor at-power models.

9 For seismic events, we're kind of in a
10 similar situation there, too. When we started this
11 project, we did not have a seismic PRA from Vogtle, from
12 the licensee. They had not completed one yet, though
13 they were working on one. So while we got some
14 information from them on the seismic PRA, we didn't
15 actually have a completed model or documentation from
16 them.

17 So we initially built all of our seismic
18 PRA akin to what we do for the SPAR all-hazard models.
19 And so we used that. We incorporated the seismic
20 fragility and hazard information that we got from
21 Southern Nuclear into our model. However, again, once
22 we completed our initial model but before we had the
23 peer review, Southern had their fire PRA, their seismic
24 PRA peer reviewed, and then submitted us, the
25 results -- well, first, they submitted the full model

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1 documentation that they went for peer review, so we got
2 that. So we already knew we wanted to update our model
3 to account for that new information. But since we were
4 waiting for our internal event model to be revised, we
5 were holding off on that. And in the meantime, that was
6 in December '14 they gave us the information they sent
7 for peer review. Then in October of '15 they sent us
8 new information because now they have incorporated all
9 the peer review comments that they received on their
10 seismic PRA and, again, updated the seismic hazard,
11 updated the fragilities, so there was a lot of changes
12 again that they made. They submitted that to us this
13 past October, and that's going to be the basis of what
14 we're going to include in our revised seismic PRA model.

15 MEMBER BLEY: Can you give us a few hints
16 of that? Did they do some plant-specific fragility
17 analysis?

18 MR. KURITZKY: Yes, yes, they definitely
19 did a lot of that. In fact, we just got a new
20 plant-specific fragility notebook from them yesterday
21 actually, Federal Express yesterday. And that will
22 form the basis for what we're going to incorporate into
23 our model.

24 The one thing also, besides the new hazard
25 information and the new fragility information is,

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1 because we based ours initially on our SPAR all-hazard
2 models, a more simplified seismic model. Now that we
3 have their PRA, we see there's a number of things that
4 they've addressed that we did not include in our initial
5 model that we may want to add in. So we're going to look
6 into those to see what else we might want to incorporate
7 in our model. One example will be seismically-induced
8 flooding. The new PRA from Southern includes that, and
9 our initial model did not, so we'll look into whether
10 we can add stuff into our model to incorporate
11 seismically-induced flooding.

12 MEMBER BLEY: Did you or they look at
13 seismically-induced fires?

14 MR. KURITZKY: I don't think that's
15 included in there. I know in our project we ruled that
16 out as scope, and it's being done --

17 MEMBER BLEY: Okay. So you didn't look at
18 all?

19 MEMBER POWERS: Why was it ruled out of
20 scope? I don't understand that.

21 MR. KURITZKY: Because the
22 seismically-induced fire, both seismically-induced
23 fire and flooding were things that were called out to
24 be in the project as active topics for consideration.
25 But because we're doing a state of practice PRA and we

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1 did not have a solid handle in how that should be
2 incorporated into the model, we put that out of scope.
3 And a separate project was started in research to address
4 seismically-induced fires and floods, so there's a
5 parallel effort that's looking specifically into those
6 issues. And we did not to include seismically-induced
7 floods in our model for the same reason, but since the
8 new seismic PRA from Southern has seismically-induced
9 floods included in it, we felt, well, if we can see what
10 they did and we understand it and agree with it, then
11 we would be comfortable putting that into our model also.

12 MEMBER BLEY: Will the seismically-induced
13 fires be an update on this PRA, or is it just a completely
14 separate project?

15 MR. KURITZKY: Not as part of this project.
16 This project is going to have a laundry list --

17 MEMBER BLEY: So that other project is not
18 going to look at this plan?

19 MR. KURITZKY: What's that?

20 MEMBER BLEY: The other project on
21 seismically-induced --

22 MR. KURITZKY: No, no, no, it's not looking
23 at this --

24 MEMBER BLEY: Not looking at this plan.
25 Okay. So this will be a whole . . .

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1 MR. COYNE: Just to clarify, so under NTTF
2 Recommendation 3, research had a task to look at
3 seismically-induced fires and floods. That was binned
4 as a Tier 3 item to look at what enhancements licensees
5 could make to make their plants more robust. I'm sorry.
6 Kevin Coyne, research staff.

7 We also had a Tier 1 portion of that item
8 to develop a PRA methodology. So the Commission
9 directed us to have a Tier 1 portion of NTTF
10 Recommendation 3. We had spent several years working
11 on developing a PRA method. Brookhaven National Lab
12 assisted us in that. We had gotten as far, in December,
13 as completing a fairly robust feasibility study to lay
14 out what a method would look like and what some of the
15 gaps remaining are.

16 That particular issue got caught up in the
17 NRR JLD's effort to sunset many of the Tier 2 and 3 items
18 so that Tier 3 portion was closed with Commission
19 approval without further action. So we've issued the
20 feasibility report, but we don't intend to do any further
21 research activities on seismically-induced fires and
22 floods.

23 CHAIR STETKAR: As a member of the
24 subcommittee, I'm going to say we're going to follow
25 that. Be prepared. We're going to plan to have, we'd

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1 like to have a subcommittee meeting that addresses the
2 issue of seismically-induced fires and floods. We
3 haven't seen the Brookhaven study. We thought that, we
4 held off because we thought that the staff was going
5 to prepare a review and a path forward on that.
6 Apparently, that's not going to happen.

7 We know also that EPRI is doing work in this
8 area for the industry. So I think the subcommittee is
9 pretty interested in hearing about that topic. We can
10 talk offline in terms of arranging a date for a
11 subcommittee meeting.

12 MR. COYNE: Yes, and we'd be happy to share.
13 We'll get that to John Lai, the result of the Brookhaven
14 study. But right now we have no resources or direction
15 to continue work in that area.

16 CHAIR STETKAR: Okay. We'll have to work
17 that out.

18 MEMBER POWERS: That seems a problem if
19 they don't have resources or charter. Maybe we should
20 make that fairly explicit in our research report. I
21 mean, it's an issue. If I didn't have pictures of the
22 seismically-induced fire in Japan, I could say, okay,
23 well, maybe they don't occur. But now I explicitly know
24 they do, in fact, occur.

25 CHAIR STETKAR: I'd be interested to see

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1 what Brookhaven did because, as I said, the subcommittee
2 hasn't received that report yet. Particularly, I have
3 a copy of it, but I haven't read it yet because I'm
4 pressed for time typically. But I think it would be very
5 worthwhile to see what Brookhaven concluded in terms
6 of -- I don't even know what they addressed, methods
7 or data. I have no idea. I --

8 MEMBER POWERS: It would be interesting to
9 see what the database is.

10 CHAIR STETKAR: Well, yes. And it's also,
11 as I said, I know that EPRI has produced a report on
12 seismically-induced fires and floods also. That is a
13 proprietary report. It's not available publicly. And
14 they have -- I'll be careful here because we're in open
15 session. They've tried to address the issue; let me
16 just say that.

17 So I think it would be useful for the
18 subcommittee if we could hear from the staff. And I
19 realize resources are a concern, even to support a
20 subcommittee meeting, but hear from the staff and
21 Brookhaven on what they've done and, if possible, from
22 EPRI on what they've done, what their path forward might
23 be.

24 MEMBER POWERS: Well, I think we ought to
25 make our interest known to those that control resources

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1 and direction. We can't create bodies. I mean, you can
2 have an infinite amount of resources. If you don't have
3 bodies to carry it out, they won't be any good. But this
4 is an issue that's been sitting around for a long, long
5 time. I mean, I can remember not too much anymore or
6 less and less, but I can definitely remember people
7 asking about seismically-induced fires 20 years ago.

8 CHAIR STETKAR: Anyway, that's, as Alan
9 correctly stated on the record, that's out of the scope
10 of the current study and, because of resources, there's
11 absolutely no plans to address it even in an update.

12 MEMBER POWERS: So do you intend to change
13 the title of the view graphs to say full scope except
14 for it's not?

15 MR. KURITZKY: No, I don't. Actually, if
16 you look at the project plan, we do call out a number
17 of areas that were not addressed, and we have an initial
18 project plan that does call out things. Offline, as Dr.
19 Powers and I were discussing earlier, digital I&C was
20 one that is out of scope, as well as seismically-induced
21 fires.

22 MEMBER POWERS: Well, the digital I&C is
23 going to cause undue amounts of --

24 MR. KURITZKY: Headaches.

25 MEMBER POWERS: -- headaches because, I

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1 mean, it's a fictitious plant about digital I&C.

2 MR. KURITZKY: Right. Okay. Moving on,
3 the seismic events, going back to what I was mentioning
4 about the information we got from the licensee, so we
5 got a full report and model in December. We got an
6 updated -- in December '14. We got an updated model in
7 October of '15. The updated model is the one we're
8 basing it on, but we don't have an updated report that
9 goes with that model. That is not going to be prepared
10 by SNC until probably closer to early 2017 in response
11 to one of the NTTF recommendations.

12 So we're kind of flying blind a little bit.
13 We can pull information out of the model, but we don't
14 often have the basis or justification for why things
15 are treated a certain way. So in some cases, if we can't
16 understand why something is a certain way, we may have
17 to make simplifying assumptions in our model because
18 we have to be able to defend whatever is in our model.
19 So if we can't feel comfortable defending what they have
20 in their model, we may have to change it to something
21 that we can be more comfortable with.

22 One example is the relay chatter issue.
23 They're re-looking at the relay chatter. We do not have
24 the resources to do a full relay chatter analysis, so
25 we're going to have to figure something out on how to

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1 address that in our model. The final revised seismic
2 model we hope to have ready in the late summertime.

3 Moving on to the IPEEE language was the
4 HFOs, the high winds, floods, and other hazards. Here
5 we've kind of broken out high winds from the other
6 hazards because we actually have the PRA model for high
7 winds. We do not have a PRA model for the other hazards.
8 Those all have been screened out through a qualitative
9 analysis or semi-quantitative semi-qualitative
10 analysis.

11 We did complete the peer review, had an
12 ASME/ANS PRA standards-based review led by the PWR
13 Owners Group completed in November of 2014 on both the
14 high wind PRA we had, as well as our other hazards
15 screening analysis. We're currently in the process of
16 updating those analyses based on the feedback from the
17 PWR Owners Group-led peer review from ACRS, the
18 Technical Advisory Group and external and internal
19 feedback.

20 One of the comments we did get back on the
21 high wind PRA was that we didn't appear to have a very
22 strong walk down focused on high winds because we had
23 a seismic team just take a look at them. So since that
24 time, we actually contracted out with Applied Research
25 Associates, which is one of the preeminent high wind

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1 PRA companies in the country, and they actually went
2 down in November of this past year and did a walk down
3 focused on high winds for us. We're currently reviewing
4 their trip report and recommendation to determine what,
5 if any, additional analysis we may want to pursue.

6 And so, in general, we hope that by fall,
7 September 2016, we'll have the revised documentation,
8 as well as any additional analyses that are needed for
9 the high wind PRA model and the screening analyses for
10 the other hazards. A couple of the other hazards that
11 we're still --

12 MEMBER BLEY: Before you go on, you're
13 looking at both tornados and hurricane?

14 MR. KURITZKY: Tornados, hurricanes, and
15 straight-line high winds, thunderstorm winds. And a
16 couple of things in the other hazards that are getting
17 some focus from us right now particularly are external
18 flooding. We're looking at the external flooding,
19 particularly the probable maximum precipitation issue,
20 and also the accidental aircraft crash. We're
21 re-looking at some of the aircraft crash screening
22 numbers because, based on some new information, we're
23 not sure that they screen out as easily as we felt
24 initially, and so we may have to sharpen the pencil a
25 little bit in terms of size of aircraft and speeds,

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1 etcetera, to see if that will still screen out
2 appropriately.

3 Moving on to Level 2, we completed the
4 standards-based peer review for that in December of 2014
5 and we're working on incorporating the feedback from
6 that peer review, as well as, again, from the ACRS, TAG,
7 external and internal feedback.

8 There are a number of things that are going
9 to change significantly in that Level 2 external and
10 internal flood model, particularly the overhaul of the
11 plant damage state binning, primarily because we've
12 changed so much in the Level 1 model, so that is affecting
13 the plant damage state binning that we had done
14 originally.

15 We also had made a lot of changes to the
16 MELCOR model and also some of the boundary conditions
17 for some of the calculations. So we've re-run all the
18 MELCOR analyses, and, because of all those re-run MELCOR
19 analyses and other internal and external feedback, we're
20 going to have to do a re-scrub of the containment event
21 tree and a lot of the issues therein to see whether or
22 not things have to change. And we hope to have that
23 updated model completed in the summertime.

24 MEMBER BLEY: We'll be hearing about that?

25 MR. KURITZKY: You'll hear about

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1 everything you'd like to hear about.

2 MEMBER BLEY: Okay. I assume that would be
3 more toward the fall then?

4 MR. KURITZKY: Yes. We'll generally be
5 coming to see the subcommittee a couple of times a year.
6 This last year, because of schedule --

7 MEMBER BLEY: I understand.

8 MR. KURITZKY: -- snafus -- so we'll
9 probably be back in the fall, you know, late fall time
10 frame. So whatever we have at that time we usually pass
11 to you and then we'll discuss it. In fact, depending
12 on what we have, it will probably be a full day meeting.
13 If you have enough topics, generally, we have a full-day
14 meeting. So, certainly, you'll hear about it.

15 Moving on to Level 3, that peer review was
16 just completed in October of this past year. And there,
17 again, we have feedback that we are going to incorporate
18 from that peer review, as well as others. We're kind
19 of moving on that slowly, primarily because we are
20 waiting for the updated results from the Level 2. So
21 we at least have to have interim results on an updated
22 Level 2 before you dive into the Level 3 update.

23 But there are some things we already know
24 that we're going to be changing. One thing is, in the
25 initial model, we had a cohort for the Unit 3 and Unit

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1 4 construction workers. One of our going-in conditions
2 for this study was that Units 3 and 4 don't exist, and
3 so we kind of feel that, well, if Units 3 and 4 don't
4 exist, those construction workers don't exist either,
5 so we're going to actually take that cohort out of the
6 analysis for the next go-around.

7 Also, based on the peer review feedback,
8 we're going to make some changes to our protective action
9 models. And also there are some newer decontamination
10 parameters that we're going to use in the new version.

11 So, anyway, all that will get wrapped up
12 into the new Level 3 internal and external flood model
13 that we hope to complete and be ready to share in November
14 of this year.

15 Moving from at-power to low-power and
16 shutdown. For low-power and shutdown, the licensee did
17 not have a model, so we are building our low-power
18 shutdown model from scratch. Southern Nuclear did
19 start a model some years back with a contractor before
20 they aborted it, and they were able to provide us the
21 information that the contractor had completed up to that
22 time, which was primarily plant operating state
23 definitions and initiating event listings. That
24 information was very valuable to us, and it gave us a
25 good starting point.

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1 We have now completed our identification
2 of plant operating states and initiating events that
3 we're going to consider in our model. Our main focus
4 is going to be on loss of RHR, loss of inventory, and
5 loss of off-site power. Those are the main three
6 categories we're looking at, at least initially.

7 We've already completed several of the
8 event trees. We're in the process of completing the
9 rest of them. There's a number of them because you have
10 different initiating events and the different operator
11 states, so you have quite a number of event trees to
12 look at.

13 We are doing kind of a prioritized, you
14 know, experientially judgmental scheme to pick which
15 ones to analyze because if you took all the possible
16 initiating event possibilities and all the operating
17 states, you would end up with a model that was just beyond
18 our resources to deal with right now. So we're trying
19 to be smart about what we're looking at.

20 CHAIR STETKAR: Trying to be smart based on
21 what?

22 MR. KURITZKY: On previous low-power
23 shutdown PRAs --

24 CHAIR STETKAR: That's interesting --

25 MR. KURITZKY: -- and what they do in their

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1 operating, you know, their outages.

2 CHAIR STETKAR: The second would be more
3 important than the first because the first, in my
4 experience, everybody has become mid-LOOP-centric, and
5 that's the only thing that's important. I don't know
6 how Vogtle organizes their outages. A lot of plants try
7 to stay away from mid-LOOP operation with fuel in the
8 reactor. My experience from seeing other PRAs that have
9 looked at all plant operating states, sometimes the risk
10 is surprising because of the way, what they do during
11 particular plant operating states and things that other
12 people hadn't thought about might be important for a
13 particular plant. So be careful about looking only at
14 previous studies.

15 MR. KURITZKY: We appreciate the caution.
16 In fact, at Vogtle, they do have, they look at operation
17 with fuel. The time frame was not very large, but it's
18 there. But we are looking well beyond that. Your
19 caution is well noted. I mean, we are looking at past
20 studies because there's information to glean from them,
21 but that's not what we're focusing --

22 CHAIR STETKAR: Alan, I really do hate to
23 throw monkey wrenches into this, so just maybe take it
24 as a question. How are you addressing human-induced
25 initiating events because of, for example, operational

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1 or testing or maintenance activities that are done? At
2 least operational and testing are typically
3 orchestrated as part of the outage plan. Maintenance
4 is more of amorphous type of activity, but operational
5 and testing activities, you know, operators are supposed
6 to line up a system by closing valve X and opening valve
7 Y and, occasionally, they do it in reverse order and
8 put water in places that it ought not to be. That's also
9 a very, very plant-specific contribution to risk because
10 it's part of that matrix of what's done as a function
11 of where you are in the outage. Are you trying to address
12 that at all?

13 MR. KURITZKY: Yes, I can't give you a lot
14 of details. I can bring Jeff Wood up. But, basically,
15 that's part of our initiating event database, looking
16 at operator actions that lead to human-induced loss of
17 inventory. That is definitely within scope, and we are
18 addressing that.

19 CHAIR STETKAR: Not only inventory but also
20 power things. I mean, I tell the sea stories. Every
21 outage, we always lose power because, when they did a
22 certain test, they always dropped a DC bus. Nobody
23 could figure out why. It just always happened. You
24 know, if you can't figure out why, at least do the test
25 during plant configuration when dropping the DC bus

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1 might be less important to risk than the more important
2 to risk. So that type of thing is what I'm talking about.

3 MR. KURITZKY: Yes, I can't specifically to
4 that issue. I've noted it and, again, you know, as part
5 of our study, we'll be aware of --

6 CHAIR STETKAR: Okay, good.

7 MR. KURITZKY: Okay. So in addition to the
8 event trees that we're working on, we also are having
9 Idaho National Lab look at the failure events in the
10 shutdown, you know, at shutdown conditions to help us
11 come up with initiating event frequencies.

12 Also, because human reliability issues are
13 so important for low-power shutdown PRAs, as you just
14 mentioned, we are looking into how we're going to
15 approach the HRA. I think right now our current
16 thinking is to use SPAR-H to do an initial quantification
17 of all the events because we have limited resources,
18 we have limited access to the plant, so we use it as
19 kind of like a screening approach. And in those events,
20 those human failure events that look like they're
21 important to the study will get a more rigorous analysis.
22 So kind of a two-stage approach. We're hoping to have
23 the initial model for low-power shutdown for internal
24 events, internal events only, completed and documented
25 by August of 2016.

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1 Moving out of the reactor space into spent
2 fuel, specifically spent fuel pool, unfortunately
3 that's one area where we have not made a lot of progress
4 since we briefed the subcommittee approximately a year
5 ago, primarily because staff availability is very
6 limited for that work. There have been competing
7 priorities that have kept the key staff in that area
8 of the study busy elsewhere. We have made some
9 incremental progress. In particular, for seismic
10 events, we've actually developed all the event trees
11 for the seismic, essentially for all the seismic events
12 we're going to consider, both seismic events and the
13 various spent fuel pool operating states. That
14 combination of event trees are complete.

15 We're also working on, actively working on
16 the fault tree and system notebook for the spent fuel
17 pool cooling and purification system. We've done some
18 analysis to come up with the temperatures that the pool
19 line and structure would see given a zirc fire. We're
20 also working on the MELCOR model for the two pools
21 simultaneously. If you recall from presentations we
22 did in the past at Vogtle, the Unit 1 and Unit 2 pools
23 are almost always thermohydraulically connected
24 through the cask bin area, so we're modeling them as
25 one big single pool.

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1 In contrast to the spent fuel pool, the dry
2 cask storage PRA, we actually have made substantial
3 progress in the last year. We're getting very close to
4 wrapping that analysis up. Through interviews with the
5 operators at the site and review of procedures, we have
6 used THERP to complete the human reliability analysis
7 for the vertical cask transporter crane. We also did
8 an analysis of the frequency of an earthquake causing
9 a cask to get knocked over, which we have determined
10 is not very significant.

11 We completed a hazard and operability
12 study, a HAZOP analysis, for the site, and from that
13 we identified one scenario that had not been previously
14 identified that we're including. That's a situation
15 where, in the cask wash-down area, where a cask would
16 drop and then tip over in the wash-down area.

17 MEMBER BALLINGER: As a point of curiosity,
18 when you did the earthquake analysis to see if it would
19 knock over a cask, did you ever decide how big an
20 earthquake it would take to knock over a cask?

21 MR. KURITZKY: Yes, that's, obviously -- we
22 have a probability for it knocking over, so we have --

23 MEMBER BALLINGER: Okay.

24 MR. KURITZKY: -- earthquakes we looked at.

25 MEMBER BALLINGER: I didn't get that much

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1 detail.

2 MR. KURITZKY: So some knock it over and
3 some don't, and there's a frequency associated. The
4 frequency associated with those big enough to knock it
5 over is low enough that it doesn't make a large
6 contribution.

7 MEMBER BALLINGER: I would hope so.

8 CHAIR STETKAR: I suspect the stuff inside
9 the plant is probably not real happy at that frequency.

10 MR. KURITZKY: Yes, there's a lot of other
11 concerns to be dealt with. That's right. Okay.
12 There's a number of things on the list here that we're
13 still working to wrap up. Many of them are very close
14 to being done, if not essentially done already.

15 First, the structural performance.
16 Pacific Northwest National Lab is doing the performance
17 of the multi-purpose canister and the fuel. That's
18 essentially done. The problem there is it's 95 percent
19 of the way done, but we've run into a contract issue
20 with the umbrella contract that this work is a piece
21 of, and that, unfortunately, is probably going to be
22 the critical path item for getting this work done because
23 that's probably -- all the other work will be done long
24 before that contract issue gets resolved for that last
25 little piece. But it is what it is.

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1 We're wrapping up our evaluation of the vent
2 blockage scenario. We've also essentially completed
3 our crane reliability analysis and the support systems
4 analyses.

5 One thing we're re-evaluating, again, the
6 aircraft impact analysis. Just like we are for the
7 reactor, we're re-evaluating it for the dry cask
8 storage. One of the main reasons is we've discovered
9 that the physical location of the pads and the
10 arrangement isn't quite what we thought originally. We
11 actually saw in a Google Earth picture that the pads
12 weren't exactly what we originally had thought, and so
13 now we're having to -- the shielding is a little bit
14 different in terms of aircraft pathways, etcetera. So
15 we have to kind of re-look into that.

16 The source term analysis, we haven't really
17 done much in that. But, actually, our thinking right
18 now is we'll probably end up using the conservative
19 source terms from NUREG-1864, the previous NRC's dry
20 cask storage PRA, because I think we can use those source
21 terms without taking much of a hit. And only if it
22 becomes an issue would we re-consider doing anything
23 different.

24 We hope to have all the, the Level 1, 2,
25 and 3 dry cask storage all done completely -- yes?

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1 MEMBER POWERS: How do you decide what a
2 conservative source term is?

3 MR. KURITZKY: Well, I think, and I'm not
4 expert on this, but in NUREG-1864 they did some analysis
5 of the fuel, which I think is the same type of fuel that
6 we have in our study. But then at the end, they decide
7 to use a value that was well above some of the source
8 terms that they calculated just for convenience. And
9 so we'll be using those same --

10 MEMBER POWERS: I always get interested
11 when somebody says calculated source terms because,
12 typically, we can only calculate well those things that
13 we measure. And the measurement data for pertinent
14 source terms here strikes me as a bit thin.

15 MR. KURITZKY: I cannot speak to the
16 robustness of the calculations that we've done in 1864.
17 If we had our, that's something our consequence analysis
18 individual or source term people or dry cask storage
19 people might be able to offer more. Actually, one of
20 them is about to walk to the microphone, Keith Compton?

21 MR. COMPTON: This is Keith Compton, Office
22 of Research. Yes, one of the things in NUREG-1864 is
23 that they calculate kind of a, they come up with a model
24 for estimating the release from the cask. Is this -- can
25 you hear me? They come up with a model for estimating

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1 the release from the cask, but then the result that was
2 actually used set a number of parameters kind of at their
3 maximum value, such that it was trying to maximize the
4 release fraction coming from the cask. And when you
5 look at the numbers that actually come out of it and
6 calculate the fraction of inventory that is in the cask,
7 it was quite high. So that's the -- I'm generally
8 cautious about the more conservative, but, in this case,
9 it does seem to be a fairly --

10 MEMBER POWERS: I mean, it causes pause
11 because my brethren who pray at the alter of PRA assure
12 me in no uncertain terms that this is all realistic,
13 and so here we do things very conservatively. We'll
14 leave that one aside, and we'll come to, again, you can
15 calculate only those things that we measure -- we can
16 calculate well only those things that we've measured
17 well. And so what you're putting into these event
18 pathways for your release analysis is the question I
19 have. The database available for pertinent source
20 terms here strikes me as a bit thin, and so how do I
21 do a calculation for the input that you give conservative
22 release fractions of or escape fractions of? How do I
23 do that well?

24 MR. COMPTON: Again, I don't want to speak
25 for the people that will be generating the source term,

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1 but I think it is fair that some of the information was
2 not terribly, was somewhat thin to kind of validate and
3 to test that kind of model. So we'd have to look at it
4 and just try to get an understanding.

5 I know from the consequence side, I can
6 speak more to the consequence side, we can get a sense
7 of, you know, how would it change if you, you know, if
8 the source term was kind of set as a very large value
9 or if I dropped the release fraction by a factor of ten
10 or a hundred or whatever it was and made some statement
11 about, you know, where am I? So I might not be able to
12 say this is what the risk is, but I might be able to
13 make, have enough information to say, well, if I did
14 do it better, I might be able to, you know, it might
15 be done in this kind of range and then, given that, and
16 in light of consideration of the reactor risk and other
17 things, I can draw some insights. That's all I can
18 really say --

19 MEMBER POWERS: I understand where you're
20 coming from. Maybe I'll turn to John and ask him should
21 I look at this 1764 for you?

22 CHAIR STETKAR: Yes, sure.

23 MEMBER POWERS: You want me to look at that?

24 CHAIR STETKAR: Yes, yes. Part of what
25 we're doing here, as Alan mentioned, this project is

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1 so big that several of us have sort of taken it upon
2 ourselves to provide input to the subcommittee, as we
3 do often. So I think that would be really useful.

4 MEMBER POWERS: Well, maybe I could look at
5 that and try to generate something that would be useful
6 to them.

7 CHAIR STETKAR: Yes.

8 MEMBER POWERS: I mean, at the very least,
9 I pay attention to this kind of stuff for reasons that
10 probably reflect a bad upbringing. But it might be of
11 interest just to know where we stand in this area because
12 these things are very difficult to do in this particular
13 situation, once you're worried about them, is what the
14 hell does the iodine do, what does the tellurium do,
15 and what are the particle size distributions, and then
16 you can put the escape fractions and things like that
17 anyway you want to. But if you get the particle size
18 distribution too big, it all falls out on the ground
19 and kills firefighters. If it gets too fine, then it
20 gets dispersed out and kills seagulls. In between, more
21 hazardous things occur.

22 CHAIR STETKAR: Yes, I certainly would
23 appreciate that.

24 MEMBER POWERS: But if you can get the
25 NUREG, I'd look it over and at least --

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1 CHAIR STETKAR: We've done it in other
2 areas. Alan has mentioned it, and we've done it in other
3 areas where individuals on a subcommittee have sort of
4 looked in more depth at particular issues and written
5 up a little bit of prepared information.

6 MEMBER BLEY: I think the other thing that
7 you've talked about before, Dana, is what appears to
8 be conservative, many of us, when you look at the
9 detailed chemistry, it might not go that way or might,
10 different reactions --

11 MEMBER POWERS: There is pertinent
12 literature. It actually comes out of transportation
13 cask kinds of things where they've done studies on leaks.
14 Most of them were done back in the 80s, and there was
15 some nice work done in Great Britain actually that's
16 pertinent here. Unfortunately, the author of that
17 work, apparently it was so difficult, it drove him over
18 the wall and he escaped to Canada and is writing the
19 great American novel or the great Canadian novel or
20 something like that. And then Canada squared off the
21 part he was living in, and so he's living like an Eskimo
22 or something like that.

23 CHAIR STETKAR: Risk assessment will do
24 that to people. I need to be a little bit more cognizant
25 of time, so let's let Alan see if he can --

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1 MEMBER POWERS: It is Alan's fault. It is
2 not yours.

3 CHAIR STETKAR: Somebody has got to be
4 responsible.

5 MR. KURITZKY: Okay. The last item we're
6 going to cover is the integrated site PRA. We've made
7 some headway on that. In the last year or so, we've
8 developed an integrated site operating configuration
9 matrix, SOC. That's actually not much different than
10 what we presented to the subcommittee a couple of years,
11 what we called then the joint plant operating state
12 matrix. Now it's site operating configuration matrix.
13 The only real difference between that version and I think
14 the version that we have now is the durations of the
15 SOCs have changed based on newer information, but,
16 essentially, it's a similar type of thing.

17 One of the big things we have completed,
18 though, in the meantime is the integrated site
19 dependency matrix. That's a crucial item because it's
20 really the dependencies between the various
21 radiological sources that are going to drive the
22 multi-source issues, and so we have combined and
23 consolidated dependency analysis frameworks from
24 various sources together to come up with this matrix.
25 We've looked at stuff that's in the PRA procedures guide,

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1 that's in, for instance, the Seabrook multi-unit PRA,
2 emerging peer-reviewed literature, also draft and trial
3 use standards that address multi-unit issues. So all
4 that information we've used to come up with this.

5 MEMBER BLEY: I don't think we've seen
6 that, right?

7 MR. KURITZKY: No, that was just something
8 that we've just been working on.

9 MEMBER BLEY: Okay. That would be very
10 interesting. Okay.

11 MR. KURITZKY: Yes. And the next time we
12 come to you, that should be more baked and we might be
13 able to give -- in fact, I'll make a note of that. Okay.
14 And so that's one thing we've done.

15 Another thing, we've started taking a look
16 at the single-source PRA models, particularly the
17 updated Level 1 external and internal flood model that
18 we've just recently completed. So our contractor and
19 our lead there is taking a look at the insights from
20 that, identify what are the dominant contributors, what
21 are the dependencies that are driving things in that
22 model.

23 From a Level 2 and Level 3 side right now,
24 we're kind of looking at them qualitatively because we
25 haven't updated those models yet. But we're using

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1 consideration to those aspects also to try and, at least
2 from the initial point of view, focus down a lot on the
3 most important things. We're never going to be able to
4 do a soup to nuts integrated site risk model, so we have
5 to kind of focus on what things we think are going to
6 be the most important, primarily looking at the
7 single-source results and looking at the dependency
8 matrix and things like that. So that's where we're
9 going with the integrated site PRA.

10 So that brings us to the path forward. Now
11 I'm going to go back and talk to you about the slide
12 I skipped over before because the terminology in that
13 slide only applies to this slide and is opposite to
14 terminology elsewhere.

15 What I tried to do in that slide was I refer
16 to the models in three different ways. I talk about
17 initial models, updated models, and revised models on
18 this slide. And so what I wanted just for
19 clarification, the initial model we talk about, when
20 I refer to that, it's the model that we first do that's
21 going to get peer reviewed. It's the initial model, the
22 first one we do, and it goes under peer review.

23 Once we get the peer review comments and
24 the comments from the ACRS and TAG, etcetera, we do an
25 updated model. So it's really the initial model and the

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1 updated model. However, as I discussed earlier, there
2 are a couple of cases, particularly the fire and seismic,
3 where we did the initial model before we had it peer
4 reviewed. We got a huge amount of new information that
5 totally changes the model, so we have to revise that
6 model before we can even do the peer review. So that's
7 why I talk about revised model.

8 So I have the three different terms in this
9 slide. Just to differentiate between them, I use those
10 definitions.

11 So in terms of revised models, like I said,
12 the seismic and the fire, we hope to have the revised
13 seismic model done August - September 2016, the revised
14 fire by the end of the calendar year. We hope to have
15 the updated Level 2 and Level 3 models for internal
16 floods completed in July and in November respectively,
17 and we hope to have the initial dry cask storage model
18 and the low-power shutdown Level 1 model for internal
19 events completed both around the August time frame.

20 So those are the things that we're looking
21 forward to getting accomplished today. And so that goes
22 back to what Kevin said that we expect 2016 to be a big
23 production year, and we're hoping to have all of these
24 things accomplished before the end of the year.

25 Moving forward, we also continue to work

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1 with the PWR Owners Group to have standards-based peer
2 reviews. And so there's several that we hope to have
3 held this calendar year: the dry cask storage model in
4 September, the low-power shutdown Level 1 internal event
5 model in October, and then the seismic PRA model in
6 December. The fire model will be the following year.

7 And I would be remiss if I didn't mention
8 again the various challenges that we've run across in
9 this project that are putting pressure on our schedule.
10 The diversion of key staff has been one. Since the
11 beginning of the project, that's always been an issue.
12 I mean, obviously, there's a limited number of PRA staff
13 here. There's a lot of high-priority work that has to
14 be addressed, and so staff has to balance all these
15 things. We don't have a dedicated staff just to this
16 project, so they're going to have to split their time
17 and essentially get what we can. So that's obviously
18 a major issue on the schedule.

19 The other thing, conversion and ownership
20 of the licensee's models. The conversion was a thing
21 that took more effort than we thought, more time than
22 we thought, switching from CAPTA to SAPHIRE. But really
23 the biggest issue has been the ownership issue. You
24 know, we realized initially going in that we thought
25 we'd be able to leverage the licensee's peer-reviewed

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1 models with doing some minor work, and they'd become
2 our models. Then we realized that we really have to
3 defend everything in there, and the more we got comments
4 on things and looked into the models, the more we found
5 things that we didn't understand, we couldn't defend,
6 and we felt we needed a change. And so more and more
7 of the models have been changing and changing, and they
8 say --

9 MEMBER POWERS: Other people's models you
10 just don't mess with.

11 MR. KURITZKY: That's obviously a lessons
12 learned. It's a real big issue if you're going to try
13 to take over someone else's models.

14 CHAIR STETKAR: That's an important
15 lesson, though, an important message also to other
16 people, not so much in the United States, but I've seen
17 a lot of people around the world saying I'm going to
18 take the, pick the plant, you know, design model or the
19 Surry model and fluff it up a little bit because I have
20 a PWR and, yes, mine looks a little different, but this
21 is my risk assessment. And your experience says that,
22 even if you're looking at the same facility, you have
23 to own your own model of that facility.

24 MR. KURITZKY: And I think that's an
25 important point. Any time that an agent is going to rely

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1 on models that they didn't develop themselves, they have
2 to keep that in mind because it's not a slam dunk.
3 There's a lot of work involved, and there's a lot of
4 things that we're not going to understand unless we
5 really dig into those models.

6 As we saw, Southern Nuclear, which I was
7 going to get to in the acknowledgments, I mean, they
8 have been a tremendous support to us on this project.
9 They have put huge resources in supporting us. They've
10 provided us tremendous amount of information,
11 tremendous access to the site, probably terabytes of
12 information on our SharePoint site that they've provided
13 us for us to go through with this model, and still we
14 have this problem. So, you know, if you're going to use
15 a licensee's model, it's a major undertaking.

16 So that's one thing. And the last one I
17 just wanted to mention under the challenges was the
18 Southern's active PRA program for Vogtle, which actually
19 is a good thing. The updates of their internal event
20 and their fire, the seismic, this is a very good thing
21 for them and their plant, and it's a good thing for us.
22 We get newer information. So for the realism and the
23 accuracy of our models, that's good. But from a project
24 management and schedule point of view, it's a real
25 headache because there's only so much we can keep chasing

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1 our tail and re-doing things. So we kind of have to draw
2 a line, which we have in many cases, but, as I discussed
3 in the fire and seismic, the changes were so major that
4 we really had to go ahead and make corresponding changes.

5 CHAIR STETKAR: But that's all. And I
6 think we raised that two or three years ago that,
7 regardless of the project or who's doing the risk
8 assessment, of necessity, you have to set a freeze date.
9 You have to, at this moment in time, our models are based
10 on the following information, and there's engineers and
11 it's always tempting to say, well, yes, but I just
12 learned something and I need to go perturb something.
13 And that has a, as you know, a terrible compound effect
14 down the road.

15 MR. KURITZKY: Yes, it does.

16 CHAIR STETKAR: Yes, it does. So it's time
17 to draw the line in the sand, Alan, because next week
18 when they change the fire model a little bit more, you
19 know, it's --

20 MR. KURITZKY: Right. So I think, as a
21 point I was making, that, from a physical point of view,
22 there's physical things at the plant, we've kind of drawn
23 a line, a freeze date. And so if they make changes to
24 RCP seals or other things, they're just not going to
25 be part of this model.

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1 In the case of this where it's more of a
2 knowledge thing, there's nothing I really change in the
3 plant. It's how something is analyzed or what our
4 knowledge of what the plant was that has changed.
5 Again, if the change is not major, we just put it on
6 a list and say this is something that, for an update -- or
7 keep in mind this is no longer accurate. But if the
8 change is major enough that it would totally re-do or
9 invalidate the work we've done, then it's a tougher
10 decision just to hang it up on the wall.

11 MEMBER POWERS: Alan, you've experienced a
12 variety of perturbations that have caused you, the
13 cascade. Nothing in the PRA gets completely
14 compartmentalized. Have you identified aspects of this
15 effort that would be very useful to have automated so
16 that when you have one of these perturbations occur over
17 here the cascading effect can all be done automatically?

18 MR. KURITZKY: I mean, it would obviously
19 make things easier to be able to do that. Remember,
20 PRAs, it's somewhat of an automated process. It's a
21 computerized model, so if we maintain just to a basic
22 event in one place, it's reflected anywhere else that
23 basic event is in the model. If you make changes, for
24 instance, to the Level 1 model, you can't really automate
25 the Level 2 model. There's a lot of manual analysis that

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1 gets done on these --

2 MEMBER POWERS: What I'm asking is, you
3 don't have to do it, but if you had your druthers or
4 your wishes or prayers answered, what kinds of things
5 would you ask to be automated so that when these
6 perturbations occur, and they occur all the time and
7 they always will occur, that it is not such a herculean
8 task to go back and fix everything that got affected
9 because -- I mean, there are two things. First of all,
10 that's a lot of work; and, second of all, your potential
11 for error, leaving something out, in that correction
12 process is very high. And, you know, it seems to me you
13 guys are in a wonderful position to say, you know, if
14 IBM's Watson really is good, here's what it would do
15 in PRA land to automate things just because, you know,
16 people are always looking for these. I mean, he has
17 thousands of graduate students clamoring for theses to
18 write. I mean, those people are looking for things, and
19 if you could suggest to them here's a list of things
20 that, if we could automate, we could do these things
21 because we know we're going to get perturbations a
22 hundred years from now when we do PRA. We're still going
23 to get these perturbations that propagate through the
24 whole system. It's just the way PRA is.

25 MR. KURITZKY: It's an interesting

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1 question, something we can think about.

2 MEMBER POWERS: Yes.

3 MR. KURITZKY: I don't have an answer right
4 now for you.

5 MEMBER POWERS: Talk to the boss man and
6 tell him you want to go to the ANS meeting and give a
7 paper on that subject. I think it would be fascinating.

8 CHAIR STETKAR: I have to try to keep us on
9 a little bit of schedule here, but backing off a little
10 bit from the sense of knowledge management, automated
11 knowledge management if you will, but looking at more
12 pragmatic realtime issues is, my experience has been
13 that, if you lay out the scope of the information that
14 you're working with initially, try to look at a complete
15 scope -- and give you an example. We talked a little
16 bit earlier about which plant operating states you're
17 going to focus on during low-power shutdown PRA. Well,
18 many, many people, when they develop a low-power
19 shutdown PRA, will develop a very large matrix of
20 possible plant operating states, perhaps hundreds I've
21 seen, and coalesce them into a subset and then maybe
22 focus on yet a further subset of that coalesced subset.

23 If you learn something that suddenly makes
24 preliminary plant operating state 97 potentially
25 important, having that information available that there

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1 is even a preliminary plant operating state 97 can be
2 important. So too quickly making assumptions about
3 what's going to be important and what subset of things
4 are we going to look at is where you run into the danger
5 of new information making you unravel all of that stuff
6 to create something that perhaps existed at one time
7 but was lost. That isn't necessarily an automated
8 process, but it's something that -- we were talking
9 earlier about inter-unit dependencies. If you had a
10 complete inter-unit dependency matrix, rather than
11 focusing only on dependent, and I don't know how it's
12 laid out yet because we haven't seen it, but rather than
13 focusing only on dependencies that you thought today
14 might be important to today's model for today's risk
15 from those units, that would help, you know, if
16 additional information becomes available.

17 Anyway, as I said, I'm now not being the
18 adult in the room anymore, so let's see if we can get
19 through your last, this is your last slide.

20 MR. KURITZKY: Again, I wanted to express
21 my sincere appreciation to Southern Nuclear for their
22 support; as I mentioned, the PWR Owners Group,
23 Westinghouse, EPRI, as Kevin mentioned before, for the
24 peer reviews and for Westinghouse and EPRI for giving
25 us a person on the Technical Advisory Group. So that

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1 continued support has been greatly appreciated, and
2 that's essentially all I have for this presentation.

3 CHAIR STETKAR: Good. Any other questions
4 or comments for Alan on the overview before we get into
5 the ISLOCA expert elicitation? If not, let's get into
6 it.

7 MR. KURITZKY: All right. Before I yield
8 the microphone to Steve, let me just give you a little
9 bit of background just to refresh the subcommittee
10 members or those who may not have been at earlier
11 briefings.

12 So the issue came up with interfacing
13 systems LOCA when we first started doing this study that
14 we leveraged over and converted over from the licensee's
15 model, and the licensee's model, ISLOCA was almost a
16 no-never mind. Their frequencies of the scenarios,
17 they looked at a lot of different potential scenarios,
18 but they all had frequencies so low that it really was
19 a non-risk contributor. And when we converted over, we
20 had the same result.

21 CHAIR STETKAR: Non-risk or non-core
22 damage?

23 MR. KURITZKY: What's that?

24 CHAIR STETKAR: Non-risk --

25 MR. KURITZKY: Non-risk because the

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1 frequency was so low that, even though you have high
2 consequence, it was still not -- we didn't know that
3 it was a non-risk contributor, but we could just tell
4 from the small frequency that it would not be a big --

5 CHAIR STETKAR: Okay.

6 MR. KURITZKY: But then what happened was
7 when we were looking at some of the data that we used
8 for the model, the INL database that supports the SPAR
9 model that we're using for a lot of events in this model,
10 there actually was some data on common cause failure
11 of MOVs and check valves to leak in what they call large
12 internal leaks greater than 50 gpm.

13 And so if you go and use that data, which
14 we did, and put it into our model, all of a sudden the
15 ISLOCA frequencies jumped up and, because of the high
16 consequences, it was clearly going to be the, by far,
17 most dominant risk contributor in the study. So we
18 recognized that the data that was in the INL data is
19 extremely sparse, and so the uncertainties or conflicts
20 in those numbers is very low. Uncertainty is very high
21 and the conflict is very low, so we felt that this was
22 an ideal opportunity to pilot the staff's draft expert
23 elicitation guidance for this particular issue.

24 And so we had Pacific Northwest National
25 Lab undertake that activity, and Steve is going to give

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1 you all the details momentarily. But, essentially,
2 we're looking at, you know, what is a reasonable value
3 for the leakage from a single valve but more importantly
4 through the two successive valves, and also where is
5 the break going to be on the outside containment?
6 Because that can make a big difference in terms of what
7 kind of release you have, and there's a lot of
8 uncertainty associated with that. So those are some
9 issues that we wanted the expert panel to address.

10 MEMBER BLEY: I think we also saw -- and I
11 might be wrong on this, I'm trying to remember -- some
12 very, very small leakage rates that were probably
13 leakage past a closed disk kind of thing. And we asked
14 if that's where it came from or if you could tell.

15 MR. KURITZKY: Right. I don't know
16 whether it was just small leakage through a closed disk,
17 but we do know there's obviously a lot more data for
18 the less than 50 gpm leaks than there was for --

19 MEMBER BLEY: There might have been
20 different kind of failure modes.

21 MR. KURITZKY: Right. And also what
22 happened was, even though there is some very small amount
23 of data for the large leaks, what we end up doing in
24 the quantification in the INL database was to take the
25 small leakage and multiply it by the ratio of the data

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1 they had for the large leaks to the small leaks. So it
2 wasn't just a pure data-driven large leak frequency.

3 So for all those reasons, we wanted to have
4 an expert panel take a look at it, and that's exactly
5 what we did. And consistent with SECY, you know, the
6 SRM for SECY-11-0172, we had this become the topic.

7 CHAIR STETKAR: When you said data, they
8 actually used a, they had no events of large leakage
9 so you --

10 MR. KURITZKY: Well, they actually had, I
11 think they had --

12 CHAIR STETKAR: I thought they used a
13 non-informed --

14 MR. KURITZKY: Three events.

15 CHAIR STETKAR: Did you really? Okay.
16 We'll hear more about that then. Before we get to Steve,
17 I wanted to ask you, Alan, because you're familiar with
18 the models, what we're going to hear about for the expert
19 elicitation is focused entirely on, as you characterized
20 it, leakage through two or more valves in series when
21 we know that those valves are closed.

22 MR. KURITZKY: Right.

23 CHAIR STETKAR: Okay. Does the PRA look at
24 the likelihood where one, let's just take the simple
25 case of two valves in series where one of those valves

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1 is actually not closed so that leakage through only one
2 valve under that condition is all you need. It doesn't
3 look at that.

4 MR. KURITZKY: That was an issue that was
5 brought up in the expert elicitation, particularly by
6 one of the experts, and it was discussed. And we do not
7 have, we have not modeled those cases. I think we do
8 address them in the report, to some extent, why we are
9 not --

10 CHAIR STETKAR: Well, let me put that, I
11 read the paragraph or the footnote that said one expert
12 brought it up. I didn't see why it's not important.

13 From other studies that I've seen, those
14 scenarios can be much more important than leakage
15 through two valves that are closed --

16 MR. KURITZKY: Right.

17 CHAIR STETKAR: -- because of the
18 plant-specific ways that people do testing,
19 plant-specific ways that people come out of an outage,
20 and your ability to actually monitor or know the status,
21 the internal status, of valves, whether they're check
22 valves or motor-operated valves, so that, as you get
23 into exceedingly small frequencies of large leaks
24 through two valves that are nominally closed, the
25 importance of these other conditions where you think

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1 one valve is closed but it isn't and maybe even do a
2 test to actively open that second valve and, oh, my God,
3 the first valve is open and you can't re-close the second
4 valve, those can be maybe more important in frequency
5 and in terms of size of leak rates than all of the other
6 stuff that you've done.

7 I'm not trying to say -- I think that what
8 was done for the expert elicitation was very important
9 and very good. But in terms of completeness in the sense
10 of are we doing a full scope risk assessment, I'm really
11 curious about why you're not addressing those other
12 scenarios.

13 MR. KURITZKY: So a couple of points.
14 First of all, when we talk about full scope, it's been
15 mentioned a couple of times, full scope deals with all
16 the initiators and other things. Specific issues I
17 don't make full scope or not. Those are various
18 assumptions of things you're going to address in your
19 study. So we're doing a full-scope PRA.

20 But as to whether or not we've addressed
21 those specific items, again, you're exactly right, Mr.
22 Stetkar. The idea, it's very plant specific. Do they
23 monitor the space between the valves? Do they know if
24 one has been re-closed or not? What type of, what's
25 their order of doing things coming out of shutdown to

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1 see whether or not they close?

2 Now, we have not done a rigorous analysis
3 of that, and I think you have a good point. The fact
4 that it initially didn't matter because we had such
5 high failure rates that they were not going to be major
6 contributors. Now that, without jumping the gun, their
7 failure rates have come back down, you're right. That
8 could be more of a contributor.

9 I don't remember the exact basis we gave
10 for not including them in the model, but an argument
11 certainly could be made that that's something that
12 should be looked at more carefully and that might be
13 an item that we have on the list of things for further
14 analysis or review or improvement or update to the model.
15 That's something that we may want to take a look at.

16 So I'll grant you that. With the numbers
17 now coming down, that becomes, relatively it could
18 become more important. But, again, I don't remember
19 exactly what the basis was that we gave for not
20 considering it.

21 Okay. So with that, let me give it over to
22 Steve. Oh, excuse me.

23 MR. SCHRAEDER: John Schraeder from Idaho
24 National Laboratory. To the extent that those events
25 you're talking about are occurring and we're catching

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1 them in the data collection effort, you would see those
2 in the database as mis-positioned events or spurious
3 transfer events. So, yes, we do tabulate those. There
4 is a rate inherent with that, but it's probably
5 conservative. So if the actual rate of specifically
6 what you're asking about is below our measurement
7 threshold, our data capture threshold, then we wouldn't
8 have any idea what the rate actually is. But to the
9 extent it's showing up at a rate that you'd expect to
10 see events, given the amount of exposure we have and
11 the failure rate that's inherent in that, we have it.

12 MR. SHORT: Okay. Let me just find the
13 slides here.

14 CHAIR STETKAR: I don't care about the
15 data. You're not modeling the scenarios. That's the
16 important thing.

17 MR. SHORT: That's the important thing.

18 MEMBER BLEY: And I don't know which is more
19 important probabilistically, but both ought to be
20 considered. I agree with John.

21 Before we get into it, Steve, a couple of
22 questions. I did see you gave us your experts later in
23 the slides, and you tried to quantify different leak
24 sizes. Did you have the experts identify different
25 failure modes and the valves that would fit with those?

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1 MR. SHORT: Well, yes, and I can talk a
2 little bit about that. But if you go into the --

3 MEMBER BLEY: When you hit the right spot --

4 MR. SHORT: Yes, okay.

5 MEMBER BLEY: -- you can talk about that.
6 That would be --

7 MR. SHORT: Just quickly, if you go into the
8 experts' data sheets, which are in the appendix, you'll
9 see that they talk about different possible failure
10 modes that they thought about as we were going through
11 the elicitation process.

12 MEMBER BLEY: Okay. We're just trying to
13 secondguess you. Here are two, three, six different
14 failure modes and trying to get all the experts to
15 acknowledge there are different failure modes and then
16 the likelihood of each would have seemed a really good
17 structure to me. But that isn't what you did, I think.

18 MR. SHORT: We did not do it by failure
19 mode. That is correct, if that's the question.

20 CHAIR STETKAR: Before you start, and I
21 don't know when the best place to ask this is, you
22 restricted this to -- we'll get into how you correlate
23 leak size to re-grade, but you restricted it to leak
24 sizes that are greater than 0.8 inch equivalent diameter
25 because you assert that the operators have enough time

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1 under those conditions to fix things.

2 Now, the small LOCA initiating event
3 frequency for the Level 3 PRA, I went back and looked
4 it up, is breaks between 3/8ths of an inch, 0.375 inches,
5 and 2 inches. So now I'm not sure why, for a 0.8 inch
6 break for an interfacing system LOCA you don't care,
7 whereas for a small LOCA, for a break that's much smaller
8 than that, we care. So how is this consistent?

9 MR. SHORT: The logic that we used there was
10 is that we looked at the Vogtle analysis of how long
11 it would take for a leak to drain the RWST and basically
12 result in not having sufficient cooling for the core
13 to keep it cooled. Their analyses, their MAP analyses
14 or thermohydraulic analyses, concluded that they had
15 enough potential actions that they could take over a
16 30, I think it was 30-hour, 36-hour, somewhere around
17 that time period --

18 CHAIR STETKAR: Thirty hours.

19 MR. SHORT: -- a 30-hour time period that
20 they could essentially result, mitigate a leak size that
21 was on the order of 0.8 inches.

22 CHAIR STETKAR: So there's no risk
23 whatsoever from an interfacing system LOCA leak of the
24 equivalent of 0.79 inches and, yet, we are quantifying
25 explicitly the risk from a small LOCA size, inside the

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1 containment by the way, of 0.376 inches?

2 MR. SHORT: First of all, there's --

3 CHAIR STETKAR: So I'm confused. The
4 reason I'm confused is that, in the expert elicitation,
5 we have this mysterious gap between zero and a magic
6 0.8 inches, and I, for the life of me, can't figure out
7 how the experts accounted for that gap. And so that's
8 part of the expert elicitation.

9 From a PRA perspective, I don't understand
10 how the PRA team didn't say, well, no, we're interested
11 in small LOCAs, which are leak rates equivalent to 3/8ths
12 of an inch or larger size because we care about those
13 inside the containment where we can have the containment
14 intact and we have a lot more ability to mitigate those
15 small leaks inside the containment. And, yet, you're
16 asserting that, you know, for a 0.79-inch break that
17 goes outside the containment there's zero risk.

18 MR. SHORT: Okay. So first of all --

19 CHAIR STETKAR: I don't know how that would
20 affect the expert elicitation results because I have
21 no idea how the experts accounted for that conceptual
22 gap, but we'll get into the gap later.

23 MR. KURITZKY: Yes. So I, first of all,
24 want to say, there is no zero risk for anything in PRA.
25 So it's just what we model and what we don't model.

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1 There's obviously a risk for everything.

2 You make a good point. We had some
3 discussions about that afterwards, too, because there
4 was some inconsistency in that lower bound. And I agree
5 with you. If we were to do the whole thing over from
6 scratch, we would have used a different lower bound for
7 the thing. Unfortunately, we do pick it up early on,
8 and so that's what the experts had when they did their
9 analysis. And so we were left trying to figure out,
10 well, can we justify -- I mean, that's the results we
11 have. We're not going to re-panel the experts, so we
12 had to live with those results. And so we had to try
13 to come to grips with ourselves that we were okay with
14 the fact we did not have that lower part of the spectrum
15 covered, and that's what I think Steve was trying to
16 explain to you.

17 But you're right. I agree. If we were
18 starting over, if this were day one, we would have had,
19 the spectrum would have gone down with that lower limit
20 size. No question about it. No question.

21 CHAIR STETKAR: Thank you.

22 MR. SHORT: Any other questions before we
23 get started, I guess?

24 CHAIR STETKAR: The only reason I brought
25 them up then is I didn't want to throw monkey wrenches --

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1 MR. SHORT: Okay.

2 CHAIR STETKAR: -- elicitation. That's
3 all.

4 MR. SHORT: Oh, yes, okay. So let me just
5 kind of go through the project team a little bit. I'm
6 the project manager, co-principal investigator with
7 Mike Zentner, who some of you may know. I don't know.
8 He's a long-time PRA guy, mostly in the DUE world. And
9 then we had Bill Ivans kind of supporting us on the
10 technical integrator scribe role as we were eliciting
11 the results from the PRA, from the experts. Bill is --

12 MEMBER BLEY: Are these all PNNL guys?

13 MR. SHORT: Yes, all these are PNNL people.
14 That's correct. Now, Bill has experience, he worked on
15 the Westinghouse WCAP document related to IS common
16 cause analysis and ISLOCA analyses. Don Daly, along
17 with, you'll see, Kevin Anderson, they supported us in
18 developing the probability distributions and taking the
19 expert data and converting those into distributions.
20 Steve Unwin was a project consultant that we used. He
21 was going to be here today but ended up having a conflict,
22 so he couldn't be here.

23 MEMBER POWERS: Worked out your prior
24 distributions for you.

25 MR. SHORT: Pardon?

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1 MEMBER POWERS: Did he work out your prior
2 distributions for you?

3 MR. SHORT: No, no. Steve? He just
4 consulted with us. When he didn't think we were doing
5 the distributions right, he let us know.

6 MEMBER POWERS: I bet you he did.

7 MR. SHORT: And then Bruce Schmitt was
8 supporting us. He did some thermohydraulic stuff, and
9 I'll talk a little bit about that for us in a little
10 bit. He basically did the analysis that correlated a
11 leak, a valve leak size to a gallon-per-minute,
12 effective diameter to a gallon-per-minute type
13 analysis.

14 MEMBER BLEY: Before you leave the first
15 page, can you explain to us in your elicitation process
16 the difference between a facilitator and a technical
17 integrator?

18 MR. SHORT: Yes, I'll tell you. So Mike
19 Zentner, he was facilitating the meeting itself. He
20 basically pulled most of the presentations and the
21 process together and facilitated and led the exercise.
22 Bill had more of an ISLOCA background, and so he
23 basically helped us make sure that we were addressing
24 what we thought ISLOCA from the right perspective in
25 the analysis.

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1 MEMBER BLEY: Okay. But Mike took care of
2 the things like controlling bias and interactions --

3 MR. SHORT: That's correct. He took care
4 of all that. That's correct.

5 So just some background. Obviously, we
6 used the Vogtle plant as the basis for doing the
7 elicitation from, and so that's important because we
8 were looking specifically at valves and the RHR or SI
9 type systems within Vogtle itself. We early on decided
10 to focus on the residual heat removal and safety
11 injection systems as the ISLOCA pathways of interest,
12 predominantly because of what Alan was saying earlier.
13 Those were driving the risks in the all-three PRA model.
14 There are obviously other contributors to ISLOCA, such
15 as charging or RCP seal cooling and pathways such as
16 those. Those, in the Vogtle PRA model, were much
17 smaller contributors. They weren't showing up in the
18 L-3 PRA model, so we focused on the key contributors,
19 and that was the scope that we took on in the expert
20 elicitation.

21 Some specific things we looked at. Number
22 one, Alan mentioned it earlier. The current database
23 has a failure rate for small leaks and a failure rate
24 for large leaks that's based on, that's an extrapolation
25 or it's basically a ratio of the number of large leaks

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1 to the number of small leaks kind of thing. And so we
2 focused on, our expert elicitation was largely focused
3 on seeing if we could improve upon how the failure rates
4 for large leaks might be or I guess coming up with a
5 better method or approach to determining what a large
6 leak failure rate would be based on expert knowledge.
7 We did that for both the check valves and the
8 motor-operated valves for internal large leak failure
9 modes, okay? Again, we specifically looked at the MOVs
10 and the CV designs that were in in the Vogtle systems,
11 RHR and SI systems.

12 We also had the experts do elicit a
13 conditional failure probability for the second valve
14 that was downstream from the first valve in a series
15 of two valves, isolation valves. I'll talk a little bit
16 more about that later. We originally were going to try
17 to elicit common cause failure, and we had the expert
18 team kind of ended up concluding that common cause is
19 not really relevant to this type of failure, to the
20 failure of isolation valves that normally are not
21 operated and are normally closed, and so they're not
22 regularly manipulated during operation. So we went to
23 a conditional probability of failure. I'll talk a
24 little bit more about that a little bit later.

25 We also looked at the possibility of being

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1 able to potentially close a normally open MOV in the
2 pathway that could isolate the failure of the ISLOCA,
3 and so we looked at failure to close probability. And
4 then the last part of it is --

5 MEMBER BLEY: And for that you looked at
6 many specific valve designs --

7 MR. SHORT: That's correct.

8 MEMBER BLEY: -- and operators?

9 MR. SHORT: That's correct, that's
10 correct. And those MOVs are not isolation valves.
11 They're not really designed to be isolation valves.

12 MEMBER BLEY: And they're not designed to
13 operate under --

14 MR. SHORT: Under high differential
15 pressure.

16 MEMBER BLEY: I want to ask a question about
17 how, I guess, probably how the facilitator controlled
18 the interaction. Looking at your group of experts, a
19 few are real valve experts, a few understand failure
20 modes in steel kind of systems, some are more PRA guys
21 and common cause guys, some have collected data for a
22 long time. When you got into a situation like the one
23 you just talked about where really understanding the
24 forces, the stresses inside the valve are really
25 crucial, did you somehow make sure the people with the

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1 real expertise in that area were either given more weight
2 or somehow --

3 MR. SHORT: I understand the question.

4 MEMBER BLEY: -- the expertise was
5 addressed? Because there was a wide variety of folks
6 on this panel.

7 MR. SHORT: We also had, you know, we'll
8 talk about it later, we also had a system expert from
9 Vogtle there, and we also had a pipe failure type expert.
10 Yes, the way we did that is -- well, without going through
11 the process in a lot of detail, we initially did
12 elicitations individually and brought the group, the
13 team together and had them elicit, you know, talk
14 together about their reasons for why they rated
15 something the way they did or evaluate something the
16 way they did.

17 So the experts had an opportunity to take
18 all that into account, but the main thing what we did
19 was is we asked the experts to rate themselves in terms
20 of their level of expertise in these different
21 categories. So we're talking about valve failures or
22 mechanisms, talking about common cause or PRA-related
23 stuff, and the pipe failure type stuff. And so we asked
24 them to rate themselves and ranking them one to five,
25 one being an expert and five not being, okay? And in

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1 the end, what we ended up doing is we used that to
2 basically say anybody rating themselves as three and
3 above we use their results in developing the
4 distributions. If they're four or five, they --

5 MEMBER BLEY: And this was a technical
6 integrator's role, I suppose?

7 MR. SHORT: That's correct. That was the
8 technical integrator's role. Some, you know, in some
9 cases, the expert chose not to even address the issue
10 because they didn't consider themselves an expert in
11 that.

12 MEMBER BLEY: I worry more from the other
13 side, the guy who says he's an expert but really has
14 never touched a --

15 MR. SHORT: Right.

16 MEMBER BLEY: -- valve or designed one or
17 operated one.

18 MR. SHORT: Right, yes, yes. I understand
19 the concern. We tried to address that through this
20 ranking process.

21 MEMBER BLEY: I'm starting to look through
22 the details.

23 MR. SHORT: You can look through the
24 details --

25 MEMBER BLEY: I haven't done that yet.

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1 CHAIR STETKAR: But it did rely entirely on
2 those self evaluations?

3 MR. SHORT: That's correct. We did not
4 make any determination.

5 CHAIR STETKAR: Three or better, they're
6 in. Less than three, they're out.

7 MR. SHORT: They're out. That's right.

8 MEMBER BLEY: Just a little more because
9 I'm concerned about this. When you had brought them all
10 together and they individually laid out their basis and
11 I assume their experience, did it feel like people came
12 to consensus around --

13 MR. SHORT: We didn't -- I would say, I
14 would say that most people recognized the expertise that
15 the others had. That's for sure.

16 MEMBER BLEY: Okay.

17 MR. SHORT: What I want to do is be careful
18 is that we did not try to reach consensus in this
19 elicitation process, but, you know, in general, if I
20 were to --

21 MEMBER BLEY: You didn't do the SSHAC thing
22 even though you used the SSHAC framework of trying to
23 reach a consensus --

24 MR. SHORT: That's correct.

25 MEMBER BLEY: -- from the community?

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1 MR. SHORT: That's correct. We did not
2 feel like we had the resources to try and go towards
3 a consensus.

4 MEMBER BLEY: Okay. I was really -- that's
5 an important point. But the other point is, even though
6 that wasn't a goal, did you feel as if you coalesced
7 on some of the things or most of the things or --

8 MR. SHORT: I guess, I think everybody got
9 their opinions out there. I think people took into
10 account additional information that other experts had
11 that they didn't necessarily have. My personal opinion
12 in doing expert elicitation, I've done lots over the
13 years for various types of purposes and things, is that,
14 oftentimes, you have people you wouldn't necessarily
15 consider a specific expert in a given area that has
16 knowledge about how systems operate. So our system
17 expert from Vogtle, he was very familiar with these
18 systems, he understood how they operated, he was
19 familiar with his, he had experience with failure, you
20 know, failures in the plant. And so, personally, I
21 considered his expertise relevant, even if you can't
22 call him a failure modes and effects analysis expert
23 on an MOV.

24 MEMBER BLEY: That's plenty.

25 MR. SHORT: Okay.

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1 MR. KURITZKY: Also, Dr. Bley, I just want
2 to mention one thing not directly related to the bias
3 of certain experts versus others but, in talking about
4 the level of expertise and talking about the closing
5 of the leak and whether those valves were designed for
6 that type of differential pressure, etcetera, you had
7 made comments in previous briefings going way back that
8 if we were going to do this we needed to have people
9 who really understood valves, and I just want to say
10 that I was at the expert, the joint meeting when they
11 all came together. What happened was that joint meeting
12 had people discuss, and the experts were allowed to go
13 and readjust their responses based on what they learned
14 at that meeting. And the two gentlemen in particular
15 that were true valve experts, I mean, these guys were
16 valve experts. I'm not a valve expert at all, and they
17 explained things so well in terms of exactly how these
18 valves, every part of the valve, how it would work, how
19 it was designed, how pressures would impact it in
20 different parts, whether there was certain designs
21 that would be subjected to warping or would allow you
22 to take this shock but then still work later. Their
23 knowledge was tremendous, and they imparted that to
24 everybody else, not in the way of biasing them to their
25 personal beliefs but just in the knowledge that the other

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1 experts really had a true understanding of how those
2 valves worked in those environments and that could, you
3 know --

4 MEMBER BLEY: That's what I was hoping
5 you'd do, and I think that's really important because
6 there are details there that you really don't know unless
7 you've been designing and really testing valves under
8 extreme cases.

9 MR. KURITZKY: Right. And if I could
10 understand what they were telling me, I know other
11 experts certainly learned from that.

12 MEMBER BLEY: Thanks.

13 MR. SHORT: Yes. And I think if you go back
14 into the data sheets, you will see those experts captured
15 a lot of their thinking process about those valves as
16 they were working. Now, their concern, just real
17 quickly, their concern was is they don't think in PRA
18 world. So they were somewhat uncomfortable eliciting
19 a probability of failure in a failures-per-hour kind
20 of thing, and so I'm going to talk a little bit about
21 how we worked through that.

22 MEMBER BLEY: Okay. Yes, I'm sure they
23 start from either it can't happen or it can happen.

24 MR. SHORT: That's right. That is right.
25 That's right. And none of them have seen major leaks

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1 like this before.

2 MEMBER BLEY: Indeed it is.

3 MR. SHORT: So let me kind of walk through
4 our process a little bit just to kind of tell you how
5 we did this elicitation. The first thing we had to do
6 was we had to lay out the problem description. That took
7 quite a bit of effort. We worked a lot with NRC staff
8 on this and internally at NRC and, to some extent, with
9 the experts as we tried to lay out and define how we
10 were going to develop the, define what parameters we
11 were going to elicit and how we were going to go about
12 doing that.

13 And so in order to do that, we put together
14 some system notebooks that basically, and this is the
15 proprietary, this contains mostly proprietary
16 information on the Vogtle systems, the different valves,
17 the different piping systems, the layout of the RHR and
18 SI systems, information on the pumps and the heat
19 exchangers and all those. So those are all in the
20 notebook.

21 CHAIR STETKAR: Steve, let me interrupt you
22 here for a second. We're now, I'm looking through your
23 slides going forward. You've got a ton of information
24 in there. It's 10:10. I want to take a break now and
25 re-group because we have some hard stops. I have a

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1 meeting that I have to go to at noon. We have a hard
2 stop this afternoon at 1:50. We need to allow enough
3 time for the topic this afternoon.

4 MR. SHORT: Okay.

5 CHAIR STETKAR: I don't know what the staff
6 is preparing to present in the closed session on the
7 Level 1 model, but there may be enough material on this
8 expert elicitation to take us until noon.

9 So let's take a break and re-group because
10 I'm concerned that we're going to hear about
11 preparations and run out of time. So let's recess until
12 10:25 for a break and kind of re-group.

13 (Whereupon, the above-referred to matter
14 went off the record at 10:09 a.m. and went
15 back on the record at 10:27 a.m.)

16 CHAIRMAN STETKAR: We are now back in
17 session. We had some discussion during the break, and
18 what we decided was that the amount of material to be
19 presented for the expert elicitation on the interfacing
20 system LOCA is quite a bit of material and that the
21 Subcommittee members are very interested in hearing
22 about that material, both in terms of the elicitation
23 process, because it has implications for other things
24 that the Agency is doing, and in particular for this
25 particular issue for the Level 3 PRA. And because of

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1 that we are going to make the executive decision, we
2 in the royal sense, that we will not hear a presentation
3 today on the Level 1 internal events PRA status that
4 was scheduled originally from 10:45 until 11:50. So
5 we're just going to surplus that.

6 For the benefit of the Subcommittee
7 members, what I'll do is -- as I've done in the past
8 in terms of fact finding, I'll go through that material
9 and prepare at least my input for the Subcommittee's
10 benefit on those topics. And I think we've shared that
11 with the staff in the past. So we'll try to do that.
12 We may want to convene another Subcommittee meeting.
13 Depending on how much material is available, rather than
14 waiting necessarily until what it looked to be the
15 September/October time frame for a full day
16 Subcommittee, we might want to look at one in the, I
17 don't know, May/June-ish-type time frame to pick up some
18 of these other topics. But let's plan to spend the rest
19 of the morning until 11:50 or noon on the expert
20 elicitation.

21 And with that, Steve, that will give you
22 a little bit more time and give us ability to have a
23 little better interaction. So we'll go back to that.

24 Alan, did you have anything else?

25 MR. KURITZKY: Yes, this is Alan Kuritzky.

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1 During the break I discussed with our Level 1 internal
2 event PRA lead, just addressing one of the issues that
3 got brought before break regarding a valve, one of the
4 valves in series for the ISLOCA pathways being -- failing
5 to close after maintenance or being left in the open
6 position. And we actually do for the RHR hot leg section
7 line -- where we had the two MOVs in series we do include
8 in the fault tree modeling the failure of that one valve
9 being left open, and then just the failure of the other
10 valve to leak. So we do have that covered in the PRA
11 model.

12 CHAIRMAN STETKAR: Good. Thank you.

13 MR. KURITZKY: And with that, Steve.

14 MR. SHORT: Okay. So back to the
15 elicitation process. I'll quickly go through this.

16 So we prepared a problem description. We
17 selected our experts. And as you've read the reports
18 and we've discussed, we have a variety of different types
19 of experts that encompass the range of expertise we
20 needed for this process. We used a lot of GoToMeetings
21 rather than get-together-type meetings to do some of
22 the initial stuff that you tend to do to train the experts
23 on what you're trying to do, go over the problem
24 descriptions, walk through the data sheets and what
25 we're trying to elicit from them. And then also via

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1 GoToMeetings we did the individual elicitations with
2 each of the individual experts.

3 And following the completion of that and
4 the compilation of results, we held the group
5 elicitation meeting where we brought the entire group
6 together and discussed some of those results and gave
7 everybody an opportunity to comment on each parameter
8 being elicited, each valve that's being elicited, and
9 an opportunity to revise their thoughts and input based
10 on what they learned there. And then we developed a
11 draft report that was reviewed by both the NRC and the
12 experts. And what you have in front of you is the result,
13 or what you have I think sent to you is a result of that,
14 incorporating the comments that we received on that
15 report.

16 MEMBER BLEY: So that was one thing I wanted
17 to confirm --

18 MR. SHORT: Yes.

19 MEMBER BLEY: -- that in fact your expert
20 group did see the final results and have concurred
21 in --

22 MR. SHORT: Yes.

23 MEMBER BLEY: -- the way you presented it?

24 MR. SHORT: Yes, every one of them I think
25 has accepted the report. We addressed all their issues,

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1 I think. That doesn't necessarily mean that they
2 necessarily liked the way we did the elicitation, but
3 in the end the results were -- they were concurrent upon
4 the results of what we did.

5 Just quickly, I wanted to walk through some
6 of the comparison between the ISLOCA process and the
7 SSHAC process. We had this preparation -- and we kind
8 of went over this already. We had a preparation period
9 where we worked with and trained the experts on what
10 the problem was and working through training them on
11 how we're going to go about doing the elicitation. Some
12 of them didn't have expert or working knowledge of
13 probabilities, and so we had to have some training on
14 that. I'll talk a little bit later about some lessons
15 learned from that. The training we had wasn't
16 necessarily effective, I don't think, and so we do
17 something different there. We're going to do it again.

18 We held the individual meetings where we
19 put the data sheet in front of them. They had the data
20 sheet in front of them. And as we talked with them over
21 GoToMeeting we elicited values. We entered those
22 values from our end, sent those back to them for their
23 review so that they could have a chance to see how we
24 entered their information into our data sheets. And
25 then they'd then send those back to us. We had put some

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1 constraints on what they could do. They couldn't just
2 change the values. If they were going to change a value,
3 they had to tell us. What we were really looking for
4 was the explanation, make sure we had the explanation
5 for why they elicited the value they did rather than
6 changing any values.

7 CHAIRMAN STETKAR: Steve, as preparation
8 for this --

9 MR. SHORT: Yes.

10 CHAIRMAN STETKAR: -- in the report you
11 have a list of references --

12 MR. SHORT: Yes.

13 CHAIRMAN STETKAR: -- that you provided to
14 the experts. I suspect that not all of the experts had
15 ever been involved in this type of elicitation process.

16 MR. SHORT: That is correct.

17 CHAIRMAN STETKAR: I didn't see in that
18 list that you -- you've characterized this process as
19 kind of an adaptation of SSHAC, or a SSHAC-like process,
20 or something like that. I didn't see that you provided
21 the experts either of the SSHAC NUREGs as a reference
22 so that they kind of understood what a full expert
23 elicitation, if you will, might be, the NUREG/CR-6372 --

24 MR. SHORT: Right.

25 CHAIRMAN STETKAR: -- or NUREG-2117, which

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1 is sort of the SSHAC in practice for Level 3, Level 4.

2 MR. SHORT: Yes, I guess what we did there
3 is is it came up in our training that they could go get
4 those; they're on the Internet, but we didn't feel it
5 particularly relevant to the ISLOCA process and what
6 we were trying to do. So in order to -- and trying to
7 not overwhelm them with information -- and you recognize
8 those NUREG documents are fairly large.

9 CHAIRMAN STETKAR: Yes.

10 MR. SHORT: We did mention to them what
11 those were in our training stuff in our opening two
12 GoToMeetings, but we didn't necessarily provide those
13 to them. Is that is correct.

14 CHAIRMAN STETKAR: Okay.

15 MR. SHORT: And what we did give them was
16 a lot of information, and I'm pretty confident that most
17 of that information they really didn't look at anyway.
18 So, but --

19 CHAIRMAN STETKAR: Yes, you can't ever
20 control what --

21 MR. SHORT: What they do.

22 CHAIRMAN STETKAR: -- people read or what
23 people don't read, but at least pointing people
24 toward --

25 MR. SHORT: The right place.

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1 CHAIRMAN STETKAR: -- this is how it ought
2 to be done or has -- not even how it ought to be done,
3 how it has been done in the past is -- you know, they
4 can then choose whether or not they have enough time
5 to do --

6 MR. SHORT: Time to look at it, yes.

7 CHAIRMAN STETKAR: -- to read that. Okay.

8 MR. SHORT: The group meeting and -- oh, and
9 following the individual meetings after -- we talked
10 about we had a group meeting here in Crystal City and
11 where we brought all the experts together and had the
12 opportunity to talk through each of the issues.

13 So, want to do the next slide? We tried to
14 maintain the basic principles of SSHAC by using a
15 structured process. We did that through a data
16 sheet-type process. Those are laid out in the report.
17 Don't want to go through those in a lot of detail, take
18 a lot of time, but they're in there.

19 We tried to make sure we had the breadth
20 of the state-of-knowledge, so we had quite a wide variety
21 of individuals that represented the different types of
22 expertise we had. All of them are very expert in their
23 areas, 30-plus years, so various involvements with MOV
24 Working Groups, PRA Working Groups and the industry.

25 Independence. We tried to sustain that by

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1 making sure that the people that we brought in were
2 coming from different parts of industry, not from the
3 same company, different companies. And so, like our PRA
4 experts, one we had was mostly spent a lot of his career
5 at NASA. The other was from the nuclear industry.

6 Interactions. We tried to deal with that
7 through our group elicitation and through our
8 GoToMeetings where we got everybody introduced to each
9 other, helped everybody to understand what each brought
10 to the table.

11 And then integration. We can talk a little
12 bit about that. We did not try to achieve consensus.
13 I think we talked about that earlier. Rather what we
14 tried to do is have each expert elicit to the best of
15 their knowledge and what they thought the right answer
16 would be or what the right estimate would be for a leak
17 rate, for instance. And so then we combined those
18 results up into distributions. And we can talk about
19 that a little bit.

20 So we had different training sessions. And
21 so the rest of I think we've kind of talked through
22 already.

23 So I wanted to just quickly give -- the
24 report gives a very detailed layout of a simplified flow
25 diagram of the RHR and SI systems. This kind of gives

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1 you a real summary of the basic configurations, valve
2 configurations we were concerned about. For the RHR
3 side you've got two isolation MOVs that are inside
4 containment. And at the Vogtle site they're inside
5 containment. And they're motor-operated valves.
6 These valves are verified to be closed before they ramp
7 up to full pressure. And then right on the
8 other --

9 MEMBER BLEY: That's with the leak test
10 between the valves?

11 MR. SHORT: That's correct, with the leak
12 test between the valves.

13 And they also have a pressure relief valve,
14 just for your information, right between the containment
15 and MOV 1 there. That's about a three-inch valve that
16 can -- the leak rate is about -- it can handle about
17 450 gallons per minute, something like that.

18 MEMBER BLEY: That's a thermal expansion
19 ring --

20 MR. SHORT: Yes.

21 MEMBER BLEY: -- so, yes.

22 MR. SHORT: Yes. Other configurations.
23 On the other side, on the hot leg injection/cold leg
24 injection side there's --

25 CHAIRMAN STETKAR: I'm sorry, Steve. I'm

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1 an engineer.

2 MR. SHORT: Yes.

3 CHAIRMAN STETKAR: I've carved out enough
4 time for us here.

5 MR. SHORT: Yes, okay.

6 CHAIRMAN STETKAR: Where did you say that
7 relief valve was?

8 MR. SHORT: Relief valve is between the
9 containment and the MOV 1.

10 CHAIRMAN STETKAR: Okay. There's another
11 relief valve downstream of MOV 2.

12 MR. SHORT: On the RCS side?

13 CHAIRMAN STETKAR: Yes, I think so. I
14 think you made a big deal --

15 MR. SHORT: Upstream of RCS 2?

16 CHAIRMAN STETKAR: Well --

17 MR. SHORT: I mean, upstream of --
18 (Simultaneous speaking.)

19 CHAIRMAN STETKAR: I'm sorry.

20 (Simultaneous speaking.)

21 PARTICIPANT: -- the RHR System.

22 CHAIRMAN STETKAR: Outside. Okay. I'm
23 sorry. I'm reading the drawing wrong.

24 MR. SHORT: Backwards? Yes.

25 CHAIRMAN STETKAR: Backwards. The relief

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1 valve that you're talking about is outside containment.

2 MR. SHORT: No. No, in this plan it's
3 inside containment. You have a three-inch relief
4 valve --

5 MEMBER BLEY: And it dumps inside
6 containment?

7 MR. SHORT: Pardon?

8 MEMBER BLEY: It releases inside --

9 MR. SHORT: Into containment. So it's
10 available for recirculation in this -- it goes into the
11 sump.

12 CHAIRMAN STETKAR: I'll pull up the
13 drawing. Keep going.

14 MR. SHORT: Okay.

15 CHAIRMAN STETKAR: My understanding was
16 from my notes that the relief valve is actually located
17 physically outside the containment.

18 MR. SHORT: Well, there's --

19 CHAIRMAN STETKAR: And it relieves back
20 into the containment.

21 MR. SHORT: Okay.

22 CHAIRMAN STETKAR: But keep going --

23 MR. SHORT: Okay.

24 CHAIRMAN STETKAR: -- because I don't want
25 to keep us --

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1 MR. SHORT: All right. Okay. For the hot
2 leg injection side there is two check valves and then
3 a closed MOV that basically only operates when you want
4 to use hot leg injection. You've already kind
5 of -- you've basically depressurized the system, so it's
6 not really an isolation valve. It's a normally closed
7 valve. That's the -- those -- that MOV is -- and
8 then -- well, I'll move on.

9 So for the cold leg injection side there's
10 the two check valves and then you've got a normally open
11 MOV. And MOV 4 was the one we looked at and said, well,
12 can we take any credit for that potentially in isolating
13 an ISLOCA through those check valves 3 and 4 under
14 certain scenarios? And so that's really where we looked
15 at the failure to be able to close a probability for
16 that MOV.

17 Quickly I'll go through the expert panel
18 members. I think you guys have kind of -- you've already
19 all looked at this.

20 CHAIRMAN STETKAR: I found it. Sorry, I
21 was wrong. It is inside the containment.

22 MR. SHORT: Yes. Okay.

23 CHAIRMAN STETKAR: Never mind.

24 MR. SHORT: I was worried I had that wrong.

25 CHAIRMAN STETKAR: You were right; I was

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1 wrong.

2 MR. SHORT: Let's see, the expert panel
3 members. Let me just point out -- I'll kind of organize
4 them into the different groups. Neal Estep, Kalsi
5 Engineering, and Paul Knittle, MPR Associates. They're
6 the valve engineers. They definitely have experience
7 in evaluating the reasons valves have failed, what
8 causes their failure. They work with the MOV Working
9 Groups and the industry to improve the reliability of
10 valves. All right. So they're expertise is vast.

11 On the PRA side we had Dr. Karl Fleming,
12 Dr. Michael Stamatelatos. I don't think I need to
13 describe those -- tell you who those guys are. They're
14 fairly well known.

15 And on the pipe failure side we had Dr. Fred
16 Simonen from Lucius Pitkin. Used to be PNNL, actually.
17 And he's done a lot of work over the years on pipe fatigue
18 and failure analysis.

19 And then we had Mike Horton. He's from
20 Southern Company. He represented the systems that we
21 were evaluating. He's a senior reactor operator. Had
22 a lot of experience with how these valves operate and
23 how they're tested and that kind of stuff. So he's able
24 to really speak to those elements of the --

25 MEMBER BLEY: You talked about -- and I'm

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1 sure he has lots of experience about operations and
2 various kind of valve failures, but I bet he never saw
3 a valve leak through at 50 gpms.

4 MR. SHORT: That's correct. That is
5 correct.

6 Let's see. So I guess we're kind of ready
7 now to go into each of the different parameters we
8 elicited. So the first is the internal large leak
9 failure rate. We basically provided the experts with
10 a significant amount of information. You saw it in the
11 report. We produced these system notebooks that gave
12 a very detailed description of these systems, pieces
13 from the safety analysis reports.

14 We actually went down to the Vogtle plant.
15 Well, actually to Birmingham to Southern Nuclear's
16 headquarters. And we were provided individual drawings
17 and design specifications and operating procedures,
18 test procedures for all the different valves and
19 components that were in the RHR and SI systems. So we
20 compiled all that and sent that to the experts. That
21 was a lot of information. The valve experts had clearly
22 gone through each of those valves and looked at them.
23 I mean, I was pretty impressed.

24 MEMBER BLEY: Let me ask some questions
25 here. I didn't get to study your report as much as I

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1 will in the future.

2 (Laughter.)

3 MR. SHORT: Okay.

4 MEMBER BLEY: I mean, you did a lot of
5 stuff. I mean, there's a lot of reporting there.

6 MR. SHORT: Right.

7 MEMBER BLEY: The thing that's always
8 worried me about this area is that the ways in which
9 a valve can leak through at these large flow rates seemed
10 to be pretty limited. Now, it's been 30 years since I
11 delved into it in any detail, but the founder of the
12 company, one of your valve guys came from -- had reported
13 back then that the only case he ever saw of one like
14 that was a failed forging, and it was a bad forging.
15 And they found it in the test program. They fixed it.
16 None of those valves ever went out to anybody anywhere.

17 MR. SHORT: Made it into a plant, yes.

18 MEMBER BLEY: Why I was hoping you would
19 have focused on failure modes is I've seen lots of people
20 extrapolate from very, very milliliters per day out.
21 And it strikes me that the failure mode that leads to
22 that kind of leak-through --

23 MR. SHORT: Is not --

24 MEMBER BLEY: -- isn't physically related
25 to how you'd get these large ones. And did your valve

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1 guys talk extensively and is it in the report, because
2 I didn't --

3 MR. SHORT: Well, I think --

4 MEMBER BLEY: -- read it yet --

5 MR. SHORT: Well, yes, I didn't --

6 MEMBER BLEY: -- about how this can
7 actually happen --

8 MR. SHORT: Okay. Well --

9 MEMBER BLEY: -- physically.

10 MR. SHORT: -- I guess we didn't really
11 summarize those elements in the report itself.

12 MEMBER BLEY: Yes.

13 MR. SHORT: We kind of left those back in
14 the data sheets. But if you go back there and you look
15 at the two valve experts specifically, you will see where
16 they talk about different sizes and how you might get
17 a two-inch leak versus a four-inch leak or something
18 bigger. And --

19 MEMBER BLEY: And see, this is the part I
20 was hoping really got conveyed well to the guys who might
21 be extrapolating from small failure rates or coming up
22 with some uninformed prior and zero out --

23 (Simultaneous speaking.)

24 MR. SHORT: Well, I will tell you that these
25 valve experts were not shy about sharing what their

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1 understanding of how these valves might --

2 MEMBER BLEY: Okay.

3 MR. SHORT: -- fail during the expert
4 elicitation. They're in a group meeting, okay?

5 Now, I'm not going to say that they
6 specifically walked down through all the different types
7 of failure modes. I think what the focus was is they
8 looked at what they thought might be causes for a
9 different gap size leak through those valves. Okay.

10 MEMBER BLEY: Okay. As long as they shared
11 that.

12 MR. SHORT: Yes, and they --

13 MEMBER BLEY: Not just put it in their data
14 sheets. That's what I'm really hoping happened.

15 MR. SHORT: I think Mike Zentner did a
16 really good job facilitating. He actually --

17 MEMBER BLEY: That's good. That's good.

18 MR. SHORT: For each parameter and each
19 valve and each leak size he gave each expert an
20 opportunity to share their thoughts about that
21 particular leak size for that particular type of valve.
22 I thought that was a really good way he did it. And to
23 the extent --

24 MEMBER BLEY: That should have worked, so
25 I'm glad to hear --

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1 MR. SHORT: Yes, to the extent --

2 MEMBER BLEY: -- that kind of detail.

3 MR. SHORT: -- that those who are more
4 PRA-focused were able to understand their logic, you
5 know, I don't know. Okay? I can only leave that to
6 them. You're right, the PRA guys tended to focus on the
7 small leaks and extrapolate when they're thinking. And
8 so did our pipe failure expert. He's used to working
9 in -- he had been involved in the LOCA expert elicitation
10 meeting, so he kind of saw how this information got used.
11 And so, he focused on the small leaks and then
12 extrapolated. But he ended up being the one that
13 evaluated himself out as a non-expert, so we didn't use
14 what he had anyway in the valve failure rate analysis.

15 MEMBER BLEY: Probably shouldn't say this
16 out loud, but out of all the people I read about in that
17 group --

18 MR. SHORT: I know. I understand.

19 MEMBER BLEY: -- I sure wish he would have
20 stayed and perhaps some others had --

21 MR. SHORT: I understand.

22 MEMBER BLEY: -- left.

23 MR. SHORT: I understand.

24 MEMBER BLEY: I will study those data
25 sheets in some detail at some point in the future and

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1 compare them with --

2 (Simultaneous speaking.)

3 MR. SHORT: Some of them were very
4 extensive.

5 MEMBER BLEY: Yes.

6 MR. SHORT: And there's a lot of repetition
7 because -- while the valves may have been different,
8 in a lot of respects the designs were very similar, even
9 though they're different sized valves. And so they went
10 through a lot of the same stuff with the different
11 valves.

12 MEMBER BLEY: Multiple times? Okay.
13 Thanks.

14 MR. SHORT: I don't think it's a hard read
15 for you. Okay?

16 MR. KURITZKY: I'll just make one point,
17 Dr. Bley. And I do remember from the group meeting that
18 the valve experts did discuss in the group setting
19 exactly how some of these valves would -- I mean, they
20 got into the details of how physically the stems and
21 the operators and the plugs would all possibly warp,
22 or what it would take to make a certain leak size -- you
23 know, that can make you a -- give you a bigger leak size.

24 CHAIRMAN STETKAR: Was that the leak size
25 or was that failure to close? I read a lot of that stuff

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1 under the failure to close under high differential
2 pressure --

3 MR. KURITZKY: Right.

4 CHAIRMAN STETKAR: -- the design
5 information. It seemed to --

6 (Simultaneous speaking.)

7 MR. KURITZKY: But I remember -- I thought
8 I remembered them talking about --

9 CHAIRMAN STETKAR: Was it also --

10 MR. KURITZKY: Oh, yes.

11 MR. SHORT: Okay. Yes, because they talk
12 about how it wouldn't take very much to get a fairly
13 big leak size. I mean, one of the things -- I think the
14 insights that they brought that may have been not
15 intuitively understood by other people was that it
16 didn't take a lot of a problem to get you a relatively
17 decent leak rate through those valves.

18 MEMBER BLEY: I mean, it doesn't take much
19 of a problem if a valve doesn't completely close.

20 MR. SHORT: Right.

21 MEMBER BLEY: Especially a gate valve.

22 MR. SHORT: Okay.

23 MEMBER BLEY: But if it's already closed
24 and seated under pressure, for it to suddenly start
25 leaking there are some failure modes that just cannot

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1 get worse and lead to that. And that's what I was hoping
2 there would have been some emphasis on.

3 MR. SHORT: And on the MOV side we did
4 specifically talk about that. They have interlocks on
5 those MOVs. Okay? So they'd talked about common cause.
6 They just didn't see any way that if you opened one
7 accidentally you could ever open the other one because
8 of the -- and that kind of thing. So that was one area
9 we'd specifically talked about.

10 MEMBER BLEY: I'll only say this, and I
11 won't dwell on this, but I'm going to study later, the
12 case I'm worried about is the case where the valve is
13 seated under pressure --

14 MR. SHORT: Okay.

15 MEMBER BLEY: -- and suddenly it starts to
16 leak. And I think the number of failure modes that can
17 lead to that are pretty restricted. And I hope the valve
18 guys made that clear. If you send a signal to open it,
19 lots of reasons it won't open, but it might crack a little
20 bit, and that could lead to a very large leak. And I
21 can understand that. It's that other case I'm worried
22 wasn't discussed as thoroughly as I want. And I'll look
23 at the data sheets to see how well that was done.

24 MR. SHORT: Yes, and you can kind of look
25 at our -- one of the things we tried to do to prompt

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1 discussion was we had a column in our data sheets that
2 was PNNL comments.

3 MEMBER BLEY: Okay.

4 MR. SHORT: And we said, well, when you're
5 considering these, you ought to consider these different
6 types of failure modes that we're aware of. Okay?
7 We're not valve experts, but we're aware of these kind
8 of things, so you ought to be thinking about these things
9 when you're doing your elicitation.

10 MEMBER BLEY: Thanks. And I do know Mike
11 well and I'm sure he did that quite --

12 (Simultaneous speaking.)

13 MR. SHORT: Zentner? Okay. So, yes.
14 Yes.

15 Well, let's see. One of the things we made
16 sure to communicate to the experts was known information
17 about failure rates. Okay? And so, we did spend some
18 time with them in our first set of training sessions
19 going over 6928, what's in there and what that data
20 means, and the appendices on how the large failure rates
21 developed for internal leaks, large leaks.

22 So we're basically -- the way we elicited
23 this -- well, okay. This is -- oh, I'll talk about that
24 in a minute, but that's -- so we shared with them current
25 information. And in addition, we shared with them EPIX

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1 data on historical internal leaks from the RHR and SI
2 systems. Not a lot there. Some. We did share that with
3 them.

4 CHAIRMAN STETKAR: I wanted to ask you
5 about that because there's not much --

6 MR. SHORT: Yes, hardly any --

7 CHAIRMAN STETKAR: -- information in the
8 report.

9 MR. SHORT: -- on that.

10 CHAIRMAN STETKAR: However, if I look at
11 NUREG/CR-6928, the 2010 version, it lists, or it asserts
12 that there are 145 small internal leakage events for
13 motor-operated valves and 204 small internal leakage
14 events for check valves. And that's ostensibly the
15 basis for the two numbers you have up here on the slides
16 for the small leakage rates which are then multiplied
17 by 0.02 to get to the large leakage rates.

18 MR. SHORT: Right.

19 CHAIRMAN STETKAR: So I have now an
20 information base of 349 actual events that are somehow
21 documented somewhere. Were the experts provided with
22 those events so that I could go read and see that of
23 the 349 events 267 were a few milliliters per hour?

24 MR. SHORT: No, we did not provide them with
25 the information on the leaks from all of those that were

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1 in 6928.

2 CHAIRMAN STETKAR: Now, they may not have
3 actual leakage events, because I've read failure events,
4 leakage rates, but sometimes you can infer from the
5 description of the event how large the leak might have
6 been.

7 MR. SHORT: Might have been, right.

8 CHAIRMAN STETKAR: So that if I were
9 thinking about -- even if I was thinking about scaling
10 or however the -- I'm not trying -- I don't know how
11 the experts made their judgments and I don't care.

12 MR. SHORT: Right.

13 CHAIRMAN STETKAR: I do care about what
14 information they had available to them. And it strikes
15 me that having information -- you noted that you tried
16 to explain to them what those failure rates mean and
17 how they were derived. Well, I don't understand what
18 a 2 times 10 to the minus 9 number is.

19 MR. SHORT: (Laughter.)

20 CHAIRMAN STETKAR: I don't.

21 MR. SHORT: Yes. Yes.

22 CHAIRMAN STETKAR: Honestly, I don't --

23 MR. SHORT: It's a small number.

24 CHAIRMAN STETKAR: -- understand that.

25 MR. SHORT: Right. But if I were being

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1 asked to say what's the relative likelihood of getting
2 a 4,500 gallon a minute flow through a break based on
3 the 349 events --

4 MR. SHORT: Right.

5 CHAIRMAN STETKAR: -- that I have that show
6 me whatever they do, because I don't know what they show.
7 I only know that they're characterized as small, and
8 I don't even know what small means in the sense of 6928,
9 because I couldn't find a definition of what small is.

10 MR. KURITZKY: Less than 50 gpm.

11 CHAIRMAN STETKAR: Okay. That's --

12 MR. SHORT: That's kind of written in the
13 original 6928. The update I don't think is real clear.

14 CHAIRMAN STETKAR: Well, but the update
15 just updates the data sheets.

16 MR. SHORT: Yes, that's right. If you went
17 to the original report --

18 (Simultaneous speaking.)

19 CHAIRMAN STETKAR: And I thought I went
20 back to the original and I couldn't even find it in the
21 original, but it might be in there somewhere.

22 MR. SHORT: I think greater than 5, less
23 than 50.

24 CHAIRMAN STETKAR: Greater than 5, less
25 than 50? Okay.

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1 MR. SHORT: I think is my understanding.
2 Okay?

3 CHAIRMAN STETKAR: Okay. But anyway, in
4 terms of -- they weren't given those actual event --

5 MR. SHORT: We did not actually give them
6 those actual events. Yes, I guess maybe that would have
7 been helpful. I'm not sure. Most of those failures are
8 associated with systems -- normal MOVs or CVs and
9 operating environments.

10 CHAIRMAN STETKAR: Well, that was my other
11 question, is if some subset of those events actually
12 applied to valves that are exposed to reactor coolant
13 system pressure --

14 MR. SHORT: Right.

15 CHAIRMAN STETKAR: -- that are exposed to
16 a delta P --

17 MR. SHORT: Right.

18 CHAIRMAN STETKAR: -- whether it's reactor
19 coolant system pressure or for some other reason.
20 Because it's a charging system you have a DP across the
21 valve to see how the leakage rates for those types of
22 valves compare to the general population that was used
23 for these frequencies might have been useful. I just
24 don't know.

25 MR. SHORT: Yes, I guess my --

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1 CHAIRMAN STETKAR: And because we're not
2 looking at 10,000 events, we're looking at -- we're not
3 looking at 6, we're looking at a couple of hundred, 350
4 or so.

5 MR. SHORT: Yes, I guess my perspective on
6 that was is that we have these valve experts that have
7 spent the last 30 years diagnosing and working with
8 industry on why valves fail, trying to determine what
9 caused the failure. In my mind they are well aware of
10 the types of leaks that have caused problems in the past
11 in the industry and have worked significantly with
12 industry in these working groups to help diagnose and
13 solve and improve the reliability of valves. So from
14 my personal perspective they should already have -- the
15 valve experts themselves should have definitely had
16 knowledge about past failures and what were the most
17 significant ones and what were the causes for them and
18 what were the design issues that caused them and that
19 kind of stuff.

20 CHAIRMAN STETKAR: That may be true for the
21 valve experts, but --

22 MR. SHORT: But for the other --

23 CHAIRMAN STETKAR: -- the valve experts
24 don't think in terms of numbers.

25 (Simultaneous speaking.)

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1 MR. SHORT: -- right.

2 CHAIRMAN STETKAR: The PRA experts don't
3 understand valves at all. They think in terms of
4 numbers, but they can look at a population -- a set of
5 evidence; and as I said, I don't know what thought
6 processes they used --

7 MR. SHORT: Right.

8 CHAIRMAN STETKAR: -- and try to
9 extrapolate from that set of evidence. It's a different
10 type of thought process. And --

11 MR. SHORT: Okay. Yes.

12 CHAIRMAN STETKAR: -- I don't know who did
13 what. Okay. Thank you.

14 MR. SHORT: That's a good comment.

15 So our elicitation approach, I'll just
16 quickly go through that. We used the same elicitation
17 form for all experts for each of the different types
18 of parameters we were eliciting. Those are in the
19 report, so you can see what those are and how we laid
20 those out.

21 Basically for the large internal leak we
22 asked the -- we used as a calibration point the
23 NUREG/CR-6928 values for small internal leaks and we
24 asked the experts to elicit -- with that knowledge they
25 could tell us -- they could elicit -- they could give

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1 us the leakage rate for each of the leak sizes in two
2 different ways: One is is they could tell us relative
3 to the 6928 a failure rate, or they could just give us
4 their own failure rate based on their own modeling, or
5 whatever knowledge they had.

6 And so, I guess we felt that that was a
7 reasonable way to do it because, one, it captured the
8 available information about internal leak rates from
9 6928. That's for which significant efforts have gone
10 on over the years to capture.

11 We also felt it was a pretty decent approach
12 for helping the experts understand how the information
13 gets used in a PRA model. And so, while a valve expert
14 may understand how a valve fails and have a general idea
15 that this type of valve is hard to conceive could fail
16 under the kind of conditions we're talking about,
17 putting it into probability terms, they could
18 understand, well, from my knowledge base of past
19 failures and my knowledge base of what kinds of valves
20 are out in the industry or used in the nuclear power
21 plants what -- how would this valve under this kind of
22 condition look different relative to my knowledge base
23 of what's going on and the failure rates that have gone
24 on in -- or failures and valves that have happened in
25 the past. So I think it set a pretty good calibration

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1 point for them.

2 I did want to note we weren't funded to have
3 these experts go off and develop mechanistic failure
4 models. When we talked with these experts, they clearly
5 don't do development of mechanistic-type failure
6 models. Their expertise is in understanding why a valve
7 fails and improving the reliability of them. And so,
8 they're not convinced that you could ever develop a good
9 mechanistic failure model for different failure modes.
10 And so, we did not see how it was possible to elicit
11 out failure rates for each individual type of failure
12 mode, so in the end we went with an aggregated failure
13 mode, failures rates relative to those in 6928. So
14 that's what we did.

15 I thought it worked pretty good. I do not
16 believe that the experts were biased, that that biased
17 them in any way. It helped calibrate them to past leaks
18 and what failure rates those materialized in.

19 And alternatively, the experts could
20 develop their own failure model. A couple individuals
21 did do that, okay, and chose not to do the other method.
22 And again, we elicited for different leak size
23 categories. And we elicited lower bound, best estimate
24 and upper bounds so that we could develop distributions.
25 NUREG-6928 has those, or you can derive those from 6928.

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1 So we used that. And then we elicited for each isolation
2 MOV and CV, so on both the suction valves -- the RHR
3 suction sized MOVs and then the hot leg and cold leg
4 CVs.

5 CHAIRMAN STETKAR: A few questions on this
6 one, Steve. Let me talk about process first.

7 MR. SHORT: Yes.

8 CHAIRMAN STETKAR: When I read the report
9 it said the facilitator asked the expert to provide -- I
10 think it said in sequence a lower bound, a best estimate
11 and an upper bound for each of them. My experience, it's
12 often useful to ask an expert first to say, well, how
13 bad could it be, how good could it be, and what's your
14 basis for how bad and how good could it be? And then
15 based on your thoughts about that, now what might be
16 your best estimate? Oftentimes if you ask someone how
17 good it could be, that immediately biases them because
18 they say, well, my best estimate is it's something higher
19 than that and my worst estimate is, well, it's got to
20 be a lot higher than that.

21 So why did you use this kind of sequential
22 lower bound, best estimate, upper bound elicitation
23 order rather than something that's been tried in the
24 past and in terms of trying to get the experts to first
25 understand the range of their uncertainty and then

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1 provide a best estimate?

2 MR. SHORT: Well, I guess I'd answer that
3 from the perspective that we're talking about failure
4 rates that are 10 to the minus 9 order. So how are you
5 going to elicit from a valve expert something that is
6 almost impossible --

7 CHAIRMAN STETKAR: But --

8 MR. SHORT: -- never been experienced --
9 (Simultaneous speaking.)

10 CHAIRMAN STETKAR: But you weren't asking
11 them, I hope, to give you a 3 significant figure on the
12 order of 10 to the minus 9 or 12, or whatever it is,
13 per hour. You were asking them given what you
14 understand about the failure modes and leakage rates
15 that contribute to that teeny-tiny number, what's your
16 best -- what's your uncertainty and your best estimate
17 about how the leakage -- the likelihood of leakage would
18 decrease given what you understand about how valves
19 work, or don't work?

20 And that's not -- that same question would
21 apply if the absolute leakage rate was 10 to the minus
22 1 per year. Doesn't make any difference what the
23 absolute leakage rate is because my understanding about
24 how the leakage rate would scale and what types of
25 failure modes would contribute in theory should be the

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1 same. It shouldn't depend on what the absolute value
2 of the leakage rate should be.

3 So I hope you weren't asking them understand
4 teeny-tiny numbers, because even the PRA people don't
5 understand those teeny-tiny numbers.

6 MR. SHORT: Well, I think that the -- so if
7 I understand your question correctly, you're suggesting
8 that an expert could -- well, I think what you're asking
9 is is did the experts look at different failure modes
10 and decide which ones are more likely and which
11 ones -- which -- for different leak sizes which
12 might -- what type of failure mode might most cause a
13 different type of leak -- that particular leak size?

14 CHAIRMAN STETKAR: I'm not trying to get
15 even that precise. I'm trying to ask about the process
16 in terms of if I ask an expert first; and I don't care
17 whether I ask him how bad it could be or how good it
18 could be first. I tend to be negative in terms of my
19 outlook on life, so I usually ask people how bad could
20 it be. So if I ask them first how bad could it be and
21 why could it be that bad -- so I get them to think about
22 all the things that could contribute to how bad it could
23 be. And then I say, well, how good could it be and what
24 are all the things that can contribute to that, now I've
25 got them thinking about a range of their knowledge given

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1 the they have available.

2 And then I say, well, now that you've
3 carefully thought about that range of how bad it could
4 be and what contributed to that, how good could it be,
5 what could make it that good, now if you had to bet over
6 that range, where would you bet? And it might not be
7 the midpoint. I might bet now considering everything
8 that it could be closer to how good it could be than
9 just a -- I don't care whether it's a geometric or
10 arithmetic mean or whatever.

11 MEMBER BLEY: Let me just toss in one thing.
12 I agree with John, but for a different reason.

13 Back in the '70s and '80s there was a fair amount
14 of literature where people tried different approaches.
15 And it was pretty well documented if you come in with
16 your best estimate -- I don't know anybody started with
17 a low estimate --

18 MR. SHORT: Yes. (Laughter.)

19 MEMBER BLEY: So even --

20 MR. SHORT: I'm sorry. I'd say that's the
21 way ours started, too, with the least estimate.

22 MEMBER BLEY: Or even if you started with
23 an arbitrary number and tell me how much worse it could
24 be or better, that once you have an anchor point, even
25 if you know it's not a real one, you tend to anchor to

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1 it and have more narrow distributions, where pushing
2 for the extremes tends to expose the uncertainty better.
3 So I think there's a fair amount of literature supporting
4 that point of view. But that isn't what you did, so --

5 CHAIRMAN STETKAR: Yes, and the reason I
6 brought it up was that in the slide presentation in
7 Appendix E on the training exercise --

8 MR. SHORT: Okay.

9 CHAIRMAN STETKAR: -- you went through that
10 seemed to anchor first on the best estimate median
11 value --

12 MR. SHORT: Right.

13 CHAIRMAN STETKAR: -- within an assessment
14 of the uncertainty, but in Section 3.5 of the report
15 where you describe the individual elicitation sections
16 it explicitly says "and for each leak size began with
17 lower bound and proceeded to best estimate and then to
18 upper bound," which is this sequential-type process.

19 MR. SHORT: Yes.

20 CHAIRMAN STETKAR: And what I'm probing is
21 if indeed that's the way that the elicitations were
22 performed, that --

23 MR. SHORT: Yes, I guess the way -- I don't
24 know. I might not have described that quite right. I
25 think the experts tended to focus on the 50 percent

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1 first, right? And I think the intent of that sentence
2 was to say that we elicited each of those data points
3 and we elicited -- and probably what it should say is
4 we elicited in kind of the order that they were most
5 interested in starting with. And usually that was the
6 50 percent. That was kind of the -- yes, well, the 50
7 percent value as their starting point.

8 Now what they did also do; and I think this
9 is the part of your contention, is is that when we looked
10 at the 5 percent and then the 95 percent, there were
11 those experts who felt that they were -- that the 95
12 percent -- well, they didn't all use the same ratio.
13 I should say that. So they didn't say that I came up
14 with a factor of 100 lower for the 50 percent and then
15 we used that also for the 5 percent and the 95 percent.
16 Most of the experts looked at that as -- a 95-percent
17 confidence means I have a sure confidence what the rate
18 is. And so they would have done a higher -- they would
19 have done a different ratio than -- and five percent
20 I think tended -- they tended to look at that kind of
21 the same as a moderate. But, so I guess I do want
22 to say that the experts generally I think started with
23 the moderate and then looked at the 95 percent and the
24 5 percent relative to how they answered the 50 percent.
25 Okay? And so --

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1 CHAIRMAN STETKAR: But I think as Dennis
2 mentioned there's been a lot of work done to show that
3 that type of process tends to underestimate the actual
4 uncertainties compared to a process that first asks the
5 experts to answer the question how bad could it be, then
6 how good could it be, and then what is your best estimate?

7 MEMBER BLEY: And to answer how bad could
8 it be in terms of what are the things that could make
9 it --

10 CHAIRMAN STETKAR: Yes. No, that's --

11 (Simultaneous speaking.)

12 MEMBER BLEY: -- given the high end, given
13 that pseudo-model or something of what are the things
14 that could make this worse, then hitting that anchor
15 point high tends to give you broader uncertainty
16 bounds --

17 MR. SHORT: Okay.

18 MEMBER BLEY: -- and probably more
19 appropriate ones.

20 CHAIRMAN STETKAR: The other question I had
21 related to this is the upper and lower bounds are used
22 quantitatively to represent the 5th and 95th probability
23 percentiles. Given the fact that some of your experts
24 likely have very little background in probability, what
25 sort of training was done to make them aware of the fact

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1 that when you say this is my upper bound, worst case,
2 however you want to characterize it orally, that there's
3 still a five percent probability that things could be
4 worse than that, that it isn't the absolute worst that
5 the world could be or the absolute best that the world
6 could be, there's still on each end a five percent
7 probability that it could be better or worse? Was
8 anything done to sort of orient people that way?

9 I mean, here's where the PRA people who
10 think maybe in uncertainty distributions would
11 intuitively understand that, but maybe not the valve
12 experts.

13 MR. SHORT: The valve kind of experts. Did
14 we -- so I'm trying to think back to our training
15 exercises. I guess we talked about -- we generally
16 talked about distributions when we did the training
17 exercise. We showed how a distribution was developed
18 based on their provided input and laid those out in
19 their -- as part of the second online meeting that we
20 had to kind of talk about those distributions and what
21 they mean, the fact that there are tails on both ends.
22 And so, we used their elicited values to develop that
23 distribution and let them know, I guess, that there were
24 tails on each end, that the distribution didn't end just
25 at 5 percent and 95, or min-max, or whatever. But other

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1 than that I don't think we did much more than that.

2 MR. KURITZKY: Steve, did we ever
3 characterize the 5th or 95th percentiles as being as
4 good or as bad as it could be?

5 MR. SHORT: I don't think we ever
6 characterized it that way. We never characterized it
7 as good or as bad as it could be.

8 MR. KURITZKY: We just talked to it as a 59
9 percent distribution --

10 (Simultaneous speaking.)

11 MR. SHORT: Yes, the 95-percent confidence
12 is what we talked about it as. And so recognizing that
13 you might be able to get worse or you might be able to
14 do better. I mean, so --

15 MR. KURITZKY: Right. So I think the PRA
16 guys, as has been mentioned, would clearly understand
17 that concept. The other guys also being engineers and
18 whatnot, they may not have been as sensitive to it, but
19 I think the concept of having an 95th percent confidence
20 or percentile I think was probably not totally lost on
21 them.

22 MR. SHORT: Well, we wanted to make sure
23 that they weren't coming up with the actual worst case
24 thing that they could think of. I mean, that -- so --

25 CHAIRMAN STETKAR: Okay. I mean, as long

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1 as that was part of the --

2 MR. SHORT: That was part of our discussion
3 of the distribution for the training exercise we had,
4 okay, on distributions and -- which we used the same
5 training exercise that was used in the LOCA analysis,
6 the 2008 LOCA Frequency Report. If I had to do it again,
7 I'd do something different for these distributions,
8 because those elicitations -- that sample problem was
9 more probability is associated with what you'd
10 ordinarily think of, you know, 30-percent, 50-percent,
11 90-percent-kind of thing. Not things like what we're
12 talking about. So we had to do some more discussion of
13 that during our group meeting about what really small
14 frequencies really mean.

15 MEMBER BLEY: I wanted to ask you a little
16 about that because as you said 10 to the minus 9 per
17 hour is a really small number, and as John said, he
18 doesn't know what that means.

19 MR. SHORT: Right.

20 MEMBER BLEY: Well, for me I have to get out
21 my pencil and say, well, there's 10,000 hours in a year
22 and we got 100 plants over 10 years, real rough, so it's
23 about a 10 to the minus 2 over the industry lifetime,
24 which is still pretty darn small.

25 MR. SHORT: That's still small. That's

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1 right.

2 MEMBER BLEY: But putting it into those
3 terms at least I can think about it.

4 MR. SHORT: Yes, I think we talked about it
5 terms of a reactor year, so we went over reactor year
6 and it was still kind of small, right? I don't think
7 we did --

8 MEMBER BLEY: But we've got a lot of reactor
9 years, but still we don't have --

10 MR. SHORT: Right.

11 MEMBER BLEY: -- enough reactor years to
12 have expected to see something this small.

13 MR. SHORT: To have seen one of these,
14 right? Yes.

15 MEMBER BLEY: Yes.

16 MR. SHORT: And we kind of explain that, and
17 we talked about that in terms of what causes deaths.
18 I mean, I think that we put the figure in the report
19 about different -- what's the likelihood of being killed
20 by various types of events, solar flares, that kind of
21 thing, and meteors, whatever, in the end is what we ended
22 up trying to describe that.

23 MEMBER BLEY: I mean, that approach over
24 the life of the industry ought to resonate with guys
25 like the valve guys. I mean, they don't know what a 10

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1 to the minus 9th per hour is, but they know what they've
2 seen and what other people have reported on, and that
3 ought to work better. I'm sorry --

4 (Simultaneous speaking.)

5 MR. SHORT: But what they do know is is that
6 they've never seen one.

7 MEMBER BLEY: Yes.

8 MR. SHORT: And the industry's never seen
9 one.

10 MEMBER BLEY: So that gives you at least an
11 anchor point, yes.

12 MR. KURITZKY: Right. And as Steve was
13 saying, it became clear during the joint meeting that
14 they didn't have a feel for some of these low, very low
15 probability numbers, so I think Mike Zentner had put
16 this -- a chart that talked about cause of death in very,
17 very low numbers to try to calibrate them a little bit
18 on that.

19 But what I wanted to bring up, which I think
20 is almost now becoming moot because we're kind of moving
21 at a slow pace and we have a lot more to go, but there
22 was an option -- we want to put the option on the table.
23 As part of the Level 1 presentation, the closed meeting,
24 we had a couple of slides, just two slides on ISLOCA
25 implementation, how it's in the model and how we use

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1 what came out of the expert elicitation for that, which
2 addresses some of the issues that have been raised
3 throughout this morning.

4 CHAIRMAN STETKAR: Yes, and we'll --

5 MR. KURITZKY: So if we had 10 minutes or
6 so at the end we could throw that up there, but at this
7 point I think it might be --

8 CHAIRMAN STETKAR: We're not going to have
9 that time. We're going to be very lucky --

10 MR. KURITZKY: Yes.

11 CHAIRMAN STETKAR: -- to get through this.

12 MR. KURITZKY: Okay. So let's --

13 (Simultaneous speaking.)

14 CHAIRMAN STETKAR: Let me ask before we get
15 to the results here --

16 MR. KURITZKY: Okay.

17 CHAIRMAN STETKAR: -- because quite
18 honestly it would be good if we get through all of the
19 material, but I think we want to understand the leak
20 stuff, because that's more of the process and important
21 as a contributor also.

22 MR. KURITZKY: Yes.

23 CHAIRMAN STETKAR: You made a note that or
24 you noted that the expert -- the initial elicitations
25 were done with the forms that you provided that showed

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1 leak size and leak rate, and that the leak rates were
2 wrong.

3 MR. SHORT: Right.

4 CHAIRMAN STETKAR: So you went back and
5 you -- and they were wrong on the low end.

6 MR. SHORT: Right.

7 CHAIRMAN STETKAR: So you went back and
8 redid the leak rates to show the range of leak rates
9 that would apply under specific thermal hydraulic
10 assumptions or whatever for that range of sizes, and
11 that as part of the group elicitation everybody went
12 through the process of reevaluating their estimates
13 based on the leak rates. Now I'm a leak rate kind of
14 guy. I'm not a leak size kind of guy --

15 MR. SHORT: Right.

16 CHAIRMAN STETKAR: -- because I -- so --

17 MR. SHORT: We have --

18 (Simultaneous speaking.)

19 CHAIRMAN STETKAR: -- it would have
20 probably affected me quite a bit, but that's just me.
21 I'm curious how much it actually affected the experts
22 when you went back?

23 MR. SHORT: It did not affect the valve
24 experts because they think in terms of leak size --

25 CHAIRMAN STETKAR: Okay.

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1 MR. SHORT: -- rather than leak rate.

2 CHAIRMAN STETKAR: All right.

3 MR. SHORT: Okay? I'd say that two experts
4 changed their evaluations as a result of the revised
5 leak rate.

6 CHAIRMAN STETKAR: Leak rates?

7 MR. SHORT: Okay? So it certainly
8 affected one expert specifically --

9 CHAIRMAN STETKAR: Okay.

10 MR. SHORT: -- because he was relying upon
11 those to come up with his failure probabilities.

12 CHAIRMAN STETKAR: Yes, okay.

13 MR. SHORT: So --

14 CHAIRMAN STETKAR: Okay. That's good
15 enough to keep us kind of --

16 (Simultaneous speaking.)

17 CHAIRMAN STETKAR: That was a curiosity.

18 MR. SHORT: So basically the way we
19 compiled results is we took the individual expert's
20 results and developed distributions. So basically for
21 each leak size/leak rate category for each valve. And
22 for each expert we developed these distributions. For
23 large internal leak rate we used the gamma distribution
24 function primarily. We did look at other
25 distributions. For these low failure rates it didn't

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1 make any difference, so we used the historical gamma
2 distribution. That's what people usually use for large
3 internal leak rates.

4 We then took the individual results,
5 combined those into a single mixture distribution that
6 my peer here Kevin can discuss, if you've got specific
7 questions on that.

8 Basically we ended up deciding and
9 combining those into a mixture distribution. We ended
10 up using the same method as was used in NUREG-1150, which
11 was an arithmetic average of the individual probability
12 distributions. And you'll see that in 1150 they talk
13 about some of the positive and negatives of that
14 approach. Generally we kind of picked it because it
15 results in more conservative 95th percentile extremes,
16 okay, because the extremes dominate. So that's kind of
17 why it worked for us. We decided it worked for us.

18 So after we developed that mixture
19 distribution, we reported it in two different ways.
20 Because that mixture distribution is not in a form that
21 can be expressed in an algorithm, we provided the tables
22 in an appendix for that mixture distribution. But
23 because we want to use the results for a PRA use, we
24 also fit a gamma distribution to that mixture
25 distribution and reported that.

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1 CHAIRMAN STETKAR: Okay. If you go to
2 the -- I'll let you get this --

3 MR. SHORT: Slide.

4 CHAIRMAN STETKAR: You're essentially
5 through this slide?

6 MR. SHORT: Yes, I'm essentially through
7 it.

8 CHAIRMAN STETKAR: So flip to the next one,
9 because it's got pictures on it.

10 MR. SHORT: Okay.

11 CHAIRMAN STETKAR: And I like pictures.

12 MR. SHORT: Yes.

13 CHAIRMAN STETKAR: So the first thing you
14 did is the experts gave you best estimate upper and lower
15 bounds and you fit a gamma distribution to
16 those --

17 MR. SHORT: Right.

18 CHAIRMAN STETKAR: -- because you like to
19 do that.

20 MR. SHORT: Right.

21 CHAIRMAN STETKAR: And then you did a
22 mixture distribution, the green picture here, of those,
23 which was weighting each -- if you had n distributions,
24 you weighted each of those distributions by one over
25 n and merged them.

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1 MR. SHORT: Yes, basically.

2 CHAIRMAN STETKAR: And the green
3 distributions are back in Appendix M where you give the
4 100-bin histograms.

5 MR. SHORT: Yes.

6 CHAIRMAN STETKAR: So aside from the fact
7 that you have fit a gamma to each of the experts, the
8 green stuff is in principle the pure merged results?

9 MR. SHORT: That's correct.

10 CHAIRMAN STETKAR: Okay.

11 MR. SHORT: Yes.

12 CHAIRMAN STETKAR: And then you fit a gamma
13 distribution to the green, which is the red on this
14 picture.

15 MR. SHORT: That's right.

16 CHAIRMAN STETKAR: And if I look at the red
17 on the picture on the left, I notice that its uncertainty
18 is quite a bit less than the green.

19 MR. SHORT: Yes.

20 CHAIRMAN STETKAR: And hence, the mean
21 value of the red is less than the mean of the green.
22 And in fact, I actually did it for one thing and it's
23 a factor of about one-and-a-half less --

24 MR. SHORT: Okay.

25 CHAIRMAN STETKAR: -- than the mean of the

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1 green.

2 So my question is why are we doing this?
3 You said, well, because we want to use it in a PRA model.
4 Well, in a PRA model I want to use the best evidence
5 available. And I got a 100-bin histogram back in
6 Appendix M for each of those things, given the constraint
7 that I fit each expert by a gamma, but at least I'm merged
8 those gammas and just reported the results. Why for a
9 PRA do we need a gamma distribution that reduces the
10 uncertainty and gives me a smaller mean value?

11 MR. SHORT: Well, I guess our logic is is
12 that --

13 CHAIRMAN STETKAR: Well, I'll ask Alan --

14 MR. SHORT: Okay.

15 CHAIRMAN STETKAR: -- because Alan's the
16 PRA guy.

17 MR. SHORT: Okay.

18 CHAIRMAN STETKAR: Alan's got to use this
19 stuff.

20 MR. KURITZKY: I honestly don't even say
21 that. I mean, we've used the numbers that are in the
22 table. I couldn't even tell you exactly --

23 CHAIRMAN STETKAR: Alan -- turn your mic
24 on, Alan --

25 MR. KURITZKY: Oh.

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1 CHAIRMAN STETKAR: -- because --

2 MR. KURITZKY: Sorry. I couldn't even
3 tell you if those numbers I used came from the green
4 or the red distribution. All I know is we used the
5 numbers that are in the table in our model. And so
6 whether they should come from the green or the red --

7 CHAIRMAN STETKAR: Yes, well, they came
8 from -- the numbers on this slide came from the red
9 distribution.

10 MR. KURITZKY: That's correct. That's
11 correct.

12 CHAIRMAN STETKAR: And I will tell you that
13 the 1.94E to the minus 9 for the first line item on
14 there -- if I go back to the green stuff in Appendix
15 M -- now, granted the fact that I didn't do a continuous
16 differentiation of the smooth curve -- so I just did
17 s step-wise differentiation -- I can't quickly find my
18 number here, but it comes to be 2.6, or something like
19 that. Big difference? I don't know. It's roughly a
20 factor of one-of-a-half different.

21 MR. KURITZKY: Yes.

22 CHAIRMAN STETKAR: I only did it for one
23 because I just wanted to make the point that we're now
24 suddenly fitting a smooth-form distribution to
25 something that we have already. It's not something that

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1 you didn't have. You have it already in Appendix M. You
2 can calculate a mean value because it's a 100-bin
3 histogram from Appendix M, if you just want a mean value.
4 And if you look at all of the curves in the report,
5 Alan -- this is for Alan.

6 MR. KURITZKY: Yes.

7 CHAIRMAN STETKAR: If you look at all of the
8 curves in the report, they all behave this way such that
9 the fitted gammas are narrower than the pure -- I'll
10 call them the distributions in Appendix M. They're all
11 narrower. And hence, the uncertainties will be narrow
12 and the mean values, because these tend to be very, very
13 broad distributions, things that people don't realize
14 unless you carefully look at this is the hash marks on
15 the X-axis are two orders of magnitude. They're not
16 even single order of magnitude.

17 MR. KURITZKY: Right.

18 CHAIRMAN STETKAR: So these are really
19 broad distributions. They tend to have -- this one in
20 particular has a factor of -- in the green a factor of
21 1,600 between the 5th and 95th percentiles. So they're
22 really broad distributions. When I reduce it to the
23 gamma, it's a factor of 1,090, if you want to be precise.
24 But it's reduced considerably 5th through 95th.

25 MEMBER BLEY: I think it's a good question

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1 for Alan. I would ask Steve, though, when you said
2 because we're going to use it in a PRA, you wanted a
3 parametric distribution that you could --

4 MR. SHORT: Well, the thing is is in a PRA
5 if you're going to -- yes, if you want to do an
6 uncertainty analysis on your results, right --

7 (Simultaneous speaking.)

8 CHAIRMAN STETKAR: But don't say in
9 a -- maybe using the tools we use for calculating PRA
10 at PNNL we have to have gamma distribution or some
11 parametric distribution. That's what I think you're
12 saying.

13 MR. SHORT: I'm saying generally that in
14 CAFTA-type models, okay, the general use is gamma
15 distributions, beta distributions --

16 (Simultaneous speaking.)

17 MEMBER BLEY: Well, gamma --

18 CHAIRMAN STETKAR: Can CAFTA take a
19 histogram?

20 MR. SHORT: I am not aware of that CAFTA can
21 take a histogram.

22 CHAIRMAN STETKAR: Well, boy, that's a
23 pretty rotten --

24 (Simultaneous speaking.)

25 MR. SHORT: Okay. So --

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1 (Simultaneous speaking.)

2 MR. SHORT: Well, SAPPHIRE can.

3 CHAIRMAN STETKAR: SAPPHIRE can?

4 MR. KURITZKY: So even though you're not
5 directing the question at me, I'm not the person to
6 answer it, because I don't have background in that area,
7 but I'm hoping that John Schroeder, INL, can shed some
8 light.

9 John?

10 MR. SCHROEDER: Yes, John Schroeder, Idaho
11 National Lab. The tendency to resort to gamma
12 distributions is for downstream users that like to do
13 Bayesian updates. There is no other reason than that.

14 The quantification tools can use about any
15 distribution that you might choose. So we could have
16 made use of any value that you had come up with.

17 MEMBER BLEY: So can a Bayesian update.

18 CHAIRMAN STETKAR: Yes, but by the way, I
19 have -- I can't give it to you because it was developed
20 by the company that I used to work for, but I see a
21 Bayesian update here that I can do on a histogram. It's
22 not so good if I got a three-bin histogram. It's a lot
23 better if I have a 100-bin histogram. It would be more
24 analytically different -- I was going to use the term
25 "precise," but that's not the right word to use. If I

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1 knew that the thing was a pure form analytical
2 function --

3 MEMBER BLEY: And there are more tools than
4 the one from your former place. And in fact, in the NRC's
5 own handbook for parameter estimation it gives a very
6 nice Bayesian analysis tool that will do any kind of
7 distribution you want.

8 MR. SCHROEDER: All right.

9 MR. KURITZKY: I will mention just to keep
10 things in perspective that if the mean is off by a factor
11 of 1.5, these ISLOCA contributions that we have in our
12 study right now I'm not really going to lose a lot of
13 sleep --

14 (Simultaneous speaking.)

15 CHAIRMAN STETKAR: No, no, but --

16 MR. KURITZKY: But whether or not it's --

17 (Simultaneous speaking.)

18 CHAIRMAN STETKAR: It might be 1.5 times 1.5
19 times 1.5. Okay? You're multiplying all of these
20 things together.

21 MR. KURITZKY: Right. So --

22 CHAIRMAN STETKAR: So be careful because
23 three times a factor of 2 is almost a factor of 10. Two
24 times two times two.

25 MR. KURITZKY: And as you mentioned, that

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1 there -- what was the range? It was 1,600 between the
2 lower and the upper?

3 CHAIRMAN STETKAR: Sixteen hundred from
4 the lower to the upper in -- just all I'm focusing on
5 is the 0.8 to 2 distribution, because that's the only
6 one I looked at. In the green curve in Appendix M the
7 ratio is 1,600.

8 MR. KURITZKY: So I think that --

9 CHAIRMAN STETKAR: They show on the red
10 curve is 1,090. They're still both very broad
11 distributions.

12 MR. KURITZKY: Right.

13 CHAIRMAN STETKAR: But if you look at it,
14 the differences -- and if you look at all of the pictures
15 in the report, the biggest differences are on the upper
16 bound tails, and the upper bound tails have the biggest
17 effect in these skewed distributions on the mean values.
18 So the worst we do -- if we try to do really, really
19 good in the median down to the zeroth percentile, we
20 aren't affecting the mean at all. If we try to do really
21 good on the upper bound, we affect the mean quite a bit.

22 MR. KURITZKY: Yes, so I'm not a
23 statistician. I can't give you an educated answer on
24 why we should use one or the other. The arguments you
25 make seem sound to me, and we take that feedback. I mean,

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1 we'll take that back. But we've used those values. How
2 much is that going to affect the results of the analysis?
3 I can't tell you. I still don't think it's going to make
4 a huge difference in terms of risk insight, but I agree
5 that --

6 CHAIRMAN STETKAR: My point is that you
7 don't need to create any new information. You have it
8 already in the report. So when you say I don't know how
9 much difference it's going to make, I'll say use the
10 information that is the actual results from the expert
11 elicitation, which is in this sense the green curve or
12 the tabulated distributions back in Appendix M. You
13 don't have to create anything more. You don't have to
14 say, well, if I used this other stuff it wouldn't make
15 much difference. Just use it. You have it available.
16 You don't need to create it from anything. It's there.

17 MR. SHORT: Right, and we'll take that
18 feedback and consider that.

19 MEMBER BLEY: But remember, this isn't the
20 ACRS speaking. These are --

21 (Laughter.)

22 MEMBER BLEY: I would at least take a lesson
23 home that there isn't a whole lot of reason to fit a
24 distribution that you don't need to do if it's going
25 to skew your answer, particularly if it's going to skew

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1 the mean.

2 MR. SHORT: Which it does a little bit, yes.
3 We worked a lot on that distribution, too, that fit
4 distribution.

5 (Laughter.)

6 CHAIRMAN STETKAR: Well, I know. There's
7 a lot of discussion about them and I know that a lot
8 of work was put into it and it --

9 MR. SHORT: It's a hard thing to come up
10 with.

11 CHAIRMAN STETKAR: Yes.

12 MR. KURITZKY: Okay. Duly noted.

13 MR. SHORT: Now, but it is -- and, yes, so
14 I'd have to think about -- we were asked to develop a
15 total failure rate distribution. And so we used those
16 best-fit distributions to do that. And you can see that
17 that also narrows the --

18 (Simultaneous speaking.)

19 CHAIRMAN STETKAR: Yes, that's --
20 there's --

21 MR. SHORT: So that was kind of a hard thing
22 to do, but -- and if you want to get into how we did
23 that, I'm not sure how we do it. I guess we might be
24 able to do it from the basis data. I'd have to think
25 about that. I guess I'd let my probability guys help

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1 me figure out how to take the green curve and create
2 a total distribution, because we -- that's --

3 CHAIRMAN STETKAR: You'd probably have
4 to -- it's -- we don't have the time to do that --

5 MR. SHORT: Right. Right.

6 CHAIRMAN STETKAR: -- in terms of trying to
7 solve the problem.

8 MR. SHORT: Right.

9 CHAIRMAN STETKAR: I think you'd have to
10 step back to the individual distributions for each of
11 the size ranges.

12 MR. SHORT: Well, yes.

13 CHAIRMAN STETKAR: Right, because
14 it's -- the blue curve is intended to be the -- I don't
15 know, the multiplier or the total failure rate --

16 MR. SHORT: Right. That's right. That's
17 right.

18 CHAIRMAN STETKAR: -- for any size greater
19 than --

20 MR. SHORT: Right.

21 CHAIRMAN STETKAR: -- 0.8 inches in this
22 case.

23 MR. SHORT: So, yes, I guess fundamentally
24 if you kind of conclude on this slide here, what's
25 interesting is is the large failure rate in 6928 to the

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1 2010 update not much different than our total -- the
2 mean from our total distribution after we've added them
3 all up. So it was kind of an interesting conclusion even
4 though our distribution is pretty wide on it.

5 Moving onto the conditional probability of
6 failure of a second valve given failure of the first
7 valve. I'll quickly go through some of this because
8 it's kind of redundant. Again, we use the same
9 elicitation form for all experts. I do want to focus
10 on this point a little bit. We originally planned to
11 try and elicit common cause failure probabilities, and
12 that was the way the forms were originally set up. And
13 so if you look in the training sessions back there,
14 that's the way they were set up. After the group
15 together the -- in last June, the team got together.
16 They kind of came to a consensus that common cause
17 failure didn't make a lot of sense for these type of
18 failure modes. Wasn't really a failure mode-type thing
19 for these ISLOCA-type of events because the valves are
20 not regularly operated during operation. They're
21 pretty much static.

22 But we did define a -- there was agreement
23 that you might have some sort of increased probability
24 of the second valve failing as a result of the first
25 valve failing due to a pressure spike or some impact

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1 upon the second valve. And so, we changed our method.
2 We changed what we were listening here to just a
3 conditional probability of failure given that the first
4 valve failure -- the conditional probability that the
5 second valve fails given that you had the first valve
6 fail. And the experts consolidated, I guess, around
7 that thought.

8 Then so we revised the elicitation to
9 reflect that. Then that was a totally open elicitation.
10 There was nothing to benchmark to or to calibrate to,
11 or anything like that. So we also did the 5, 95 and 50
12 percent distribution on that.

13 CHAIRMAN STETKAR: Steve?

14 MR. SHORT: Yes?

15 CHAIRMAN STETKAR: On this, when I read
16 through the -- I got really confused on the common cause
17 stuff.

18 MR. SHORT: Okay.

19 CHAIRMAN STETKAR: And because of the time
20 constraints I'll just cut to one of the issues that I
21 wanted to raise.

22 When I read through it, it seemed to say
23 that you asked the experts to give you a conditional
24 probability of failure of the second valve as a function
25 of leakage rate through the second valve without regard

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1 to the leakage rate of the first valve. Is that correct?

2 MR. SHORT: No, we based it on the leakage
3 rate of the first valve.

4 CHAIRMAN STETKAR: Okay. That didn't
5 come --

6 MR. SHORT: Okay.

7 CHAIRMAN STETKAR: When I read the report,
8 it didn't --

9 MR. SHORT: I probably need to -- I need to
10 make --

11 (Simultaneous speaking.)

12 CHAIRMAN STETKAR: Because if I was
13 thinking about it, I would think that the
14 conditional -- but I don't know about valves -- that
15 the conditional probability for failure of the second
16 valve would be less perhaps if I had a smaller leak
17 through the first valve compared to a very large leak
18 through the first valve.

19 MR. SHORT: So, yes -- so --

20 CHAIRMAN STETKAR: And it didn't --

21 MR. SHORT: Come across.

22 CHAIRMAN STETKAR: -- come across when I
23 read the report.

24 MR. SHORT: Okay. So if you'll look at the
25 elicitation sheets, you'll see that what we do is for

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1 each failure rate, each failure size we elicit
2 conditional probabilities for any failure size given
3 that failure size. And then we move to the next failure
4 size and we elicit failure rates for that size.

5 CHAIRMAN STETKAR: Oh, okay.

6 MR. SHORT: Okay? So --

7 (Simultaneous speaking.)

8 CHAIRMAN STETKAR: Yes, so you do it for
9 each size? Yes, okay.

10 MR. SHORT: That's what we did.

11 CHAIRMAN STETKAR: Okay.

12 MR. SHORT: And maybe I need to make it --

13 CHAIRMAN STETKAR: Okay.

14 MR. SHORT: -- expand --

15 (Simultaneous speaking.)

16 CHAIRMAN STETKAR: Yes, you're right.
17 You're right.

18 MR. SHORT: Okay?

19 CHAIRMAN STETKAR: You're right. Okay.
20 Good. Thanks. That helps. Thank you.

21 MR. SHORT: Yes. Let's see. Oh, and just
22 the final bullet there. We did elicit for each pair of
23 isolation MOVs and CVs in the RHR and SI system. So we
24 used basically the same valves that we looked at from
25 an independent failure point of view. We now looked at

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1 them in pairs.

2 So the results. Same thing. We did the
3 same thing as we discussed earlier. We did each valve
4 design, each leak size category, each expert developed
5 distributions. We used the gamma again. We did look
6 at other distributions again. There was no difference
7 because the failure rates were all -- I mean, the
8 conditional probabilities were always a lot lower than
9 one. And so, basically the beta and gamma
10 distributions, the log-normal distributions, they all
11 kind of -- they basically became the same, between the
12 5 and 95 percent anyway.

13 Again, when we combined them into a single
14 mixture distribution, we used that arithmetic average
15 of the individual probability distributions. I will
16 note that there was a lack of spread sometimes for these.
17 Some of the experts really didn't give us a spread on
18 this. And so we did some mathematical manipulations to
19 try and incorporate their input into the distributions.
20 And we can talk a little bit about that, what I call
21 additional data handling.

22 We tried to put a spread around the -- so
23 that we didn't have these -- or 90-degree changes in
24 the curves. Okay?

25 CHAIRMAN STETKAR: Did you -- again,

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1 because of time, I disagree with perturbing my -- if
2 I'm an expert, I wouldn't want somebody going in and
3 saying that my uncertainty in my estimate is based on
4 the average of the other people who expressed their
5 uncertainties two sigma.

6 MR. SHORT: Okay.

7 CHAIRMAN STETKAR: That would bother me an
8 awful lot.

9 MR. SHORT: Okay.

10 CHAIRMAN STETKAR: Did you go back and ask
11 each of the experts who did not provide uncertainty
12 bounds about why they didn't?

13 MR. SHORT: We -- well, yes, of course.

14 CHAIRMAN STETKAR: because they might have
15 had --

16 MR. SHORT: What we discussed with them was
17 is that -- well, I guess what we pointed out is that
18 developing distributions is really hard when you don't
19 have anything to put a distribution on. (Laughter.)
20 And so we did kind of pursue that a -- we did try to
21 pursue that in the context of if you thought that you
22 had a -- so I'll just kind of start
23 -- most of the experts, they kind of thought from a median
24 or a -- not median perspective. That's kind of where
25 their starting point was, right? And so, we

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1 specifically would ask them, well, so -- and discuss
2 with them when you look at a 95 percent, that implies
3 that you have greater -- whatever you're going to give
4 us there gives you greater confidence that your end
5 result is pretty good, right? It's pretty -- you have
6 pretty high confidence.

7 And so, do you really -- we would ask the
8 question do you want to keep that value that you put
9 in there? The same as what you've had for your median
10 value or mid-value, do you want to keep that as your
11 95 percent? So we questioned them about it.

12 CHAIRMAN STETKAR: Okay. Suppose --

13 MR. SHORT: And most of the times --

14 CHAIRMAN STETKAR: -- you asked me and I
15 said hell, yes, I do for the following reasons, and I
16 also want to keep the 5th percentile the same value --

17 MR. SHORT: Yes, right.

18 CHAIRMAN STETKAR: -- for the following
19 reasons. Why then when you did your mathematical
20 perturbations did you then tell me that I can't think
21 that way? And how would that affect the overall results
22 if you kept my distribution as I'll call it extremely
23 narrow? Because it might not make it -- I don't know
24 whether -- I don't know numerically how it would affect
25 the results, because all I see is the results from those

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1 expanded distributions merged together and then with
2 a gamma distribution fitted to it.

3 MR. SHORT: Yes, I guess the only answer I
4 can really give to that is in order to develop a mixture
5 distribution it was --

6 CHAIRMAN STETKAR: You could have
7 developed a mixture distribution treating me though
8 as --

9 MR. SHORT: Line?

10 CHAIRMAN STETKAR: -- a line. I mean, if
11 I'm an accepted expert and I'm adamant about the fact
12 that there are real physical reasons; because you've
13 asked me about this now, why the uncertainty is in this
14 case exceedingly narrow, but very narrow, why not treat
15 me that way?

16 MR. SHORT: Kevin?

17 MR. ANDERSON: Sure. Kevin Anderson,
18 PNNL. If you look at the next picture, it looks like -- I
19 was actually when I saw this surprised to see that those
20 two straight up and down designs --

21 (Simultaneous speaking.)

22 CHAIRMAN STETKAR: I was, too, and I didn't
23 have enough time to go examine where --

24 (Simultaneous speaking.)

25 MR. ANDERSON: Yes, I didn't do these

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1 calculations, but that's -- the effect of the straight
2 lines --

3 CHAIRMAN STETKAR: Yes.

4 MR. ANDERSON: -- is causing those -- well,
5 usually a mixture distribution will be kind of humpy.
6 But of course when you have these straight up and down
7 things, it starts becoming step-like, the mixture
8 distribution.

9 MEMBER BLEY: And when they're the high
10 estimates, I guess.

11 MR. SHORT: That's right. Yes, that's
12 right. They are. That's right.

13 CHAIRMAN STETKAR: That's why I was
14 surprised, because I saw this in the results. And I ran
15 out of steam. Because I read what was done -- I would
16 have expected to see no vertical lines based on what
17 I read was done. I would have expected to see three or
18 four distributions having the same uncertainty range --

19 MR. SHORT: Right.

20 CHAIRMAN STETKAR: -- on a relative sense.
21 Which actually I did when I went and looked at the
22 individual results. I saw three distributions that had
23 basically the same factors between the 5th and the 95th.

24 MR. SHORT: Right. Right.

25 CHAIRMAN STETKAR: They were shifted a

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1 little bit based on what the best estimate was. So I
2 was surprised to see the vertical lines and I didn't
3 go --

4 MR. SHORT: So I guess we'll take that back
5 as a comment. I'll talk with Don about --

6 MEMBER BLEY: I'm just going to mumble once
7 more about the thing I said earlier. If in fact you'd
8 ask people to talk about, think about, build a little
9 model about what could make this --

10 MR. SHORT: Yes.

11 MEMBER BLEY: -- as bad as possible. And
12 then they first estimate the higher end, they're almost
13 forced into thinking about what it would be like under
14 other conditions. In fact, that's exactly the way the
15 elicitation was done for 1150 twenty years or more ago.
16 That isn't what you did. So now you're stuck with
17 something like this or some kind of machinations. Did
18 you feed back what you -- I know you gave them the report,
19 but did you specifically say, hey, expert No. 3, look
20 what we did to your distribution?

21 MR. SHORT: We did share with them their
22 individual distributions. We had experts who were not
23 willing to go off of the straight line. (Laughter.)

24 MEMBER BLEY: Okay. Even when you showed
25 them what you did, they said I don't like that? So you

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1 kind of didn't accept their comment about their own
2 judgments? (Laughter.) Okay.

3 CHAIRMAN STETKAR: I'll just say on the
4 record if I was one of them, it would have really pissed
5 me off.

6 (Laughter.)

7 MEMBER POWERS: We did not have that
8 problem in 1150 that I recall.

9 MEMBER BLEY: Well, at least what they did
10 on the internal event side was -- I forget what they
11 called them, but they had everybody for each issue lay
12 out a little model of what are the things that could
13 make this worse? Rather than just saying what's your
14 best estimate for this and how much higher could it be,
15 that forced you to think about what are the things that
16 could make this different? And once you do, you're
17 almost forced into a distribution.

18 MEMBER POWERS: Yes.

19 MEMBER BLEY: So, no, they didn't have that
20 problem.

21 MEMBER POWERS: Yes, we didn't -- I
22 mean --

23 MEMBER BLEY: And I didn't follow the Level
24 2 side of it too much, so I --

25 MEMBER POWERS: Well, when the --

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1 MEMBER BLEY: But I think they did it the
2 same way.

3 MEMBER POWERS: Exactly the same way. And
4 then when they asked -- when they produced their final
5 distributions, they asked does this adequately
6 reflect --

7 MEMBER BLEY: Yes, what you --

8 MEMBER POWERS: -- your view on things?
9 And I think what happened is that if that cumulative
10 distribution included the high side that the high people
11 like, then it was okay. And if it included the low region
12 that the low people like, they said that was okay. And
13 we didn't -- we never got into violent disagreements
14 about the resulting final distribution as --

15 MEMBER BLEY: Now, I do have a
16 counter-example, and I think I can't say exactly what
17 it was, but it was done for the Department of Energy.
18 It was done in the area of proliferation and physical
19 protection. And they did a giant elicitation and then
20 they did multiple machinations. And then they
21 published the report and several of the experts
22 disavowed the report as being nonsense later. You don't
23 want that.

24 MR. SHORT: Yes, we didn't have that
25 problem and --

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1 MEMBER BLEY: They bought in, I mean, yes.

2 MR. SHORT: And they bought into what we
3 did, but like Kevin says, I can't quite explain the text
4 in the report and the figure that we're seeing here
5 either, so --

6 CHAIRMAN STETKAR: And as I said, I looked
7 at some of the individual distributions and I didn't
8 try to derive everything.

9 MR. SHORT: Right. Right.

10 CHAIRMAN STETKAR: It's not productive.
11 But I did notice that the ranges of uncertainties
12 for -- I'm going to say three; I don't remember --

13 MR. SHORT: Yes. Yes.

14 CHAIRMAN STETKAR: -- looked like the same.
15 And from what I read in the report, at least the words,
16 it said it -- okay, these must be the people that had --

17 MR. SHORT: Right.

18 CHAIRMAN STETKAR: -- that average
19 uncertainty essentially applied to it. And then as you
20 said, I did -- then I looked at these curves and said,
21 well, gee, the --

22 MR. SHORT: Just something a little
23 different, yes.

24 CHAIRMAN STETKAR: It's something
25 different.

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1 MR. SHORT: Yes. So, yes, we'll have to
2 take that back and I'll have to ask Don about it. So
3 I'll see what he did.

4 CHAIRMAN STETKAR: Okay. Let's --

5 MR. SHORT: Because my -- yes, the way he
6 explained it to me is is he needed to go off of the
7 straight line in order to really make the distribution
8 work.

9 CHAIRMAN STETKAR: Maybe he did for some
10 sort of --

11 MR. SHORT: I need to ask --

12 CHAIRMAN STETKAR: -- math that he was most
13 familiar with, but one does not need to do that in an
14 absolute sense.

15 MR. SHORT: Okay.

16 CHAIRMAN STETKAR: I'm going to let us run
17 until 12:15, and no later than 12:15. I need to ask for
18 public comment. So need to wrap up everything by -- in
19 the next 10 minutes or so, 10 to 12 minutes. We're not
20 going to get through all your slides, obviously.

21 MR. SHORT: Oh, we're almost there.

22 CHAIRMAN STETKAR: Yes. Sure. I have to
23 set that time limit because we have other constraints.

24 MR. SHORT: I guess this table is intended
25 to show kind of how the -- you know, if you're going

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1 to compare the conditional probability thing to -- or
2 conditional probability failures, second failure,
3 second valve failure to let's say the alpha factor model
4 for conditional failure probability, this is kind of
5 how it would rack up. We're on the order of the
6 conditional failure probability for the pathways would
7 be 50, 100 -- a factor of 50 less than if you added up
8 all the sequences for the common cause failure model.
9 So we are somewhat -- it'll be less in the end. That's
10 all that's intended to show, trying to do a comparison.

11 So the failure to close probability. I
12 don't have anything really new to report on this.
13 Again, we used -- we calibrated the team to the failure
14 to close probability that's currently in 6928. That's
15 of course contains all data that's in the database.
16 What we're looking at is is potentially having to close
17 a valve against a differential pressure that it was not
18 designed to close against in order to isolate the ISLOCA.
19 And so, that's just a reference point.

20 We use the same I guess --

21 MEMBER BLEY: I wanted to correct that a
22 little.

23 MR. SHORT: Okay.

24 MEMBER BLEY: I think specifically it was
25 intentionally designed not to be able to open at those

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1 pressures, which means it's very unlikely to be able
2 to close.

3 MR. SHORT: That's correct. Yes, that
4 would be another way to say it.

5 MEMBER BLEY: But it was designed so that
6 it wouldn't be accidentally opened while you were at
7 power?

8 MR. SHORT: You're talking about -- I'm not
9 sure you're talking about the same valves I'm talking
10 about.

11 MEMBER BLEY: Oh, okay.

12 MR. SHORT: Okay? I'm sorry.

13 MEMBER BLEY: Not the RHR?

14 MR. SHORT: No.

15 CHAIRMAN STETKAR: No, these are
16 not -- these are other motor-operated valves.

17 MEMBER BLEY: I'm sorry.

18 CHAIRMAN STETKAR: These are flow paths --

19 MEMBER BLEY: Okay.

20 CHAIRMAN STETKAR: -- that are normally
21 open that need to close that were designed to close under
22 like 200 pounds differential pressure --

23 MR. SHORT: That's right. That's right.

24 CHAIRMAN STETKAR: -- or something like
25 that that now need to close under 2,000 pounds

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1 differential pressure.

2 MR. SHORT: Well, we wanted to see if we
3 might be able to credit them in some ways, right --

4 CHAIRMAN STETKAR: Yes, yes, yes.

5 MR. SHORT: -- to mitigate the ISLOCA. So,
6 let's see. Okay. So again we used the 6928 value as
7 a calibration point for the experts to elicit against.
8 We did different categories of differential pressure,
9 and so we looked at 1,000, 1,500, 2,000 psi differential
10 pressure across that valve. We did 5, 95 and 50 percent
11 again. And we elicited for each of the normally open
12 MOVs that could be potentially used to isolate the
13 ISLOCA. And there are just two of them.

14 And then the results are for this one here,
15 we did use a beta distribution functions for this because
16 we wanted it to stop at one as our top probability. For
17 the mixture distribution again we used the arithmetic
18 average. And we also developed distribution tables, so
19 we did the same thing. Okay? We developed a -- we put
20 a beta best fit around that distribution.

21 And here are the results. You can see that
22 it's an interesting distribution because we had some
23 people say it would absolutely fail and we had others
24 that said it would not fail. Okay?

25 (Laughter.)

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1 MR. SHORT: So we were trying to combine
2 those, which is kind of difficult, but -- and then the
3 results showed that -- and you can see over there the
4 comparison to the 2010 update that that failure rate,
5 the mean failure rate probability definitely going up.
6 And in some cases at 2,000, 2,700 psi it definitely
7 valuated by most of the experts to fail, but obviously
8 there's one expert who -- given the results didn't think
9 it would necessarily fail.

10 CHAIRMAN STETKAR: I think one expert
11 thought it would get better, didn't --

12 MR. SHORT: One expert thought it would get
13 better. Now we actually dropped him out
14 because --

15 CHAIRMAN STETKAR: Yes.

16 MR. SHORT: -- because he evaluated himself
17 as not an expert. But he did give a reasoning for his
18 thought basis there.

19 CHAIRMAN STETKAR: Yes.

20 MR. SHORT: Okay?

21 MR. KURITZKY: So one thing just to quickly
22 mention and going along with one of those expert's idea
23 was that the differential pressure when you first start
24 can be the, say, system pressure on one side and very
25 low pressure on the other side. But once you actually

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1 have the break of outside containment, you start to
2 depressurize. And you really don't need to isolate the
3 break until sometime afterwards. And so pressure will
4 start coming down fairly rapidly depending on the size
5 of the ultimate ISLOCA break. And so the bigger isn't
6 so much -- well, I mean, this is a big issue coming up
7 with these failure probabilities, but also from a
8 modeling point of view is what differential pressure
9 do you assume when we stick our value into our PRA?

10 CHAIRMAN STETKAR: Right.

11 MR. KURITZKY: And that was something we
12 had to wrestle with because even if we could do a
13 calculation to show that we had enough time, that
14 pressure would come down very low, and so we could use
15 a fairly lower failure probability. But the thing is
16 that they may attempt to close it earlier on, and
17 depending on the design of the valve and the -- they
18 made damage the valve enough when they first attempt
19 it that when they want to go back to do it later, they
20 may --

21 (Simultaneous speaking.)

22 CHAIRMAN STETKAR: Sure, you could --

23 MR. KURITZKY: Yes, so --

24 CHAIRMAN STETKAR: But the torque limits
25 are going to --

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1 MR. KURITZKY: Right.

2 CHAIRMAN STETKAR: -- trip out on you
3 and --

4 (Simultaneous speaking.)

5 MR. KURITZKY: So there's a lot of
6 uncertainty there.

7 MR. SHORT: But we did have one expert
8 specifically comment that -- he said, you know, he
9 doesn't even see this as a problem. You'd wait until
10 you blew down and then you'd close that valve.

11 CHAIRMAN STETKAR: He would. And nobody's
12 every melted a nuclear power plant either, so --

13 (Laughter.)

14 MR. SHORT: So, I mean, that's -- but he
15 ended up opting out as being an expert on it. But that
16 was a comment he made. And that was a reasonable -- that
17 was a good comment.

18 MEMBER BLEY: That's a good comment if
19 you're already trained on it and you --

20 MR. SHORT: Yes. Sure.

21 MEMBER BLEY: -- were thinking about it and
22 had been --

23 CHAIRMAN STETKAR: Well, and you knew --

24 MEMBER BLEY: -- focused on --

25 CHAIRMAN STETKAR: -- and you knew --

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1 MEMBER BLEY: -- and you knew the valve
2 design --

3 CHAIRMAN STETKAR: -- and you knew -- well,
4 and you knew everything and you knew that indeed you're
5 supposed to sit there and wait despite the fact that
6 everybody's telling you you ought to isolate it if it's
7 possible.

8 MR. SHORT: Yes. (Laughter.)

9 CHAIRMAN STETKAR: Yes.

10 MR. SHORT: Right. If you got the pressure
11 on you, right, to isolate this leak?

12 CHAIRMAN STETKAR: Yes.

13 MEMBER BALLINGER: I have a question. The
14 torque limiters will trip it out?

15 CHAIRMAN STETKAR: Oh, yes.

16 MEMBER BALLINGER: Okay.

17 CHAIRMAN STETKAR: Yes, that's why they
18 have them. They'll trip out the motor contactor.

19 MEMBER BALLINGER: Right.

20 CHAIRMAN STETKAR: So you got to go, you
21 know --

22 MEMBER BALLINGER: Okay.

23 CHAIRMAN STETKAR: Yes.

24 MEMBER BALLINGER: I have a different
25 experience.

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1 (Laughter.)

2 MR. KURITZKY: Well, some valves --

3 MEMBER BLEY: And they're the right ones.

4 MR. KURITZKY: -- may only have a position
5 when they're --

6 CHAIRMAN STETKAR: Usually they'll have a
7 torque limit though on --

8 (Simultaneous speaking.)

9 MR. KURITZKY: Right, but if you only have
10 a position limit, you'll be in trouble.

11 CHAIRMAN STETKAR: The idea is typically
12 the position limit kicks in before the torque limit,
13 because you basically want to try to not break the valve.

14 MR. KURITZKY: Right. Right. But if some
15 valves do only have a position limit, then they would
16 get damage. It wouldn't cut off.

17 CHAIRMAN STETKAR: Anyway, let's -- I'm
18 going to cut us off.

19 MR. SHORT: Oh, you're ready to end? Okay.

20 CHAIRMAN STETKAR: Yes, because this is
21 interesting, but it's --

22 MR. SHORT: This last page, is that what
23 you're saying?

24 CHAIRMAN STETKAR: Yes, we're --

25 MR. SHORT: Okay. Yes.

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1 CHAIRMAN STETKAR: We just don't have time
2 to get through it. It's an interesting exercise and
3 it's really useful for the PRA, I think, but we just
4 don't have time. And I apologize for that. It's just
5 there's more material to cover than we anticipated when
6 we set up the schedule, and if we would have done it
7 differently, we might have had this session in the
8 afternoon so we could run long, but we didn't.

9 What I'd like to do here is see if we can
10 get the bridge line open. I don't know if we have anybody
11 on the bridge line, but get that open. And while we're
12 doing that as if there is anyone in the room who has
13 any comments that you'd like to make. If you do, please
14 come up to the microphone and do so.

15 (No audible response.)

16 CHAIRMAN STETKAR: It's open?

17 PARTICIPANT: Let me try --

18 CHAIRMAN STETKAR: Okay. I just heard a
19 pop. If someone is out there on the bridge line, do me
20 a favor and just say hello just so I can confirm that
21 it's open. Anybody.

22 MS. GIBBS: Hi, this is Kathy Gibbs and the
23 bridge line is open.

24 CHAIRMAN STETKAR: Thank you so much.

25 Now, if there's anyone out there who would

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1 like to make a comment, please identify yourself and
2 do so.

3 (No audible response.)

4 CHAIRMAN STETKAR: Hearing nothing, thank
5 you, Kathy, for confirming that it's open.

6 We'll re-close the bridge line and as a
7 final wrap-up, I'll go around the table and see if any
8 of the members have any additional comments that you'd
9 like to make. Ron?

10 MEMBER BALLINGER: I had some questions,
11 but I think they're probably --

12 CHAIRMAN STETKAR: Ron, turn your
13 microphone on.

14 MEMBER BALLINGER: I'm going through this
15 and I was looking in particular at figure 4.10(a) in
16 the elicitation report. And I'm looking at this and I'm
17 saying these are valve experts, but --

18 CHAIRMAN STETKAR: Steve, be careful with
19 the mic.

20 MR. SHORT: Yes, sorry.

21 CHAIRMAN STETKAR: As long as it's on, you
22 make terrible crashing noises. Thank you.

23 MEMBER BALLINGER: First off, I have a
24 conceptual problem, and it's probably because of my
25 ignorance of why the estimates of the failure

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1 probability of the second valve to operate are
2 higher -- the conditional probabilities are higher after
3 the first valve doesn't work.

4 MEMBER BLEY: Over a shorter time period,
5 I think.

6 MEMBER BALLINGER: Huh? Okay. Maybe it's
7 just my ignorance, right?

8 CHAIRMAN STETKAR: Be careful. What is
9 it, 4.10(a).

10 MEMBER BALLINGER: 4.10(a).

11 CHAIRMAN STETKAR: Exactly what parameter
12 is that one eliciting?

13 MEMBER BALLINGER: It's the conditional
14 probability of failure of two motor-operated valves in
15 series.

16 MR. SHORT: It's a figure that kind of shows
17 the --

18 PARTICIPANT: Microphone.

19 MR. SHORT: Oh.

20 CHAIRMAN STETKAR: That's the other thing
21 is with your --

22 MR. SHORT: It's a figure that basically
23 shows what each expert elicited. Okay?

24 MEMBER BALLINGER: Right. So if you
25 unpack this a little bit, you see the folks, whoever

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1 they were, would have no uncertainties, they're all
2 high.

3 MR. SHORT: Yes.

4 MEMBER BALLINGER: The ones with
5 uncertainties, you have six orders of magnitude in
6 uncertainty. And the total uncertainty is at least six
7 or seven orders of magnitude. And I'm just curious as
8 to where the valve experts were on this. Okay? You
9 can't tell by A, B, C, D or E. And were they the ones
10 that put uncertainties on there or were they the ones
11 that didn't?

12 CHAIRMAN STETKAR: No, because the data
13 sheets are --

14 (Simultaneous speaking.)

15 MR. SHORT: Can I answer that?

16 MEMBER BALLINGER: I mean, I'm sure it's a
17 dumb question, but it just --

18 MR. KURITZKY: Okay. So the reason you
19 can't tell from that is because we've used letters
20 specifically to hide the names of the experts.

21 MEMBER BALLINGER: Right.

22 MR. KURITZKY: So I don't think it would be
23 appropriate for us to actually identify them.

24 CHAIRMAN STETKAR: Why did you do -- I read
25 that in the report, and that seems to be silly. Isn't

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1 it counter to the general SSHAC process where each expert
2 has to own their particular estimates and the basis for
3 it and defend them to the other experts so that I, John
4 Stetkar, have to defend why I believe, and all of the
5 other experts get to attack me and question my beliefs?
6 And I might alter my beliefs based on that exchange.
7 So why this notion of anonymity?

8 MR. KURITZKY: That's a good question. I
9 remember we had this discussion at the joint meeting,
10 because there was certain information that we wanted
11 to share with all the members and there was discussion
12 of whether that would violate the independence. And
13 then there was the decision, well, we would share it
14 but we would block out the names so they wouldn't know
15 who the other people were. And unfortunately I'm not
16 a SSHAC expert. Jing Xing was our --

17 (Simultaneous speaking.)

18 MEMBER BLEY: Yes, just a couple of things.
19 I don't know why you did it. I know why it was done in
20 1150, but the general rule is, as John said, you want
21 experts who will stand behind what they say and you want
22 to know who you're getting the information from, if
23 you're looking at this kind of expertise. And as a
24 reader I want to know, or if I'm you I want to know where
25 it came from.

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1 MR. SHORT: I know.

2 MEMBER BLEY: In 1150 when they did their
3 elicitations a limited number of people came from
4 organizations for whom they were worried if anybody saw
5 their expert opinions, it would get them in trouble
6 and -- with their organizations. And there was a policy
7 decision to allow them to participate and then not put
8 anybody's names on anything. But if you didn't have
9 something like that, a real extenuating circumstance,
10 I don't know why you don't show who the experts are
11 attached to their information, their data sheets and
12 all of that.

13 MR. SHORT: Yes, I know. Honestly, I don't
14 have an answer for that. I don't know what the decision
15 basis was behind that.

16 MEMBER BALLINGER: But there's a clear
17 pattern, at least in my mind here, which --

18 MEMBER BLEY: Yes, you can figure it out.

19 MR. SHORT: Yes, you can figure it out.
20 It's not that hard.

21 MEMBER BALLINGER: Okay. Then I'd ask --

22 MR. SHORT: But I will say that generally
23 I don't think any of our experts would have a problem
24 with us showing --

25 MEMBER BLEY: Then why did you hide the

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1 names?

2 MR. SHORT: There was a concern about
3 maintaining this individual --

4 (Simultaneous speaking.)

5 CHAIRMAN STETKAR: It says it was based
6 upon -- the quote in the report says, "However, based
7 on concerns by an NRC observer." So if PNNL didn't do
8 this, the NRC did it. So now, Alan, why does the NRC
9 do this?

10 MR. KURITZKY: The NRC observer, whom I'm
11 intimately familiar with --

12 (Laughter.)

13 MR. KURITZKY: -- raised the issue did it
14 make a difference whether people knew their name for
15 independence? Didn't rule on the decision one way or
16 the other. Just raised that concern. What the ultimate
17 decision -- well, we know what the ultimate decision
18 was. Why that decision was made, I don't recall.

19 CHAIRMAN STETKAR: Okay.

20 MR. KURITZKY: I do --

21 (Simultaneous speaking.)

22 CHAIRMAN STETKAR: Anyway, I read it in the
23 report. That was a direct quote from the
24 report --

25 MR. KURITZKY: Right.

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1 CHAIRMAN STETKAR: -- that the reason that
2 it was done was based on concerns by an NRC observer.

3 MR. KURITZKY: Actually there were
4 multiple observers, but I think I recall the individual
5 who brought that issue up. But it was just raised as
6 an issue, not as a decision.

7 MEMBER BLEY: Okay.

8 CHAIRMAN STETKAR: We got that on the
9 table.

10 Ron, anything else?

11 MEMBER BALLINGER: No.

12 CHAIRMAN STETKAR: Dr. Powers, sir?

13 MEMBER POWERS: So I have a task?

14 CHAIRMAN STETKAR: You have a task.

15 MEMBER POWERS: It's NUREG-1764?

16 CHAIRMAN STETKAR: Whatever the number
17 was.

18 MEMBER POWERS: And you're going to get
19 that for me?

20 CHAIRMAN STETKAR: He will.

21 MEMBER POWERS: And I will report back to
22 you what I learn from same?

23 CHAIRMAN STETKAR: That would be -- yes,
24 seriously that would be good.

25 MR. KURITZKY: 1864.

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1 CHAIRMAN STETKAR: 1864? Whatever the
2 NUREG is.

3 MEMBER POWERS: And I will do that with
4 aplomb.

5 CHAIRMAN STETKAR: I like peaches better,
6 but never mind. Anything else?

7 MEMBER POWERS: I am the peach.

8 CHAIRMAN STETKAR: You are. Anything
9 else?

10 MEMBER POWERS: No, just that we are
11 exploring alternate ways of confabulating expert
12 opinions, especially from the point opinions. And in
13 a way I have taken the point of view that we will not
14 assume a distribution. I mean, you guys use gammas.
15 I'm surprised they don't us Weibulls, because failure
16 guys seem to love Weibulls for everything known to man
17 for reasons that are unknown to me.

18 But we're doing non-parametric types
19 approaches for those that have the infraction and will
20 not assume the distribution, but not primed to handle
21 these guys on expert elicitations that say here's the
22 probability and the probably is one and it's right here
23 versus the guy that somehow had smeared that all over
24 the place.

25 And it's -- there's always the hard spot

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1 of how do you rate the relative experts of opinions?
2 We're not getting into that. The guy's either an expert
3 or he's not. If he's not an expert, then we assign zero
4 weight to his view and whatnot. But the issue, the
5 approach we've taken though is that we generally ask
6 our experts to provide us a distribution of where they
7 think the technical community's uncertainty is in a
8 quantity we're asking, but not their own. They can tell
9 us what their own opinion is, but we want to know what
10 they think.

11 If we could poll an infinite number of
12 experts, what that community would give is a
13 distribution. And that gives us very different results
14 than if we ask just for their opinion on things.

15 MR. SHORT: I will just kind of point out
16 that we did emphasize to the experts that they weren't
17 just representing themselves. They were representing
18 the knowledge base of the industry to the extent that
19 they knew it. Okay? And so to the extent they took that
20 into account, only they can answer that question.

21 MEMBER POWERS: Yes, you never know how
22 much, but we spend a lot of time harping on that. And
23 then when you have the meeting of the experts and the
24 panel, we say, well, how come you came up with this
25 step-function distribution when you can hear these other

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1 experts --

2 MR. SHORT: Right.

3 MEMBER POWERS: -- have different views and
4 you're trying to reflect that opinion? And in general
5 people say, oh, okay, I forgot that and they just -- and
6 give us a distribution. We're interested from a
7 methodological point of view of suppose we didn't do
8 that and we just took their point value versus
9 distributions. How do we combine those things into a
10 distribution? It's an interesting intellectual
11 exercise. It surprises me that it -- it doesn't seem
12 to make a huge amount of difference.

13 MR. SHORT: Yes. Right. I think that's a
14 hard thing to ask of someone, right? I think that's a
15 very hard thing to ask of somebody.

16 MEMBER POWERS: Well, you know going in
17 you're going to get an imperfect answer --

18 MR. SHORT: Right.

19 MEMBER POWERS: -- because most people
20 don't give a damn about what the rest of --

21 (Laughter.)

22 MR. SHORT: People have got very strong
23 opinions about their own opinions.

24 MEMBER POWERS: Yes, I think it was
25 Professor Apostolakis said his first reaction when

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1 somebody says I have 32 years of experience is, oh, that
2 means you've been wrong for 32 years?

3 (Laughter.)

4 MR. SHORT: I can see him saying that.

5 (Laughter.)

6 CHAIRMAN STETKAR: Anything else?

7 MEMBER POWERS: No.

8 CHAIRMAN STETKAR: Dennis?

9 MEMBER BLEY: Yes, I'm glad you did this.
10 I'm glad you got some real valve experts involved.
11 You've heard a few things I'm not as happy about in how
12 it was implemented.

13 You keep saying this is full scope, but you
14 keep telling us the things that are ruled out. And it
15 seems odd. I would call it full scope with the following
16 exceptions. And it just reminded me of Douglas Adams
17 and "The Hitchhiker's Guide to the Galaxy" when he turned
18 it into books. It started as a trilogy. By his fifth
19 book he said the increasingly misnamed trilogy. And I
20 don't want those words to apply to the name of your report
21 when it eventually comes out.

22 CHAIRMAN STETKAR: Thank you. Anything
23 else?

24 MEMBER BLEY: Nothing I haven't said
25 earlier.

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1 CHAIRMAN STETKAR: Again, despite
2 everything I said, I think this was a very useful
3 exercise. I think that if I were the PRA team I would
4 be careful about how I used the results from it rather
5 than -- not necessarily just pluck numbers out of a table
6 for some of the reasons that we discussed here. I think
7 that the lessons learned that you document are really
8 important lessons learned.

9 I think that part of the reason for doing
10 this was in response to the Commission's SRM on
11 developing methods for using expert opinion in
12 risk-informed decisions or regulatory decision making.
13 I know the staff is somewhere, somehow, sometime working
14 on guidance for doing that. I'm sure that this will help
15 the staff in that effort also.

16 So with that, I'd like to really thank you. I have
17 to apologize both to Alan and the Level 3 PRA people
18 for not getting to the summary of the model. As I said,
19 I will go through that in parallel with Dana and provide
20 my comments in terms of fact finding on what the current
21 snap shot of the model is so that the Subcommittee can
22 benefit from that. And again, I apologize for terrible
23 time management.

24 I'd really like to thank PNNL. I think you
25 crammed a heck of a lot of material into even this

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1 expanded time and I really appreciate the effort that
2 you made.

3 And with that, we will adjourn. And we will
4 reconvene at 1:00, because we have somebody from an
5 external organization planning to come in at that time.
6 So we are recessed until 1:00.

7 (Whereupon, the above-entitled matter went
8 off the record at 12:18 p.m. to reconvene at 1:00 p.m.
9 this same day.)

10 CHAIR STETKAR: We are back in session.

11 This afternoon we are going to have a
12 presentation by Jack Vecchiarelli.

13 I hope I have not butchered your name too
14 badly.

15 MR. VECCHIARELLI: No, not at all.

16 CHAIR STETKAR: He is from Ontario Power,
17 on the topic of whole-site risk assessment and safety
18 goals. The reason that we organized it as part of the
19 Subcommittee meeting on a Level 3 PRA is that, obviously,
20 the topic of whole-site risk assessment is directly
21 germane to what the staff is doing for the Vogtle site,
22 because they are evaluating both units there.

23 We didn't have enough time. We had a
24 Subcommittee meeting back in December of 2015 with
25 presentations on other forms of safety goals. In

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1 particular, the Canadian industry and the government
2 up there have been doing quite a bit of work in this
3 area. It is also germane to the Level 3 PRA project
4 because, at least at one time or another, the
5 Subcommittee was informed that the Level 3 PRA project
6 might be examining other metrics in addition to the
7 traditional health objectives that are examined in terms
8 of fatalities and long-term cancers and land
9 contamination and things like that.

10 So, with that, that is kind of a brief
11 introduction. Unless any of the members have any
12 questions, hearing none, I will turn it over to you,
13 Jack. You have the floor, and John Lai will be running
14 your slides for you.

15 MR. VECCHIARELLI: Thank you very much.

16 You have my presentation up for viewing?

17 CHAIR STETKAR: We do.

18 MR. VECCHIARELLI: Excellent. Thank you
19 very much.

20 First, I would like to thank the
21 Subcommittee for this opportunity to share with you some
22 of the work that has been performed by the CANDU Owners
23 Group.

24 I am joined today by one of my PRA experts,
25 Agnes Moisan, and perhaps on the line is my colleague

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1 Keith Binney**10515**Giminey from Amec Foster Wheeler.

2 Keith, are you there?

3 (No response.)

4 He may be joining momentarily.

5 MEMBER BLEY: Could he be on the other line?

6 CHAIR STETKAR: Now we are running into
7 another issue.

8 MR. VECCHIARELLI: No worries.

9 CHAIR STETKAR: Because we have two lines.
10 One line I believe, Jack, you are on, so that you can
11 speak to us. We have another line that is available to
12 the public. Anybody in the world can all in and be on
13 that line.

14 MR. VECCHIARELLI: I see.

15 CHAIR STETKAR: Your companions may be on
16 the second line. If you want them to participate
17 actively, we may need to get them a different phone
18 number to dial-in on.

19 MR. VECCHIARELLI: No problem. I just
20 wanted to acknowledge that Keith has been a long-time
21 expert on the topic of safety goals in Canada, and that
22 I am also accompanied here by my PRA expert at OPG, Agnes
23 Moisan.

24 With that, I, again, thank you for this
25 opportunity. We are very much interested in the

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1 initiatives being developed in the United States as well
2 as the ongoing work in other jurisdictions
3 internationally. So, we are grateful to have the chance
4 to exchange information here.

5 I was asked to describe our industry's use
6 of risk metrics, especially any additional risk metrics
7 beyond those used to assess health effects. In so
8 doing, I need to talk about risk assessment and safety
9 goals, as these are two separate but intertwined issues.
10 Hence, the title of my presentation is Whole-Site Risk
11 Assessment and Safety Goals. I will clarify what I mean
12 by whole site in a moment.

13 Moving on to slide 2, if you could, please,
14 I do have to make a disclaimer that this ongoing work
15 that is described in the presentation is preliminary
16 in nature and it does represent the finalized views of
17 the members of the CANDU Owners Group. It is a
18 work-in-progress and the work is subject to further
19 discussions within the Canadian industry and with our
20 regulator as well. So, I do want to make that clear.
21 This is by no means a final position or conclusion on
22 the work-in-progress.

23 Slide 3, please.

24 Just to give you an outline of what I will
25 be discussing, I would like to give a little bit of

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1 background on this topic of whole-site risk, what are
2 the key issues that we are facing, and an overview of
3 the work that has been conducted by COG, CANDU Owners
4 Group. Lastly, we want to focus on risk metrics and how
5 we see their role in the bigger picture of assuring
6 nuclear safety.

7 Slide 4, please.

8 By way of background, what I would like to
9 mention is that our current risk metrics are applied
10 on a per-unit, per-hazard basis. So, for example, we
11 have a large release frequency safety goal. That is
12 defined on a per-reactor-year basis. It is applied
13 separately for each of the various hazards, internal
14 events, seismic, fire, flood, et cetera. It is applied
15 on a per-unit, per-reactor-unit, and per-hazard basis.

16 As a result of this, there is a lot of public
17 interest around the overall site risk, and to the point
18 where in 2013, as part of a licensing hearing in Ontario,
19 there was a license hold-point placed on the Pickering
20 Nuclear Generating Station, which has six operating
21 units just east of Toronto.

22 One of the hold-points or the hold-point
23 in question here was that we were asked to provide a
24 whole-site PRA or a methodology for it. The intention
25 of this whole point was to characterize the overall risk

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1 of the site due to aggregation of risk from a number
2 of things: the fact that we have multiple reactor units
3 on the site, the fact that there are other onsite
4 radiological sources such as spent-fuel bays, given that
5 there are different hazard types, internal and external
6 hazards, and that there are various plant operating
7 modes, full power, low power, and shutdown state.

8 The idea was, how do we characterize the
9 overall risk of the site, given that to date we have
10 been assessing risk on a per-reactor-unit, per-hazard
11 basis? So, that was the challenge that was set forth
12 as part of background to my discussion here today.

13 On slide 5, I would like to highlight some
14 of the key issues that are germane to this challenge.
15 The topic of whole-site risk is not really new. It has
16 been around for some time. However, to the best of our
17 knowledge, there really isn't an international
18 consensus on the methodology with respect to risk
19 aggregation, in particular.

20 The simple addition of all risks from the
21 various hazards, so if you just look on a per-unit basis,
22 simply adding up the risks from internal events and fire
23 and flood and seismic and high wind, that can lead to
24 an overly-conservative result. This is, in part, due
25 to the different levels of uncertainty associated with

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1 the various hazard PRAs. This is a disparity in the
2 maturity level of internal versus external hazard PRAs.

3 If you apply that on a per-unit basis,
4 summing up all the hazards, that can be
5 over-conservative. But, even for a given hazard, the
6 multi-unit risk does not necessarily equal the per-unit
7 risk times the number of units. For example, the
8 per-unit risk for internal events on a four-unit
9 station, the multi-unit risk is not four times the
10 per-unit value.

11 CHAIR STETKAR: Jack?

12 MR. VECCHIARELLI: Yes?

13 CHAIR STETKAR: Since you don't get
14 absolved of being interrupted or queried simply because
15 you are north of the border --

16 (Laughter.)

17 MR. VECCHIARELLI: By all means.

18 CHAIR STETKAR: Explain to me, if I am a
19 member of the public sitting at the fencepost and I am
20 curious about how often I might be exposed to an event
21 at a site, now let's just take the second part of your
22 discussion there you said, "If I have four units at the
23 site...", and let's just assume for the moment that they
24 are completely independent and they are isolated
25 from -- they are all in their own little bubbles, so

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1 they can't be affected by common external hazards. Why
2 wouldn't the risk to me as someone at the fencepost,
3 if I have four units at the site, be four times "N",
4 where "N" is the single-unit risk?

5 MR. VECCHIARELLI: All right. Well,
6 first, I do want to preface it with the comment that,
7 in particular, the multi-unit CANDU stations, there is
8 a fair degree of dependency or interconnection amongst
9 the supporting systems and we share a common containment
10 as well.

11 But, in your scenario where there is
12 complete independence, what I would say is that, for
13 large release frequency, we do calculate the total
14 offsite release. So, in a case where there are four
15 totally independent units, you could have a common-mode
16 event, say a seismic event, that let's just
17 theoretically say all units are affected in exactly the
18 same way and the accident progresses in the same manner.
19 Then, our calculation of the large release frequency
20 would consider the total releases from all units.

21 And so, if you were to now try to do an
22 aggregate risk in a multi-unit perspective, you
23 shouldn't be quadrupling the initiating-event
24 frequency for the seismic hazard. You have already
25 accounted for the total release from all units --

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1 CHAIR STETKAR: Yes.

2 MR. VECCHIARELLI: -- for the same
3 initiating event.

4 CHAIR STETKAR: I understand what you are
5 saying. I tried to walk you into a case where we were
6 not discussing units that had shared systems or that
7 were subject to the same external hazard. I thought I
8 heard you saying that, if I had four units at a site,
9 that if I talked about only internal initiating events,
10 that I couldn't add the risk from those four units.

11 And I understand what you are saying about
12 units that have shared systems, that have shared
13 confinements or containments, that have shared external
14 hazards. Those are certainly different issues. So,
15 maybe we weren't communicating directly, but I would
16 think that internal initiating events for units, if they
17 were independent of one another, could be added.

18 MR. VECCHIARELLI: To a certain extent,
19 they can. But the problem is there are also internal
20 events, such as a loss of grid, that affect multiple
21 units at the same time. And so, we have to be careful
22 not to double-count those initiating events.

23 CHAIR STETKAR: Right. Okay. I will let
24 you go because we do have a hard stop at 1:50 because
25 we have another meeting at 2:00. I was abysmal at

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1 managing the meeting this morning. So, go on.

2 MR. VECCHIARELLI: I just want to touch on
3 the third key issue, which is really a perception issue.
4 Although the risk metrics, safety goals, historically,
5 they were introduced to help answer the question how
6 safe is safe enough, I think there has been a
7 misconception that these safety goals are a hard
8 delineation between what is safe and unsafe plant
9 design. And this was not the intention with the
10 introduction of safety goals in Canada. So, there is
11 this misconception out there, and that is an issue to
12 be dealt with from a public communication point of view.

13 Slide 6, please.

14 In terms of the role of safety goals, as
15 we see it, ultimately, safety goals are there; they are
16 intended to ensure that risks are kept acceptably low.
17 And hence, that helps to support the case that the
18 nuclear plants are licensable.

19 Now PRA as applied provides an indicator
20 of risk. We don't see it as a true measure of risk. And
21 so, we need to consider and incorporate the broader
22 aspects of what contributes to managing planned risk.

23 What I am referring to here is the various
24 programmatic elements together with analytical
25 elements, that these help to support the process of

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1 communicating about nuclear safety. The message here
2 is that it is not all about the PRA numbers at the end
3 of the day. One needs to put PRA numbers into
4 perspective, and I will be elaborating a little more
5 on what I mean by that.

6 But I am just trying to convey the use of
7 PRA in a bigger context. Yes, they do help to ensure
8 that the risks are given some sort of a criterion or
9 target to ensure that risks are kept low, but they are
10 not the be all and end all. I will elaborate on that
11 in a moment.

12 On slide 7, just to give you an overview
13 of some of the work that has been performed by COG, we
14 hosted an international workshop in 2014. That was very
15 well-attended. We had Dr. George Apostolakis
16 participate in that workshop. There were
17 representatives from the International Atomic Energy
18 Agency, from EPRI, our Canadian regulator, and many
19 others.

20 That was a very useful workshop. We took
21 the insights and feedback that we heard at that workshop
22 and incorporated it into a paper, a concept-level paper,
23 on the topic of whole-site PRA and safety goals. So,
24 that was a COG publication which we made publicly
25 available through the Ontario Power Generation external

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1 website.

2 Following that concept-level paper, we
3 initiated a COG joint project. There are three phases
4 to this joint project that is underway.

5 Phase A focuses on safety goals and in the
6 context of a safety goals framework. I will describe
7 what that means. This is really intended to help
8 provide a basis for the development of a public
9 communication tool. This work is being supported by
10 Amec Foster Wheeler.

11 Phase B looks at risk aggregation studies,
12 where the intention here really is to determine how you
13 go about quantifying whole-site risk in a comprehensive
14 manner. This work is being supported by Kinectrics and
15 Amec Foster Wheeler as well.

16 Within this phase, just to touch on some
17 of the activities there, it includes identify the risk
18 sources and the various reactor operating states that
19 need to be considered as part of a whole-site risk
20 evaluation. It also looks at developing risk
21 assessment methods for the non-reactor sources, so a
22 spent-fuel pool, for example, or other sources.

23 We also are considering habitability
24 effects and how that needs to be taken into account in
25 the PRA modeling. Is there some source of onsite

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1 radioactivity that could impede the mitigation of
2 emergency equipment, for example?

3 Phase B also includes trials of different
4 risk aggregation methods. The one option is the simple
5 arithmetic addition, but we are also keeping an open
6 mind and considering other techniques and weighing the
7 pros and cons, identifying what the strengths and
8 weaknesses are of those alternative methods.

9 Lastly, we are also considering other risk
10 assessment approaches that are not necessarily purely
11 PRA. They may be other risk assessment methods that we
12 want to explore as part of a whole-site risk assessment
13 approach. So, that is all within Phase B. My focus
14 really today is on Phase A as it concerns risk metrics.

15 Lastly, Phase C is to pilot the lessons
16 learned, the information from Phases A and B, and apply
17 that to the Pickering Station and conduct a whole-site
18 PRA or risk assessment for the entire Pickering site.
19 That is slated to be performed by the end of 2017.

20 CHAIR STETKAR: So, Jack, if it is going to
21 be performed by the end of 2017, I would assume that
22 that is well underway now. Is that correct?

23 MR. VECCHIARELLI: The Phase B work is well
24 underway, and that is really a very important part of
25 the legwork to get Phase C completed. So, we will be

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1 looking to initiate Phase C, in all likelihood, a little
2 bit later this year.

3 CHAIR STETKAR: Okay.

4 MR. VECCHIARELLI: A lot of the groundwork
5 that will be used in Phase C is being put in Phase B.

6 CHAIR STETKAR: This is in the context of
7 the NRC's Level 3 PRA for a two-unit site that has been
8 going on for quite a while now. So, I hope you folks
9 can accomplish this by the end of 2017. I would
10 personally be really interested in seeing that.

11 MR. VECCHIARELLI: Uh-hum, uh-hum. Mind
12 you, this is not a Level 3 PRA, and a lot of the groundwork
13 is being done using existing information and the
14 data-gathering that is part of Phase B. So, we are
15 looking to leverage existing information as much as
16 possible.

17 CHAIR STETKAR: Okay. Thanks.

18 MR. VECCHIARELLI: Yes.

19 I am on slide 8 now, where I would like to
20 talk a little bit more about risk metrics. In
21 particular, from the Phase A portion of the joint
22 project, these are some emerging views that we have on
23 the topic of risk metrics.

24 First, a primary focus of safety goals
25 should remain the protection of the life and health of

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1 the public. Indeed, some Canadian utilities have
2 quantitative health objectives. Some do; some don't.

3 We do make use of surrogate risk metrics.
4 Where surrogates are used, we need to show that they
5 represent an equivalent or more limiting criterion than
6 the underlying health-related goals. So, for example,
7 large release frequency, as I mentioned earlier, is an
8 existing safety goal in Canada. That is based on the
9 sum of frequencies of event sequences that can lead to
10 an offsite release of more than 10 to the 14 becquerels
11 of cesium. It is understood or expected that a greater
12 release may require long-term relocation of the local
13 population. This is straight out of a regulatory
14 document that really is applicable for new-builds.

15 But the point is that the large release
16 frequency, essentially, it limits the frequency of
17 long-term relocation to similar or the same frequency
18 values as that associated with the health risks. So,
19 it is a more stringent or limiting criterion, if you
20 like. As such, both health-related and societal
21 disruption effects are considered in the large release
22 frequency metric. It actually addresses both health
23 effects and societal disruption issues. The particular
24 the societal disruption issue of concern is long-term
25 relocation.

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1 CHAIR STETKAR: That is, by the way, just
2 for the record, that is a fundamental difference between
3 what the U.S. NRC uses as, I will call it a philosophical
4 basis, if not a quantitative basis for large release
5 frequency, right, Jack? Our large release frequency is
6 anchored to prompt fatalities, directly related to
7 health effects and only health effects.

8 MR. VECCHIARELLI: Understood, yes.

9 CHAIR STETKAR: Okay.

10 MR. VECCHIARELLI: What we are saying is
11 that our large release frequency risk metric can address
12 both long-term relocation concerns as well as having
13 margin to health effects.

14 CHAIR STETKAR: Right. Thank you. Good.

15 MR. VECCHIARELLI: On slide 9, I just
16 wanted to talk a little further about the existing risk
17 metrics for current plans in Canada, the existing
18 CANDUs. We actually, I mean, the two surrogate risk
19 metrics that we tend to use are large release frequency
20 and severe core damage frequency. What we have actually
21 instituted is a space-equal limit and safety-goal
22 target.

23 So, on the left side of this figure you will
24 see that there is an upper limit and a lower goal. That
25 lower goal is actually a target. For example, for large

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1 release frequency, the safety goal limit is 10 to the
2 minus 5 per year; whereas, the target is an order of
3 magnitude lower, 10 to the minus 6.

4 What we maintain is that we should be
5 migrating to a revised lexicon, if you like, this idea
6 of a limit. You know, it is creating the perception that
7 there is a hard delineation between what is safe and
8 unsafe. And so, we are looking to relax or soften the
9 language around safety goals. Perhaps what we would
10 call the limit may just be a safety goal, and what is
11 currently a safety goal target could be considered an
12 administrative goal. So, that is a bit of a nuance in
13 terms of how we have been referring to risk metrics for
14 the existing plants. We want to move away from this
15 notion of calling it a limit and recognize that we have,
16 essentially, a target and a more stringent lower
17 administrative goal, if you like. It is the
18 administrative goal of the lower value that we try to
19 meet that lower value as much as practicable, but we
20 are typically well below the actual safety goal, quote,
21 "limit".

22 MEMBER CORRADINI: So, can I just ask -- I
23 think I understand what you are saying. You have to be
24 below one 10 to the minus 5th or one 10 to the minus
25 4th for the CDF or the LRF?

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1 MR. VECCHIARELLI: Correct.

2 MEMBER CORRADINI: But you could be above
3 the one 10 to the minus 6th and one 10 to the minus 5th?

4 MR. VECCHIARELLI: That's correct. What
5 we would do, if we were above, say, 10 to the minus 6
6 for LRF, we would see what we could do from a cost/benefit
7 perspective to further reduce the risk. We would
8 endeavor to get below target. But, ultimately, what we
9 need to show is that we are below the so-called limit.

10 MEMBER CORRADINI: Okay. Thank you.

11 MR. VECCHIARELLI: Yes.

12 On slide 10 now, other considerations.
13 There is a growing international recognition that the
14 protection of public health may not be enough and that
15 certain other societal impacts due to nuclear accidents
16 should be avoided to the extent practicable.

17 So, the Fukushima accident is a case in
18 point. While it appears that radiation-induced
19 fatalities may have been averted by the protective
20 measures, there was a large impact of societal
21 disruption.

22 Following the Fukushima event, the CNOs in
23 Canada established a set of principles to address
24 beyond-design-basis accidents where the stated
25 objective of these principles is to, quote, "practically

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1 eliminate the potential for societal disruption due to
2 a nuclear incident by maintaining multiple and flexible
3 barriers to severe event progression".

4 Here the underlying intention of the CNOs
5 is to avoid any extensive permanent relocation of
6 society to the extent practicable. This was meant as
7 a qualitative objective and it has largely been the
8 driving force for the implementation of emergency
9 mobile, emergency mitigating equipment, which you would
10 refer to as FLEX in the U.S. So, it is a qualitative
11 objective that was brought in post-Fukushima to really
12 address this growing international recognition that,
13 while, yes, we want to protect the health of the public,
14 we should be striving for more than that.

15 Really, the OPEX is supporting this. I
16 mean, that is true of Fukushima. It is true of
17 Chernobyl, and it is also consistent with the ASME
18 nuclear safety construct as well as other stated views
19 internationally, that this is something that we need
20 to be very mindful of and actually address in one manner
21 or another.

22 CHAIR STETKAR: Jack, hold on a second. I
23 want to get a clarification for the record.

24 A lot of folks down here may not be familiar
25 with the acronym OPEX. So, just for the record, it is

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1 operating experience.

2 MR. VECCHIARELLI: Correct. I apologize
3 for that.

4 CHAIR STETKAR: Dr. Corradini, sir?

5 MEMBER CORRADINI: So, you keep on adding
6 a phrase at the end of this, "to the extent practical".

7 MR. VECCHIARELLI: Yes.

8 MEMBER CORRADINI: So, tell me what you
9 mean by that. Are you saying cost/benefit; there's a
10 cost/benefit measure that, if it cost more than this
11 for a certain benefit, it is not practical? I am trying
12 to understand the definition of that because, while a
13 laudable goal, I imagine there's got to be some sort
14 of measure here that, if something seems impractical,
15 you would -- can you define what you mean by that?

16 MR. VECCHIARELLI: Well, my view on that is
17 that "to the extent practicable" meaning that, where
18 we have comprehensibly reassessed the robustness of the
19 facilities following the Fukushima event and identified
20 that there is risk/benefit to introducing an additional
21 layer of defense-in-depth through our FLEX-like
22 equipment, and the point is that we have looked at
23 various possible event scenarios, focusing on sort of
24 station blackout-type conditions and considered the
25 various means by which we can ensure continued reactor

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1 cooling and maintenance of containment integrity.

2 So, there is a point where, when you have
3 applied enough diversity and redundancy with respect
4 to our mitigation capability, that that is within all
5 reason sufficient. Some utilities have actually
6 incorporated the FLEX-like equipment into the PRA and
7 sort of gauged the risk/benefit in terms of the risk
8 results. It makes a very significant reduction in the
9 calculated risk, to the point where we feel that, with
10 this additional equipment that has been procured and
11 has been implemented, that has provided a substantial
12 improvement in real plant safety, that we are at the
13 point where we feel this is reasonable and it is
14 practicable.

15 MEMBER CORRADINI: So, I will ask it one
16 more time slightly differently, just so I get it. But
17 at some point, I mean, there is going to be a residual
18 risk. That residual risk, to eliminate it or cut it down
19 by half is going to cost something. And so, I am still
20 wondering, is there some sort of cost/benefit ruler that
21 is applied to this, so that if it gets too costly, you
22 live with the residual risk? You don't eliminate it or
23 eliminate 50 percent of it?

24 MR. VECCHIARELLI: The way I would approach
25 it is that, when we look at the PRA results, they are

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1 quite low, having included the additional mitigating
2 equipment; that together with other programmatic
3 measures that we have in place to address residual risk,
4 including, for example Severe Accident Management
5 Guidance, which is typically not included in the PRA
6 modeling because it is guidance and not prescriptive
7 procedures, we have a more pragmatic approach to all
8 of this. It is not a hard cost/benefit line in the sand.
9 It is more of an overall assessment of how much is enough,
10 given the PRA results, given the other measures that
11 are in place such as Severe Accident Management Guidance
12 and other provisions at the facility. And it provides
13 a reasonable case to say that this is sufficient.

14 MEMBER CORRADINI: Okay. So, let me ask a
15 number now and, then, I will stop bothering you. If you
16 looked at all the units for Ontario Power, how much did
17 you spend per unit to essentially install these
18 post-Fukushima measures? Is there an approximate
19 average number per unit?

20 MR. VECCHIARELLI: I think I would rather
21 discuss that offline, if it is possible.

22 MEMBER CORRADINI: Okay.

23 MR. VECCHIARELLI: It is substantial.
24 Let's put it that way.

25 MEMBER CORRADINI: So, is substantial more

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1 than a million and less than 10?

2 (Laughter.)

3 MR. VECCHIARELLI: It is many millions.

4 MEMBER CORRADINI: Okay. Thank you.

5 MR. VECCHIARELLI: I am on slide 11 now.

6 This is providing you a construct, if you like. This
7 illustration is really an adaptation of an approach that
8 is emerging from the IAEA. There is a Draft Tech Doc
9 on Safety Goal Framework, where the idea is that one
10 can define a set of safety goals arranged in a
11 hierarchical framework.

12 Now there are other constructs that we are
13 considering, but this is our preliminary adaptation of
14 the IAEA approach. We are considering other formats to
15 sort of convey the same message, basically. But the
16 idea is that one can envision that there is a mix of
17 both qualitative and quantitative safety goals, and that
18 they can be arranged in different levels, and that there
19 is a logical interrelation from the bottom to the top
20 of these safety goals, such that the top safety goal,
21 the overarching safety goal around public health and
22 well-being, is met.

23 If I were to just sort of proceed from the
24 top-down here, I will just highlight a few things about
25 this concept. At the top level, this would be, for

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1 example, a qualitative goal that you would find in the
2 Nuclear Safety Control Act, for example. But this is
3 an alternative version of that wording.

4 But the idea is, qualitatively, you would
5 have a statement around the protection of public health
6 and the well-being of the public. And then, at the upper
7 level, moving down a notch, you could capture the notion
8 of wanting to essentially practically eliminate
9 long-lived radionuclide releases that could lead to
10 extensive land contamination, in light of the experience
11 that we have seen with accidents such as Fukushima and
12 Chernobyl, for example, as I mentioned earlier.

13 And then, you move down to the intermediate
14 level. These are more generic, still generic-type
15 safety goals or objectives. On the left side, there are
16 various safety and control programs. So, these are, if
17 you like, action-oriented, defense-in-depth-type
18 provisions that are programs around the testing and
19 maintenance, training of personnel, emergency
20 preparedness, et cetera. These are all action-oriented
21 things that are happening at the facility that are based
22 on defense-in-depth, good things to be doing to
23 essentially help ensure that the risk is maintained low.

24 Moving a little more inwards, we have
25 beyond-design-basis programs. For example, the Severe

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1 Accident Management Guidance framework, or SAMG, that
2 is something we have in place.

3 As well, moving further along, you tend to
4 have, you find in this level quantitative criteria for
5 deterministic and probabilistic safety analysis at the
6 site level. So, what this would mean, for example, for
7 design-basis accidents, we have public dose limits.
8 For beyond-design-basis, this is where you would have
9 your, you could have your PRA risk metrics defined at
10 a site level. That could be a quantitative health
11 objective or it could even be, as an option, it could
12 be a site-based large release frequency, for example.

13 At the lowest level, this is where it
14 becomes mostly quantitative and tends to be
15 plant-specific. You have compliance criteria for the
16 various provisions in the intermediate level. In the
17 PRA space, this is where you would tend to see, for
18 example, the per-unit-based risk metrics. So, large
19 release frequency or severe core damage frequency would
20 appear here.

21 The whole point of this illustration here
22 is to try to put PRA into a broader perspective, that
23 you see that the risk metrics are part of the supporting
24 care. They, along with other qualitative or
25 action-oriented programmatic-type activities

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1 collectively, they accomplish the top-level objective
2 of providing protection of public health and well-being.

3 So, that is really the overarching message
4 in this illustration here. It is one construct. We are
5 considering other formats. But this is something that
6 the IAEA right now has drafted in a Tech Doc as an
7 approach to conveying the notion that there are a
8 multitude of safety goals, not just PRA risk metrics,
9 which are also safety goals.

10 On slide 12, this is really summarizing some
11 of the key messages that we see coming out from a public
12 communication point of view, the key messages that arise
13 from this perspective of a safety goal framework. That
14 is that PRA is part of the safety story. It is not the
15 be all and end all. It has a place in the greater scheme
16 of things and it is part of it. It is an important part
17 of it.

18 The PRA safety goals are targets, not hard
19 limits. Really, the main benefits of PRA are in
20 identifying the risk insights that one can use to improve
21 plant design and operation.

22 Lastly, another key message here is that
23 the existing PRA safety goals which are currently
24 applied on a per-unit, per-hazard basis, together with
25 the existing programs, we view that this provides

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1 confidence that the site risk is low. Now this is not
2 suggest that each unit could be up to the safety goal
3 value for each hazard right at the limit. That is not
4 the intention here.

5 But the fact that the programs that are in
6 place actually tend to drive the individual PRA results
7 low enough, such that they support, if you were to
8 aggregate them, they provide a supporting rationale for
9 claiming that on a whole-site basis the risk is
10 relatively low. So, existing safety goals on a per-unit
11 basis low enough, as driven by existing programs, provide
12 us the confidence that the site risk is low.

13 To help support that, on slide 13, I would
14 like to talk a little bit about a preliminary assessment
15 of the risk metrics. What we did was we assessed the
16 margins to possible quantitative health objectives for
17 a range of large release frequency values and
18 consequence assumptions. This would be, for example,
19 the quantitative health objective, one possible one is
20 around incremental risk of delayed fatalities, for
21 example.

22 What we found is that, as an overall
23 judgment, that the total large release frequency, on
24 the order of 10 to the minus 5 per year, that provides
25 margin to possible quantitative health objectives for

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1 a wide range of accident sequences while serving as a
2 reasonable basis for practical elimination of the
3 potential for long-term relocation.

4 This gets back to an earlier comment: what
5 is practicable? If the aggregated large release
6 frequency is on the order of 10 to the minus 5 per year,
7 that is a reasonable basis to say that you, in our view,
8 have practically eliminated long-term relocation,
9 which is our prime concern from a societal disruption
10 point of view. It also generally provides a robust
11 margin to the quantitative health objective.

12 This is being stated in a qualitative sense.
13 I recognize that. The reason is that, in terms of
14 acceptance criteria for risk metrics, we see that the
15 issues are really what I call trans-scientific, that
16 you can't solve these issues solely by means of science.
17 There are other factors that come into play, such as
18 socioeconomic considerations.

19 And so, it is not purely a numbers
20 assessment. You have to sort of be more of a judgment
21 approach to how much is enough in terms of the aggregate
22 risk.

23 So, on average, what we are finding is that
24 a total large release frequency on the order of 10 to
25 the minus, that is a reasonable, in our judgment, that

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1 is a reasonable value to ensure that quantitative health
2 objectives are reasonably met as well as a basis for
3 practical elimination of long-term relocation.

4 Just to summarize, then, on slide 14, our
5 view is that nuclear safety and low risk is assured
6 through a collection of safety goals and objectives,
7 not necessarily by a single numerical value or risk
8 metric. One can envision a hierarchical framework of
9 safety goals consisting of a mix of qualitative and
10 quantitative safety goals in different levels and
11 logically interrelated, such that the overarching
12 safety goal or health objective is met, while also
13 adequately addressing other important considerations,
14 in particular, long-term relocation. And this may be
15 used as the basis for the development of some public
16 communication tool or mechanism.

17 Lastly, in our view, there is flexibility
18 in what is the acceptable value of a total calculated
19 large release frequency. It is not a pass-and-fail in
20 our view. For example, you could have a total large
21 release frequency somewhat in excess of 10 to the minus
22 5 per year, which is our current per-unit base value.
23 The risk metric is not limited to addressing health
24 objectives. There are other considerations, in
25 particular, long-term relocation impacts.

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1 In terms of managing whole-site risk, we
2 believe this can be managed through compliance with the
3 current per-unit-based risk metrics together with
4 programmatic measures, which actually drive the PRA
5 results to be sufficiently low to provide confidence
6 that site risk is also low.

7 CHAIR STETKAR: Jack, thank you very much.
8 Stay on the line here --

9 MR. VECCHIARELLI: Yes.

10 CHAIR STETKAR: -- because we have got a
11 couple of other administrative things to do. I want to
12 make sure you have a chance to hear those.

13 We are in the process of getting the public
14 line open, which I think it is.

15 Let me, first, ask if there is anybody in
16 the meeting room here who would like to make a comment.
17 Come up to the microphone and do so.

18 (No response.)

19 Seeing no stampede to the microphones, I
20 will ask, are there any members of the public out on
21 the public line who would like to make a comment?

22 Just somebody, again, because of the high
23 technology, somebody other than Jack, please just say
24 "Hello," so we can confirm that the other line is open.

25 PARTICIPANT: Hello.

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1 CHAIR STETKAR: Thank you.

2 PARTICIPANT: Hello.

3 CHAIR STETKAR: That is good enough.
4 Thanks.

5 Now, if there is anybody on that other line
6 who would like to make a comment, please identify
7 yourself and do so.

8 **14913MR. GIMINEY: This is Keith
9 Giminey**14915 in Toronto.

10 I think we are trying to draw a balance here
11 in terms of --

12 CHAIR STETKAR: Sir, sir?

13 **14924MR. GIMINEY: Yes?

14 CHAIR STETKAR: Step back from your phone
15 just a little bit. You are kind of overloading the line
16 here.

17 **14930MR. GIMINEY: Okay. How about
18 that?

19 CHAIR STETKAR: That is I think okay. Try
20 saying something.

21 **14938MR. GIMINEY: I just need to add
22 that we believe that it is absolutely not health impacts
23 which are the primary cause of public concern these days
24 from large nuclear accidents. What we are trying to do
25 here is to come across with an approach which covers

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1 a broader range of consequences and, in doing so, ensures
2 adequate public health protection.

3 But I think none of the methods we currently
4 have for assessing the cost/benefit, for example,
5 seriously underestimate the economic consequences of
6 large releases. So, rather than go through a complex
7 methodology, we are trying to come up with a safety goal
8 approach which encompasses these broader
9 considerations.

10 CHAIR STETKAR: Thank you very much.

11 Because you were kind of overloading the
12 line when you first came on, could you again give us
13 your name and your affiliation?

14 **15042MR. GIMINEY: Yes. This is Keith
15 Giminey**15044 from Amec Foster Wheeler here in Toronto.

16 CHAIR STETKAR: Okay. Thank you very
17 much, Keith.

18 Anybody else on the public line who would
19 like to make a comment?

20 (No response.)

21 If not, we will reclose the public line
22 because it gives us pops and whistles and things here
23 in the meeting room.

24 As we usually do in a Subcommittee meeting,
25 I will go around the table and ask each of the

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1 Subcommittee members if you have any additional comments
2 that you would like to make.

3 Dr. Bley, let's start with you.

4 MEMBER BLEY: Only a thank you to Jack for
5 the presentation.

6 I was looking forward to seeing what
7 approach they were taking on this societal risk issue.
8 Now that I see that, it is kind of straightforward. So,
9 I understand it and I appreciate what they had to say.

10 Thanks.

11 CHAIR STETKAR: Dr. Corradini, sir?

12 MEMBER CORRADINI: Thanks to Jack from
13 Ontario Power Generation. I think he answered most of
14 my questions.

15 I am still struggling on how I deal with
16 the gray area that still exists, but I think I understand
17 the process and the approach you guys are taking.

18 So, thank you so much.

19 CHAIR STETKAR: Ron?

20 MEMBER BALLINGER: Again, thanks for the
21 presentation, but everybody has covered everything that
22 I would say.

23 CHAIR STETKAR: Jack, this is John Stetkar
24 again.

25 I really appreciate your taking the time

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1 for putting this together. I am sorry that you couldn't
2 make it down here and get grilled in person, but you
3 may have an opportunity to do that sometime later.

4 I think that this has been very interesting
5 to me because it illustrates a little different
6 thinking. It illustrates a thought process that has
7 come out of the industry or at least with a lot of input
8 from the industry in Canada.

9 I think you heard from a couple of the
10 questions that we had it is a little different
11 perspective than we are used to here in the U.S. I think
12 that is useful for us to hear those different
13 perspectives.

14 So, again, I would like to thank you very,
15 very much for the time and effort you put into this.
16 We may be in touch in the future as you get further along
17 on that full-site risk assessment for Pickering.

18 With that, I think we are finished, and I
19 will adjourn the meeting because we have another meeting
20 starting in six minutes.

21 (Whereupon, at 1:53 p.m., the meeting was
22 adjourned.)

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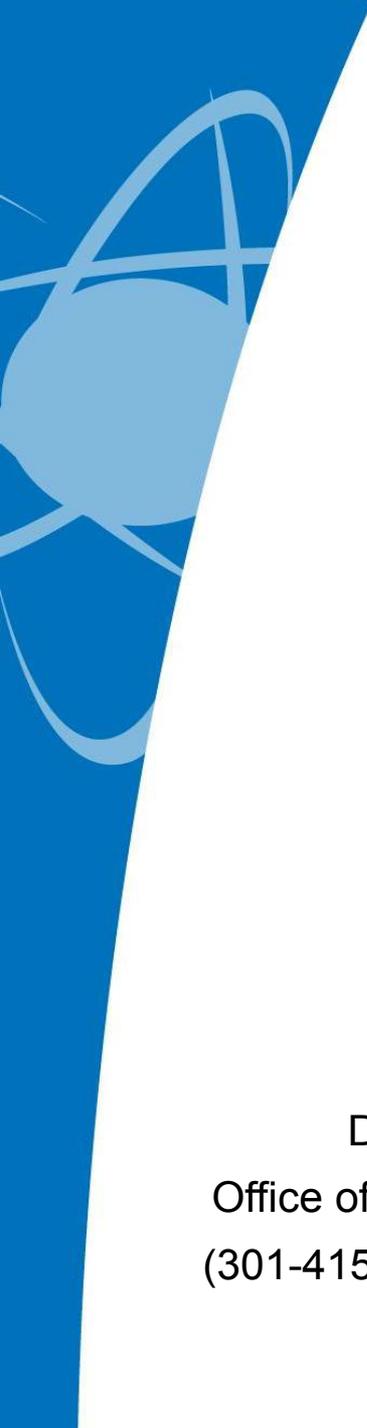
Full-Scope Site Level 3 PRA

Advisory Committee on Reactor Safeguards
Reliability and PRA Subcommittee

March 1, 2016
(Open Session)

Outline

- Open Session
 - Project status overview
 - ISLOCA expert elicitation
- Closed Session
 - ISLOCA expert elicitation
 - Level 1 internal event and flood PRA



Level 3 PRA Project Status Overview

March 1, 2016

Alan Kuritzky

Division of Risk Analysis

Office of Nuclear Regulatory Research

(301-415-1552, Alan.Kuritzky@nrc.gov)

Mary Drouin

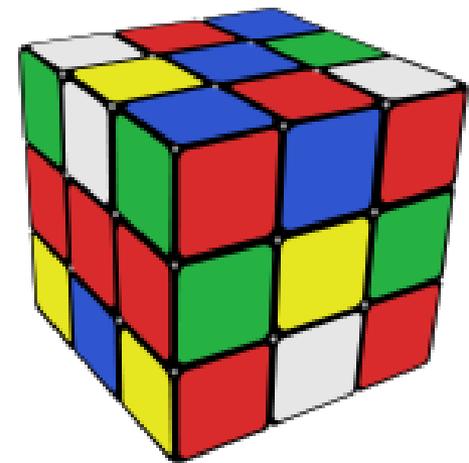
Division of Risk Analysis

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Outline of Project Status

- Reactor, at-power, Level 1
 - Internal events and floods
 - Internal fires
 - Seismic events
 - High winds, external flooding, and other hazards
- Reactor, at-power, Level 2
- Reactor, at-power, Level 3
- Reactor, low power and shutdown
- Spent fuel pool (SFP)
- Dry cask storage (DCS)
- Integrated site risk
- Path Forward



Model Phases

- Initial model – The first model developed for a particular part (scope element) of the Level 3 PRA project. Often referred to as the R01 version of the model.
- Updated model – The model developed for a particular part of the Level 3 PRA project after incorporating comments from the PWROG-led ASME/ANS PRA standard-based peer review and technical advisory group (TAG) review, and other feedback. Often referred to as the R02 version of the model.
- Revised model – A revision to the initial model, prior to peer review, that involves significant changes due to updated information provided by Southern Nuclear Operating Company (SNC). Currently, only applies to the reactor, at-power, Level 1 PRA models for internal fires and seismic events.

Internal Events and Floods (Reactor, At-Power, Level 1)

- Completed ASME/ANS PRA standard-based peer review, led by PWR Owners Group (PWROG)
- Revising model and documentation to address peer review and other comments
 - Revised (R02) model essentially complete
 - Significant changes to event trees, some fault trees, human reliability analysis, number of flooding scenarios modeled, and flooding initiating event frequencies
 - Currently revising reports
- Completed expert elicitation for interfacing systems LOCA (ISLOCA)

Internal Fires

(Reactor, At-Power, Level 1)

- Beginning update of initial Level 1 fire PRA model and documentation based on new input from SNC
 - Refined fire modeling for a subset of sequences
 - Electrical enclosure fire modeling techniques
 - Fire growth/spread assumptions (i.e., cable tray spread)
 - Zone of influence screening conservatisms (i.e., plume vs. flux)
 - Fire protection suppression systems
- Conducted another site visit in November 2015 to gather information to evaluate new fire modeling approaches and to support update to fire HRA
- Anticipating completion of updated model and documentation by the end of 2016

Seismic Events

(Reactor, At-Power, Level 1)

- Beginning update of initial seismic PRA (SPRA) model and documentation, based on new input from SNC
 - New seismic hazard bins
 - Updated seismic fragilities
 - Additional seismic considerations
- Revised SNC seismic PRA report not currently available
 - NRC may need to make some simplifying assumptions due to lack of information or analysis (e.g., regarding relay chatter)
- Anticipating completion of revised model and documentation in August/September 2016

High Winds, External Flooding, and Other Hazards (Reactor, At-Power, Level 1)

- Completed ASME/ANS PRA standard-based peer review, led by PWROG
- Revising Level 1, at-power, high wind PRA and “other hazards” evaluation
 - PWROG-led peer review comments
 - TAG comments
 - Site walkdown by Applied Research Associates (ARA)
- Anticipating completion of revised documentation and, if necessary, revised high wind PRA model and additional other hazards analyses, in September 2016

Reactor, At-Power, Level 2

- Completed ASME/ANS PRA standard-based peer review, led by PWROG
- Revising model and documentation to address peer review, TAG, and other comments
 - Overhaul of plant damage state binning
 - Significant modifications to MELCOR model and re-computation of all MELCOR analyses
 - Re-visiting many containment event tree issues/analyses
- Anticipating completion of revised model and documentation in Summer 2016

Reactor, At-Power, Level 3

- Completed ASME/ANS PRA standard-based peer review, led by PWROG
- Revising model and documentation to address peer review, TAG, and other comments
 - Elimination of Vogtle construction worker cohort
 - Refinement of emergency and intermediate phase protective action models
 - Use of updated decontamination model parameters
- Anticipating completion of revised model and documentation in November 2016

Reactor, Low Power and Shutdown

- Developing new PRA model in SAPHIRE
 - Some information provided by SNC from an earlier effort
- Identified set of plant operating states and (internal) initiating events to be modeled
- Completed several event trees
- Currently:
 - Developing additional event trees
 - Updating initiating event frequencies
 - Beginning to exercise human reliability analysis approaches
- Anticipating completion of initial model and documentation in August 2016

Spent Fuel Pool PRA

- Marginal progress since February 2015 (owing to competing priorities)
- Areas of movement include:
 - Accident sequence modeling for large seismic events
 - System modeling of SFP cooling
 - Estimating liner/structure over-temperature regimes
 - MELCOR modeling of two pools simultaneously
 - Documentation

Dry Cask Storage PRA

- Completed human reliability analysis for the vertical cask transporter (VCT) crane reliability model
- Completed seismic tip-over frequency analysis
- Completed Hazard and Operability Study (HAZOP)
- Continuing to evaluate
 - Structural performance of fuel and multi-purpose canister during impact events
 - Thermal events (e.g., vent blockage)
 - VCT crane reliability analysis
 - Cask support systems (e.g., ventilation system failure, overhead crane failure)
 - Aircraft impact frequency analysis
 - Source term for consequence analysis
- Anticipating completion of initial DCS Level 1/2/3 PRA and documentation in Summer 2016

Integrated Site PRA

- Developed integrated site operating configuration (SOC) matrix
 - Identifies distinct combinations of operating states for major site radiological sources and their relative contributions to site operating cycle duration for prioritization
- Developed integrated site dependency matrix
 - High-level framework for identifying, classifying, and documenting potential dependencies or interactions across major site radiological sources for different SOC
- Reviewing insights and results from available single-source PRA models to identify:
 - Significant contributors to risk for modeled initiators
 - Dependencies with potential multi-source effects for each significant risk contributor to focus integrated site PRA model development efforts

Path Forward (1 of 2)

- Continue work in all technical areas of the study
 - Complete updated reactor, at-power, Level 2, internal event and flood PRA (July 2016)
 - Complete initial dry cask storage, Level 1, 2, and 3 PRA (July/August 2016)
 - Complete initial reactor, LPSD, Level 1, internal event PRA (August 2016)
 - Complete revised reactor, at-power, Level 1, seismic event PRA (August/September 2016)
 - Complete updated reactor, at-power, Level 3, internal event and flood PRA (November 2016)
 - Complete revised reactor, at-power, Level 1, internal fire PRA (December 2016)

Path Forward (2 of 2)

- Continue with PWROG-led, PRA standard-based peer reviews
 - Dry cask storage, Level 1/2/3 PRA (September 2016)
 - Reactor, LPSD, Level 1, internal event PRA (October 2016)
 - Reactor, at-power, Level 1, seismic PRA (December 2016)
- Schedule challenges
 - Diversion of key staff
 - Conversion and “ownership” of SNC peer-reviewed PRA models
 - SNC’s active PRA program for Vogtle
- Acknowledgements
 - SNC
 - PWR Owners Group
 - Westinghouse and EPRI



Interfacing Systems LOCA (ISLOCA) Expert Elicitation

March 1, 2016

ISLOCA Modeling in the Level 3 PRA

- Issues
 - For large internal leaks (≥ 50 gpm) for check valves and motor-operated valves in the various ISLOCA pathways, the Level 3 PRA uses alpha factors for common-cause failures from the 2010 update to NUREG/CR-6928, though it is recognized that these are very uncertain and could have an overly conservative impact on ISLOCA frequency.
 - The break size and location of an ISLOCA are also highly uncertain, and can significantly impact the radiological consequences.
 - Combined, these uncertainties can significantly distort the risk profile for VEGP, Units 1 and 2, developed under the Level 3 PRA project.
- Proposed resolution
 - An expert elicitation will be performed to increase our understanding of these parameters and phenomena.
 - The expert elicitation will pilot the staff's draft expert elicitation guidance (consistent with SRM-SECY-11-0172).

Results of Expert Elicitation supporting ISLOCA Modeling

Presentation to ACRS PRA Subcommittee March 1, 2016

Steve Short, PE

Kevin Anderson/Don Daly

Pacific Northwest National Laboratory (PNNL)

Jing Xing

Nuclear Regulatory Commission (NRC/RES)

- ▶ Mr. Steve Short, P.E.
 - Project manager, co-principal investigator
- ▶ Mr. Michael Zentner, P.E.
 - Facilitator, co-principal investigator
- ▶ Mr. William (Bill) Ivans
 - Technical integrator/scribe
- ▶ Dr. Don Daly
 - Development of probability distributions
- ▶ Dr. Stephen Unwin
 - Project consultant
- ▶ Other project support
 - Dave Engel
 - Kevin Anderson
 - Bruce Schmitt

Scope of Elicitation Project

- ▶ Vogel Electric Generating Plant (VEGP) Units 1 and 2
- ▶ ISLOCA pathways:
 - Residual Heat Removal (RHR) System
 - Safety Injection (SI) System
 - Other pathways judged to be smaller contributors to CDF (e.g., charging, letdown, RCP seal cooling)
- ▶ PRA model parameters:
 - Normally-closed isolation valves:
 - Failure rates (failures/hour) for check valves (CV) and motor operated valves (MOV) for internal large leak (ILL) failure mode
 - Conditional probability of failure of the second down-stream valve given failure of the first valve (two valves in series)
 - Normally-open MOVs that could be used to mitigate the ISLOCA:
 - Failure-to-close (FTC) probability (failures/demand)
 - Probability of break by location outside containment

Elicitation Process

I. Prepare Detailed Problem Description

- Problem definition
- Elicitation process and objectives
- Level of detail expectations
- System Notebooks



II. Select Expert Team for Elicitation

- PRA
- Common Cause Failures
- Piping and Valve Failure Experts
- System Engineers



III. Expert Training

- Initial Video Conference, Expert Elicitation Training
- Second Conference – Review Training, Systems Familiarization



IV. Individual Elicitation Meetings

- Individual Elicitation with Each Team Member
- PNNL Collects and Collates Results
- Provide Draft Results to Team



V. Group Elicitation Meeting

- Review Results of Individual Elicitation Meetings
- Group Elicitation with All Team Members
- PNNL Collects and Collates Results



VI. Issue Draft Report for Review

- Review by NRC and Experts
- Incorporate Comments

Adapted SSHAC process for ISLOCA

Preparation

Individual meetings

Workshop – Group meeting

Prepare detailed
problem description
and data



Select expert
team for elicitation



Training

Understanding of
problems, models &
data

Evaluate data

Initial elicitation of
judgment
(center/body/range
with justification)
on the stated
problems

Review and discuss
results of individual
meetings

Elicit and modify
individual judgment



Integrate individual
judgments and
document the results



Review the results by
NRC and experts

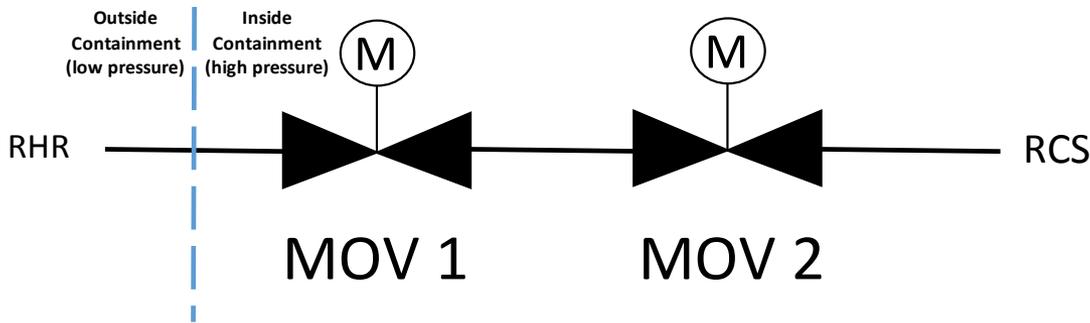


Participatory peer review, transparency, and documentation

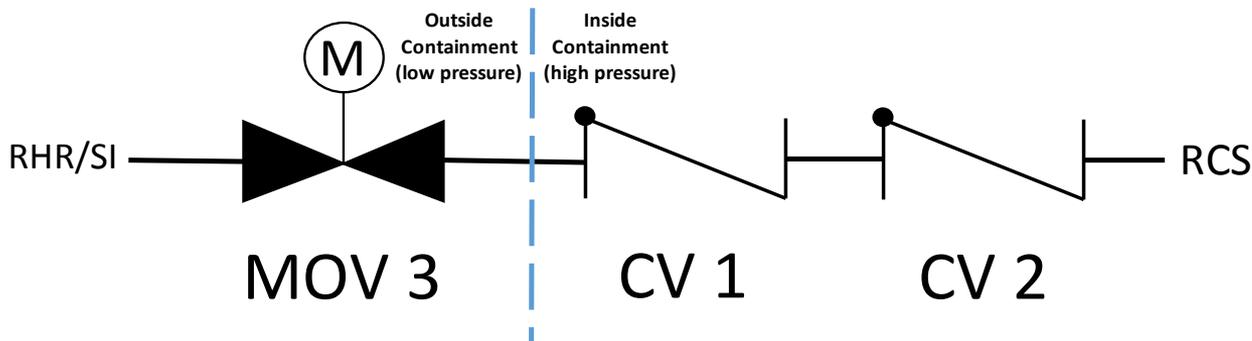
Summary of the adapted SSHAC process

- The adapted process preserved SSHAC principles:
 - ✓ **Structured** process to facilitate elicitation and minimize biases
 - ✓ **Breadth of State-of-Knowledge** – Evaluation of available data, balance of expertise
 - ✓ **Independence** – Judgment based on knowledge and individuals' expertise
 - ✓ **Interaction** in evaluating models/data and assessing uncertainties
 - ✓ **Integration** (rather than consensus) of interpretations / judgment
- The three training sessions were effective and ensured that the experts understand the stated problems and expressed uncertainties with probability distribution.
- Using individual meetings in lieu of SSHAC Workshop #1 achieved the goals with some minor caveats that were fixed at the group meeting.

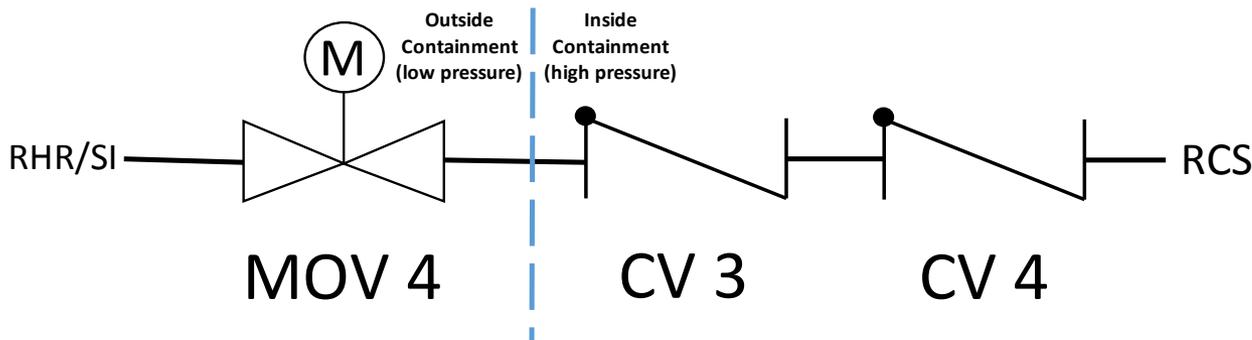
ISLOCA High/Low Pressure Interface Configurations on RHR/SI Systems



- RHR Suction Pathways
- Two normally closed MOVs in series, both inside containment
- MOVs leak tested each outage



- RHR/SI Hot Leg Injection Pathways
- Two CVs and one normally closed MOV in series; CVs inside containment, MOV outside containment



- RHR/SI Cold Leg Injection Pathways
- Two CVs and one normally open MOV in series; CVs inside containment, MOV outside containment

Expert Panel Members

- ▶ Mr. Neal Estep – Kalsi Engineering, Inc.
 - Nuclear power plant (NPP) valve engineer, 30+ years experience
- ▶ Dr. Karl Fleming – KNF Consulting Services LLC
 - NPP PRA/common cause failure, 40+ years experience
- ▶ Mr. Michael Horton – Southern Co.
 - System engineer, Sr. Reactor Operator license, 35 years experience
- ▶ Mr. Paul Knittle – MPR Associates, Inc.
 - NPP valve engineer, 30 years experience
- ▶ Dr. Frederic Simonen – Lucius Pitkin, Inc.
 - NPP piping fatigue/failure analysis, 40+ years experience
- ▶ Dr. Michael Stamatelatos – Self (Retired – NASA)
 - PRA/common cause failure, 40+ years experience

- ▶ Information provided to expert panel:
 - VEGP RHR and SI System description
 - System notebooks
 - Valve/component design, fabrication, and test specifications, including drawings
 - Current small internal leak failure rate assumption from NUREG/CR-6928 based on actual valve failure data:
 - MOVs – $2.02E-09$ failures/hour (mean)
 - CVs – $6.15E-09$ failures/hour (mean)
 - INPO Equipment Performance and Information Exchange (EPIX) data on historical internal leaks in RHR/SI systems

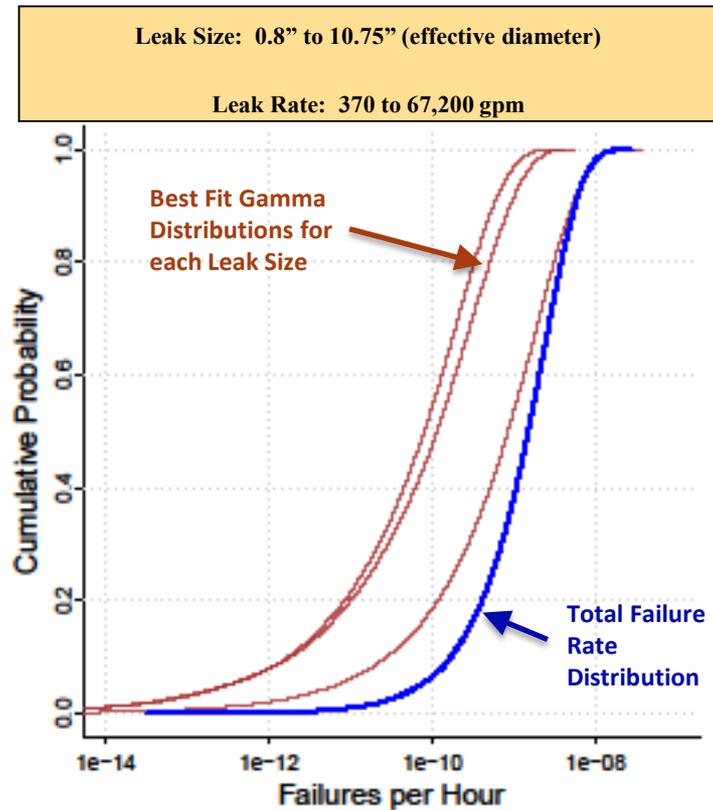
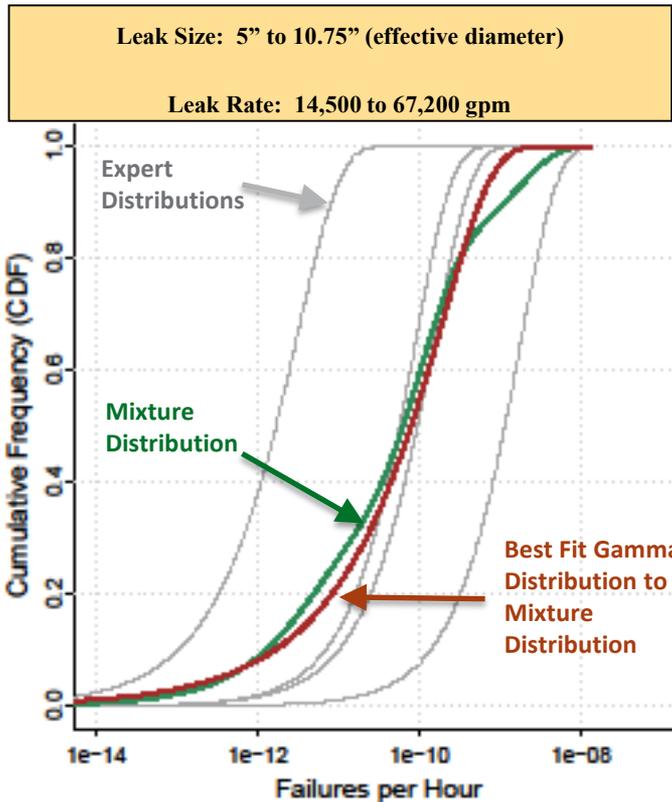
► Elicitation approach:

- Use common Elicitation Form for all experts
- Each expert provides the change in failure rate relative to the failure rate for small internal leaks from NUREG/CR-6928
 - Information represents the best available data on valve ILL failures
 - Best approach for experts not experienced with expressing failures in probabilistic terms
 - Not funded to develop mechanistic failure models
- Alternatively, expert can provide the component failure rate (failures/hour)
- Failure rate elicited for different leak size categories [effective diameter (inches) and leak rate (gpm)], depending on size of valve
- Failure rate elicited for lower bound (5%), best estimate (50%), and upper bound (95%)
- Elicited for each isolation MOV and CV

► Results

- Cumulative distribution functions developed for each “unique” valve design, each leak size category, and each expert
- Gamma distribution functions used based on industry practice; no technical reason to change
- The individual distributions developed for each expert were combined to estimate a single mixture distribution reflecting the uncertainty in the elicited results
 - Used same method as used in NUREG-1150 (arithmetic average of the individual probability distributions)
 - Method results in higher mean and 95th percentile and lower 5th percentile results than other methods (because extremes dominate)
- Two distributions reported:
 - Actual mixture distribution represented by a lookup table of values
 - Best fit parametric gamma distribution represented by the mean, alpha, and beta parameters
- Total large internal leak failure rate
 - Gamma distribution fit to the sum of the individual mixture distributions

Internal Large Leak Failure Rate – RHR Hot Leg Suction MOVs



Leak Size (inches effective diameter)	Leak Rate (gpm)	Mean ILL Failure Rate (failures/hour)
0.8 to 2	370 to 2,325	1.94E-09
2 to 5	2,325 to 14,500	3.04E-10
5 to 10.75	14,500 to 67,200	2.04E-10
Total (0.8 to 10.75)	370 to 67,200	2.35E-09
NUREG/CR-6928 (2010 Update)		2.02E-09

Conditional Probability of Failure of 2nd Valve (MOV downstream and in series with 1st MOV)

► Elicitation approach:

- Use common Elicitation Form for all experts
- Changed from initial plan to elicit common cause failure probabilities (for input to common cause failure model)
- Each expert provides the conditional probability of failure of the 2nd valve in series with the 1st failed valve (as a consequence of the change in conditions due to the independent failure of the first valve, i.e., sudden pressure surge)
- Conditional failure probability elicited for different leak size categories [effective diameter (inches) and leak rate (gpm)], depending on size of valve
- Conditional failure probability elicited for lower bound (5%), best estimate (50%), and upper bound (95%)
- Elicited for each pair of isolation MOVs and CVs

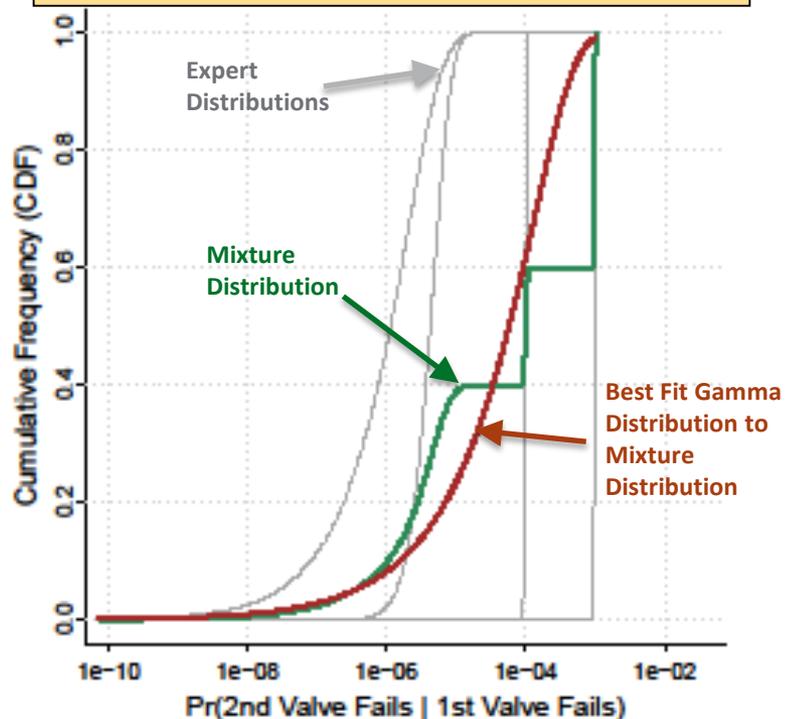
Conditional Probability of Failure of 2nd Valve (MOV downstream and in series with 1st MOV)

► Results

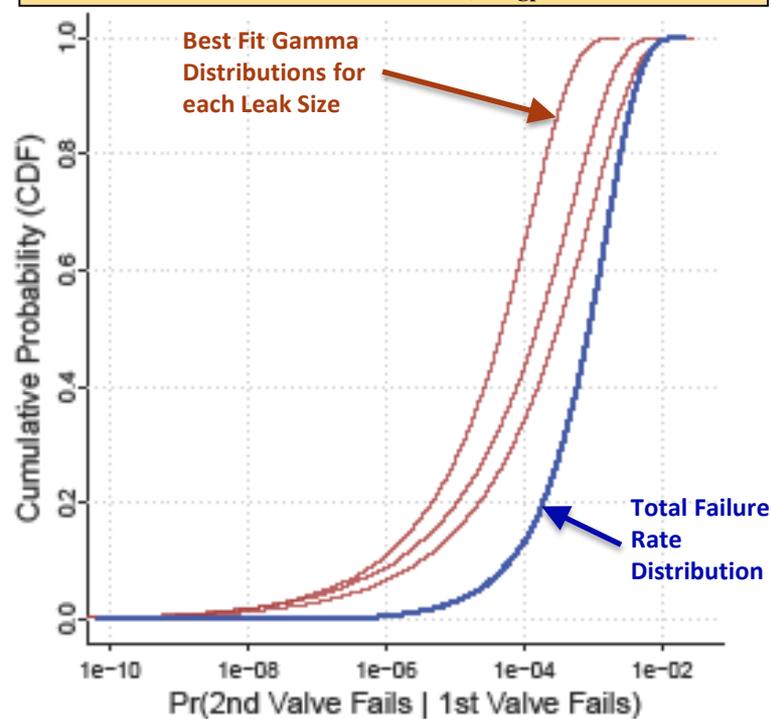
- Cumulative distribution functions developed for each “unique” valve design, each leak size category, and each expert
- Gamma distribution functions used (essentially same result as beta distribution)
- The individual distributions developed for each expert were combined to estimate a single mixture distribution reflecting the uncertainty in the elicited results
 - Again, used same method as used in NUREG-1150 (arithmetic average of the individual probability distributions)
 - Lack of spread between 5%, 50%, and 95% (i.e., all same values) required some additional data handling in order to include this input in the development of the distributions
- Two distributions reported:
 - Actual mixture distribution represented by a lookup table of values
 - Best fit parametric gamma distribution represented by the mean, alpha, and beta parameters

Conditional Probability of Failure of 2nd Valve (MOV downstream and in series with 1st MOV)

Leak Size: 5" to 10.75" (effective diameter)
Leak Rate: 14,500 to 67,200 (gpm)



Leak Size: 0.8" to 10.75" (effective diameter)
Leak Rate: 370 to 67,200 gpm



Conditional Probability of Failure of 2nd Valve (MOV downstream and in series with 1st MOV)

Leak Size (inches effective diameter)	Leak Rate (gpm)	Conditional Failure Probability	×2 for 2 pathways
0.8 to 2	370 to 2,325	1.03E-03	2.06E-03
2 to 5	2,325 to 14,500	5.19E-04	1.04E-03
5 to 10.75	14,500 to 67,200	1.37E-04	2.74E-04
Total (0.8 to 10.75)	370 to 67,200	1.52E-03	3.04E-03
Alpha Factor Model, group size of 4, staggered-testing, alpha factors from INL Database ($\alpha_1 = 9.47E-01$, $\alpha_2 = 3.46E-02$, $\alpha_3 = 1.41E-02$, $\alpha_4 = 4.70E-03$)		1.13E-01 (conditional probability after summation of frequency for all combinations/cutsets)	

- ▶ Information provided to expert panel:
 - VEGP RHR and SI System description
 - System notebooks
 - Valve/component design, fabrication, and test specifications, including drawings
 - Current failure-to-close (FTC) probability assumption from NUREG/CR-6928 based on actual valve failure data:
 - $9.63E-04$ failures/demand (mean)

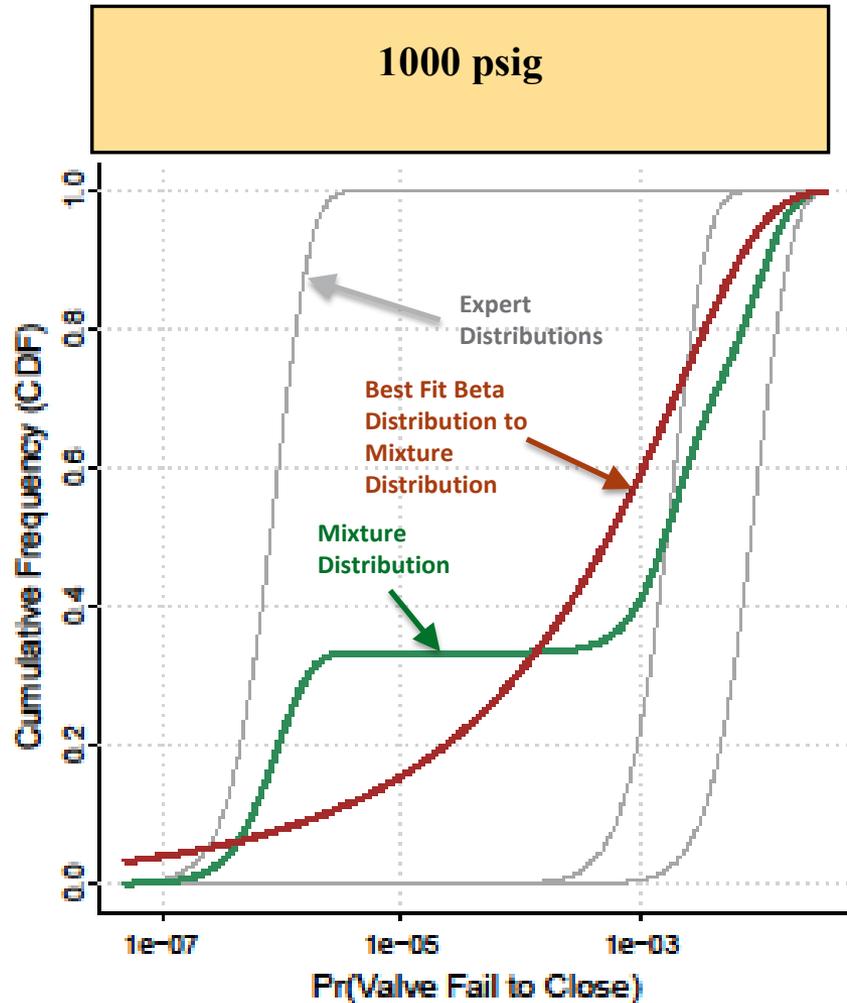
► Elicitation approach:

- Use common Elicitation Form for all experts
- Each expert provides the change in failure probability relative to the FTC probability from NUREG/CR-6928
 - Information represents the best available data on valve FTC probabilities
 - Best approach for experts not experienced with expressing failures in probabilistic terms
 - Not funded to develop mechanistic failure models
- Failure probability elicited for different categories of differential pressure across the valve
- Failure probability elicited for lower bound (5%), best estimate (50%), and upper bound (95%)
- Elicited for each normally-open MOV that could potentially be used to isolate/mitigate an ISLOCA

► Results

- Cumulative distribution functions developed for each “unique” valve design, each differential pressure category, and each expert
- Beta distribution functions used based on industry practice; no technical reason to change
- The individual distributions developed for each expert were combined to estimate a single mixture distribution reflecting the uncertainty in the elicited results
 - Used same method as used in NUREG-1150 (arithmetic average of the individual probability distributions)
- Two distributions reported:
 - Actual mixture distribution represented by a lookup table of values
 - Best fit parametric beta distribution represented by the mean, alpha, and beta parameters

Failure-to-Close Probability (RHR MOV)



Differential Pressure (psig)	Mean FTC Probability
1000	2.19E-03
1500	5.67E-02
2000	5.93E-01
2695	5.93E-01
NUREG/CR-6928 (2010 Update)	9.63E-04

Probability of External Break Location

- ▶ Information provided to expert panel:
 - VEGP RHR and SI System description
 - System notebooks
 - Valve/component/piping design, fabrication, and test specifications, including drawings

Probability of External Break Location

► Elicitation approach:

- Use common Elicitation Form for all experts
- Each expert provides the likelihood that the external break will occur at a specific location relative to a reference location (inside containment)
 - Assumes an external break will occur at some location
- Eliciting probability of external break not within the project scope
- Best estimate probability elicited
- Elicited for each ISLOCA pathway

Probability of External Break Location

ISLOCA in the RHR system is initiated due to failure of the redundant MOVs on the suction lines from Hot Leg Loop 1

RHR ISLOCA	Probability	Break Location
	0.0004	1
	0.048	2
	0.008	3
	0.008	4
	0.726	5
	0.014	6
	0.168	7
	0.012	8
	0.003	9
	0.014	10



Backup Slides

Adapted SSHAC process for ISLOCA



Pacific Northwest
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Preparation

Preparation

Prepare detailed
problem description
and data



Select expert
team for elicitation



Training

- Problem definition
 - Project plan development – elicitation process, objective, etc
 - Level of detail expectations
 - System notebook – available models and data
-
- PRA
 - Common cause failures
 - Piping and valve failure experts
 - System engineers
-
- Initial video conference on expert elicitation training
 - Second video conference for systems familiarization
 - Workshop training on probability distribution and uncertainties

Adapted SSHAC process - Training

Initial video conference on expert elicitation training

- Review and discussion of the problem description.
- Overview of the current NRC L3PRA ISLOCA model.
- Description of the elicitation process.
- Discussion of some of the pitfalls of the elicitation process, such as bias, anchoring, and uncertainty underestimation.
- Tutorial of the elicitation training exercise and associated questions.

Second video conference for systems familiarization

- Review the initial results of the elicitation training exercise.
- Briefly re-review the problem description.
- Provide an overview of the content of the RHR and SI System Notebooks
- Describe and discuss the information to be elicited at the individual and group elicitation sessions.

Workshop training on probability distribution and uncertainties

- Exercise on identifying uncertainty factors and expressing uncertainties with probability distribution

Adapted SSHAC process for ISLOCA – Individual meetings

Individual meetings

Understanding of
problems, models &
data ²⁷

Evaluate data

Initial elicitation of
judgment
(center/body/range
with justification)
on the stated
problems

Datasheets for elicitation

- 1) Large internal leak failure rate for CVs and MOVs
- 2) Common cause failure likelihood for pairs of in-series CVs and MOVs
- 3) Probability of failure-to-close (FTC) against differential pressure for normally-open MOVs
- 4) Likelihood of external break location due to a large internal valve leak relative to a reference location inside containment

Meeting procedure:

- The facilitator introduced the Datasheet; the expert was given the opportunity to ask additional questions to clarify the intent and meaning of any of the data fields.
- The integrator recorded the expert's judgment (probabilities) in an expert-specific Datasheet and comments (justification).
- Expert sometimes made changes to previously entered values and comments to ensure consistency or to reflect an evolution in the Expert's thought process.
- The outcome of the meetings was distributed to all the experts prior to the next workshop.

Adapted SSHAC process for ISLOCA - Workshop

Group meeting

Review results of
individual meetings

Have group discussion
and elicitation

- Each expert presented the basis for their individual results, with discussion among the panel members encouraged.
- Following completion of discussions, each expert was given an opportunity to modify their original judgment based on the additional information presented by the various experts.
- Each expert provided their updated Datasheets to PNNL during a three month period after the workshop – Experts reviewing their changes, adding comments, and reconsidering their input in light of the additional information discussed during the meeting and made available subsequent to the meeting.

NUREG/CR-6928 (2010 Update)

Table 1-7. Selected industry distributions of p and λ for MOVs.

Pooling Group	Failure Mode	Source	5%	Median	Mean	95%	Distribution		
							Type	α	β
All	FTO/C	EB/PL/KS	1.76E-04	8.12E-04	9.63E-04	2.27E-03	Beta	2.05	2.123E+03
	FC	EB/PL/KS	7.40E-09	5.18E-08	6.62E-08	1.74E-07	Gamma	1.46	2.205E+07
	SOP	EB/PL/KS	2.54E-10	1.72E-08	3.39E-08	1.24E-07	Gamma	0.57	1.684E+07
	ILS	EB/PL/KS	1.36E-09	5.64E-08	1.01E-07	3.52E-07	Gamma	0.65	6.477E+06
	ILL	EB/PL/KS	2.16E-13	4.92E-10	2.02E-09	9.24E-09	Gamma	0.30	1.485E+08
	ELS	EB/PL/KS	9.81E-11	1.42E-08	3.28E-08	1.28E-07	Gamma	0.48	1.451E+07
	ELL	EB/PL/KS	2.46E-13	5.59E-10	2.29E-09	1.05E-08	Gamma	0.30	1.308E+08

Table 1-28. Selected industry distributions of p and λ for CKVs.

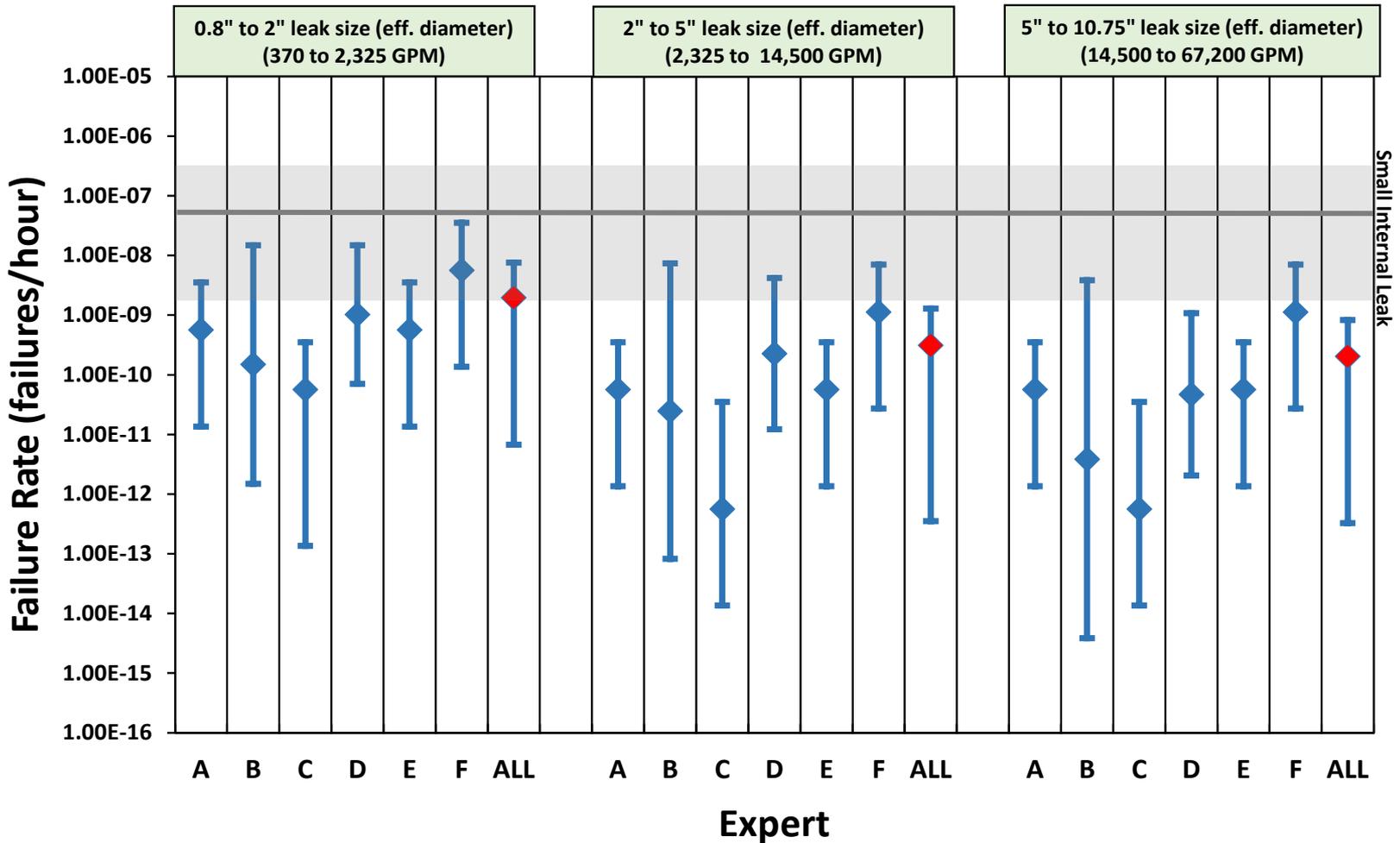
Pooling Group	Failure Mode	Source	5%	Median	Mean	95%	Distribution		
							Type	α	β
All	FTO	JNID/IL	4.20E-08	4.86E-06	1.07E-05	4.10E-05	Beta	0.50	4.684E+04
	FTC	EB/PL/KS	6.68E-06	1.50E-04	2.38E-04	7.70E-04	Beta	0.81	3.384E+03
	SOP	JNID/IL	1.08E-09	3.16E-09	3.48E-09	7.00E-09	Gamma	3.50	1.005E+09
	SC	JNID/IL	2.28E-09	5.15E-09	5.47E-09	9.79E-09	Gamma	5.50	1.005E+09
	ILS	EB/PL/KS	2.32E-09	1.56E-07	3.08E-07	1.13E-06	Gamma	0.57	1.856E+06
	ILL	EB/PL/KS	6.58E-13	1.50E-09	6.15E-09	2.81E-08	Gamma	0.30	4.876E+07
	ELS	JNID/IL	5.77E-09	1.01E-08	1.05E-08	1.63E-08	Gamma	10.50	1.005E+09
	ELL	JNID/IL	7.87E-14	1.79E-10	7.35E-10	3.36E-09	Gamma	0.30	4.082E+08

Internal Large Leak Failure Rate

RHR ISLOCA Elicitation Form											Date: 06/24/2015		
Large Internal Leakage Failure Mode for High Pressure/Low Pressure Isolation Valves											Expert: XXXXXXXXXXXX		
Change in Component Failure Rate Relative to Small Internal Leak (e.g., 0.1x, 10x)					Component Failure Rate (failures/hour)			PNNL Comments		Expert Comments			
RHR ISLOCA Scenario	Component ID	Event Number	Internal Leakage Size (effective diameter - inches)	Leakage Rate (gpm)	Lower Bound (LB)	Best Estimate (BE)	Upper Bound (UB)	Lower Bound (LB)	Best Estimate (BE)	Upper Bound (UB)			
RHR Suction from Hot Leg Loop 1	MOV HV-1, Gate Valve	1	very small	5 to 50	NA	NA	NA	1.36E-09	5.64E-08	3.52E-07			
		2	<0.8	<370	No Need to Evaluate			No Need to Evaluate					
		3	0.8 to 2	370 to 2325									
		4	2 to 5	2325 to 14500									
		5	5-10.75 (maximum for schedule 120 12" pipe)	14500 to 67200									

Internal Large Leak Failure Rate

RHR Hot Leg Suction MOVs

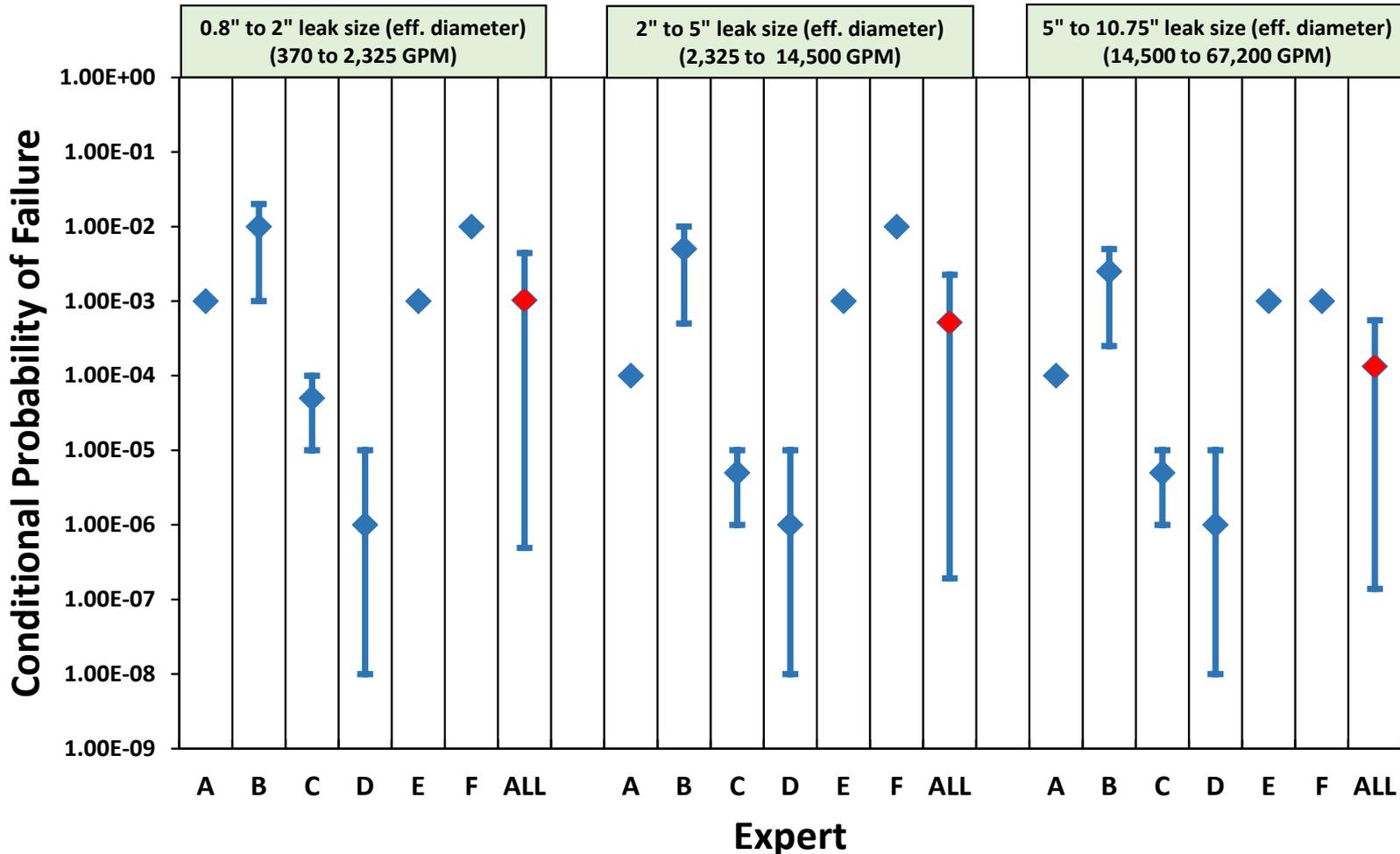


Conditional Probability of Failure of 2nd Valve (downstream and in series with 1st valve)

RHR ISLOCA Elicitation Form										Date: 06/24/2015	
										Expert: XXXXXXXXXXX	
Conditional Probability of Failure of the 2nd Valve in Series for Large Internal Leakage Failure Mode for High Pressure/Low Pressure Isolation Valves							Conditional Probability of 2nd Valve Failure			PNNL Comments	Expert Comments
RHR ISLOCA Scenario	Component ID Combinations	Event Number	Scenario ID	Internal Leakage Size (effective diameter - inches)	Leakage Rate (gpm)	Independent Component Failure Rate (failures/hour)	Lower Bound (LB)	Best Estimate (BE)	Upper Bound (UB)		
RHR Suction from Hot Leg Loop 1	MOVs HV-1, HV-2	1	RHR.HL1.MOV.CCF2.1	very small	5 to 50	1.36E-09 (LB) 5.64E-08 (BE) 3.52E-07 (UB)	No Need to Evaluate				
		2	RHR.HL1.MOV.CCF2.2	<0.8	<370		No Need to Evaluate				
		3	RHR.HL1.MOV.CCF2.3	0.8 to 2	370 to 2325	1.36E-11 (LB) 5.64E-10 (BE) 3.52E-09 (UB)					
		4	RHR.HL1.MOV.CCF2.4	2 to 5	2325 to 14500	1.36E-12 (LB) 5.64E-11 (BE) 3.52E-10 (UB)					
		5	RHR.HL1.MOV.CCF2.5	5-10.75 (maximum for schedule 120 12" pipe)	14500 to 67200	1.36E-12 (LB) 5.64E-11 (BE) 3.52E-10 (UB)					

Conditional Probability of Failure of 2nd Valve (downstream and in series with 1st valve)

Conditional Probability of Failure of Two MOVs in Series

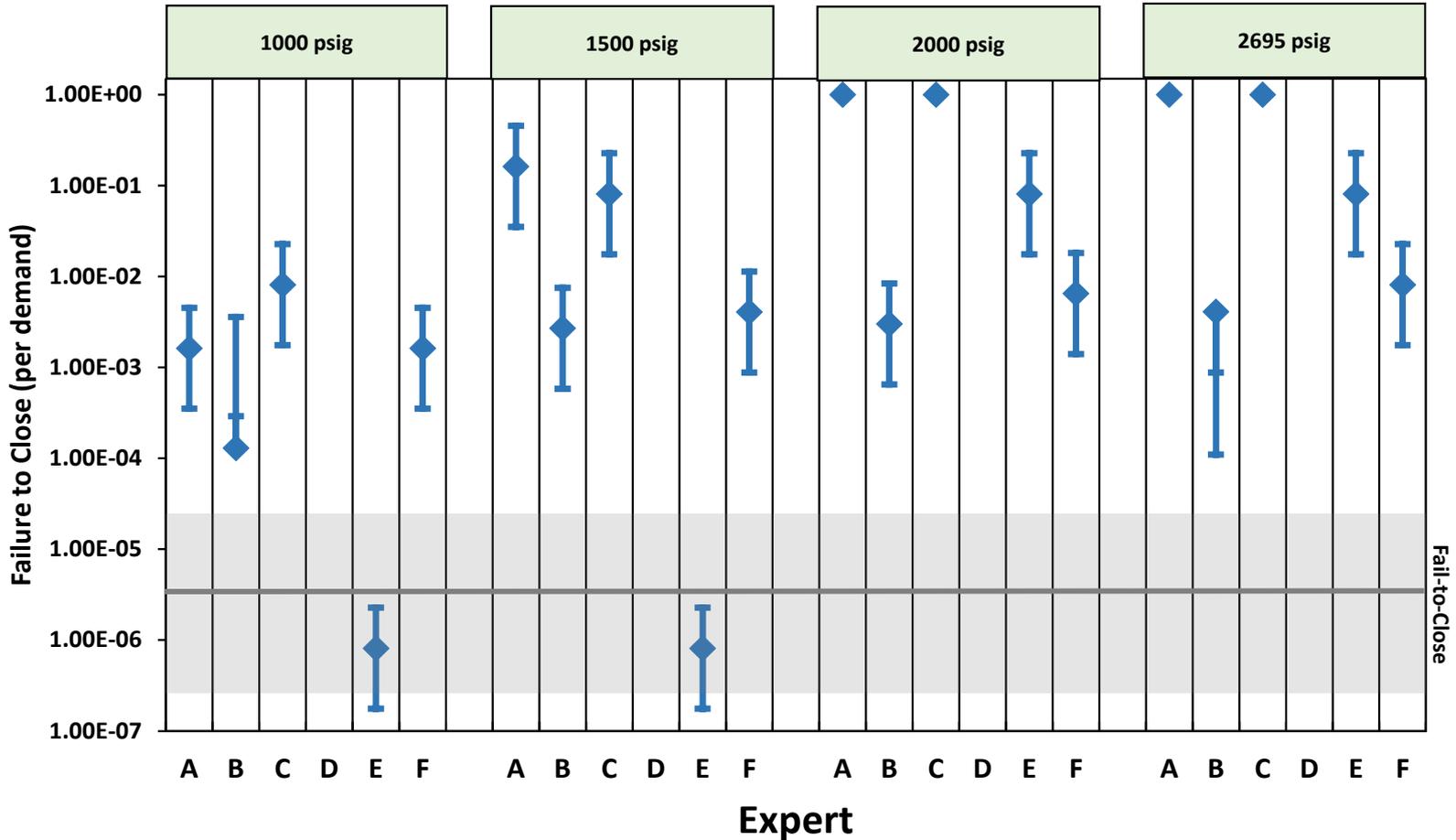


MOV Failure-to-Close Probability

RHR ISLOCA Elicitation Form										Date: 06/24/2015	
Failure-to-Close Failure Mode for High Pressure/Low Pressure Isolation Valves				Change in Failure Rate for Fail-to-Close Against Differential Pressure Relative to NUREG/CR-6928			Fail-to-Close Against Differential Pressure (failures/demand)			PNNL Comments	Expert Comments
<i>RHR ISLOCA Scenario</i>	<i>Component ID</i>	<i>Event Number</i>	<i>Differential Pressure Across Valve (psi)</i>	<i>Lower Bound (LB)</i>	<i>Best Estimate (BE)</i>	<i>Upper Bound (UB)</i>	<i>Lower Bound (LB)</i>	<i>Best Estimate (BE)</i>	<i>Upper Bound (UB)</i>		
RHR cold leg injection path Loops 1 and 2	MOV HV-3, Gate Valve	1	600	NA	NA	NA	1.76E-04	8.12E-04	2.27E-03		
		2	1000								
		3	1500								
		4	2000								
		5	2695								

MOV Failure-to-Close Probability

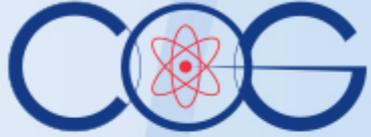
MOV FAIL-TO-CLOSE AGAINST DIFFERENTIAL PRESSURE



Probability of External Break Location

RHR ISLOCA Elicitation Form				Date: 06/24/2015		
				Expert: XXXXXXXXXXXX		
Line Break from Over-Pressurization				Characterization of Break Location	PNNL Comments	Expert Comments
RHR ISLOCA Scenario	Event Number	Break Location (Component ID)	Maximum External Leak Size (effective diameter)	Likelihood of Break Location Relative to Reference Location (e.g., 0.1x, 10x)	Assumptions and Other Considerations in Developing Rankings	Assumptions and Other Considerations in Developing Rankings
RHR Suction from Hot Leg Loop 1	1	Pipeline Segment immediately after MOV HV-1	12"	1	Reference Location - Pipe location immediately downstream from internal leak; first location to see pressure spike.	
	2	2	12"			
	3	3	14"			
	4	4	12"			
	5	5	12"			
	6	6	8"			
	7	7	8"			
	8	8	8"			
	9	9	3"			
	10	10	8"			
	11	11				

CANDU Owners Group Inc.



"Excellence Through Collaboration"

Excellence through Collaboration

Whole-Site Risk Assessment and Safety Goals

Jack Vecchiarelli

Ontario Power Generation

ACRS Meeting, Rockville, MD
March 1, 2016

Disclaimer



The ongoing work described in this presentation is preliminary in nature and does not represent the finalized views of members of the CANDU Owners Group (COG).



Outline



- Background on “whole-site risk”
- Key issues
- Work conducted by COG
- Risk metrics and their role



Background



- Current risk metrics are applied on a per-unit, per-hazard basis (e.g., Large Release Frequency)
- 2013 licensing hold point on Pickering Nuclear Generating Station (6 operating units east of Toronto, Ontario)
 - required a “whole-site PRA” OR a methodology for it
- Intent is to characterize the *overall* risk of the *site* due to the aggregation of risks from:
 - multiple reactor units
 - other on-site radiological sources → e.g., spent fuel bays
 - different hazard types (internal and external)
 - various plant operating modes



Key Issues



- No international consensus on methodology
- Simple addition of all hazard risks (internal events + fire + flood + seismic + high wind...) → can be overly-conservative
 - Also, for given hazard → multi-unit risk \neq per-unit risk \times (# units)
- PRA safety goals are perceived as a hard delineation between safe / unsafe plant design



Role of Safety Goals



- Ultimately, safety goals are intended to ensure risks are kept acceptably low
 - and hence, that nuclear plants are licensable
- PRA, as applied, provides an *indicator* of risk, not a true *measure* of risk
- Need to incorporate broader aspects of what contributes to managing plant risk (i.e., both programmatic and analytical elements)
 - to support the process of communicating about nuclear safety



COG Work



- Hosted international workshop (2014)
- Issued concept-level paper on whole-site PRA & safety goals
- Initiated COG Joint Project:
 - Phase A - Safety goals framework → public communication tool
 - Phase B - Risk aggregation studies → quantify whole-site *risk*
 - Identify risk sources and reactor operating states
 - Risk assessment methods for non-reactor sources
 - Consider habitability effects in PRA modelling
 - Trials of different risk aggregation methods
 - Consider other risk assessment approaches
 - Phase C - Pilot whole-site PRA for Pickering (2017)



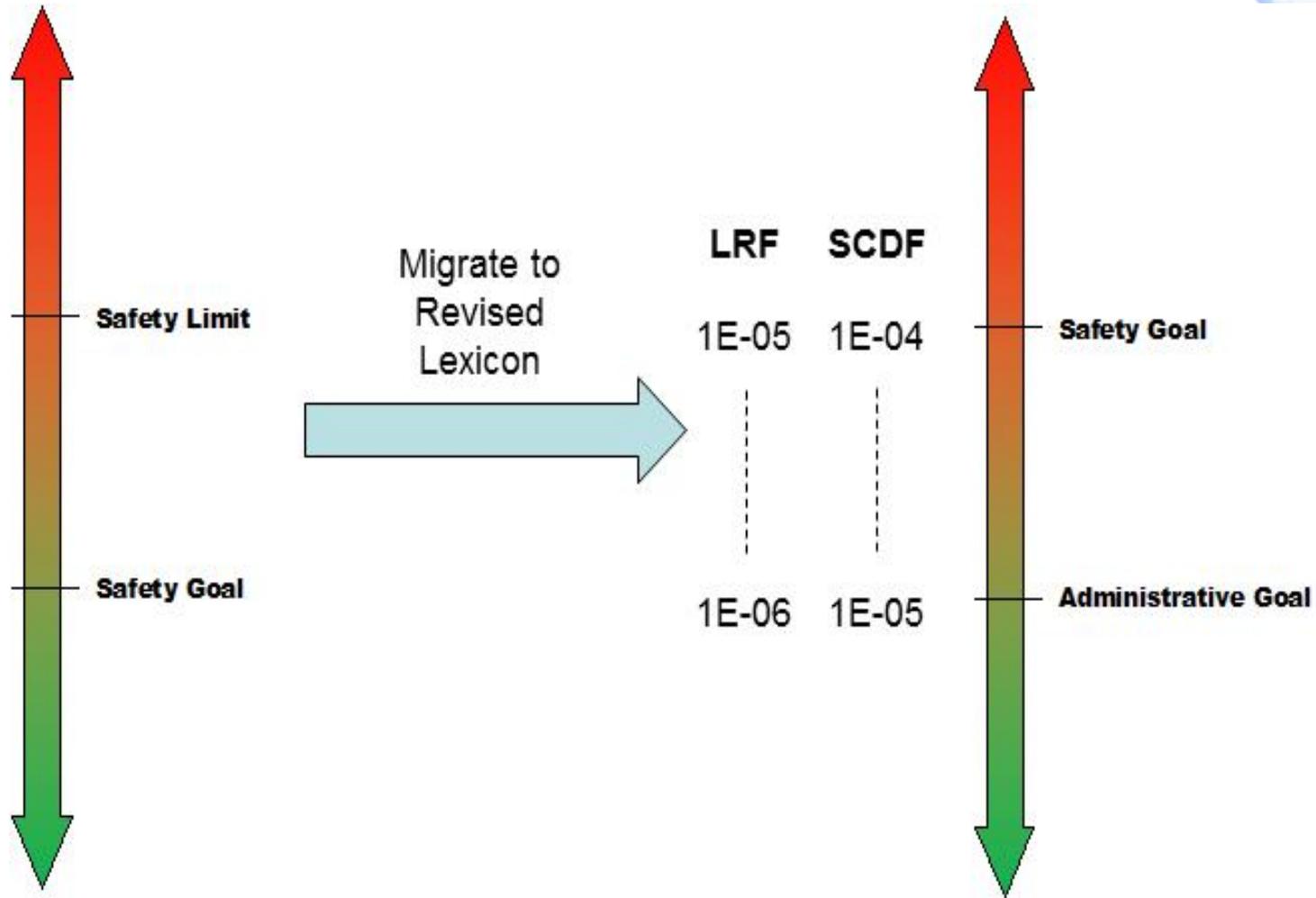
Risk Metrics



- A primary focus of safety goals should remain the protection of the life and health of the public
- Where surrogate risk metrics are used, show that they represent an equivalent or more limiting criterion than the underlying health-related goals
 - e.g., Large Release Frequency (LRF):
 - Based on sum of frequencies of event sequences that can lead to an off-site release of more than 10^{14} becquerel of cesium-137
 - *a greater release may require long term relocation of the local population (CNSC Regulatory Document 2.5.2)*



Risk Metrics for Existing CANDUs



Other Considerations



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Risk Metrics in a Safety Goals Framework Concept



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Key Messages



- PRA is *part* of the safety story
- PRA safety goals are “targets” , not hard “limits”
- The main benefits of PRA are in identifying risk insights to improve plant design and operation

- *Existing* PRA safety goals (per-unit/per-hazard) AND *Existing* Programs → confidence that *site* risk is low



Preliminary Assessment of Risk Metrics



- Assess margins to possible QHOs for range of large release frequency (LRF) and consequence assumptions
- Total LRF of $\sim 1\text{E-}05/\text{yr}$ would provide margin to possible QHOs for a wide range of accident consequences, whilst serving as a reasonable basis for practical elimination of the potential for long-term relocation
- Recognizing that, in terms of the acceptance criteria for risk metrics, the issues are “trans-scientific”



Summary

- Nuclear safety (low risk) is assured through a collection of safety goals and objectives, not necessarily by a single numerical value (risk metric)
- A hierarchal framework of safety goals can be constructed
 - Consisting of a mix of qualitative and quantitative safety goals in different levels and logically inter-related
 - Such that the over-arching safety goal (health objective) is met whilst also adequately addressing other important considerations (long-term relocation)
 - May be used a basis for public communication
- There is flexibility in acceptable values of total calculated LRF
 - LRF risk metric is not limited to addressing health objectives
 - Whole-site risk can be managed via compliance with current per-unit based LRF risk metric and programmatic measures

