

UNITED STATES OF AMERICA
U.S. NUCLEAR REGULATORY COMMISSION

BRIEFING ON SEVERE ACCIDENTS AND OPTIONS FOR
PROCEEDING WITH LEVEL 3 PROBABILISTIC RISK
ASSESSMENT ACTIVITIES

JULY 28, 2011

9:00 A.M.

TRANSCRIPT OF PROCEEDINGS

Public Meeting

Before the U.S. Nuclear Regulatory Commission:

Gregory B. Jaczko, Chairman

Kristine L. Svinicki, Commissioner

George Apostolakis, Commissioner

William D. Magwood, IV, Commissioner

William C. Ostendorff, Commissioner

APPEARANCES

Stakeholder Panel:

Biff Bradley
Director of Risk Assessment,
Nuclear Energy Institute

Stuart Lewis
Program Manager for Risk and Safety Management,
Electric Power Research Institute, Inc.

Karl Fleming
President,
KNF Consulting Services, LLC

NRC Staff:

Bill Borchardt
Executive Director for Operations

Brian Sheron
Director, RES

Daniel Hudson
Level 3 Project Manager, RES

Martin Stutzke
Senior Technical Advisor for PRA Technology, RES

1 PROCEEDINGS

2 CHAIRMAN JACZKO: Good morning, everyone, the Commission
3 meets today to receive a brief overview of the agency's approach to severe
4 accidents and to discuss the potential uses for Level 3 probabilistic risk
5 assessments. Since the 1995 PRA policy statement, the Commission has
6 endorsed and encouraged the use of PRAs and other risk tools to strengthen our
7 regulatory framework. Today, they are widely used by the NRC and in number of
8 important safety areas, including fire protection and new reactor design reviews.
9 Although not all of our activities necessarily lend themselves to this type of risk
10 analysis, it is no exaggeration to say that the NRC today is a leader in the state
11 of the art use of PRA technology, and I want to thank the staff for developing a
12 paper that lays out several options on how we can build on a strong foundation
13 and move forward with the future use of Level 3 PRAs. And I recall, as we had
14 the RIC, which now seems like years ago, given the things that happened in
15 between the RIC, I suggested that we look to having Level 3 PRAs within five
16 years, or at least have a standard, a consensus standard, on Level 3 PRAs in the
17 next five years. I think the paper laid out some options that are even more
18 aggressive and potentially more significant than that. I think that there's no
19 question that the state of the art has improved significantly over the last two
20 decades and that there are new issues that perhaps should be examined through
21 the completion of Level 3 PRAs. As the staff notes in their paper, those include
22 issues raised by the Fukushima accident, specifically the challenges posed by
23 multi-unit events in the risks of radiological releases from spent fuel pools.

24 It is credit to everyone who has worked on these issues, especially
25 my colleague Commissioner Apostolakis, and all the work he's done for a long

1 time on these issues. I remember years ago, I was trying to learn about what
2 PRA was all about and I started pulling all these papers from the beginnings of
3 this stuff, and there was this guy, name was all over them. It was George
4 Apostolakis, and, but --

5 COMMISSIONER APOSTOLAKIS: Somebody actually read those
6 papers?

7 CHAIRMAN JACZKO: I did, I will tell you. I tried to find the
8 journals, but they didn't have them, so I had to call around, eventually got it on
9 eBay, so [laughs]. No, so today, we are considering the development of a full
10 scope Level 3 PRA. Before we begin today's meeting, would any of my
11 colleagues like to make any remarks?

12 COMMISSIONER APOSTOLAKIS: Yeah, I would. Well, as an
13 agency, we pride ourselves on being a risk informed agency, and of course the
14 Level 3 PRA is the most complete representation of planned risk. It's been about
15 36 years since the Reactor Safety Study was published, the first Level 3 PRA,
16 and about 20 years since NUREG-1150. And the Chairman mentioned
17 Fukushima, I mean the near term task force says that the dose assessment is
18 the primary means for assessing the potential consequences of radiological
19 emergency, and it seems to me a Level 3 PRA addresses the issue of those, and
20 it would be very useful in that context. So I think this meeting is very timely, and
21 I'm looking forward to listening to our guests and the staff, looking forward to
22 disagreeing with the staff, in fact.

23 CHAIRMAN JACZKO: [laughs]. I'm sure they're looking forward to
24 their presentation now. Well, if you want to begin, we'll begin with Biff Bradley,
25 who is the Director of Risk Assessment at the Nuclear Energy Institute.

1 BIFF BRADLEY: Thank you, Mr. Chairman, and thank you to the
2 Commission for inviting us today. Industry is and has been a strong supporter of
3 risk informed regulation, and we believe this has been a successful technique for
4 improving plant safety as well as improving our plant operations, and we're
5 always interested in enabling and keeping these activities moving forward, so I
6 appreciate the opportunity to discuss this today. Slide, please.

7 Let me get to our punch line. Industry does support the concept of
8 an updated Level 3 study, and we believe that there could be significant value to
9 this. NUREG-1150, even though it is 20 years old, is still held in high esteem by
10 the risk community, and has proven to be an excellent foundation for everything
11 we've done, and the concept of updating it to reflect everything that's happened
12 in 20 years is a good idea. We know that there have been significant changes to
13 plant design, operation, we have the maintenance rule, we're using risk in the
14 operation of plants now. There have also been improvements in the analytical
15 techniques that underpin PRA, and as well as in the state of knowledge; we have
16 a lot more operational experience now -- excuse me -- both in the U.S. and
17 worldwide.

18 We do believe that the Level 3 effort is not needed to replace the
19 current regulatory approach. For most risk informed decision making now,
20 we're using the concept of Reg Guide 1174, which is Core Damage Frequency
21 and Large Early Release Frequency. This lends itself very well to most of the
22 types of decisions we make in the plant, and we do use Level 3 in some places,
23 SAMA for license renewal, and going forward with emergency planning
24 considerations, there might be a purpose for Level 3 in a risk informed
25 emergency planning approach, but we do believe that for the majority of the uses

1 of PRA that the current approach is appropriate. Next slide.

2 This is just a quote from the 90 day Task Force report. I won't read
3 it to you, but it's essentially making the same comment I just made, that the
4 existing system has served us well. There wasn't enough room on the slide, but
5 there was another paragraph that followed this that said that it would be a good
6 idea to perform some selected Level 3s to confirm the existing approach, and I
7 think we agree with that. Next slide.

8 I wanted to talk about some industry considerations that we believe
9 would be beneficial for this study, and they're a little different from some of the
10 things that may be in the SECY. We've -- we're moving toward an era where
11 we're really using PRAs in decision-making, and it's a different era than we were
12 in 20 years ago. 1150 was done primarily to look at primary contributors,
13 insights, potential safety enhancements, but now we're in a different era where
14 we're making regulatory decisions on numerical thresholds. These are small
15 thresholds, these are thresholds that can be affected by assumptions in the PRA,
16 any number of things in the PRA can affect these decisions. Because of that,
17 there's much more scrutiny of the PRA than there was in that era, and we now
18 have a whole regime of standards, which has been an effective tool to help us
19 achieve better PRA, but even underlying standards, there are methods. The
20 standards tell you what to do, the methods tell you how to do it, and as we've
21 moved into -- for instance, NFPA 805 implementation, we've seen tremendous
22 scrutiny of the underlying methods in PRA. And that, I guess, you know, would
23 be expected, given that we're using it in a much more rigorous regulatory
24 application.

25 There are also larger uncertainties. We've done a pretty good job

1 to develop really, I think, robust internal events models, but as we move into fire
2 and seismic, where you're starting to get into spatial considerations as well as
3 external hazards that have their own uncertainties, even before you build the
4 model, you're also dealing with larger uncertainties than we typically had in the
5 past, so that's another challenge.

6 So we've sent some letters to NRC with respect to the need to have
7 better understanding, clarity on the underlying methods, and we believe this
8 study could actually do that because in order to build a Level 3, you have to have
9 a really good Level 1, Level 2 that looks at all modes, all initiators, and that's
10 where we believe the real benefit of this comes, from the underlying methods
11 development that would do that. We also believe that a pilot plant is essential; I
12 agree with the ACRS letter on this subject. Developing these methods or filling
13 gaps, what you have, in the absence of a real plant application, doesn't really get
14 us to where we need to be. We have experience from NUREG-6850, which was
15 a joint project, also with EPRI-1011989, and some good methods developed, but
16 we didn't fully pilot at them, and we found out later that it would have been a
17 great benefit to have a full pilot of those methods, so we really believe we don't
18 want to replicate that experience.

19 We believe Level 1 for all modes and all initiators is a logical first
20 step. ACRS sort of recommended sequencing this in terms of developing full
21 Level 3s for groups of initiators and modes, but I think our view is more try to get
22 the Level 1 stuff done first and then move on to Level 2, Level 3. There's also
23 the issue of the Fukushima insights, and what will be learned from that accident
24 going forward, and how that can be folded in. ACRS letter spoke to that to some
25 degree. Next slide.

1 So, our perception of benefits from this is one, a practical benefit, is
2 this provides and documents acceptable methods of Level 1 as well as LERF for
3 an expanded scope of modes and hazards. That's our, probably our compelling
4 need right now in, in terms of applications. Also, this would inform and pilot the
5 standards. We have a lot of standards development going on, and we've learned
6 in standards development that having a pilot and an actual application integrated
7 into that process is extremely beneficial. This could also provide a reference
8 study that documents methods and standards compliance going forward. Right
9 now, we have some ongoing struggles with the peer review process and the
10 standards and issues of interpretation, so more clarity going forward would be
11 helpful in that regard, and help us to have more efficient applications. Also, NRC
12 has the SOARCA project, which wasn't a PRA but looked at some selected
13 sequences, and we believe that some of the technology developed for SOARCA,
14 which included some improved computer codes and other improvements can be
15 folded into this effort and would be, can be used to support the Level 3 study.
16 Next slide.

17 So, we know what the three options were that were proposed in the
18 SECY. Status quo, that's where we are now and, as I mentioned, we're
19 struggling to get better understanding of methods just to underlie our PRAs, so
20 we would like to move away from that and get into a more -- an effort that gets us
21 to where we need to be. I mentioned already that the Option 2 doesn't include,
22 or is not proposed to include a pilot plant and we believe that does not get us to
23 where we need to be.

24 Relative to Option 3, I think we're in general agreement with the
25 ACRS observations that a sequenced Option 3 approach makes sense. Not

1 sure, you know, ACRS recommended doing a PWR. I think we believe there's
2 value to doing both a P and a B. We do recognize the challenges presented
3 here, that there are competing resource priorities, and that -- I think that is the
4 essential challenge for this effort. I'm not sure anyone doesn't think this isn't the
5 right thing to do, it's just a matter of how do we, how does this fit in the other
6 activities that are going on. Next slide.

7 We, you know, we recognize this is a resource intensive effort, for
8 both NRC and the pilot plant. We've had experience with this with the original
9 1150 as well as SOARCA, where even just doing a couple of sequences, that
10 was a major undertaking for NRC as well as the pilot plants. I observed the, you
11 know, the original NUREG-1150 was a lengthy effort, and a, you know, I wouldn't
12 expect this to be much easier. It's not -- we shouldn't underestimate the
13 challenge. So as I mentioned, we need to factor in the other priorities. I do
14 believe that the timeline proposed is optimistic. Our experience has been that
15 these are multi-year efforts, so just make that observation. Next slide.

16 We have discussed this with industry, and I do have several
17 possible pilot plants that are willing to engage in discussion with NRC staff,
18 relative to supporting this effort. I don't have formal agreements from those
19 plants, but they are willing to engage in discussion. Not clear that we have a
20 single plant that can meet all the expectations that were delineated in the SECY
21 relative to multi-unit external hazards, et cetera, but we're ready to sit down and
22 talk with you about that. So we're ready to engage in those discussions should
23 the decision be made to proceed. Final slide.

24 Again, we believe that the new Level 3 study could provide
25 important insights to complement and confirm NRC's risk informed approach.

1 You know, we do believe there's a significant practical additional benefit in the
2 development of Level 1 methods and demonstration of standards. That's the
3 world we live in now, and doing the study without that part really isn't going to
4 give us maximum benefit. Finally, as I've mentioned, the timing schedule are
5 challenging, and so we'll have to deal with that. So, I know my time is up, so
6 thank you.

7 CHAIRMAN JACZKO: Thank you. We'll now turn to Stuart Lewis,
8 who is the Project Manager for Risk and Safety Management at the Electric
9 Power Research Institute.

10 STUART LEWIS: Thank you, and thank you for this opportunity to
11 speak to you about this effort. As you may know, EPRI has been engaged in
12 advancing PRA tools and methods for many, many years, and --

13 As I was saying, EPRI has been involved in developing and advancing
14 PRA tools and methods for a very long time now, and over that period, from time
15 to time, we've worked pretty effectively with the staff to do that, going back to at
16 least the development of common cause failure analysis methods back in the mid
17 1980s. So I'd like to talk to you now -- if we could go to the first slide after the
18 introduction. I'd like to talk to you very briefly from a technical perspective about
19 some of the programmatic aspects of this project, and then give you some
20 thoughts on where we might consider working together, if you were to engage in
21 doing a Level 3 PRA. Next slide, please.

22 I have just a few comments about some of the objectives that might
23 come into play in undertaking a Level 3 PRA. Of course, I think we've all
24 recognized updating NUREG-1150 would be a valuable thing to do. We talked
25 already about some of the reasons for doing that. Biff also mentioned SOARCA

1 and providing a Level 3 PRA would add context to what was done in SOARCA,
2 and draw on technical elements of SOARCA. Certainly, there are specific areas
3 in which we think that the technology needs to be improved for PRA, and doing
4 that in the context of PRA in some cases can be a valuable way to go about
5 doing business. In other cases, it makes sense to do those developments before
6 you get into a PRA, but, again, the PRA provides context and helps you
7 understand whether you've gone far enough in the methods development in
8 some cases.

9 One thing that may not be as high on NRC's radar screen as it is for
10 the industry, is to try out new standards that are being developed. We have new
11 standards, for example, that are pretty close to being available in both Level 2
12 and Level 3 space. We have a new standard coming out in low power shutdown,
13 and we have other standards that haven't been fully tested yet in seismic and
14 other external hazards. The more we can test those standards before we start to
15 use the results in risk-informed applications, then the better off we will all be,
16 think, NRC and industry both.

17 Another think that I think would be valuable and it's hard to put a --
18 to assess that value, is to provide real hands on experience among staff
19 members in performing PRAs. A lot of us, like me, are getting a lot more gray
20 hair; that's true in the industry and the staff, I think. In developing new expertise,
21 people who have actually been involved in doing PRAs as opposed to reviewing
22 methods or handling specific cases adds real value. I recognize that's a
23 challenge in terms of having the resources within the staff to do that, but I think
24 it's one that's worth considering very carefully. Next slide, please.

25 With regard to the overall scope again, I think that most of us

1 believe that Option 1 is --that we can do better than Option 1, that we need to do
2 more development than really is reflected in Option 1. I recognize that Option 2
3 may seem to fit best with the current resources that the staff has available or
4 even maybe that would be a stretch to some extent. At the same time, I think, as
5 Biff said, there is merit to, first of all, doing this development work in the context
6 of a real plant, and also, I think there are other reasons for engaging in
7 something more like your Option 3 that's been proposed. In particular, I think
8 that when you look at a lot of these risks, looking at them in isolation is much less
9 valuable than having an integrated, comprehensive framework, understanding
10 the interaction between external hazards and other aspects in plant operation, for
11 example, would be very important, and you don't necessarily get that tackling one
12 issue at a time. I think that we still have a ways to go. We've been working with
13 the staff on the treatment of uncertainties in PRA and risk-informed applications,
14 and a comprehensive Level 3 PRA would help to provide more of a context for
15 that development as well. And I think there is a real benefit you need to
16 recognize in terms of actually doing a full PRA, and that is that much for the real
17 work comes when you think you're finished and you're trying to understand the
18 results, putting everything together and figuring out what the PRA is telling you,
19 and you end up doing a lot of iteration and a lot of refinement of the models,
20 further investigation of things you didn't think were important, and you simply
21 don't have that aspect of it present if you tackle the PRA on an issue by issue
22 basis. You're not forced to achieve the same level of closure that you are when
23 you do a full PRA. I think that's a benefit that shouldn't be overlooked in pursuing
24 your options there. Next slide, please.

25 Certainly the schedule is a challenge. I think depending on what

1 the scope chosen would be for a Level 2 -- or of an Option 2 PRA, even two
2 years might be optimistic given that it's likely that you're going to be engaged
3 longer than two years in this work. I think it's worthwhile thinking about it and
4 more in context of Option 3. Again, I recognize that you have, like everyone else,
5 have limitation on your staff and the financial resources you can bring to bear.
6 Nevertheless, I think it's certainly worth thinking about further. I also think that
7 Fukushima certainly plays a role in the way we schedule the tasks for any kind of
8 Level 3 development that's done. I think that there are issues associated with
9 responding to Fukushima that could be informed by pursuing the Level 3 PRA.
10 At the same time, all of us are stretched trying to do the best we can in light of
11 our new challenges. And so I hope that we can move forward on a Level 3 PRA
12 in a way that enhances response to Fukushima without diverting resources from
13 other things that need to be done. I think that's going to be a real challenge for
14 everyone going forward in this work. Next slide, please.

15 I think there are a number of areas in which we would be pleased to
16 talk to the staff about engaging in cooperative work. We've done that most
17 recently in areas including human reliability analysis, uncertainty analysis, of
18 course, Biff would mention NUREG/CR-6850, the fire work. There are several
19 other areas where we've worked together usually in an effective manner,
20 sometimes in a -- not quite as effectively, but there are often good reasons for.
21 And I think this Level 3 PRA offers an opportunity for us to bring to bear some of
22 the research we already planned to do and augment your resources and your
23 ability to engage in some of the technical activities.

24 Now, I've just listed a few areas here where we might talk about
25 doing that. Again, these are all areas in which we already have work underway

1 or planned. I'm on slide six. That includes, again, further development of the
2 treatment of uncertainty. We're working right now on a project to evolve methods
3 for human reliability analysis and that work will go on for some time yet, but
4 would seem to play an important role in a Level 3 PRA. We're engaged in quite a
5 bit of work related to assessment of external hazards: external flooding, high
6 winds from tornados, that sort of thing. We've long had work going on in the
7 severe accident research area. As you may well be aware, we have our own
8 severe accident suite of codes under the MAAP umbrella, and it would be an
9 opportunity to further benchmark MAAP against MELCOR, again, with real
10 problems to solve. But I think that would be valuable for both you and the
11 industry. We're engaged in work to further our understanding of the risks
12 associated with spent fuel pools. And we have our – have other programs at
13 EPRI engaged in that work as well in the fuels area, and materials and so forth.
14 And we're also beginning to do more work in the areas of low power and
15 shutdown operation and transition risk. And again, all of those things would bear
16 directly on the Level 3 PRA that might be conceived by the NRC and are areas
17 where we'd like to talk about cooperative efforts.

18 To summarize, my last slide, I think that the -- we all agree that
19 Level 3 PRA development would be a valuable thing to do. It's primarily a matter
20 of deciding the best way to go about it to make use of everyone's available
21 resources. I think that the -- a staged approach certainly makes sense, and any
22 venue would tend to start with a Level 1 PRA. The only qualification I might add
23 to what Biff had to say is that there's a difference between deciding to do a Level
24 1 PRA and deciding to do a Level 3 PRA where you start with a Level 1 PRA.
25 You look at different things with respect to the types of core damage accidents

1 you might have to consider when you want to carry all the way through to
2 evaluating consequences, as opposed to stopping when you've evaluated what
3 kinds of core damage sequences you could have and their frequencies. So that's
4 a fairly subtle qualification I think that it's important to keep in mind.

5 So I -- again, I think that Option 3 in some form is still worth
6 pursuing if we can do that. And I'd be very pleased to talk further with the
7 research staff at NRC about how we might help to work on that project. And I
8 think I'm giving back some of Biff's time.

9 CHAIRMAN JACZKO: Thank you, Mr. Lewis. We'll now turn to
10 Karl Fleming who is the president of KNF Consulting Services.

11 KARL FLEMING: Thank you very much, and I want to thank the
12 Commission for inviting me to provide a PRA practitioner's input and views on the
13 topics under consideration, severe accidents and Level 3 PRA. First slide,
14 please.

15 What I'd like to do is offer some insights from some work that we
16 did about more than 20 years ago on Seabrook station that looked into some of
17 these multi-unit risk issues, offer a couple of insights from the Fukushima
18 accident, identify some modular reactor licensing considerations that might play
19 into the decision-making process, and just offer my PRA practitioner's input on
20 these options that you're talking about. Next slide, please.

21 I want to talk a little bit about work that was done more than 20
22 years ago on Seabrook station and it was a project that I was deeply involved
23 with and many of my colleagues, including George Apostolakis, and Dennis Bley,
24 and John Stetkar, and Nathan Siu, and many others worked on these projects.
25 But we did this project while Seabrook was still under construction. The plant

1 was still planning to be a two unit station and there were already identified some
2 very serious emergency planning issues that needed to be resolved to get the
3 plant licensed. So they went out for bids for a comprehensive PRA and there
4 was a lot of emphasis being placed on it being a very comprehensive study. And
5 there was a contractual requirement put in the bid spec that I had to worry about
6 as a project manager, that we had to include the integrated risk of the two reactor
7 station. I'm not exactly why that was in there and what they meant by that, but
8 we did our best to try to address it in that particular accident.

9 The PRA that we did was full scope Level 3 PRA to the extent that
10 we knew how to do it at the time. The initial work in the mid-'80s was focused on
11 full power operating conditions, but by the time we got through the emergency
12 planning applications of this, we extended it to low power shutdown, including
13 seismic, fire, flood, and Level 3 at low power shutdown. Also because the plant
14 was -- the owner was struggling to get the plant in the rate base, we did
15 extensive sensitivity studies looking at the plant operating at 25 percent power,
16 40 percent power, and running through the Level 3 applications. Of course, the
17 strategy there was to try to get the plant in the rate base. But from that, we got
18 insights as to the impact of the power level and the inventory of radionuclides
19 and how that would play into the overall situation. Next slide, please.

20 As we first finished a full scope PRA on Unit One and then we set
21 off to the task to do the integrated site PRA for Unit One and Unit Two. Now,
22 Seabrook as originally planned was two separated -- what's called slide along
23 units with very few shared systems, more or less identical units sitting side by
24 side on the same site. But still we had to consider the multi-unit effects on the
25 PRA. We went back through the initiating events as shown in this slide, and we

1 had to look at different categories of initiating events: those that would affect
2 each reactor independently, those that would obviously affect both reactors, and
3 then of course there was a gray area where the event -- you had to sort of tease
4 it apart to find out, well, in some cases it might involve multiple challenges to the
5 plant. We then completed a Level 1 PRA for the integrated site -- and if we could
6 go to the next slide, please.

7 We were surprised to find out that even though these were not
8 highly integrated sites, the core damage frequencies that we were calculating for
9 the dual unit accidents were a sizable fraction -- more than 10 percent -- of the
10 frequency for a single reactor accident. That was due primarily as we see on the
11 next slide, it was due to seismic events, external flooding, events of that source
12 that would challenge both plants. As you see the numbers, I wanted to make an
13 obvious comment there. These numbers for core damage frequencies that we
14 obtained for Seabrook were considered realistic in its day. It was a plant that had
15 no operating experience, and the generic database we had on initiating event
16 frequencies, component failure rates and so forth, did not show the improved
17 performance that exist today. So it was typical to see core damage frequencies
18 in excess of 10^{-4} . And today, if you look at the Seabrook results,
19 their core damage frequencies are more than an order of magnitude less. Even
20 though Seabrook didn't complete Unit Two, had they carried through the
21 integrated risk assessment with the upgrades that they've done in their PRAs, my
22 personal view is that the relative contributions of the multi-unit events would have
23 been comparable to what they were in the past.

24 If we can go on to the next slide, please, that shows some results
25 on consequences. Well, we did the Level 3 analysis and we looked at scenarios

1 involving one or two reactor worth of source terms. There's a pair of -- two pairs
2 of curves on this slide. These are the conditional results for consequences for
3 health effects. The slides on the upper right are latent cancer fatalities and the
4 lower left are early fatalities. And what we found was that in the case of early
5 fatalities, there was a non-linear effect for certain conditions. These -- those
6 results you're looking at happen to be for what we call small unscrubbed
7 bypasses. That included things like containment isolation failures and small
8 penetrations with no sprays which were borderline in producing early health
9 effects. They had high enough doses that were -- under certain meteorological
10 conditions, would produce early effects. And what we found in those cases is
11 that you can have much more than linear increases in consequences under
12 certain conditions which, combined with the results on the core damage
13 frequency, led us to conclude that there really isn't any reasonable way to
14 manipulate single reactor risk metrics to produce a perspective for an integrated
15 plant.

16 If we go on to the next slide, there's a total risk profile for latent
17 cancer fatalities --

18 CHAIRMAN JACZKO: I'm sorry. Can you just go -- can you --
19 what are the different curves on that graph?

20 KARL FLEMING: Okay, in the previous curve if we can back up --

21 CHAIRMAN JACZKO: On the -- for the small unscrubbed
22 bypasses.

23 KARL FLEMING: Yeah, okay. This is for a certain class of
24 scenarios. The two curves on the right, the curve with the subscript one --

25 CHAIRMAN JACZKO: Yeah.

1 KARL FLEMING: -- is a single reactor accident. And the ones with
2 the subscript two are the double -- or the dual source term accident. So the
3 upper curves are latent cancer fatalities and the lower curves on the lower left
4 are early fatalities.

5 CHAIRMAN JACZKO: Oh, okay. Okay.

6 KARL FLEMING: So there are two sets of risk metrics all put in
7 one; it's kind of confusing, but the twos versus the ones show the effect of
8 doubling the source term, basically, on the consequences.

9 CHAIRMAN JACZKO: That was using a -- that was using a
10 Seabrook population -- I mean, that was using actual --

11 KARL FLEMING: Yeah, the actual site, evacuation plans, site
12 characteristics at Seabrook station.

13 CHAIRMAN JACZKO: Got early fatalities on the order of -- the
14 number of health effects I assume is individual -- I mean, essentially -- I mean, is
15 it --

16 KARL FLEMING: That's the total health effects in the population
17 surrounding the sites. The --

18 CHAIRMAN JACZKO: -- of about 1,000 people?

19 KARL FLEMING: Yeah, this is typical of a Level 3 PRA result of
20 that day if you looked at NUREG-1150 and, you know, WASH-1400 with the
21 source terms that we were using. This is typical --

22 CHAIRMAN JACZKO: Today, would you expect -- again,
23 recognizing that those are conditional probabilities --

24 KARL FLEMING: These are conditional --

25 CHAIRMAN JACZKO: -- 10 to the minus four --

1 KARL FLEMING: Yeah, these are conditional on the accident and
2 the accident already has a very low probability. I mean, there would be certain
3 conditions in which you would see numbers of early fatalities. Now, the
4 consequences in today's source terms would be significantly less based on the
5 advances in source term technology, but, you know, the message I wanted to get
6 across here is the relative contribution of dual reactor versus single reactor
7 accident. That might be scaled down in today's context.

8 If we go off to the next slide, which shows an integrated risk
9 assessment that has the accident frequencies and consequences all blended
10 together for latent cancer fatalities, this shows the total risk of the two reactor
11 station in terms of the conditional complementary cumulative contribution from
12 latent cancer fatalities. And basically what this slide shows is that in the high
13 frequency, low consequence end on the upper left-hand side of the risk curves,
14 the risk is dominated by single reactor accidents, having been elevated in
15 frequency by having two reactors there. And on the low frequency, high
16 consequence end on the lower right, the results are dominated by dual unit
17 events. And I want to point out that this is the case where we have very, very
18 highly separated reactor units. If we had integrated units, I'm sure that the
19 results would look a lot different.

20 So to get on to the next slide which will sort of wrap up this part of
21 the Seabrook insights is that there's just no way to manipulate single reactor risk
22 metrics in order to produce a perspective on integrated risk. And I think that
23 combined with the fact that most of our reactors in the fleet are on multi-unit
24 sites, that really raises questions about the ability to link the QHOs to the single
25 reactor risk metrics. I mean, you have to sort of wave your arms around the

1 multi-unit risk issue to do that, so I think that's one of the motivations to proceed
2 with this Level 3 work is to get a better handle on how to do the -- how to link
3 these risk metrics to the QHOs.

4 The final point on this slide I wanted to mention is that after having
5 done this early work on multi-unit effects at Seabrook, my view is that this -- the
6 reason why we're not doing integrated risk assessments today, I think, is less of
7 an issue with the limitations of the state of the art as it is with the willingness to
8 do it. I'm sure that whatever we did at Seabrook can be improved upon. I know
9 there's gaps, there's challenges that -- but the only way we're going to make
10 progress on those challenges is to actually do it. Can you go on to the next slide,
11 please?

12 On the Fukushima insights, just want to make a couple comments
13 about that. You know, when the Three Mile Island accident happened, in the
14 PRA community, we realized that there was a big gap in PRA technology and
15 that human errors of commission wasn't really very well handled. I feel a little bit
16 differently about the Fukushima accident in the sense that given the conditions
17 that the plants were exposed to and the loss of equipment and electric power and
18 instrumentation, in standard PRA modeling assumptions, those conditions
19 would've just been assumed to be core damage. So it doesn't leave me with a
20 lot of issues there except to go back and say, "Well, what was the role of the
21 seismic PRA? Did they do a seismic PRA at Fukushima?" I don't think they did
22 one. I'm not 100 percent sure about that. I was also surprised to learn a number
23 of years ago that it has not been standard practice in Japanese plants to do
24 internal flooding PRA. And I'm confident that had they done a basic ordinary, you
25 know, garden variety internal flooding PRA, they would have realized the

1 vulnerability they had to having the switch gear located in the basement of the
2 turbine building.

3 So I think that we need to, you know, work on more of an integrated
4 perspective on how we do our PRAs and get out of the business of fragmenting
5 the seismic PRA from the fire PRA from the flood PRA, which even our standard
6 has sort of fallen into the trap on. We need to get more of an integrated
7 perspective.

8 If I go on to the next slide, please, the -- just wanted to mention that
9 in the modular reactor licensing arena, this integrated risk issue has come up and
10 we're working on a standard for advanced non-light-water reactors and we are
11 putting requirements in those standards to do PRAs on an integrated basis. And
12 that includes looking at multiple reactor scenarios, looking at multiple sources of
13 radioactivity, and we're trying to make some progress on this issue on that
14 standard. This standard has been working on for the last five years and it's about
15 ready to go out for a pre-ballot review in the near future.

16 And if I might, final -- conclude on my final slide on the
17 recommendations. I agree with my colleagues that it makes sense to move
18 forward with Option 3 according to the ACRS recommendation. My concern
19 about Option 2 is that doing research without an endgame in mind may not be
20 fruitful. It may be better to do Option 3 and figure out better what the research
21 ought to be in the future. So, again, I want to thank the Commission for the
22 opportunity to speak and I conclude my remarks.

23 CHAIRMAN JACZKO: Well, thank you. We will start our
24 questions, comments with Commissioner Ostendorff.

25 COMMISSIONER OSTENDORFF: Thank you, Mr. Chairman.

1 Thank you all for your presentations. Biff, I'd like to start off with you if I could,
2 please. And you mentioned in one of your slides about a pilot and the
3 advantages of having standards development in a reference study. I wanted to
4 hear from you and your colleagues if they want to add to your comments, do you
5 think one pilot or maybe two pilots would result in the ability to extrapolate or
6 have broader applicability? How would that be viewed on the industry side of the
7 house, as far as taking one or two plants, doing a PRA there and then trying to
8 have those results serve as a broader industry standard?

9 BIFF BRADLEY: I believe our intent -- I'm not sure how much you
10 can extrapolate directly those results to other plants. Generally our experience
11 with PRA has been things don't extrapolate very well, that there's a lot of plant
12 unique situations. I think what we view the value of doing some selective Level 3
13 studies would be to inform the current decision-making process and confirm that
14 making decisions on the basis of the kinds of the decisions that we make on the
15 basis of CDF and LERF is -- just to confirm that. I'm really not sure how far you
16 can extrapolate. I will defer to my more technically astute colleagues if they
17 would like to --

18 COMMISSIONER OSTENDORFF: Well just to make sure, I may
19 have misunderstood. Could be my misinterpretation, but are you trying to maybe
20 standardize the methodology? I'm looking at your slide that says PRA standard
21 development once complete we provide reference studies. Is that trying to
22 provide a framework for other plants to use?

23 BIFF BRADLEY: Yes.

24 COMMISSIONER OSTENDORFF: Is that the spirit of that?

25 BIFF BRADLEY: Yes.

1 COMMISSIONER OSTENDORFF: Would that be generally
2 something that you think is feasible to extrapolate? Maybe not the results, but
3 the methodology?

4 BIFF BRADLEY: That's an excellent question. What we've found
5 is it's not always simple, even as we've gotten into fire PRA where we get very
6 plant-specific, configuration-specific, spatial-specific kinds of situations come up,
7 and methods narrowly have to be looked at on a plant-by-plant basis. So how far
8 that assumes into Level 3 space I don't know, but I think what we're learning as
9 we get beyond internal events and start looking at broader scopes and going
10 beyond Level 1, 2, it does become difficult and very plant-specific. I do think
11 there's value in having methods that we understand and that NRC staff and
12 industry agree on. The standards have been a good start, but there's also
13 methods that can come up that are under the standards that can still be
14 controversial. The standards don't necessarily solve all the issues, so having
15 methods that we all agree to, I think, would be valuable.

16 COMMISSIONER OSTENDORFF: Anything?

17 STUART LEWIS: I think I agree with what Biff said. I think that
18 performing a pilot-plant Level 3 PRA would expose and help us resolve many of
19 the gaps that would be common to any other PRAs we would engage in. That
20 doesn't say that the next time we did a Level 3 PRA, we wouldn't run into some
21 new issues that hadn't been fully resolved, and there might need to be some
22 incremental improvement or development done, but certainly taking a really hard
23 look at performing a comprehensive PRA right now would help all the future
24 PRAs that would be done.

25 COMMISSIONER OSTENDORFF: Karl, do you have anything?

1 KARL FLEMING: Yeah, I think the whole concept of standards is
2 that we want to hold off on writing standards so that we can codify best industry
3 practice, and I think in the early days of PRA we were working mostly on
4 developing methods for how to do PRA, and then in the last 10 years or so, a lot
5 of the efforts now have been writing standards. And I think we've gotten things a
6 little bit out of balance now on this integrated risk and Level 3 PRA. We need to
7 do the work and establish the industry practice, and the standards should follow
8 that after the fact. But I also have a little bit of a concern that the oxygen in the
9 room has been kind of consumed in the standards areas and conforming to the
10 standards, and there's a gap I think in the methods on how to do it. So the
11 practitioners are tied up writing standards, and they should spend a little bit more
12 of their time working on these areas of uncertainty.

13 COMMISSIONER OSTENDORFF: I'm going to turn another
14 question. Stu, you started to talk about post-Fukushima areas that EPRA is
15 interested in, and Karl hit on that in one of his examples on flooding. I'd be
16 interested, from -- informed by what we know today about Fukushima, is there a
17 top-three list from the EPRI perspective of those substantive areas that warrant
18 further exploration and refinement in the PRA arena?

19 STUART LEWIS: Well, I think that it's not necessarily an area that
20 we didn't recognize as important before, but Fukushima has certainly reminded
21 us that we need to do a lot more work on the treatment of other external hazards.
22 But there are a variety of reasons for that. One of them is, Karl mentioned for
23 example that the Seabrook risk results are at least an order of magnitude or so
24 lower than they were back in the 1980s when they were first assessed, and that's
25 pretty much true across the industry. And with our focus on internal events, that

1 now means that it's likely that external hazards are more significant on a relative
2 basis. So if we focus all our efforts on internal events, we're perhaps misleading
3 ourselves, not making the best decisions we could. So I would put that down
4 pretty far at the top of the list in terms of insights that are at least reinforced by
5 Fukushima.

6 Beyond that, there are other things. We were all very concerned
7 about the status of the spent fuel pools. That's an area that we haven't spent a
8 lot of time on. It turns out our concerns were probably not so well-founded based
9 solely on Fukushima, but we have started to do some investigations that lead us
10 to believe there is more that ought to be done in the area of understanding spent
11 fuel pool risk and addressing perhaps better severe accident management
12 guidelines or perhaps a different regime or procedure, but some sort of better
13 integrated response. And also understanding the impact a spent fuel pool can
14 have on operation and response to events involving the reactors. So I would put
15 that lower, certainly, than the external hazards, but important there. I think
16 largely, much of our work right now is really trying to understand what the more
17 subtle implications of Fukushima are, and make sure we make good choices in
18 terms of what we do going forward as opposed to trying to react too quickly
19 without having full knowledge. We still all have significant gaps in our
20 understanding of the event that we really hope to try to participate in filling.

21 COMMISSIONER OSTENDORFF: Anything, Karl?

22 KARL FLEMING: My big three from Fukushima would be the
23 multiple concurrent reactor accidents, the need for integrated treatment of
24 multiple hazards -- tsunami, seismic, floods, and so forth -- in an integrated
25 fashion, and the third that's obviously a big deal, and that is that once one has

1 some radiological contamination at the site, that greatly impedes accident
2 management strategies, so how the accident management can continue on in
3 light of high radiation fields on the site.

4 COMMISSIONER OSTENDORFF: Biff, you want to add anything
5 to any of the comments?

6 BIFF BRADLEY: I believe between the two of those, that was a
7 good comprehensive list.

8 COMMISSIONER OSTENDORFF: Karl, thank you. Let me get
9 one final question here. On your slide, not sure I had it marked -- it was the back
10 of your slides, your recommendation slide.

11 KARL FLEMING: Yeah.

12 COMMISSIONER OSTENDORFF: Your second bullet says,
13 "Should avoid letting existing PRA standards inhibit PRA development." Could
14 you maybe explore that just a little bit more?

15 KARL FLEMING: Yeah. Part of this is -- sort of two parts to this.
16 One is what I mentioned. The resources, the standard has gotten to be kind of
17 onerous. It's a large standard, it's many pages of requirements, it's kind of
18 onerous for the users of the standard to maintain, and given the investments
19 they're making to try to conform to the standard, we even have difficulty
20 upgrading the standard. We want to put changes in the standard. There's a lot
21 of resistance because they have to go through another administrative hoop-jump,
22 if you will, to address that. So that's an issue. And the resources of the
23 practitioners being consumed in the standards area, and not enough time being
24 spent to look at these areas of larger uncertainty. And I think the other part of
25 this is that it goes back to really the first bullet on the same slide, is that one of

1 the concepts that we used to have in some of the early days of PRA is that we
2 had the ability to focus the resources in the PRA on the areas for that site and
3 that plant that had the greatest source of uncertainty. So we didn't have a one-
4 size-fits-all kind of model, so that we could optimize the project plan and
5 resources to focus on what was important for that site. And that was an issue
6 because we don't have standardized plants. The sites are different, the vintages
7 of the licensing requirements are different, and so forth. But the standards make
8 it difficult to do that. If you want to claim that you're going to meet the standards
9 for risk-informed applications, you need to bring everything that's risk significant
10 up to a certain level of treatment, and that consumes the resources so that it's
11 difficult then to have any resources left for these areas of higher uncertainty. So
12 that's basically the point there.

13 COMMISSIONER OSTENDORFF: Thank you. Thank you, Mr.
14 Chairman.

15 CHAIRMAN JACZKO: Commissioner Svinicki.

16 COMMISSIONER SVINICKI: Well good morning. Thank you all for
17 your presentations here today. This first question, any of you may respond, but
18 Biff in particular, if you could share some thoughts with me. You've all mentioned
19 competition for resources, but let's set that aside for a moment and say that a
20 Level 3 PRA, perhaps the suggestion of a PWR and BWR pilot, could be pursued
21 with some kind of expediency. It may take, of course, then some years for any of
22 the outcomes of that to be reflected in a regulatory framework. What benefit, Biff,
23 for those units that are interested even in engaging and maybe being pilots? Is
24 there some use that they would put of their Level 3 PRA results in the near term
25 that would be the reason that would motivate them to want to be pilot sites, or are

1 there just generally -- for any of you who want to respond -- are there things that
2 licensees, uses they could put to the Level 3 PRA results? How would they use
3 the results?

4 BIFF BRADLEY: Yeah, let me speak to that. I think the sites that
5 have an interest are all sites that have a fairly extensive risk-informed culture
6 already, and are interested in moving in that direction. And I think as a general
7 rule, they see this as confirming where they're headed. I would expect, and I
8 can't say that I've had explicit discussions with them on exactly how they would
9 use this, but I expect there could be value in the SAMA work as well possibly as
10 EPs, as I mentioned earlier. Our current applications, the classic risk-informed
11 applications we're doing now generally are not Level 3 applications, with the
12 exceptions of the ones I mentioned. But I do believe that they're interested in
13 supporting the cause and moving this technology forward. I can get more
14 information about explicit --

15 COMMISSIONER SVINICKI: Okay, I realize it's just speculation
16 but I just wondered if you let your mind wander, what you thought that they might
17 do with it. Would either of -- yes, Karl?

18 KARL FLEMING: Just very briefly, is that I think by doing the type
19 of Level 3 PRA that's discussed in especially Option 3, one gets a better
20 understanding of what the risk levels are and what the contributions to risk are,
21 and that gives you a greater opportunity to allocate your resources where it
22 makes the most difference. So that's --

23 COMMISSIONER SVINICKI: Okay, so much as they do now.
24 They just have another tool that would have informed them in that process.
25 Okay. There's been some discussion about using these activities to inform post-

1 Fukushima regulatory response or industry responses. If you were to look at that
2 from completely the other direction, is there anything that you think would be a
3 key piece of knowledge to have coming out of whatever accident reconstruction
4 or sequenced chronology that is eventually done for Fukushima, that would
5 inform Level 3 PRA efforts going forward? Meaning that we would have real-
6 world information about, I guess this is obviously more relevant for BWR, but I
7 don't know if I thought broadly, maybe there are things that would be informative
8 for a PWR as well. Could any of you speak to that, just what you think are the
9 key technical areas that might be useful in that regard?

10 KARL FLEMING: Well the first question that comes to my mind in
11 answering your question is still with the big thirst for knowledge about just exactly
12 what did happen at Fukushima. I mean, my knowledge base today is based on
13 everything that I can read, and I think I've gotten about as good insights from the
14 Wall Street Journal as some other technical reports as to what actually
15 happened. So I think understanding what happened in more detail, what was
16 damaged by what, how did the hydrogen get in the building, and what level of
17 damage if any was done by the seismic event and what level of damage if any
18 was done by the hydrogen detonation event -- these are all important questions
19 that I'm a little bit concerned that we don't get too far down the lessons learned
20 trail without understanding more clearly what happened. I think once we have
21 better understanding, I think it should be obvious what the lessons would be from
22 that.

23 STUART LEWIS: I think that when we can actually gain some sort
24 of access, whether it's through fibro-optic cameras or some other means to
25 assess the real state of the cores, to try and do some benchmarking of the tools

1 we use to assess severe accident response, that will be very valuable.
2 Fortunately we have very limited experimental data that are really applicable to
3 this situation, and we need to take advantage of the understanding we eventually
4 achieve of the status of the three cores that are damaged to some extent. To
5 what extent we don't yet know, but that's going to be very important to us, I think,
6 informing the Level 2 part of our PRAs. At the same time, I think that there are
7 measurements all over Japan and beyond that may help us to understand how
8 realistic some of our consequence models are. We have the meteorological data
9 and the depositions to infer from some measurements, at least, perhaps to help
10 us in that area as well. So I think both of those are going to be important. Both
11 of those are going to take quite awhile to evolve.

12 COMMISSIONER SVINICKI: And again Biff, I don't know if you
13 wanted to add anything, and I appreciate that, Stuart. Because what I'm trying to
14 get to, is there anything that if we were to run full speed ahead on PRA work for
15 BWRs, is there anything that suddenly we would maybe have information out of
16 Fukushima that might really affect that work?

17 BIFF BRADLEY: I think some of the areas could be containment
18 venting. The sequence, and which we still don't really understand too well, that's
19 a key issue for the Bs, as well as the SBO sequence and exactly what equipment
20 failed and what didn't. I think that's really important to inform how we address
21 SBO here. A full understanding, because there are a lot of different ways you
22 can potentially expand your coping, but I want to make sure you do it in the right
23 way and not still exposing yourselves to the situation they had. I think that's
24 important.

25 COMMISSIONER SVINICKI: And I would ask a very general

1 question. If, again, we were to proceed but laying aside the resource constraint
2 issues and resources were available to move forward in a very full way on Level
3 3 PRA -- again, perhaps with some pilot locations -- what do you see as perhaps
4 the biggest mistake we could make, given what we know right now? And we in
5 that case is just the community of practice that's the practitioner, PRA
6 practitioners, the regulators, and the industry generally. Is there anything that
7 you think is a potential lack of knowledge we have now, or something we could
8 potentially be overconfident about?

9 BIFF BRADLEY: Yes. I think there is overconfidence on the
10 schedule and possibly on the resources to do this. You know, I think we do need
11 to be reasonable and realistic in our expectations. ACRS, I think, spoke to that to
12 some degree. We've been working on PRA for about 30 years now. Some of
13 these problems are difficult nuts to crack, so not everything is the same. Just
14 because we can do internal events at power, doing seismic shutdown fire, that's
15 a lot more tricky of a proposition. So I think we need to be realistic about how
16 many of these permutations of modes and initiators can we really do and
17 especially given the pedigree and the expectations now with respect to standards
18 and methods -- that, to me, is the challenge. This is a big chunk of work, and we
19 shouldn't underestimate that.

20 COMMISSIONER SVINICKI: Would either of you like to comment?

21 KARL FLEMING: Yeah, I think one area that we could examine our
22 overconfidence perhaps would be in the source term development area, and if
23 we could sort of reverse-engineer the source term at Fukushima, try to figure out
24 what we know from a scientific basis, what's the nature of that source term, and
25 see if we can reverse-engineer our severe accident codes to see whether, you

1 know, what we observed at Fukushima is consistent with what our models did. I
2 recall this kind of exercise was done after Three Mile Island, and I also recall
3 there wasn't a very good agreement between what the severe accident codes
4 would have predicted under those conditions, and what they actually observed in
5 the core. But it's unfortunate that the accident happened, but it's empirical
6 evidence and we want to make sure we milk it for every insight we can.

7 COMMISSIONER SVINICKI: I'm so glad you said that, because
8 I'm not a PRA practitioner but that's been something that I think going forward
9 would really be a way to have some learning out of this tragedy that I think would
10 be, just again as an engineer, I think that would be so beneficial. So I feel kind of
11 validated now. Thank you. Stuart, did you want to add anything?

12 STUART LEWIS: I don't think I have anything to add.

13 COMMISSIONER SVINICKI: Okay, thank you. Thank you, Mr.
14 Chairman.

15 CHAIRMAN JACZKO: Commissioner Apostolakis.

16 COMMISSIONER APOSTOLAKIS: Thank you Mr. Chairman.
17 Thank you, gentlemen. Very informative presentations as usual. Let's start with
18 you, Biff. On your first slide, you say that the studies should complement, not
19 replace, the use of CDF and LERF, and I agree with that. Although as you know,
20 with LERF we have had some problems when it comes to power uprates. The
21 question is whether that was a good metric, so I think a Level 2 PRA and a Level
22 3 PRA would help us answer questions like that. Maybe we could still continue
23 using LERF, but we will have a better basis for saying yes, it's okay. I notice that
24 you couldn't resist quoting the near-term task force regarding the Level 3 PRA. I
25 think the near-term task force did such a great job in everything else that they felt

1 they had to prove that they were human, and they inserted this paragraph.

2 [laughter]

3 Stuart, you said that the EPRI is ready to, quote, "collaborate with
4 the NRC." In fact, we do have I believe at least one MOU, memorandum of
5 understanding with you, and we're doing this work on fire and other areas.

6 STUART LEWIS: We are working together on --

7 COMMISSIONER APOSTOLAKIS: Human reliability.

8 STUART LEWIS: HRA seismic, and several others.

9 COMMISSIONER APOSTOLAKIS: One issue that the staff also
10 will raise, I believe, is that you know, doing a Level 3 PRA is a matter of
11 resources and so on, so I'm wondering whether collaborating with you, if the
12 gentleman on my left here allows us to do that from the OGC, whether that would
13 maybe make the problem go away or reduce its significance, because then the
14 burden will be shared.

15 STUART LEWIS: I would hope that it would reduce the level of
16 burden. I certainly don't expect it would go away entirely. Again, we certainly
17 have constraints on our resources as well. What I tried to convey was that there
18 are areas we already have plans to engage in, that I think would help in this
19 process as well. We're not in a position to be able to apply substantial new
20 resources because the NRC undertakes a Level 3 PRA, but I think we can find
21 some synergy there between our efforts and yours that would help to reduce the
22 loading to some extent. To what extent, well I haven't tried to explore in any
23 detail yet. It seems likely that would be the case, though.

24 COMMISSIONER APOSTOLAKIS: On your slide five, you said
25 Fukushima response further complicates scheduling. Well, here's another

1 thought, though. Seems to me that in the context of Fukushima, we would have
2 to do some work that will be beneficial to the effort of the Level 3 PRA, and the
3 Level 3 PRA would give the context for the Fukushima work. So I view those two
4 things as being mutually beneficial. Is that the correct view?

5 STUART LEWIS: I think they can be, and all I was trying to point
6 out was that we really need to think in that context and not add another set of
7 development activities or analyses to what we already know we need to
8 undertake. I think we need to find the overlaps and the areas where we can feed
9 back and forth between those two objectives in the most efficient manner. From
10 our perspective, we've engaged our staff and the competent contractors that we
11 can bring in to help us with activities to a very significant extent, and there's not a
12 lot of bandwidth left to draw on. So we need to make the most efficient use of all
13 the resources we can. Nothing new in that concept. It's just that Fukushima
14 adds some complexity and some additional burden to that consideration, I think.

15 COMMISSIONER APOSTOLAKIS: Karl, when you did the two-unit
16 calculations, did you consider the possibility that there would be a release from
17 one unit at time T, and the release from the other unit would be at another time
18 later, in which case maybe the weather pattern would have changed? Did you
19 go into that detail?

20 KARL FLEMING: We did that to a limited extent, but I wouldn't
21 want to overstate what we did there. I would like to point out, though, as far as
22 our early health-effects calculations are concerned, we modeled realistically the
23 evacuation model so that all the early health effects we were calculating were
24 close in to the site and were folks that were exposed before they were able to get
25 out in the evacuation plan. So while we were able to do that, in terms of early

1 health effects it's not clear that that would have been too important because if we
2 stretch out the time beyond the evacuation -- well, we discovered that if the
3 second release took place several hours after the first one, that would certainly
4 eliminate the early health effects because of the evacuation effects. So I think
5 we understood that. But this is an important issue that you bring up, and when
6 you get into multiple releases, the timing of course would be a factor to consider.

7 COMMISSIONER APOSTOLAKIS: I remember that there were
8 some problems that the utility had with the State of Massachusetts regarding
9 evacuations and so on. Did the work that your team did help in any way there
10 with the emergency planning?

11 KARL FLEMING: Well I think it did, but an indirect way. What
12 happened at Seabrook was that given the fact that the State of Massachusetts
13 was not participating in emergency planning, there was effectively a roadblock in
14 getting the license approved. And seeking a way out of that, the plant owners
15 petitioned to shrink the emergency planning zone to get it out of Massachusetts,
16 and we put together a technical case pretty much along the lines of NUREG-
17 0396, which was one of the supporting documents that helped define the 10-mile
18 EPZ, so we put together a case to shrink the EPZ. That case was denied by the
19 ASLB. However, the signal was sent to the Commission that effectively, the
20 plant had no way to proceed with its license because of the emergency planning
21 issue, so a new rule was passed by the Commission to allow the plant owners to
22 basically compensate for the lack of participation by Massachusetts. So we think
23 in the end that the work paid off, but the licensing pathway into that was not --

24 COMMISSIONER APOSTOLAKIS: But what role did the work
25 play? I mean, you said the work paid off. Was it just a matter of the ASLB and

1 the Commission taking action, or the technical work?

2 KARL FLEMING: Well, yeah. I think the work paid off in the sense
3 that I think everybody got a better understanding of the role of emergency-
4 planning issues and the actual risk at Seabrook station, and I think it was clear
5 from our results that all the concerns about early health effects were actually
6 within one to two miles of the plant, and all the sensitivity studies that we did
7 assuming no evacuation, with evacuation, different speeds, and so forth -- we did
8 extensive studies and we were able to show that whatever early health effect
9 risks did exist at Seabrook station was confined to the --

10 COMMISSIONER APOSTOLAKIS: Do you think it's a -- I think
11 when we talk about Level 3 PRA, automatically we're thinking in terms of acute
12 and latent fatalities. It seems to me that we would have the benefit of that study
13 by doing only dose calculations. I mean, we still could do emergency planning,
14 sensitivity studies, and so on. Do you think it would be best to stop there and
15 produce frequency, dose calculations, which is by the way what the technology-
16 neutral framework proposes, a common metric for all types of reactors. Or is it
17 essential that we go all the way to health effects?

18 KARL FLEMING: I think using the frequency dose metrics is more
19 optimum for looking at design questions, okay? How do I manage my licensing
20 events? How frequent can they be? How my design and operator actions are
21 influencing that, and having a simple metric for offsite consequences make sense
22 of that application. But when you're trying to resolve emergency-planning issues,
23 I mean, the emergency plan, the roads, the speed of evacuation, the two-
24 dimensional map of people moving around the place -- you absolutely need to
25 have a good full-scope Level 3 model to address that.

1 COMMISSIONER APOSTOLAKIS: Thank you. One last question.
2 This was a full-scope Level 3 PRA sponsored by the utility.

3 KARL FLEMING: Yes.

4 COMMISSIONER APOSTOLAKIS: Can you summarize? I mean,
5 did they see any real benefits from it? Were they pleased at the end? Did it help
6 them with anything? Just to say understanding, it's always nice to understand,
7 but in terms of real benefits, some decisions were based on it, are there any
8 examples of that?

9 KARL FLEMING: I believe -- and you'd have to ask the executives
10 at, then, Public Service New Hampshire -- this question directly, but I believe
11 they would tell you that the Level 3 PRA was instrumental in helping to resolve
12 the emergency-planning issue. It brought out information about the strength of
13 the containment at Seabrook, which since Seabrook was designed for an aircraft
14 crash of an F-111 aircraft, the design strategy that United Engineers and
15 Constructors used to build the containment led to what I think we know today is
16 probably the strongest containment in the country. The median pressure
17 capacity found for that containment was five times design pressure, and that
18 stood up to the scrutiny of the Brookhaven and NRC reviews. So all that work
19 that was done to look at severe accidents at Seabrook station put information on
20 the table that I think calmed the fears of many in terms of the emergency
21 planning risk issues for that plant. Had they not done it, it's questionable in my
22 mind whether they would have been able to succeed.

23 COMMISSIONER APOSTOLAKIS: Thank you very much, Mr.
24 Chairman.

25 CHAIRMAN JACZKO: Commissioner Magwood.

1 COMMISSIONER MAGWOOD: Thank you and good morning.
2 Appreciate your comments today. They were all very helpful. I was particularly
3 interested in hearing about the Seabrook work. I hadn't heard about that before.
4 It's very interesting. I think I hear something a little bit different across the three
5 of you. I think I hear from Mr. Fleming a real belief that there's a real value in
6 proceeding with Level Three PRAs. I want to make sure I understand what I'm
7 hearing from EPRI and NEI. It sort of reminds me of the analogy of the space
8 program that people always talk about. Maybe going to the moon wasn't really
9 such a wonderful idea, but we got some great technology out of it along the way
10 and trained a lot of really smart people. And I guess what I hear you saying is
11 something analogous to that. I don't really hear from you that you believe there's
12 an intrinsic value into moving to Level 3 PRA as a general practice, but there's
13 value in things we'll learn along the way. Can you disabuse me of that, or
14 explain that further?

15 BIFF BRADLEY: Probably can't disabuse you. I think that is
16 generally correct. In the current regulatory framework the way the decision-
17 making is done, there isn't an obvious compelling practical value for a plant to
18 perform a Level 3 beyond what's being done currently for license renewal. Now,
19 it's conceivable the regulatory environment will be in some state of flux going
20 forward. That could change, but I do believe there is intrinsic value in having a
21 modern version of NUREG-1150, because that's just a foundational study that
22 we can always look back on to confirm that what we're doing is correct. So I
23 guess the space program analogy is not too far off. It doesn't have immediate
24 practical value currently, however it does have that overall value intrinsically.

25 STUART LEWIS: Yeah, I think outside the specific framework of

1 risk-informed regulations, I think a utility could expect to gain some additional
2 insights from performing a Level 3 PRA. I think that you would have a different
3 perspective on the kinds of severe accidents that are important for a plant, and
4 you might make somewhat different decisions. I think those are incremental
5 improvements in your ability to make decisions beyond Level 1 or a Level 1/Level
6 2 PRA. Most of the things that would be done, would be done to prevent core
7 damage in the first place. There are things we learn in performing Level 3 PRAs
8 that help us make changes or make improvements, that limit the potential for
9 releases, and could conceivably in the future be used to better inform emergency
10 planning. But that's not -- there's not an obvious path for doing that right now, I
11 believe. But beyond that, I think that's why you hear maybe a little less
12 enthusiasm for the specific value to a plant in performing a Level 3 PRA versus
13 perhaps a more comprehensive Level 1 or Level 2 PRA that looked at a broader
14 set of hazards, looked at different modes of operation, and that sort of thing.

15 COMMISSIONER MAGWOOD: I don't know, do you figure just a
16 bunch of Luddites, or --

17 [laughter]

18 KARL FLEMING: No, I think you captured my passion directly. I
19 also wanted to point out, listening to these comments about maybe a distinction
20 between the operating plants and the new plants coming down the pike in the
21 sense that small modular reactors, non-light water reactor technology, and so
22 forth -- I think there will be a much greater need for Level 3 PRAs for those types
23 of plants, so that we can figure out what their unique safety issues are. Because
24 the light-water reactor risk metrics don't translate very well at all, and if you have
25 modular reactors that are very small, even light-water reactor based like 100

1 megawatt thermal that are being discussed, then the risk metrics, the CDF and
2 LERF don't enable you to take credit for, if you will, the much lower inventory of
3 fission products that you have to deal with. So I think that there would be a
4 difference between the new advanced reactors, and the existing reactors in the
5 context of what Biff and Stuart were talking.

6 COMMISSIONER MAGWOOD: And sort of along the same lines, it
7 seems to me that one of the insights that you and the Chairman were sort of
8 talking about, the multi-unit effects, which I found quite interesting. It's not clear
9 to me that you are able to gain those insights without a Level 3 PRA. Give you a
10 chance to comment on that. Because it seems to me that what you're really
11 looking at is not just simply whether the core damage frequency of the two units
12 are -- in fact, I'm not sure you can link the two unless you have a Level 3 PRA.
13 I'll give you a chance to comment on that.

14 KARL FLEMING: Well I think the Level 3 is necessary to get the
15 full appreciation of the multi-unit effects, but if you were just doing a Level 1
16 multi-unit study, I think you would have a better handle on the interdependencies
17 and the competing of resources. If I have core damage going on on two reactors
18 concurrently, my operational resources and my emergency planning resources
19 are going to be spread over those issues and there could be interactions, and if
20 there are differences in terms of what's going on in the units at the same time,
21 that could increase the probability they don't do the right thing. And those kinds
22 of interactions in multi-unit sites haven't really been done very well for the single-
23 reactor PRA models. I mean, there's requirements in the standard that you're
24 supposed to look at multi-unit effects while doing a single-reactor PRA, but I'm
25 not sure how well that's done unless you do the whole package.

1 BIFF BRADLEY: I think our existing Level 1 PRAs have done a fair
2 job. We do know there are multi-unit effects, that there are some sequences that
3 lead to multi-unit core melts. That's done through Level 1. I agree with Karl that
4 to get all the insights from that, to get more insights, you could have a Level 3,
5 but I think we have a pretty good handle right now on which sequences can go to
6 -- and it's not always just external events. You can even have some internal
7 event sequences that can lead you to a dual-unit situation. So we do, I think,
8 have a pretty good understanding on that from our Level 1 and LERF work
9 already, but icing on the cake kind of thing, I think.

10 COMMISSIONER MAGWOOD: I wanted to ask this next one just
11 for my information. Are we all using the same tools? Does the industry and NRC
12 staff -- everyone using Sapphire Eight? Are we using different tools? What's
13 going on out there?

14 STUART LEWIS: No, actually there are a variety of tools out there.
15 You mentioned Sapphire, and we actually have our own suite of PRA tools. It's
16 called the CAFTA suite of codes that's widely used within the industry. There are
17 some individual utilities that use Sapphire in a very limited way. I'm not aware of
18 anyone who relies on Sapphire as their primary PRA tool within the industry.
19 Most widely used is CAFTA, WinNUPRA from Sciencetech. There are a few plants
20 that still use the wristband code that was developed in PLG. Karl can tell you all
21 -- you want to know about wristbands, certainly. Up until recently, there was one
22 plant that used a program called Risk Spectrum that was developed in Sweden,
23 but they are converting to CAFTA. So we use comparable tools, but they're not
24 the same tool.

25 COMMISSIONER MAGWOOD: But the fact that we're using

1 different tools, would that impact or ability to cooperate in doing projects together
2 on some of these subjects?

3 STUART LEWIS: I don't think it would matter in a really significant
4 way. I think that the tools all attempt to achieve the same objectives, and to
5 some extent they have similar structure. We have the ability to communicate
6 back and forth between different software platforms with our tools, so I don't think
7 that would be a big impediment. It might be a minor problem from time to time,
8 and every time I say that about any kind of software, it turns out that I'm wrong.

9 COMMISSIONER MAGWOOD: I want to come back to Mr.
10 Fleming for another question. One of the things about Level 3 that I'm still
11 sorting out in my own mind, and I think your comments would highlight this -- you
12 end up looking at not just the effects at individual plants, but you start looking at
13 these much broader effects, and I think your earlier work pointed out that it's the
14 low-probability, high-consequence events that really drive the worst sequences.
15 And I think seismic came up quite prominently. Now if you have a large seismic
16 event, it isn't just going to be isolated to one nuclear power plant site. Depending
17 on what part of the country you're in, you could have impacts on several nuclear
18 power plant sites, and you could also have impacts on dams -- I think there was
19 a dam issue related to the Fukushima incident. Certain refineries, LNG terminals
20 -- I guess, where does it end? How do you responsibly go forward with a Level 3
21 analysis if you're looking at a large event like a seismic event? Do you have to
22 encapsulate all of that into your model, or do you just ignore that? How does one
23 approach that?

24 KARL FLEMING: Well I think that first of all, with respect to the
25 seismic, when you're doing a Level 3 analysis of a given site, your modeling of

1 the emergency planning process, i.e. the evacuation and sheltering, needs to
2 take the seismic conditions into account if we're going to fail bridges and roads
3 and dams and things like that. Some thought needs to be given, and not just
4 using your standard evacuation model for those types of things. I'm not sure how
5 fruitful it would be to try to model what's going on at different reactor sites at the
6 same time. It seems like -- I don't know whether that would be value added to
7 the risk insights, but, you know, I think that -- I think we have the tools and the --
8 and the capabilities to address these issues and sometimes we have to address
9 them with maybe some simplified, maybe conservative assumptions in some
10 cases. But we have to do it to understand it rather than speculate on what might
11 happen if we may or may not do it.

12 COMMISSIONER MAGWOOD: Just one last -- my time is up.
13 One quick question for you. I think I heard you say that you believe the tools are
14 in place to proceed to do this now and just figure it out as we go. And then
15 there's not a -- I don't hear from you the need to go do several years of work to
16 develop more tools. Is that --

17 KARL FLEMING: Well, I think if you look back at the PRA
18 development, you know, when we first started doing PRAs, we didn't have very
19 good handle on fires or floods, seismic events, common cause failures, human
20 reliability, and we finally got through -- worked our way through to the point where
21 we're at least able to do those to a certain degree. But in each one of those
22 instances, the progress towards solving those technical issues came from doing
23 it rather than doing research and development -- I don't want to minimize the
24 importance of research and development that fed into it, but the -- if you take the
25 position that we're going wait for the R&D to give us the tools, I don't think you

1 ever get there. I think you got to just go ahead and do it.

2 And you're going to find holes and gaps as you go along, and those
3 can be taken into account when you draw conclusions from your studies. And
4 then after doing it, you'll have a better handle on what additional R&D you need
5 to do. So I've always been a believer in just try to do the problem, work your way
6 through it, because until you do that, you don't fully appreciate what the issues
7 are. I mean, that's my practical --

8 COMMISSIONER MAGWOOD: It's like going to the moon, right?
9 Thank you, Mr. Chairman.

10 CHAIRMAN JACZKO: Just following up on that, it -- you know,
11 there's been a lot of talk about the resource challenges. What are we talking
12 about when we talk about resource challenges? I mean, is it money? Is it
13 knowledge of individuals? Is it lack of individuals with appropriate knowledge? Is
14 it the inability to translate a physics model into code and then put that into a
15 probabilistic framework? What -- I mean, what are the resource issues? I mean,
16 why can't I just have a bunch of undergraduate nuclear engineers go out and in a
17 year have Level 3 PRAs for a bunch of sites?

18 BIFF BRADLEY: Where do we start? All right, I'll start by saying
19 that I think we have state of knowledge issues. And for --

20 CHAIRMAN JACZKO: But what -- I mean, what do you mean by
21 state of knowledge issues? I mean, do we not understand reactor physics? Do
22 we not understand computer science? I mean, which is it?

23 BIFF BRADLEY: It's not so much computer science. I think it -- it's
24 phenomenology, it's initiating event itself, the state of knowledge we have on
25 initiating event frequencies, states of knowledge relative to -- we spoke about

1 combinations of initiators. That's an extremely difficult problem that I don't think
2 we've tackled --

3 CHAIRMAN JACZKO: But it's a difficult problem from the
4 standpoint of having the right -- being able to put the right parameter into the
5 PRA or not knowing and understanding how to incorporate that kind of issue into
6 a PRA. I mean, we don't know the event frequencies for seismic. Okay, but we
7 can -- could I today put -- run a PRA -- Level 3 PRA with some value, and the
8 model would, based on that value give me an answer?

9 BIFF BRADLEY: Well, yes, you could, and I think the types of
10 PRAs we did in the past were aimed at sort of trying to bound the risk or to get
11 general insights. And as I mentioned earlier, I think now that we're in a -- there's
12 a much more strict regulatory envelope for the use of PRA, so the types of things
13 we did in the past get much more scrutiny now. And there's a high expectation
14 for proof -- there's an expectation of proof of assumptions. I've seen a lot of this
15 in fire; fire's a, you know, a great case study in the difficulties in getting this right.
16 And it's basically acceptance, you know, what's realism? What's conservatism?
17 How do we account for lack of data? Those kinds of things are the difficult
18 problems. Uncertainty, I know --

19 CHAIRMAN JACZKO: But those are -- I mean, these are all
20 fundamentally Level 1 problems. They're not Level 3 problems. I mean, having
21 bad initiating events isn't -- or not having a good understanding of the initiating
22 events, not having a good understanding of these issues affects your Level 1. It
23 doesn't prevent you from being able to carry that calculation through to Level 3
24 PRA --

25 BIFF BRADLEY: It introduces --

1 CHAIRMAN JACZKO: But you're -- I mean, what's the holdup and
2 the inability to get to the Level 3?

3 BIFF BRADLEY: Well, I don't -- I think you're right. I think that -- at
4 least in my experience, and you have to understand most of what we've been
5 doing over the past several years is heavily concentrated on Level 1, so that's
6 where we know what we run into. I don't -- we haven't done a lot of Level 3 and
7 I'm -- and I know Karl and others have and they may be able to speak better --

8 CHAIRMAN JACZKO: Well, maybe but --

9 BIFF BRADLEY: -- but I do want to say that even at Level 1, you
10 know, there are challenges that remain, especially when you start looking at low
11 power shutdown. You're looking at, you know, hundreds of different plant
12 operating states in a single outage. So how do you really model something like
13 that?

14 CHAIRMAN JACZKO: But -- and again, I'm just raising it because
15 what I'm hearing is that there's resource challenges to getting to a full Level 3
16 PRA, but what I'm hearing -- and I mean, maybe Karl and Stuart, you can explain
17 to me -- is that there's problems with Level 1 PRA. So what is the -- I mean,
18 today do Level 3 PRAs exist or what is the gap to get me from the Level 2 --
19 again, recognizing and acknowledging our initiating events may not be good yet
20 for Level 1, et cetera, et cetera. Is there a huge delta in resources to take the
21 existing Level 1 models and run them out to giving me dose assessments that
22 incorporate EP -- I mean, does the computing technology, does a code exist to
23 do that today?

24 BIFF BRADLEY: I believe it does and I'll let you guys speak to that.

25 STUART LEWIS: I think we certainly have the tools and I think

1 there are areas where if we were going to do this, we know we would like to
2 enhance the methods, but we -- we have the technical ability to do that work. It's
3 not a trivial exercise to go from a Level 1 PRA to a Level 3 PRA as I think I
4 alluded to earlier --

5 CHAIRMAN JACZKO: Yeah, that's what I'm trying to figure out.
6 What's non-trivial about it?

7 STUART LEWIS: Well, for one thing, the Level 2 is a significant
8 amount of work to understand really the evolution of the severe accidents, but
9 before that -- again, as I alluded to earlier -- defining the accident sequences in
10 such a way that you can carry information from the Level 1 into the Level 2 and
11 then to the Level 3 means that that affects the way you delineate your accidents
12 in the Level 1. So you can't necessarily tack Level 2 and 3 onto the Level 1 part,
13 you have to go back almost to the beginning and make sure you've covered the
14 bases. That's not an insurmountable problem --

15 CHAIRMAN JACZKO: Right, but that's -- isn't that something I can
16 give a bunch of undergraduate nuclear engineer students to figure out -- I mean,
17 it doesn't seem like that is -- that's kind of a brute force exercise of -- you know,
18 it's not an issue of understanding of -- I mean, I could probably give that to
19 chemistry students because it's -- it doesn't matter what the underlying physics
20 are, it's a modeling problem. So how do I carry through information from this to
21 this model? I mean, why is that something that we can't just get done?

22 STUART LEWIS: Well, I think that -- and speaking as somebody
23 who for most of my career has been a practitioner, I suppose I'd like to think that
24 it takes some level of expertise to do this kind of work. But we -- it really requires
25 -- there's nothing that's very much cookbook about the way you do a PRA. It

1 really requires a pretty good understanding of how the plant works, of severe
2 accident phenomena and how those two things interact, how the models can be
3 built in a way that reflects those aspects of the accident scenarios. There's not a
4 lot of work that can be effectively done by someone without any specific technical
5 knowledge about the way PRAs are put together.

6 CHAIRMAN JACZKO: So we've got to use the -- but --

7 STUART LEWIS: You at least have to have involvement of people
8 who know what they're doing. And they may be assisted --

9 CHAIRMAN JACZKO: Well, I'm not saying we give random people
10 who don't know what they're doing, but I'm saying I'm not -- I'm trying to
11 understand what, you know, what -- I mean, I'm hearing "resource problems" and
12 I'll be honest. I'm not -- I mean, I'm not convinced that this should be a problem
13 for this industry. I mean, I really don't see -- I mean, everything you're telling me
14 leads me to believe that our Level 1 and now even Level 2 PRAs are in terrible
15 shape, that we don't have a good understanding of phenomenology, we don't
16 have a good understanding of how to take from Level 1 to Level 2. I mean, that's
17 surprising for me to hear that. So what -- if what you're telling me is the
18 challenge is simply a modeling problem where I just have to make sure that I
19 develop and prepare my inputs in the right way so that when my Level 1 spits out
20 a core damage and a frequency, that I've got the ability from a modeling
21 perspective to carry that information over to my Level 2 to spit out my
22 containment impacts with some source term. But I've just got to make sure I
23 have a good way to carry that through. That doesn't seem like a huge
24 challenging problem.

25 STUART LEWIS: Well, first of all, somehow we've led you to

1 believe that our Level 1 and Level 2 PRAs are in terrible shape. That's a
2 misimpression and I don't want to leave you with that impression there. We've
3 been doing Level 3 PRAs for more than 30 years, WASH-1400 was a Level 3
4 PRA and we've extracted.

5 CHAIRMAN JACZKO: And I'm running out of time--so tell me in a -
6 -so what is the problem? I mean, Carl maybe you can, and maybe you're telling
7 me and I'm just not listening.

8 KARL FLEMING: Yeah I think in terms of resources, it may be
9 useful to separate the qualitative and the quantitative. First of all, get the
10 quantitative out of the way. When we were doing full-scale Level 3 PRAs we
11 would go out for bids, and we'd send our proposals in, and put together teams, it
12 was about a 60-20-20 mix in terms of 60 percent of the resources was in the
13 Level 1 PRA, about 20 percent in Level 2, and 20 percent in the back end Level
14 3. So that's one cut on resources, and maybe that'd be different today, I'm not
15 sure, but ballpark would probably be reasonable. But on the qualitative side,
16 when you go from Level 1 PRA to first of all, Level 2 PRA, you've got to bring in
17 different kinds of expertise. You have to have thermo hydraulics and structural
18 expertise and people that can deal with severe accident phenomena and
19 pressures and stresses and what's going to break the containment.

20 CHAIRMAN JACZKO: You telling me we don't know how to do
21 that?

22 KARL FLEMING: No we do.

23 CHAIRMAN JACZKO: It's a different set of resources it just takes
24 people --

25 KARL FLEMING: It's a different set, resources, it's a different set of

1 people, then of course the back end analysis is a further set of people. The thing
2 I want to comment on is, in the early days of PRA it was done by consulting
3 companies and the NRC and the NRC contractors. And after the IPEs and
4 IPEEEs, there was a very effective technology transfer to the utility industry
5 where the utility industry built up very, very substantial capabilities to do their own
6 PRAs. Well that technology transfer was heavily focused on the Level 1 PRA
7 part of the process. So you can go into any utility industry and find very
8 competent, very skillful Level 1 PRA practitioners. But it's -- from a business
9 model perspective, it's not very easy to hire in severe accident guy, a
10 probabilistic structures guy, a radiological consequence person and so forth, so,
11 the resources are spread around in different places. And the --

12 CHAIRMAN JACZKO: What are the--

13 KARL FLEMING: The utility resources are consumed on the Level
14 1 part of the problem right now. And to go and get the technical resources to do
15 the Level 2 and Level 3, I think that's where maybe the problem is. It's -- we
16 have--

17 CHAIRMAN JACZKO: The problem is that we don't have literally
18 enough bodies in the country that know how to do this.

19 KARL FLEMING: Yes, that's it. Enough people with the right
20 expertise that together with graduates -- people coming out of college can get the
21 job done. You have to have a mix of senior people.

22 CHAIRMAN JACZKO: If that's where the problem is, I don't know
23 that the Commission can solve that, I mean we can't solve that problem. I mean
24 we can't, I mean we could I guess. We have a grant program. Should we take
25 our existing grant program and focus that exclusively on PRA and developing

1 PRA practitioners or model developers?

2 BIFF BRADLEY: Oh you're talking to a bunch of PRA people here.

3 CHAIRMAN JACZKO: So you should say yes.

4 BIFF BRADLEY: It wouldn't be a bad idea. Obviously you can't
5 do that.

6 CHAIRMAN JACZKO: Well I don't know why we couldn't –

7 BIFF BRADLEY: We would certainly support --

8 CHAIRMAN JACZKO: I'm just trying to find what the root, the
9 problem is, you're telling me I need 10 years worth of research to better
10 understand some element of reactor physics before I can develop a model that I
11 can then turn into some kind of code that I can run in a PRA. That's one
12 problem. If it's just, I need to get the pipeline filled with more people to get more
13 people to go out and do the grunt work of developing the models, that's a very
14 different problem. And it sounds like it's the latter, not the former.

15 BIFF BRADLEY: It's some of both but it's certainly the latter, but
16 there's also some fundamental issues that I think do need more attention. We --

17 CHAIRMAN JACZKO: But those seem to be what I'm hearing, is
18 Level 1 issues, not Level 3 issues.

19 BIFF BRADLEY: But from my perspective, having been sort of
20 embedded in the Level 1 world, yes, I do think there are, and it has to do mainly
21 with combinations of modes of power operations and certain initiators that we
22 really, there's work that remains to be done there.

23 CHAIRMAN JACZKO: Okay, good, well thank you. I appreciate
24 that and you know, certainly it's something I have strong interest in, and I don't
25 mean, I'm not trying to criticize you -- I'm just trying to really understand what the

1 problem is so we can figure out how to solve it. Because just hearing that it's
2 resources doesn't necessarily help. But knowing where those resource gaps are
3 really fundamentally is important. So, any other questions for this panel? Okay
4 great, thank you, appreciate it. Take a quick recess and then we will hear from the
5 staff.

6 [break]

7 CHAIRMAN JACZKO: Ready Bill?

8 BILL BORCHARDT: I'm ready.

9 CHAIRMAN JACZKO: Okay, go for it.

10 BILL BORCHARDT: Good morning. I appreciate the first panel's
11 discussion. I think it highlighted the fact that there's good agreement about the
12 importance of doing some additional work on Level 3 PRA. I think the issue
13 comes down to what's the best path to get to where we all want to go, which is to
14 be able to have this capability and that's the basis for the three options that we
15 prepared. And Dan Hudson, who is the project manager for this effort's going to
16 give a presentation this morning on our views and on the options that were
17 presented in the paper. Before that though, Brian's going to give an introduction
18 on severe accidents, just as some background into the context of this overall
19 effort. So I'll turn to Brian first.

20 BRIAN SHERON: Good morning. I'm Brian Sheron, the Director of
21 the Office of Nuclear Regulatory Research and I'll provide an overview on severe
22 accidents. If I can get slide three.

23 I'll begin my overview of severe accidents by reviewing some nuclear
24 power plant terminology. First off, a design basis accident is postulated accident
25 assumed coincident with the worse postulated single act failure of a component.

1 It's a performance intended safety function for which a nuclear facility is designed
2 to withstand without exceeding offsite exposures in excess of 10 CFR Part 100.
3 Beyond design basis accident is one which involves either a more serious
4 initiating event or multiple failures following an accident initiation. Although not
5 specifically designed to do so, nuclear power plants are capable of handling
6 many design basis, or I'm sorry, beyond design basis accidents without resulting
7 in core damage. However there are some beyond design basis accidents
8 involving multiple failures that could lead to core damage. For some, the extent
9 of damage could be minor, for others, such as those involving a prolonged failure
10 of core cooling systems, substantial core damage could result. A severe
11 accident is an accident which results at a minimum in substantial damage to the
12 reactor core. Slide four please.

13 Prior to the accident at TMI-2, the NRC and nuclear industry were
14 largely focused on design basis accidents and particularly the large break loss of
15 coolant accident, referred to as an LB LOCA, as the accidents of concern for
16 commercial nuclear, light water nuclear power plants. Adequate protection of
17 public health and safety was demonstrated by designing plants to withstand
18 these DBAs and by using defense in depth safety strategy which promotes the
19 use of multiple, independent defense mechanisms to prevent or mitigate the
20 consequences of a severe accident, should one occur.

21 Four years prior to the TMI-2 accident, the NRC completed the first
22 comprehensive, probabilistic risk assessment of two nuclear commercial power
23 plants, Peach Bottom and Surry, as part of the Reactor Safety Study, published
24 in WASH-1400. While this PRA concluded that accidents initiated by transients
25 or small break LOCAs were more likely to cause core melt than traditional DBAs,

1 it was not until the TMI-2 accident that this realization became apparent. The
2 accident at TMI-2 was not a stylized, large break LOCA. Instead, it was a small
3 break LOCA due to a stuck open valve that was initiated by a loss of feedwater.
4 Off-site power was not lost. The worse single act of failure didn't occur and most
5 importantly, operator error was a major contributor to the event. Slide five.

6 Following TMI-2, NRC research was redirected to focus on severe
7 accidents. The objectives of this research were to one, obtain a better
8 understanding of the physical phenomena of severe accidents. Two, develop
9 models of these phenomena to predict the ways that sever accidents might
10 progress. And three, develop more realistic estimates of the radionuclide
11 releases that could result from severe accidents. And four, examine available
12 data sources and existing PRAs to identify important accident sequences. To
13 meet these objectives, the NRC invested millions of dollars in major research
14 programs. In August, 1985, on the basis of available information from the severe
15 accident research program, the Commission issued its severe accident policy
16 statement in which it concluded that the existing plants pose no undue risk to the
17 public health, and no immediate additional regulatory changes were
18 recommended for these plants to address severe accidents. However,
19 acknowledging that safety could be further improved by identifying and
20 addressing plant specific vulnerabilities to severe accidents, the Commission
21 articulated its desire to perform an individual plant examination, or IPE, of each
22 nuclear power plant. Next slide please.

23 Three years later, in November 1988, the NRC issued Generic
24 Letter 8820, requesting that each licensee perform an IPE to identify plant
25 specific vulnerabilities to severe accidents that could be fixed with low-cost

1 improvements. Based on guidance provided in Generic Letter 8820, the scope of
2 the IPE submittals was limited to internal initiating events occurring during at
3 power operations. Therefore in June 1991, the NRC issued supplement four to
4 Generic Letter 8820, requesting that each licensee perform an individual plant
5 examination of external events, or IPEEE, to identify further severe accident
6 vulnerabilities. Scope of the IPE submittals included consideration of internal
7 fires, seismic events, floods, high winds, and other external initiating events. The
8 IPE and IPEEE programs led to improved understanding of PRA and severe
9 accidents and served as catalysts for further improving nuclear power plant
10 safety.

11 In April 1986, a severe accident at Unit Four at the Chernobyl
12 Nuclear Power Station in the Ukraine released huge amounts of radioactive
13 material to the atmosphere that were detected worldwide. Subsequent
14 assessment of this accident concluded that the cause was due to certain design
15 features of the Russian RBMK type reactor that were not present in Western
16 reactors. However, human error and safety culture were found to have been key
17 contributors to the accident and these elements are not necessarily unique to
18 Russian reactors.

19 Since the accidents at TMI-2 and Chernobyl, and also the events of
20 9/11, the NRC and the U.S. nuclear industry have used insights from research
21 programs and PRAs to identify and implement numerous and substantial
22 additional measures to reduce the vulnerability to or mitigate the consequences
23 of, severe accident events. Example measures include the implementation of the
24 risk informed regulations such as the hydrogen combustion rule, 10 CFR 50.44,
25 anticipated transients without scram or ATWS, 10 CFR 50.62, and the station

1 blackout rule, 10 CFR 50.63. The addition of hardened vents to the boiling water
2 reactors, the BWR Mark I containment, and the development of severe accident
3 management guidelines and the extensive damage mitigation guidelines or B.5.b
4 measures. Next slide, slide six.

5 The progression of a severe accident can be divided into multiple,
6 successive stages, with each stage beginning with a specific event. To illustrate
7 this progression, a station blackout example scenario will be discussed. The first
8 stage begins with a loss of off-site power initiating event, which leads to a reactor
9 trip. Concurrent assumed failures then lead to the unavailability of emergency
10 on-site A/C power sources, resulting in a station blackout. Failure to restore A/C
11 power and depletion of D/C power sources ultimately leads to a loss of injection
12 and core cooling capability. Next slide.

13 The second stage begins with the onset of sustained core uncovering
14 as the water level drops below the top of the active fuel due to coolant boil off.
15 Because of low vapor flows, the cooling of fuel in the uncovered part of the core
16 is relatively ineffective resulting in core heat up. Third stage begins with the
17 onset of steam-induced oxidation of the Zircaloy cladding, which results in heat
18 release and hydrogen production, cladding failure and the release of gaseous
19 fission products from the fuel cladding gap into the reactor coolant. The fourth
20 stage begins with the melting of the remaining Zircaloy cladding and subsequent
21 melting of the fuel, which releases fission products from the fuel into the reactor
22 coolant. Next slide please.

23 The fifth stage begins with the flow of molten fuel material into the
24 lower plenum of the reactor vessel. The sixth stage begins with the failure of the
25 reactor pressure vessel, with consequent discharge of hot core debris and

1 radionuclides into the containment. Reactor pressure vessel failure can result
2 from weakening of either the lower head or its penetrations due to contact with
3 the hot core debris. Challenges to containment integrity can occur during
4 different time periods including at accident initiation. Example phenomena that
5 can present challenges to the containment include hydrogen combustion and
6 containment over pressurization due to non-condensable gas generation. Final
7 stage begins with containment failure or bypass, which leads to the transport,
8 dispersion, and deposition of radionuclides through the environment. Next slide.

9 Through years of severe accident research, sophisticated computer
10 codes have been developed for performing severe accident progression
11 analyses. NRC uses the MELCORE code for performing integrated severe
12 accident analyses by modeling important severe accident phenomena, such as
13 accident initiation, reactor coolant thermo-hydraulics, core meltdown, and
14 relocation, reactor pressure failure, fission product transport and release, and
15 containment thermo-hydraulics and failure.

16 Figure on slide nine illustrates an output from a MELCOR
17 simulation of a long-term station blackout involving a GE BWR reactor. The
18 graph illustrates how reactor pressure vessel pressure changes as the accident
19 progresses from initiation to pressure vessel lower head failure. Note the
20 pressure spikes at core relocation and reactor pressure vessel lower head
21 failure. Next slide.

22 Figure on slide 10 is a graphical display of a MELCORE simulation
23 of the TMI-2 accident, which illustrates the probable relocation routes of the
24 melted TMI-2 core. Note the debris located in the core's support assembly in the
25 lower plenum. This concludes my overview of severe accidents and now I'll turn

1 it over to Dan.

2 DANIEL HUDSON: Thank you Brian. Good morning Mr. Chairman
3 and Commissioners. As you heard, my name is Dan Hudson. I'm a technical
4 assistant in the Office of Nuclear Regulatory Research and I'm the project
5 manager for the staff's new Level 3 PRA initiative. I'm pleased to have the
6 opportunity this morning to discuss the staff's proposed options for proceeding
7 with future Level 3 PRA activities that were provided for Commission
8 consideration earlier this month in a notation vote paper. As to whether or not I'll
9 be pleased to have the opportunity to address the questions that will be coming
10 my way, especially coming those from Commissioner Apostolakis, guess that's to
11 be determined. Slide 12 please.

12 To set the stage for our discussion related to Level 3 PRAs and for
13 the benefit of our audience members who might not have a background in this
14 area. I'll begin by providing a brief overview of both PRA and the levels of risk
15 characterization that have traditionally been used in PRAs for nuclear power
16 plants.

17 At its core, PRA is a structured, analytical process that provides
18 both qualitative insights and quantitative estimates of risk that can be used to
19 support decision-making and risk management. It does this by systematically
20 answering three basic questions. First, it answers the question, what can go
21 wrong by developing a set of possible accident scenarios? Each accident
22 scenario begins with an initiating event that disrupts the system's normal
23 operations and ends with an undesired outcome or end state. Within each
24 scenario, there can be multiple intermediate events, such as the successes or
25 failures of equipment and/or operator actions that can determine whether and

1 how an initiating event leads to a particular end state.

2 Next, it answers the question, how likely is it by estimating the
3 likelihood of each accident scenario, using its initiating event frequency and the
4 probabilities of different combinations of successes and failures that can lead
5 from the initiating event to a particular end state. Finally, it answers the question,
6 what are the consequences by estimating the consequences of various damages
7 or losses that can occur at the end states of interest. Slide 13 please.

8 Within this PRA framework, risk can be characterized in different
9 ways, depending on the end states and consequence measures of interest for a
10 particular risk informed application. PRAs for nuclear power plants have
11 traditionally been organized into three levels of risk characterization that are
12 based on three sequential end states of interest within a severe reactor accident
13 scenario. The end states of interest in a Level 1 PRA are either the onset of
14 reactor core damage or the achievement of a safe state. A Level 1 PRA
15 therefore models the possible equipment and operator responses to various
16 initiating events to identify those sequences of events that can result in the onset
17 of reactor core damage. The estimated frequencies of possible core damage
18 accident sequences are then added together to calculate the total core damage
19 frequency, or CDF for the analyzed plant. The end state of interest for a Level 2
20 PRA is the release of radioactive material from the container to the environment.
21 Therefore in addition to the Level 1 PRA analyses, a Level 2 PRA models the
22 progression of possible core damage sequences to evaluate system and
23 containment performance under accident conditions. A Level 2 PRA can
24 therefore be used to estimate conditional containment failure probabilities,
25 radioactive material release frequencies such as large early release frequency or

1 LERF and various characteristics of the released radioactive material, otherwise
2 known as the source term. The end state of interest of a Level 3 PRA are
3 various off-site radiological consequences. Therefore, in addition to the Level 1
4 PRA and Level 2 PRA analyses, a Level 3 PRA assumes various models for
5 atmospheric transport and dispersion, emergency response, dose response, and
6 economic phenomena to estimate off-site radiological consequences. Inputs to a
7 Level 3 PRA include the source term characteristics from a Level 2 PRA and
8 several site specific factors such as local weather patterns, population density,
9 emergency planning measures, and land use. Outputs from a Level 3 PRA can
10 include estimates of population dose at various locations around the site, early
11 and latent cancer fatalities, and economic costs associated with evacuation,
12 relocation, property loss, and land decontamination.

13 By combining both the core damage sequences from a Level 1
14 PRA and the radioactive material release frequencies from a Level 2 PRA, with
15 the offsite radiological consequences associated with each release, a Level 3
16 PRA directly estimates the risk to the public from nuclear power plant accidents.
17 Slide 14 please.

18 The staff's new Level 3 PRA initiative began with an overall vision.
19 Our vision was ultimately to enhance regulatory decision-making by extracting
20 new and improved risk insights. We envisioned that these insights could be
21 realized by performing new Level 3 PRAs that include three fundamental
22 enhancements when compared to the last NRC sponsored Level 3 PRAs that
23 were performed in the late 1980s as part of the NUREG-1150 study. The first
24 enhancement would be to incorporate important technical advances made in the
25 more than two decades that have passed since NUREG-1150. Examples of

1 such technical advances include various modifications to enhance nuclear power
2 plant operational performance, safety, and security; improvements in our
3 understanding and modeling of severe accident phenomena; and improvements
4 in PRA methods, models, tools, and data, which we collectively refer to as PRA
5 technology.

6 The second enhancement would be to expand the scope of the
7 analysis beyond that of prior NRC sponsored Level 3 PRAs, to provide an
8 assessment of site accident risk as opposed to reactor accident risk. The
9 envisioned scope would therefore include an assessment of not only single unit
10 reactor accidents, but also accidents involving additional site radiological
11 sources, such as multiple reactor units and spent fuel. The third enhancement
12 would be to achieve better analytic consistency by using more consistent PRA
13 technology, assumptions, and level of detail in the modeling and assessment of
14 the broad spectrum of possible accident scenarios, and this was an issue that
15 was raised earlier with the stakeholder panel. Because of our early focus on the
16 single unit reactor accidents initiated by internal events such as a loss of cooling
17 accident, our existing PRA technology has evolved and is quite capable of
18 modeling and assessing these types of accidents. However, for modeling and
19 assessing accidents involving additional site radiological sources, and accidents
20 initiated by various external events, our PRA technology is somewhat less
21 mature. These differing degrees of sophistication can introduce additional
22 challenges when attempting to identify the most significant contributors to risk.
23 Our vision is therefore to achieve a more level playing field so that in the end, we
24 can make a meaningful comparison and obtain a relative ranking of the various
25 contributors to risk at a nuclear power plant site.

1 To realize this vision, the staff thought a three phased approach
2 would be needed. The first phase would consist of a scoping study, to evaluate
3 the feasibility of performing a new and more comprehensive site Level 3 PRA
4 that includes these enhancements. The second phase would consist of a pilot
5 study to demonstrate our ability to develop such a Level 3 PRA. And finally, the
6 third phase would consist of any needed follow-on studies or activities. Slide 15
7 please.

8 During the annual Commission meeting on Research Programs,
9 Performance and Future Plans that was held on February 18, 2010, the staff
10 presented this vision and proposed to move forward with the scoping study. In
11 the subsequent Staff Requirements Memorandum dated March 19 of 2010, the
12 Commission expressed its conditional support for proceeding with Level 3 PRA
13 related activities and directed the staff to first continue internal coordination and
14 external stakeholder engagement activities in formulating a plan and scope for
15 future actions. And second, provide various options for proceeding, which
16 include cost and perspectives on future uses. Slide 16 please.

17 Through numerous interactions with internal and external
18 stakeholders including staff workshops, Advisory Committee on Reactor
19 Safeguards briefings and a Category 2 public meeting, the staff identified a set of
20 seven high-level potential future uses for Level 3 PRAs. In doing so the staff
21 explored not only the ways in which the NUREG-1150 PRAs were used to
22 support the development of our existing risk informed regulatory framework, but
23 also potential enhancements that could be made to this framework by performing
24 new Level 3 PRAs. It should be noted that this set of potential uses that we're
25 about to discuss is meant to apply to future Level 3 PRAs in general, and not

1 specifically to the Level 3 PRA proposed as one of the options for proceeding.
2 As with any PRA, the use of a single site specific Level 3 PRA would ultimately
3 depend on its scope, and the extent to which its results and insights can be
4 generalized to apply to the larger population of nuclear power plant sites. The
5 seven high level potential future uses identified by the staff include (1) assess the
6 agency's current use of PRA and risk informed regulatory decision-making. An
7 example could be to confirm the acceptability of using the results of Level 1 and
8 limited scope Level 2 PRAs to support various regulatory applications. (2) verify
9 or revise regulatory requirements and guidance, particularly those that were
10 developed using information from the NUREG-1150s PRAs. An example could
11 be the regulatory analysis guidelines used to evaluate the cost and benefits of
12 proposed backfits. (3) support specific risk informed regulatory applications in
13 areas beyond those we have historically addressed using risk insights.
14 Examples include providing the technical basis for risk informing the regulation of
15 spent fuel storage and handling, siting, and emergency preparedness. (4)
16 prioritize generic safety issues and nuclear safety research programs. Slide 17
17 please. (5) develop and pilot test PRA technology, industry consensus standards
18 and regulatory guidance. This could include evaluating potential risk metrics for
19 future use. (6) support both PRA knowledge management including the
20 development of in-house PRA technical capability and risk communication
21 activities. (7) support future risk informed licensing of new and advanced reactor
22 designs including small modular reactors. Slide 18 please.

23 In addition to these potential future uses, the staff coordinated with
24 internal and external stakeholders to identify and develop various options for
25 proceeding with future Level 3 PRA activities. The three primary options deemed

1 by the staff to be the most feasible and cost beneficial are presented on slide 18.
2 Each of these primary options, including its relative advantages and
3 disadvantages will be discussed in more detail momentarily. Slide 19 please.

4 In developing options, the staff recognized that the Commission
5 has considerable flexibility in selecting an option for proceeding with future Level
6 3 PRA activities. Therefore in addition to the three primary options we are about
7 to discuss, the staff also considered other options for proceeding. These options
8 included for example, a limited scope Level 3 PRA that could be used to address
9 specific issues of interest; a full-scope Level 3 PRA for new or advanced reactor
10 design; and a licensee to develop Level 3 PRA, supported by NRC staff
11 participation. The staff used these other options as essentially variations on the
12 primary options that could allow for completion of a Level 3 PRA with different
13 schedule and resource implications for the agency. Slide 20 please.

14 I will now discuss in more detail the three primary options
15 presented for Commission consideration. Option 1 maintains the status quo in
16 ongoing and planned activities related to the development and implantation of
17 PRA technology and risk informed regulation. The objection of this option would
18 be to continue the evolutionary development of PRA technology on a resource
19 available basis. Like other agency research activities, the scope of this option
20 would ultimately be determined by program office user need requests,
21 Commission tasking and the agency's long-term research plan. For example, as
22 part of its strategic long-term research plan, the staff has identified Level 2 and
23 Level 3 PRA as areas that would benefit from examination of more advanced
24 methods and is therefore performing limited scope research in these areas.
25 Slide 21 please.

1 When compared to the other primary options, an advantage of
2 Option 1 is that it's consistent with the current fiscal climate, by focusing limited
3 available staff and contract support resources on ongoing and planned mission
4 critical work. If Option 1 is selected, resources that have already been requested
5 to support future Level 3 PRA activities, could be reallocated to support other
6 important activities. One disadvantage of Option 1 is that insights from a new
7 and more comprehensive site Level 3 PRA would not be realized. Another
8 disadvantage is that this option can result in an inconsistent and more costly
9 treatment of potential future issues by developing the necessary PRA technology
10 on an ad-hoc basis, rather than developing up front a useful tool that can provide
11 an integrated perspective. I realized earlier this week as I was preparing for this
12 meeting that I needed to be careful about how this last statement can be
13 interpreted and I want to be clarify that as a regulatory agency, the NRC always
14 strives to be stable and consistent in its decision-making. So when I talk about
15 consistency in this context, I'm talking about striving for consistency in the quality
16 of the information and the tools that we use to support our decision-making, not
17 necessarily the decision-making itself. Slide 22 please.

18 Option 2 involves conducting near term focused research over the
19 next two years. The direct objective of this research would be to prepare for
20 developing a new, full-scope comprehensive site Level 3 PRA by addressing
21 identified gaps in existing PRA technology. These technical gaps that we've
22 identified relate primarily to the proposed expansion in PRA scope and the
23 differing degrees of detail and sophistication in existing PRA technology that can
24 be used to assess the risk from various site radiological sources and initiating
25 event hazards. Example areas for further research that could be included in the

1 scope of Option 2 include: modeling of consequential multiple initiating events
2 such as seismic induced floods and fires; modeling of multi-unit dependencies
3 and accidents involving multiple units; post core damage and external events
4 human reliability analysis including the modeling of severe accident management
5 guidelines and extensive damage mitigation guidelines and extensive damage
6 mitigation guidelines, or B.5.b measures; development of spent fuel PRA
7 technology; and Level 2 and Level 3 PRA uncertainty analysis.

8 It's important to note that this list of research areas is not intended
9 to be comprehensive or fixed. Moreover, given the proposed resources and two
10 year schedule, we recognize it would not be possible to address all identified
11 areas. So if Option 2 is selected, the staff would prioritize its research efforts and
12 use budgeted resources to address the highest priority areas. At the end of the
13 two year period, the staff would assess the agency's progress and readiness for
14 performing a new and more comprehensive site Level 3 PRA and would provide
15 the Commission with various options and a recommendation for proceeding with
16 future Level 3 PRA activities.

17 I want to just take a brief moment to deviate from my prepared
18 remarks here because it's become clear to me through the earlier discussion with
19 the stakeholder panel, that Option 2 might be misunderstood. I get the
20 impression that people see researchers operating in their vacuum, maybe in the
21 offices of Research, performing this research without a clear focus or context.
22 And that's not what we meant at all and it's become clear to me that maybe I
23 didn't articulate that quite as clearly as I should have in the paper. But the vision
24 for Option 2 is really to make important progress over the next two years. The
25 ultimate purpose is to prepare for doing a Level 3 PRA. And we wouldn't be

1 doing that research in a vacuum. The idea here is to engage with licensees and
2 to perform this research within the context of a PRA, whether it's the licensee's
3 PRA or it's one of the agency's standardized plant analysis risk PRA models.
4 But it would be performed in a context and the advantage that it gives us is that
5 we have the flexibility to engage with multiple licensees rather than restricting
6 ourselves to a single site like we would with proceeding with Option 3. So just
7 thought I'd put that out there, in advance, anticipating that we might be receiving
8 some questions about that. Slide 23 please.

9 An advantage of Option 2 is that like Option 1, but to a lesser
10 extent, it focuses limited available staff and contract resources on ongoing and
11 planned mission critical work. Another advantage is that it focuses additional
12 staff and contract support resources that have already been requested to support
13 future Level 3 PRA activities on research that is needed to support the eventual
14 development of full scope comprehensive site Level 3 PRAs. Yet another
15 advantage is that it produces results and insights that would advance the state of
16 practice in specific PRA technical elements and would thereby enhance our PRA
17 technical capability in these areas. A disadvantage of Option 2 is that when
18 compared to Option 3, it delays the insights that could be gained from performing
19 a new and comprehensive site Level 3 PRA. Slide 24 please.

20 Finally, Option 3 involves planning for, and performing a new, full-
21 scope comprehensive site Level 3 PRA for an operating nuclear power plant.
22 Research identified in Option 2 also would be conducted as part of this option,
23 but on an accelerated schedule to support the completion of this study within a
24 proposed three year schedule. Three main objectives for the proposed site Level
25 3 PRA have been identified. Consistent with our overall vision, the first and

1 primary objective would be to extract new and improved risk insights. The
2 second objective would be to enhance our PRA capability, expertise, and
3 documentation. The third and final objective would be to demonstrate the
4 technical feasibility and evaluate the realistic costs of developing new site Level 3
5 PRAs. Slide 25 please.

6 This figure on slide 25 illustrates the envisioned scope for the
7 proposed site Level 3 PRA. The approximate scope of NUREG-1150 is captured
8 by the blue shaded region in the lower left corner of the figure. As you can see,
9 these Level 3 PRAs were limited to the assessment of single unit reactor
10 accidents occurring at power and that were initiated primarily by internal initiating
11 event hazards, with a very limited treatment of some external initiating event
12 hazards. Consistent with our overall vision, we have proposed to expand the
13 scope beyond NUREG-1150 to provide an assessment of site accident risk. The
14 proposed scope would therefore include an assessment of accidents involving all
15 reactor units and spent fuel on site, accidents initiated while at power and during
16 low power, shutdown plant operating states, and accidents caused by both
17 internal and site specific external initiating event hazards. The only factors
18 specifically excluded from the analysis would be radiological sources involving
19 fresh nuclear fuel and radiological waste and initiating events involving deliberate
20 malevolent acts such as terrorism and sabotage. Slide 26 please.

21 When compared to the other primary options, an advantage of
22 Option 3 is that it provides the new and improved risk insights that we are
23 seeking, and it does so earlier than Option 2. Another advantage is that it
24 enhances our PRA capability, expertise and documentation earlier by developing
25 up front, a useful tool that can provide an integrated perspective for addressing

1 potential future issues. The major disadvantage of Option 3 is that it is resource
2 intensive, requiring more staff and contract support resources than have already
3 been requested to support future Level 3 PRA activities. As such, it would
4 require reallocation of qualified risk analysts from other ongoing and planned
5 important activities, such as reviews of license amendments to support the
6 voluntary implementation of National Fire Protection Association Standard 805,
7 refinements of the agency's standardized plant analysis risk PRA models, used
8 to support the reactor oversight process, and reviews of PRAs in support of
9 combined operating license applications. Slide 27 please.

10 Through numerous interactions with internal and external
11 stakeholders, the staff has concluded that performing a new and more
12 comprehensive site Level 3 PRA would be beneficial. And I think that everyone
13 would agree that there's some agreement on that today. However, obtaining
14 additional resources to support this initiative would be challenging in light of the
15 existing fiscal climate and in particular, the need to otherwise reallocate a limited
16 number of qualified risk analysts from other ongoing and planned important
17 activities. The staff therefore recommends the Commission approve Option 2.
18 Selecting this option would enable the staff to use resources already requested
19 to support future Level 3 PRA activities to continue important progress toward
20 ultimately performing a new and more comprehensive site Level 3 PRA.
21 Moreover, it would enable the staff and the Commission to better understand the
22 potential needs and implications of both the recently completed near term task
23 force review and the pending recommendations from the task force for
24 assessment of options for developing a more holistic risk informed and
25 performance based regulatory approach before committing substantial resources

1 to support the development of a new and more comprehensive site Level 3 PRA.
2 Slide 28 please.

3 Thank you very much Mr. Chairman, this completes the staff
4 panel's prepared remarks.

5 CHAIRMAN JACZKO: Anything else? Okay, great, Commissioner
6 Ostendorff?

7 COMMISSIONER OSTENDORFF: Thank you Chairman. I was
8 intrigued by the Chairman's question, questions on the previous panel
9 associated with resources and so forth and I think given the nature of that
10 element being very prominent in the staff's recommendation for Option 2, I
11 wanted to maybe just ask a couple questions along these lines to start out. Dan,
12 I'm going to put you on the spot here. I'd be interested in knowing what is your
13 background as Level 3 PRA project manager? I've never had a discussion with
14 you so I'd just be curious to see what you've done, where you've been, what your
15 education is.

16 DANIEL HUDSON: Sure, I'll start off by saying I am not a PRA
17 practitioner. I came to the agency in the fall of 2009. I had served for seven
18 years in the Navy as a submarine warfare officer so I have experience in the
19 operation and supervision of the operation of nuclear power plants within the
20 naval nuclear power regime. So I came into this position having some
21 experience with operations. I also had a background in human factors and some
22 experience with human reliability analysis but hadn't really operated in the
23 context of a full PRA, let alone a Level 3 PRA. So I was relatively new to the
24 PRA field when I took over this position and just dove right in and started
25 developing the knowledge that I needed to serve in this role.

1 COMMISSIONER OSTENDORFF: And I assure my colleagues, I
2 did not know in advance the answer to this question, that I knew he was a Navy
3 guy.

4 CHAIRMAN JACZKO: Did you know him when you were in a
5 submarine?

6 DANIEL HUDSON: I did not.

7 COMMISSIONER OSTENDORFF: Full disclosure. Well thanks.
8 You know, when I look at, on page 10 of the SECY where, and I'll but the EDO
9 on the spot here a little bit, because I'm trying to really understand, I think, what
10 I'm hearing is all the recommendation towards Option 2 was really predicated
11 upon a resource constraint. Is that a fair characterization?

12 BILL BORCHARDT: Yeah, and it's based, I mean it's a resource
13 constraint based on input from all of the program offices and the -- recognizing
14 the support that they asked for from the Office of Research and the limited
15 resources. So it all folds together in kind of an integrated assessment.

16 COMMISSIONER OSTENDORFF: Okay so I'm looking, I'm going
17 to read, I'm going to provide a couple of examples because I'm going to ask you
18 for a rack and stack where this fits in, that's where I'm going with this question.
19 Page 10 of the SECY it talks about other Commission work that's already been
20 directed in evaluation of different HRA models. It goes back to 2006 SRM.
21 Development of guidance will be used for the development of expert, use of
22 expert guidance and decision-making. Development of guidance will support risk
23 informing SMR reviews. Program office work on the SPAR model development,
24 transition to 805 implementation by our licensees, simulated research, et cetera,
25 et cetera. There's probably 10 or so different elements here. Where does the

1 Level 3 PRA, if the Commission approved that, where does that fit into the list of
2 priorities for the limited, what I understand. limited risk analysts in the agency?
3 And whoever wants to answer that.

4 DANIEL HUDSON: I'll start by saying that the areas that you've
5 just identified on page 10 of the SECY were meant to be examples of some of
6 the ongoing and planned work that some of the qualified risk analysts that we've
7 talked about would be participating in. So we're not saying up front that this
8 Level 3 PRA initiative would be more important than that work, it's just examples
9 of ongoing work that would be competing for the same resources. And we put in
10 the SECY that if the Commission were to direct the staff to proceed with Option 3
11 or some other option involving a Level 3 PRA, we would take an approach that is
12 very similar to what the ACRS recommended, and that's that we would engage
13 with industry to identify a site that would participate in the study. We'd develop a
14 more detailed project plan and obtain more realistic resource estimates than we
15 have today. And then we'd engage with the program offices to identify what
16 resources, the more realistic resources that would be needed to support that
17 effort. And then we'd try to determine at that point where this initiative fits out, or
18 plays out with the other ongoing activities and what's more important.

19 COMMISSIONER OSTENDORFF: Well, but -- okay, what's less
20 important than the PRA work? I'm just trying to get a feel for this on a relative
21 basis. Because I'm hearing that the PRA three, Level 3 PRA work overall
22 appears to have merit, that pursuing Option 2 will delay getting to that end state.
23 Everything is not an equal priority; there's certain things more important than
24 others. I'm just trying to, curious to -- where does this fit in the list of other
25 things?

1 BILL BORCHARDT: My initial answer to that question anyway
2 would be consistent with every other prioritization that we make in this agency.
3 The top priority's got to be operating reactor safety. So that goes to reactor
4 oversight, to the SPAR models, to making sure that they're as usable and
5 functional as possible. So that's at the top of the list. I see there's kind of a large
6 middle of the priorities that -- I would say currently licensing actions in which fire
7 protection would fall, other license amendments where licensees use, rely on risk
8 information to support the submittal, those are equally important. The new
9 reactor reviews would fall into that great middle. And I think I would put that
10 Level 3, because it's going towards the future, as being in there. But I certainly
11 couldn't displace current operating reactor issues with the Level 3.

12 COMMISSIONER OSTENDORFF: Brian, do you have anything to
13 add to that?

14 BRIAN SHERON: Well, the only thing I'd point out is that the
15 resource estimates are very uncertain right now. And actually this two year
16 period gives us a little bit of time to kind of think through what makes sense. For
17 example, if we were to start a Level 3 using the SOARCA plants, we've already
18 got a fair amount of the work done, okay. The question is, do you learn
19 something more by doing a Level 3 on those two plants versus you know, just
20 looking at the SOARCA results and the like. Should I pick, for example, a
21 different kind of plant? Should I pick an ice condenser? Should I pick a B&W
22 plant for the Level 3? Are these two utilities, Peach Bottom and Surry utilities,
23 would they be willing to continue to participate? We don't know. So I look at this
24 two year period as giving us some time to kind of scope out what makes sense.
25 We can work with the ACRS, and the like, and come back then, and say okay we

1 really kind of rung this through. Here's the kind of plant we think we ought to do.
2 Here's the -- we met with the industry, here's the utilities that are willing to
3 participate. Here's the kind of reactors they have; this is what makes sense.

4 Obviously the resource estimates we put in the paper were sort of
5 like, if we were to start from a blank piece of paper. If we were to start with an
6 existing plant that already had a PRA or one of the Peach Bottom or Surry, I think
7 the resource estimates would be less, okay. But it would still be more than what
8 we have budgeted right now, but not the full amount.

9 COMMISSIONER OSTENDORFF: Brian, a follow up question for
10 that. Is there anything from your current understanding of the Fukushima events
11 or anything else in the operating reactor side of the house that would create a
12 greater urgency to do the Option 3 route at this time?

13 BRIAN SHERON: This is my personal opinion. I think looking at
14 site risk, as long as I've been in the agency it's always been a pro-reactor year
15 type of risk. And I'm very interested personally in what kind of synergy as we
16 saw like at Fukushima. Are there external effects that can affect multiple units?
17 Can they affect the spent fuel pool which might in turn have an effect on a reactor
18 or vice versa? So you know, doing it for that reason I think, in my mind, would
19 give us some new and important information.

20 COMMISSIONER OSTENDORFF: Thank you, thank you Mr.
21 Chairman.

22 CHAIRMAN JACZKO: Commissioner Svinicki.

23 COMMISSIONER SVINICKI: Thank you for those presentations.

24 That was very helpful. Brian, I'd like to return to SOARCA. Can you just
25 describe the status of the SOARCA right now? I mean, the analysis is done, are

1 we still in the peer review?

2 BRIAN SHERON: We're finishing up the peer review. I think
3 there's one more meeting planned where we're going to go through and basically
4 just show the peer review panel how we responded to their last set of comments.
5 We're not asking for further comments from them. We're finishing up the
6 analyses, finishing up the documentation. The plan would be to then put it out for
7 a draft, out for public comment. We would then get public comments; we want a
8 disposition the comments. I think there's a final ACRS meeting involved and
9 then we would bring it to the Commission.

10 COMMISSIONER SVINICKI: And is it true that there are not at this
11 time any, there's no specific direction as to how the SOARCA results might
12 inform any kind of regulatory decisions at this time? Is that true that that direction
13 doesn't exist right now?

14 BRIAN SHERON: Not, I would say not officially or anything. I
15 mean we've been thinking about what kind of uses it might be used for and the
16 like. And I think one of the plans we had when we send the SOARCA results to
17 the Commission, would be with a recommendation at least on where we think we
18 would go next with it, or how it could be used.

19 COMMISSIONER SVINICKI: So if I were to lay that answer
20 alongside the comment you made earlier about thinking about how SOARCA
21 might at least inform the conduct of Level 3 PRA depending on how NRC
22 decided to proceed here, what would be the plusses and minuses in your mind at
23 a very high level of utilizing the SOARCA sites?

24 BRIAN SHERON: Well the plus obviously would be lower
25 resources, obviously since we've done most of analyses and I think we could

1 probably focus more attention on the multiple unit and the spent fuel pool aspects
2 for say, the less than full power shut down rather than at the full power. That
3 would be the biggest benefits I would think of using of the SOARCA plants.

4 COMMISSIONER SVINICKI: And the down side is just as you
5 indicated earlier is that they may or may not be representative of what you're
6 most interested in right now?

7 BRIAN SHERON: Well I've mean, we've done these two plants;
8 they were done for WASH-1400. They were part of NUREG-1150. We just did
9 them with SOARCA. I guess the question is should we do a different plant, you
10 know with a different design and stuff. What we found in SOARCA is there are
11 some subtleties in the design that can have significant affects on what the results
12 are, even though they may -- you may think that all plants, all BWR-1s look alike
13 or something like that, or Mark-1s, But there can be subtle differences based just
14 on licensee changes made over the years that can have big effects. So looking
15 at a different plant may shed some insights on that.

16 COMMISSIONER SVINICKI: And so if we try to understand better
17 Dan, Option 2 and Option 3 and the difference which you said upon hearing the
18 first panel, you thought maybe Option 2 is being characterized as a let's just
19 stand down and study for a couple more years. Do you have an idea of if the
20 difference between Option 2 and Option 3 expressed as the time differential of
21 how many years before we would have gotten to the Level 3 PRA completed?
22 What is the difference in terms of timing? Is it just the two year delta.

23 DANIEL HUDSON: Well I think making an initial assumption that
24 maybe two years from now, after performing some work in these research areas
25 that we've identified, that maybe the fiscal climate might have improved, that we

1 might have more available staff resources to support moving forward with a Level
2 3 PRA. I think in an ideal situation then, we'd obtain approval from the
3 Commission to move forward with the study at that point, which would give us
4 just the two year delta. However, we may find after two years of work, that the
5 climate still hasn't improved and we're still not in a very good position in terms of
6 risk analysts to be able to support such an effort and we may need to delay
7 further. That being said, I think the vision for Option 2 moving forward would be
8 then, okay we might not be able to do the study at that point, but we still have
9 more work that can be done. And to touch on some of the comments that were
10 made earlier and in the ACRS letter, we're not disagreeing that a very efficient
11 way to identify gaps that need to be filled is by proceeding with the study. But we
12 do know in advance, especially in some of these areas that we've identified, that
13 there is methods development work that needs to be done. And so we can make
14 progress in those areas and then once we move forward with a Level 3 PRA
15 study, we may identify some other gaps that may need to be filled, but I think
16 we're going to be in a better position to complete the study more efficiently and
17 not subject ourselves to potential costly staff turnover by having a very drawn out
18 Level 3 PRA study.

19 COMMISSIONER SVINICKI: So you could potentially, if you
20 pursued Option 2 at the end of that period of time, you could not only be better
21 informed and ready to take on the Level 3 analysis, there's some chance in the
22 positive scenario that your risk analysts may have gotten through things like
23 NFPA 805 reviews and things like that, you may actually have some of the
24 relevant expertise. It's possible that they could be more available in two years
25 than they would be right now.

1 DANIEL HUDSON: That's the optimistic outlook.

2 COMMISSIONER SVINICKI: Okay, okay. And then returning Dan,
3 and I don't know how closely you've followed SOARCA but I was just asking Dr.
4 Sharon, if at the moment, there was specific direction to take those insights out of
5 SOARCA and apply them to the regulatory framework and his answer was not
6 officially. But staff must have some conceptualization both with SOARCA and
7 with Level 3 PRA. How, what are those areas that would be early areas that
8 would kind of identify themselves that you might want to take insights and apply
9 them to the regulatory framework. Do you have any just informal thoughts, and
10 then if Brian if you have some on SOARCA, you could add those as well.

11 DANIEL HUDSON: Well I think I might be in a position to talk about
12 how we could potentially use some of those insights within the context of a Level
13 3 PRA rather than how they could be applied in the larger regulatory framework.
14 But I can say that the SOARCA study had identified some of the issues that we
15 want to go after with this Level 3 PRA. The issue of a large seismic event,
16 creating problems with multiple units simultaneously and the resource issues in
17 terms of managing simultaneous accidents involving multiple units. And there's a
18 pretty generic issue on multi-unit risk that was initiated because of some of the
19 insights that were gained early on with SOARCA. So I think it's going to be
20 beneficial to inform that effort in terms of things that we might need to consider.
21 There was also important developmental work in terms of the tools that we would
22 use as part of the Level 3 PRA, namely the MELCORE severe accident analysis
23 code and MAX2, the code that we would be using for the consequence analysis
24 piece. So there are definitely insights that we have gained and advances that
25 have been made as a result of the SOARCA study that I think we can take

1 advantage of.

2 COMMISSIONER SVINICKI: Okay, and those specifics are very
3 helpful. I think the larger question I'm posing of course is that NRC isn't a
4 research -- a peer research institution. Our research always has to have some
5 application to our regulatory mission. And so SOARCA, it's not been clear yet
6 what we would do with the SOARCA results. And so now, if we're using
7 SOARCA to inform this Level 3 PRA, it really is just pushing that same question
8 then further out into the future. So at some point, I think that knowing how well
9 we can have two purposes here, one is to further inform the regulatory
10 framework going forward. But we also of course need to conduct research to
11 make sure that those things upon which we've had reliance in the past, that our
12 knowledge was correct or perhaps to refine that and perfect that going forward.
13 So, at some point those of course, that's how we best shape our research in the
14 Office of Research is to know what its regulatory purpose and objective will
15 ultimately be. Brian, did you want to add something?

16 BRIAN SHERON: Well I just, when SOARCA was first started,
17 which was even before I was the office director here, my understanding is that
18 there was a Sandia study, the Siting Study 1982 which used very conservative
19 results. And it was being misused, okay, the results were. They were being
20 cited as being realistic when in fact they were very, very conservative and I think
21 part of the intent of SOARCA was to come up with a realistic assessment of a
22 severe accident. So I mean that was, I think one of the original regulatory uses,
23 was to just you know, show people that the, you know, that the 1982 citing study
24 was in fact, you know very, very conservative on purpose.

25 COMMISSIONER SVINICKI: Yes. And that gets to the purpose I

1 described as making sure that those evaluations on which we've relied for a long
2 time are adequate or appropriate so I agree with you. I'm acquainted with that
3 same history. Again thank you all for your presentations. Thank you, Mr.
4 Chairman.

5 COMMISSIONER JACZKO: Commissioner Apostolakis?

6 COMMISSIONER APOSTOLAKIS: Thank you. Brian, in your
7 presentation you went over some of the accidents that have occurred and we
8 talked about what happened and so on. I was a little surprised that you didn't say
9 anything about human error. I mean, it was all over the place, wasn't it?

10 BRIAN SHERON: Well, I think I mentioned it in both the TMI 2
11 accident -- I could find it in here, but I think I mentioned it, "operator error" --

12 COMMISSIONER APOSTOLAKIS: But it is a major element. I
13 mean --

14 BRIAN SHERON: Yes, and I pointed out we have even -- the
15 Chernobyl Accident, human error was a big element.

16 COMMISSIONER APOSTOLAKIS: Yeah. Well, anyway, that's a
17 side remark. It looks like the major argument that you gentleman are making for
18 Option 2 is resources. And I'm wondering whether, you know, there are ways
19 around that. For example, we heard earlier that EPRI would be willing to
20 collaborate and presumably carry some of the burden. And I have a couple of
21 more things, but what do you think of working with EPRI? I mean, you think
22 that's reasonable?

23 DANIEL HUDSON: I think it's reasonable that there would be some
24 degree of collaboration and I know that we talked about that with them at the
25 Category 2 Public Meeting, and that was held in April. We started having

1 discussions then about the possibility of a relationship that we could maintain
2 perhaps under the memorandum of understanding that we have with them. I
3 guess some of the issues that might need to be worked out in terms of how
4 feasible and how beneficial it might be to increase the degree of collaboration
5 with EPRI and the industry, and completing a Level 3 PRA would be: how much
6 are we willing to sacrifice some of the potential training benefit that we would
7 receive in house by having staff participate and be directly involved and
8 participating in the study. So I think you heard Biff Bradley talk about that, or
9 maybe it was Stuart Lewis. One of them mentioned the fact that the way that you
10 really develop good PRA expertise is by participating in a study like this, rather
11 than participating in reviews of methods and things of that nature.

12 COMMISSIONER APOSTOLAKIS: PRA's another issue. I mean, I
13 thought your argument was there are not enough risk analysts to do the work, but
14 now you're saying you would bring people who are not risk -- who is a risk
15 analyst, by the way? I mean, is -- it was discussed earlier, there are so many
16 different kinds of expertise that are required. So, you know, just guys who do the
17 level one PRA, that's not enough. I mean, you need thermo-hydrologists, you
18 need structural people, you need health effects people. So, I don't know what we
19 mean by not having a lot of risk analysts.

20 BRIAN SHERON: Well in terms of budgeted resources, okay, I
21 think in the paper we said that we have two FTE budgeted for this. But you're
22 right, okay. I mean, it's not just a PRA analyst, okay? You need seismic
23 experts, you need thermo-hydraulic experts, you know, and the like. And you
24 need to gather, you know, and a lot of times we have maybe the expertise that --
25 for the folks that can do those analyses and everything, but they're working on

1 other things, okay? And then it gets into a matter of priorities.

2 COMMISSIONER APOSTOLAKIS: I guess my point is the training
3 issue. I mean, if we manage to sensitize people, you know, who are working
4 structural mechanics or thermo-hydraulics, that uncertainty's important and that
5 their work fits in the bigger picture in a certain way, then it seems to me that
6 would be a major benefit. That they will appreciate what it means to do a PRA.
7 Whether you want to call them risk analysts or not, I don't know, but that would
8 be a very good opportunity here to achieve that.

9 And the third point with the resources. It seems to me that as a
10 result of Fukushima, the Office of Research will have to do some work that really
11 would be beneficial to a Level 3 PRA, right? You will have to consider things like
12 emergency planning perhaps, or what can happen to the spent fuel pool under
13 earthquake, and so on, or flood. I mean, some resources will have to be
14 expended anyway on things that are part of a Level 3 PRA. So that also might
15 ease the pain. I don't know.

16 BRIAN SHERON: I would agree. And yes, that information that we
17 generate is, you know, on whatever we do on a follow-up on Fukushima, I'm sure
18 will contribute to our knowledge in preparing for a Level 3.

19 COMMISSIONER APOSTOLAKIS: It seems to me that a major
20 change in the way that we think about things, and, Brian, you mentioned it
21 earlier, after Fukushima, is that we really have to talk about the site risk. We
22 should start talking about site years rather than reactor years. So that is
23 probably a major change. And again, to do that, we have to do a Level 3 PRA.
24 But, it -- I like the cartoon you showed Dan, what Level 3 PRA would be,
25 including spent fuel pool, and then you said that you are excluding security.

1 Now, again, this is an area where I don't think that risk information has been
2 utilized to any significant degree. But if I have a Level 3 PRA, would that be a
3 good first step, to actually evaluate, perhaps, some of the security strategies that
4 we have and the industry has or some measures? And then start slowly getting
5 into it and figuring out, you know, how valuable these things are and how they
6 contribute to the security of the site. Would that be a benefit of a Level 3 PRA?

7 DANIEL HUDSON: A very quick response to that, is I don't think in
8 terms of PRAs there's going to be a better framework to do it than a Level 3 PRA.

9 COMMISSIONER APOSTOLAKIS: There will not be a better?

10 DANIEL HUDSON: I think that that -- in terms of the options
11 available to us, evaluating those types of things in the context of a Level 1 PRA,
12 a Level 2 PRA, or a Level 3 PRA, I think of those different options that we're
13 talking about, a Level 3 PRA that provides a more comprehensive and integrative
14 perspective provides the best framework to evaluate those types of things.

15 COMMISSIONER APOSTOLAKIS: Okay. Now, a final comment
16 here. I sort of like the ACRS recommendation of a Level 3 -- well, first of all, I
17 was a little surprised when you said in your document, Option 2 would take two
18 years, but Option 3, which includes Option 2, would also take -- will take three
19 years, or two, three years, of -- with doing less work on research. But what if we,
20 say, adopt the ACRS recommendation which is an expanded Option 3. To give
21 you a chance to place everything in perspective, although I appreciate what you
22 said, that you are, you know, you are not working in vacuum in Option 2. How
23 much more time would you need? I don't think you can do it in three years. If
24 we say an expanded Option 3 according to what the ACRS recommends, so you
25 will have some time to also do a decent amount of research. Should we make it

1 four years, five years?

2 DANIEL HUDSON: My view on that is that, as we put in the paper,
3 if the Commission decides that Option 3 in whatever variety or some other option
4 that involves the Level 3 PRA, we'd begin the process of engaging with industry,
5 developing a project plan, and obtaining more realistic resource estimates. And I
6 think at that point, we'd in a better position to identify how long we'd realistically
7 need to be able to organize the schedule to address our current resource
8 limitations and still complete the study in a reasonable period of time. So I think
9 that there's work to be done before we can be in a position to really say how long
10 is long enough.

11 COMMISSIONER APOSTOLAKIS: But given the work that you
12 have done to tell us that Option 3 would take three years -- I mean, you must
13 have an idea how much time you could need. Are you -- You are saying that you
14 want to come back to the Commission if the Commission approves that option,
15 the expanded option, you want to come back and say, "Well then, this is what
16 would be required," that's really your position right now?

17 DANIEL HUDSON: Yeah. Our position is that we would develop a
18 more detailed plan, with the resource estimates so that the Commission would be
19 in a better position to understand the resource implications and how this project
20 might impact other ongoing work.

21 COMMISSIONER APOSTOLAKIS: Can you give me --

22 BRIAN SHERON: It still would -- it's a matter of, you know, the
23 question of, you know, "What plant do you pick", you know, "Do I start from
24 scratch?", "Do I start with an existing plant" -- which has a big effect on the
25 resources. If you just take the resources estimate, we had three years, eight

1 FTE, that's 24 FTE total and \$15 million. Okay, which was sort of a rough
2 estimate for what we think it would take to do a full blown Level 3 starting from
3 scratch.

4 COMMISSIONER APOSTOLAKIS: But are you saying, Brian, that if
5 we go with Option 2, we don't need to have a plant in mind? I mean, can that
6 research be done independently of some idea of what's out there?

7 BRIAN SHERON: Well, I think that if you follow the ACRS proposal,
8 I think, and what we were talking about, I think Dan said it before and that is that,
9 you know, we could actually start doing some of the studies we need to develop
10 the models and the like, using, yeah, parts of different plants so we had --
11 because not every plant has the same --

12 COMMISSIONER APOSTOLAKIS: But your answer, a minute ago,
13 you said that, you know, if we have to have an Option 3 element in it, you'll have
14 to pick a plant and this and that. And my question is, you won't have to do that if
15 you go with Option 2?

16 BRIAN SHERON: No, with option --

17 COMMISSIONER APOSTOLAKIS: You may not --

18 BRIAN SHERON: What we said with Option 2 is that we would
19 actually do that, okay.

20 COMMISSIONER APOSTOLAKIS: Okay, so you -- the problem's
21 there as well.

22 BRIAN SHERON: We would -- during the Option 2 work, we would
23 still be interacting with the industry, with the ACRS, trying to decide, let's pick a
24 plant.

25 COMMISSIONER APOSTOLAKIS: But my question is, to do the

1 work in Option 2, you don't need the plant?

2 BILL BORCHARDT: I think the answer is you would have a variety
3 of plants. You would pick one plant to do one aspect of Option 2. Because,
4 multi-unit, right? You'd go to a multi-unit site for the seismic element, you'd go to
5 one that has an interesting seismic perspective and so there'd be -- you'd spread
6 the wealth or spread the burden, if you will, across the industry to more plants
7 rather than focusing just on one plant to do a complete Level 3 at a single plant.

8 COMMISSIONER APOSTOLAKIS: Thank you, Mr. Chairman.

9 CHAIRMAN JACZKO: Commissioner Magwood.

10 COMMISSIONER MAGWOOD: Thank you, Chairman. I always
11 hate following Commissioner Apostolakis. Oh, first let me just reassure Brian
12 that we know you don't work in a vacuum, so don't worry about that. The -- one
13 question about SOARCA that just as -- now it's been several months since
14 Fukushima and I know that the staff, you know, still doesn't have access to all the
15 information -- none of us do -- but, just curious, I mean, as you've talked with the
16 SOARCA staff has -- have you heard any thoughts about how the SOARCA
17 model may have gotten things right or gotten things wrong, just sort of generally
18 any impressions of this point, based on what you've seen so far since
19 Fukushima? Any -- is there any reaction at all from the SOARCA staff?

20 BRIAN SHERON: I think, you know, for a long-term station
21 blackout, you know, from what we've seen, I don't think we've seen anything that
22 is, you know, horribly contrary to what we've concluded. One of the things that I
23 did ask the staff to consider following Fukushima was to at least think through the
24 question of whether any of that -- any of the scenarios that we considered would
25 have affected the spent fuel pool such that the pool might have, you know, had

1 some sort of an accident that in turn affected the reactor. For example, if you
2 assume operator action, down the road, to I think to restart like the RCIC and the
3 like, would the spent fuel pool have produced any kind of a source term that
4 would have made that area uninhabitable so that operators could not access --
5 take those actions?

6 So I've asked the staff to do a little bit of looking at that based on
7 Fukushima. But I'm not aware of anything right now. But again, we're -- we
8 signed -- I just signed a memorandum with the Department of Energy. They're
9 going to conduct a -- they want to conduct a sort of a building of the sequence to
10 find out what happened and the like and make sure we fully understand it. And
11 so we'll be working with them and as, you know, information evolves, we'll
12 obviously be going back and crosschecking against our calculations.

13 COMMISSIONER MAGWOOD: Is there a target date for that work
14 or is it just kind of an ongoing activity?

15 BRIAN SHERON: I'm guessing it's kind of ongoing just because a
16 lot of it will depend on when we get the information from the Japanese, when
17 they can get into a containment and find out what really happened and stuff.

18 COMMISSIONER MAGWOOD: Marty, you're sitting here at a
19 table, you look bored, so I thought I'd give you something to talk about. You
20 know, one of the comments that I think Dan made was that -- or in the second
21 paper perhaps it was made -- that one aspect of the level three work that would
22 be pursued would be the development of spent fuel PRA technology. I wonder if
23 you could give us sort of a little bit of a primer on what that means and what's
24 involved in spent fuel PRA technology.

25 MARTIN STUTZKE: Basically we would develop a spent fuel PRA

1 using similar techniques that we would for reactor PRAs, so there's identification
2 of initiating events and delineation of accident sequences. I suspect that that
3 delineation of sequences is much less complex than it is for a reactor. There
4 simply aren't that many systems involved. And one would hope that you could
5 connect them and their common support systems: service water, electric, power,
6 like this.

7 So the bulk of the effort in my mind for the spent fuel is in the Level
8 2, it's the understanding of progression of the accident. How is the fuel actually
9 damaged to get it done that way? The other issue that one needs to deal with in
10 spent fuel is what are appropriate metrics of risk in spent fuel? The staff has
11 kicked around the idea that land contamination perhaps may be the most
12 significant measure of risk from spent fuel accidents. I don't know whether that's
13 true or not, but then one would like to be able to compare that, of course, to
14 reactor risk as well, which means then you would have to look at land
15 contamination from reactors so you could look at a relative proportion sort of
16 thing like that.

17 COMMISSIONER MAGWOOD: I appreciate that. One of the
18 things that, I guess that when used especially in the context of Fukushima,
19 there's a definite opportunity to tie the spent fuel sequences with the reactor
20 sequences and I think Brian mentioned this a few minutes ago. Are the -- is it
21 your thought that this work would also include looking at the interactions between
22 the spent fuel?

23 MARTIN STUTZKE: Oh, absolutely. In fact, we were debating this
24 yesterday somewhat about how we could incorporate what we know so far about
25 Fukushima into our PRA somewhat, and I think it boils down to basically three

1 areas. One is the human reliability that Commissioner Apostolakis had talked
2 about, the implication of SAMGs and the EDMGs. In my mind, there's many
3 questions about command and control sorts of issues. When I look at the timing
4 of the scenario, it's like why did things take so long? And I can't tell whether the
5 transcript is incomplete, these sorts of things like that.

6 So there's certainly great interest in HRA. At the same time when
7 you envelope the external events on top of it, you worry about accessibility to
8 plant locations. So even if operators know what they're supposed to do, they
9 physically can't get there to do it. If I add the spent fuel on top of that where I
10 have a radiation hazard or a contamination issue now, all three become very
11 intertwined. And these are exactly the sorts of issues that we would hope to
12 study in this project.

13 COMMISSIONER MAGWOOD: All right, thank you, appreciate
14 that. Dan, sort of -- just a couple of things for you. I think Commission
15 Apostolakis touched on this a little bit, but you're excluding the malevolent
16 events. That's, I think that's how you put it, malevolent events such as, you
17 know, terrorist attacks on nuclear plants from the initiating events. It -- why
18 would we exclude that? Why not include that?

19 DANIEL HUDSON: I'd say that the quick answer to that is that
20 that's one of the areas where there might be some large uncertainties right now.
21 And we view this project in terms of the options that we're recommending right
22 now as potentially a first step in an evolutionary process. We're not seeking this
23 gold plated, gold standard Level 3 PRA at the end of this initiative, and say that
24 by the end of it, we've done everything we need to do. I think the vision here is
25 that there's still going to be more work that needs to be done, even after the

1 completion of the study. And this was just one of those areas up front that we
2 said, you know, we might exclude from the scope for those reasons.

3 COMMISSIONER MAGWOOD: When you say there's
4 uncertainties, are you talking about uncertainties about, you know, how to talk
5 about the probabilities of an attack or are you talking about what happens after
6 an attack?

7 DANIEL HUDSON: When I talk about that, I'm talking more
8 specifically about the uncertainties in the threats.

9 COMMISSIONER MAGWOOD: Okay.

10 DANIEL HUDSON: And the frequencies of events.

11 COMMISSIONER MAGWOOD: Okay, what I think I would find
12 most interesting is not so much the frequency of the event, but more what the --
13 once the initiating event has happened, what is the sequence of events that
14 leads to core damage, because that's an insight that I think is extremely valuable
15 to us, so that's something I'd like to keep on the table because I think it's actually
16 quite important. Just for a final thought, I think that Commissioner Apostolakis
17 and I think the Chairman's comments in the last panel -- you know, there clearly
18 seems to me to be some desirable aspects of Option 3, but I recognize the
19 resource constraints. Now I wonder, how much conversation did you have with,
20 with the industry, with EPRI, with NEI, with others about cooperative activities,
21 and is it really -- is it just really just very initial conversations, or --

22 DANIEL HUDSON: Yeah, I'll just say at this point that we started
23 talking about this, we started broaching the subject with them in a public meeting,
24 and all of the discussions at this point have been somewhat superficial. They've
25 talked about the fact that he has a few licensees that have expressed interest,

1 but ultimately, the licensees, I think, would like to better understand the resource
2 implications for them, how a PRA like this might potentially be used, and we
3 haven't gone into detailed discussions of that nature because truly, in writing this
4 paper, we wanted to provide various options for proceeding, some of which did
5 not include moving forward with a Level 3 PRA for one reason or another. So we
6 didn't want to invest substantial resources in developing a detailed project plan,
7 having detailed discussions with industry about what their level of involvement
8 would be, until we had a better sense that we would be moving forward with this
9 initiative.

10 COMMISSIONER MAGWOOD: So, either Dan or Bill, it sounds
11 like I guess what I hear from that then is that if the Commission were to decide,
12 you know, we like Option 3, but we'd like to get some more fidelity as to how to
13 proceed, one of your first steps would be to go back and talk to the industry, talk
14 about the possibility of cooperative activities, and then come back with more, sort
15 of, sub-options to that. Is that kind of the way you read that?

16 BILL BORCHARDT: That's right.

17 COMMISSIONER MAGWOOD: Fair enough. Thank you very
18 much. Thank you, Mr. Chairman.

19 CHAIRMAN JACZKO: Brian, I want to follow up on a question or a
20 comment you made in which I guess has me a little bit puzzled. Why wouldn't
21 CDF and LERF -- I mean, maybe, you know, call it CDF, maybe you call it, you
22 know, fuel failure, I mean, it's not in the core anymore, but it's just -- why wouldn't
23 the onset of fuel failure and then LERF be reasonable metrics for spent fuel in
24 the same way they're the metrics we use for, for reactors?

25 MARTIN STUTZKE: Well, one can certainly calculate the

1 frequency of spent fuel uncovering in the pool, which, to my mind, is almost a
2 reliability metrics compared to risk. What you don't know until you get to Level 3
3 is, is that an appropriate surrogate for public health risk?

4 CHAIRMAN JACZKO: So what would you, wouldn't, I mean,
5 wouldn't LERF still be, I mean, you know, ultimately at the Level 2 stage, or large
6 release maybe is not a LERF, maybe it's just a large release frequency, or the,
7 you know, I mean, presumably the issue with spent fuel is largely zirconium fire.
8 That's -- so you'd have a metric which is not maybe -- I mean, fuel damage in the
9 form of fire as your metric, I mean, again thinking in terms of Level 1, and I,
10 again, I don't necessarily discount the land contamination might be a useful
11 metric, but why wouldn't that then just as easily be a useful metric for, maybe the
12 other way, for the power reactors, too, even if -- I mean, that is true that a more
13 reliable form of understanding what the real impacts are to the public.

14 MARTIN STUTZKE: It may in fact turn out to be a useful metric, or
15 at least something, you know, related to the frequency of release offsite, you
16 know, like that. This issue is, in my mind, is a large early release of spent fuel
17 equivalent, how does that relate to a large early release of the reactor? Also,
18 LERF tends to be our surrogate for prompt fatalities, and we don't anticipate
19 prompt fatalities from most spent-fuel types of accidents, so. There's a little bit of
20 apples and oranges, in my mind.

21 CHAIRMAN JACZKO: So the issue seems to be more of this
22 comparability with the comparable terms end up on the power reactor side,
23 exactly? Okay, thanks, that's helpful.

24 Just taking a step back, I mean, we've talked a lot about Level 3
25 PRAs -- it's kind of been the whole basis of the meeting, but, one point has not

1 been perfectly clear to me. Is the goal here for the NRC to have Level 3 PRAs
2 so that so that as we go about doing our regulatory work, we have the benefit of
3 insight of a Level 3 PRA? Is the goal to have utilities to have Level 3 PRAs, so
4 that they have safer plants? Or both? What, what is it?

5 DANIEL HUDSON: Well, in one of my slides, I talked about the
6 overall vision for this new Level 3 PRA initiative, and we envisioned that vision
7 being realized by going through three different phases, and the first phase was
8 this scoping study to develop different options for proceeding, the second phase
9 would be if we decided to move forward with the Level 3 PRA, would be a pilot
10 study to demonstrate our capability to do so, and then --

11 CHAIRMAN JACZKO: "Our," meaning NRC capability or the
12 nuclear industry at large.

13 DANIEL HUDSON: In the context of this paper that we've provided,
14 we envisioned NRC staff participating in the study, potentially using the agency's
15 tools, such as the SPAR models, as the foundation to start off with the study, and
16 the idea was that in the end, the NRC would have a tool in-house that we could --

17 CHAIRMAN JACZKO: Like a SPAR 3, that would get you to Level
18 3 PRA.

19 DANIEL HUDSON: An enhanced SPAR model that could be used
20 to address various issues.

21 CHAIRMAN JACZKO: Right. Well, I appreciate that, and I think
22 that's a helpful distinction because, I'll be honest with you, I think my interest is
23 for utilities and licensees to have Level 3 PRA. I think that there is more value
24 from a safety perspective, and you can comment on this if you want, or Brian or
25 Bill or any of you, there's more value in licensees having the Level 3 PRAs as I

1 can see it, than there is for us having a Level 3 PRA right now.

2 BRIAN SHERON: Well, yeah, I think there's always value for the
3 licensees. The more information they have about their plant, I think the better
4 they understand it and the like. But there is a value, I think, for example, as you
5 know with SOARCA, one of the things --

6 CHAIRMAN JACZKO: I'm not saying there's no value, I'm saying
7 there's a, we're in a resource constrained situation. You know, and I mean, and
8 if that's what this paper was saying, we're talking about resource constraints for
9 the agency, that's a completely different question from the ability of licensees to
10 be able to produce Level 3 PRAs, which, of course, and now, I'm sure all the
11 folks sitting behind you are about to, their jaws are about to drop, what I'm going
12 to say, well, maybe one of them won't. Why don't we just require them to have
13 Level 3 PRAs? I mean, if that's what we want, why don't we require them? I
14 guessed right. The one jaw that I didn't think was going to drop didn't, but the
15 others maybe did.

16 BRIAN SHERON: Well, I think that what we're proposing is that we
17 think there's a benefit, at least for the NRC to have it, and a lot of times, we, we
18 serve as the --

19 CHAIRMAN JACZKO: That's not what I'm asking. Why don't we
20 require licensees to have Level 3 PRAs? I mean, new reactors, we require them
21 to submit a PRA.

22 BRIAN SHERON: Right.

23 CHAIRMAN JACZKO: Why don't we have a provision that says that
24 all utilities shall be required to have a PRA, and within five years, they have to
25 have a Level 3 PRA? I mean, seems to me that that's really, we've got two

1 different questions in front of us, one is this issue which we can talk a lot about,
2 about how we manage our resources, how we figure out how we get to the point
3 of having a level -- you know, expanding the SPAR models to be able to go on to
4 a Level 3 PRA. That's a totally different question, though, from whether or not
5 utilities should have Level 3 PRAs, and if we think they should have them, why
6 don't we require it?

7 BRIAN SHERON: Well, let me back off. I don't think we're saying
8 that we think that all the utilities have to have them because, and I'm not in NRR,
9 and I can't speak for NRR, okay? But I would say, you know, unless the agency
10 articulates what do we want them to do with it once they have it, okay? What I
11 think is that a lot of times, we provide the leadership, and show the industry the
12 benefit, okay, and then they get on board, okay? For example, SOARCA, even
13 though it's not a Level 3 PRA, it's still a, it's a good consequence analysis, and I
14 think it showed the benefit of the B.5.b measures that the agency put in place.

15 CHAIRMAN JACZKO: Those -- we already put them in place, so
16 we have --

17 BRIAN SHERON: I understand.

18 CHAIRMAN JACZKO: -- already issues orders to do it.

19 BRIAN SHERON: I understand, but we used it to confirm --

20 CHAIRMAN JACZKO: Yeah.

21 BRIAN SHERON: -- that they actually showed a significant benefit,
22 okay? And perhaps if we had this tool, in advance, as the Commission was
23 considering, say some other requirement, we could put it into the Level 3 PRA
24 and be able to at least articulate, at least for an example plant, what kind of
25 benefit might accrue or not accrue from it.

1 CHAIRMAN JACZKO: Well, no, and I appreciate that, and I think
2 there's a point there, but again, I think we just have to be careful that we
3 distinguish the two problems. I mean, I don't think the way we should get
4 licensees to do Level 3 PRAs is to spend all the time and effort to develop our
5 own Level 3 PRAs. I mean, I don't think -- and Brian, you'll be the first one to tell
6 me -- I mean, it's not our job to do the industry's research for it. Nor is it, I think,
7 our job, if they should have Level 3 PRAs, for us to take all the time and effort
8 and leadership to develop the Level 3 PRA, so that they can go on and do that.

9 You know, and so I'll say quite clearly, one of the things I really
10 appreciated Biff mentioning was the use -- the ultimate goal of a risk conformed,
11 performance-based EP regulation. I don't think that can be done, and I think --
12 but if you said that was one of the, you know, I think one of the potential uses of
13 a Level 3 PRA, you can't do that without a Level 3 PRA. And in my mind, that
14 would be one of the tremendous opportunities and enhancements, and I think
15 that would be a real enhancement to our EP program -- is to have a regulation
16 that is more risk informed performance based, and much like the NFPA 805,
17 would go hand-in-hand with a Level 3 PRA. They would be inseparable. You
18 know, I think -- well, not that NFPA 805 is a Level 3 PRA, but the PRA goes
19 hand-in-hand with the adoption of NFPA 805.

20 So, you know, in looking back at the paper, to me in a way that was
21 the issue to really talk about, is what -- and it's not really in the papers -- what do
22 we want licensees to do? And I think that's a separate question. I don't think it
23 was really hit upon, but certainly from my perspective, I would like to see them
24 have Level 3 PRAs. And I think it's something we should explore in our
25 regulatory tool. Maybe it's through a Generic Letter, maybe it's through a -- some

1 other mechanism to get there, but I don't know that it's the best thing in the world
2 for us to just go on and do it and then turn around and say, okay, we've spent all
3 this time and effort doing this, now don't you all see it's a great idea? If we think
4 they should do it, we have other ways to get them to do it. So, again, you may
5 not necessarily agree that they should, but I'm certainly interested in pursuing
6 that.

7 BRIAN SHERON: I was just going to say that, you know, it wasn't
8 the intent to just have them follow by example, but --

9 CHAIRMAN JACZKO: Yeah.

10 BRIAN SHERON: -- we have a number of uses I think we would
11 have for a Level 3 PRA. I think we had mentioned, for example, in our generic
12 issue program, using this to help in the prioritization and to understand what the
13 impact is. And there's just a lot of other of these, in the normal things that we do
14 every day which help us make our decisions.

15 CHAIRMAN JACZKO: Couldn't -- I mean, as I say prioritizing the
16 generic issues program, why couldn't we rely on, you know, on utility Level 3
17 PRAs? I mean, we could, if we got to a generic issue and part of the decision-
18 making process could be as we go out for comment on the generic issue, which
19 we do, you know, tell us, you know, show us as part -- you know, through a
20 generic letter or whatever, demonstrate to us why this is a, you know, where this
21 falls in priority based on your Level 3 PRAs.

22 Now that probably -- we'd probably want to have the capability to
23 confirm that independently, but I don't think we need our own Level 3 PRAs to do
24 that. I think we could rely on licensee Level 3 PRAs to do the same thing. I
25 mean, we would ask them for the information in much the same way we do with

1 other things. You know, is this flooding, you know, GSI more significant than,
2 you know, a sump GSI? What do your Level 3 PRAs tell us? You tell us at your
3 site which of these is a higher priority based on your Level 3 PRAs. I mean, I
4 think we could get, I think, the same information through that or not.

5 BRIAN SHERON: I would ask Marty if you want to comment a little
6 bit if -- in terms of --

7 CHAIRMAN JACZKO: And I'm way over my time, so I probably
8 should --

9 BRIAN SHERON: I was just going to say for an industry, when the
10 industry comes in and gives us their risk assessment, how well does it really line
11 up with, say something we do independently?

12 MARTIN STUTZKE: Well, it's a matter of perspective. You know,
13 clearly because the industry has greater resources, their PRAs would be more
14 detailed than things we could reasonably produce in the amount of time. One of
15 the issues I see with relying on industry's PRAs for generic issues is, you know,
16 first of all, the staff is the one that surfaces the generic issues, so then we could
17 be forced to go to the industry and say, "We think you have this problem. And
18 there's regulatory mechanism --"

19 CHAIRMAN JACZKO: Don't we do that now? To some extent,
20 don't we put -- isn't there a part in the process of generic issues where we go out
21 and get comment on whether --

22 BRIAN SHERON: Well, but we have to kind of establish first that
23 there is a real problem. Okay, or at least there's a potentially real problem.

24 CHAIRMAN JACZKO: But we don't do that with a Level 3 PRA
25 now.

1 BRIAN SHERON: No, not right now.

2 CHAIRMAN JACZKO: What you were talking about is ranking
3 those generic issues, so we're identifying the issue without the Level 3 PRA and
4 then it's the ranking where we could go to the industry to get an input from them
5 about the ranking -- the relative ranking, relative to other.

6 BRIAN SHERON: Well, we try to understand the relative
7 significance first --

8 CHAIRMAN JACZKO: First, okay.

9 BRIAN SHERON: -- before we go out and say, you know, "We
10 need you to expend resources and provide us all this information."

11 CHAIRMAN JACZKO: Okay, good. Well, that's helpful. Well, I've
12 taken too much time as it is anyway, so we're -- I appreciate your answers and I
13 appreciate our previous panel being here as well, and I think it was a very
14 interesting meeting. Thanks.

15 [Whereupon, the proceedings were concluded]