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NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

NOVEMBER 18, 1999

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This transcript had not been reviewed, corrected and edited and it may contain inaccuracies.

1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

3 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

4 ***

5 MEETING: RELIABILITY AND

6 PROBABILISTIC RISK ASSESSMENT

7 ***

8 Conference Room 28-1

9 Two White Flint North

10 11545 Rockville Pike

11 Rockville, Maryland

12 Thursday, November 18, 1999

13 The committee met, pursuant to notice, at 8:30

14 a.m.

15 MEMBERS PRESENT:

16 GEORGE APOSTOLAKIS, ACRS, Chairman

17 DANA A. POWERS, Member, ACRS

18 THOMAS S. KRESS, Member, ACRS

19 JOHN J. BARTON, Member, ACRS

20 JOHN D. SIEBER, Member, ACRS

21 MARIO V. BONACA, Member, ACRS

22 ROBERT E. UHRIG, Member, ACRS

23 ROBERT L. SEALE, Member, ACRS

24

25

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

2 [8:30 a.m.]

3 DR. APOSTOLAKIS: The meeting will come now to
4 order. Is this on? Oh, it's only for you, oh. Oh, this is
5 an amplified.

6 This is a meeting of the ACRS subcommittee on
7 reliability and probabilistic risk assessment. I am George
8 Apostolakis, chairman of the subcommittee. ACRS members in
9 attendance are Mario Bonaca, Tom Kress, Dana Powers, Robert
10 Seale, William Shack, Jack Sieber and Graham Wallis.

11 The purpose of this meeting is to review the
12 staff's proposed low-power and shutdown operations risk
13 insights report and start plans to develop an associated
14 commission paper on this matter. The subcommittee will
15 gather information, analyze the relevant issues and facts
16 and formulate proposed positions and actions as appropriate
17 for deliberation by the full committee. Michael T. Markley
18 is the cognizant ACRS staff engineer for this meeting.

19 The rules for participation in today's meeting
20 have been announced as part of the notice of this meeting
21 previously published in the Federal Register on November 1,
22 1999. A transcript of the meeting is being kept and will be
23 made available as stated in the Federal Register notice. It
24 is requested that the speakers first identify themselves and
25 speak with sufficient clarity and volume so that they can be

1 readily heard. We have received no written comments or
2 requests for time to make oral statements from members of
3 the public.
4 We will now proceed with the meeting, and I call
5 upon Mr. King and Mr. Cunningham and Ms. Lois to begin.
6 MR. KING: Let me say a couple of words before we
7 get into the formal presentation. My name is Tom King from
8 the research staff, by the way. You had received probably
9 10 days or 2 weeks ago a draft report on our low power and
10 shutdown work. That's really a report that represents work
11 in progress. The presentation today will take it a step
12 beyond the draft that you saw as we try and settle in and
13 come up with the recommendations that we ultimately want to
14 give to the commission. We owe the commission a report in
15 December on what we've found out and where we think we ought
16 to go in the research area on looking again at additional
17 low power and shutdown risk work.
18 We would like a letter from the committee in
19 December. We're prepared to come back to the full committee
20 at your December meeting and talk some more about this
21 subject, but we would like a letter representing the
22 committee's thoughts on the proposed work and the insights
23 that we gained over the past year or so.
24 So with that, I'm going to ask Mark and Erasmia to
25 get into the presentation.

1 MR. CUNNINGHAM: Good morning. I'm Mark
2 Cunningham from the research staff. As Tom said, I'm going
3 to introduce this work, and then, Erasmia Lois will be doing
4 the bulk of the presentation. We've got support here from
5 two contractors in this area, Sandia and Brookhaven people
6 to help out, and as you'll see, we've been involved in a
7 fair amount of discussions with a number of people in the
8 public, individual licensees and consulting engineering
9 groups, and between Erasmia and our contractor staff, I
10 think we can give you some ideas of what we're seeing out
11 there in terms of what's being done and what are the issues
12 in shutdown risk.
13 In terms of the presentation today, we've got two
14 main parts. The bulk of the presentation will cover what
15 was provided to you a week or so ago in the insights report.
16 That report has some observations based on our review of
17 what's going on in the industry, but also, later in the
18 presentation, we will talk about some potential research
19 topics that come out of our review of what's going on. We
20 have a fairly broad list of research topics, probably more
21 than we have money to do, and part of this discussion today,
22 I think, we'd be interested in getting comments from the
23 committee in terms of what they see of this relatively long
24 list; first of all, do you think it's a complete list? Are
25 there issues that are missing? And also, what would seem to

1 be -- in your minds, what would be the more important issues
2 to tackle first? So we're trying to get some sense of
3 priorities from the committee as well.
4 As Tom mentioned, we will be back at the full
5 committee meeting, and then, we're addressing a letter on
6 this subject. One topic we're not planning to cover today
7 is the work that's underway in terms of the development of
8 the ANS standard on shutdown risk. It might be appropriate
9 at some point for you, the subcommittee or the full
10 committee, to hear from ANS in terms of what they're doing
11 in this area, but we are working closely with the ANS group
12 as we develop this -- our recommendations and see how that
13 meshes with the development of the standard.
14 Mary Drouin would have been here today to help,
15 actually, to do the talking that I'm doing, but she's out at
16 an ANS standards meeting in California right now.
17 DR. APOSTOLAKIS: When will the ANS have a good
18 first draft for us to review? I mean, you don't have to be
19 precise.
20 MR. KING: It's around June.
21 MR. CUNNINGHAM: Something like that.
22 DR. APOSTOLAKIS: June?
23 MR. CUNNINGHAM: Yes.
24 MR. KING: Let me just follow up on one thing Mark
25 said: the budget. At one point, we had had a fairly

1 significant budget identified over the next 2 to 3 fiscal
2 years to do work in the low power and shutdown area. That
3 got cut back quite a bit over the past couple of years. The
4 current budget for FY 2000, the fiscal year we're in right
5 now, is about $400,000. I can't remember the exact number,
6 but it's somewhere in that neighborhood. Beyond that, there
7 is no money in our budget for continuing work on low power
8 and shutdown risk.
9 I don't want that to constrain what we think ought
10 to be done. I'd like to come up with a list of things that
11 we think, based on the work to date, would be reasonable
12 followup actions; identify how we would use that information
13 and go back to the commission and request that money be
14 restored to our budget to deal with these items. You know,
15 part of that is making sure we have a good, solid pace as to
16 what needs to be done and how it's going to be useful to the
17 staff.
18 DR. APOSTOLAKIS: So there is no plan to continue
19 this next fiscal year?
20 MR. KING: There is no money to continue this next
21 fiscal year. What I'd like to do is come up with a plan
22 that will be solid enough that we can get some money. So, I
23 don't want to be constrained by saying, well, we don't have
24 any budget next year; therefore, we can only recommend a
25 couple of things to be done this year, and that's it. I'd

1 like to really come up with a plan that says, you know, put
2 the money aside; this is what makes sense to do and then see
3 if we can get the budget to do it.
4 So, you know, I just want to mention that at the
5 start, that where we stand in budget space doesn't support a
6 whole lot of additional work, but let's try and figure out
7 what makes sense to do and see where we can go from there.
8 DR. APOSTOLAKIS: Okay; so, the significance of
9 the clouds there in the view graphs --
10 [Laughter.]
11 DR. LOIS: It's symbolic.
12 [Laughter.]
13 DR. APOSTOLAKIS: Can you find software that
14 allows you to have smooth transition from light barriers to
15 dark barriers?
16 [Laughter.]
17 DR. APOSTOLAKIS: You have to do that part.
18 MR. CUNNINGHAM: The bulk of the presentation,
19 what it is going to do is it's going to be related to the
20 insights report. Within that, the key topics with the last
21 three or four on this slide basically, what have we seen in
22 talking broadly to people here and abroad about -- what do
23 they say about the significance of shutdown risk, and what
24 is the overall risk? What do we see about what's going on
25 in terms of methods, tools that are being developed and why

1 to manage this risk or to use it in a regulatory framework?
2 Then, we go back and start to say, well, how,
3 given these methods that are out there, how are they for our
4 purposes, which is basically risk-informed decision making?
5 And we've got some conclusions and observations and
6 recommendations.
7 Again, just to remind the committee, go back to
8 our Reg. GAP 1.174 days, and the risk that's talked about
9 there and evaluated there is the total risk of the plant,
10 consistent with the previous policy of the agency and the
11 safety policies, et cetera. So we have a statement in the
12 reg guide that we have to consider shutdown risk, but we are
13 not very precise as to how that should be done. One of the
14 key goals of the research program here is what can we do to
15 help fill that gap, if you will, or build a more concrete
16 statement of guidance to make it easier or more appropriate
17 to consider shutdown risk when we're using -- in license
18 applications, we would use 1.174.
19 We should also note, though, it's probably -- when
20 we started out, we were thinking in the context of 1.174.
21 So over the last years, as we've gotten into risk-informed
22 part 50, Reg. 50, as it's called, I think it brings other
23 issues to the table that we need to think about in terms of
24 the requirements of the shutdown risk. We've seen
25 presentations, I believe, on the proposed new 50.69 and

1 Appendix T, which bring categorizations and risk information
2 of categorization of SSCs and the risk information to much
3 more of the forefront of our requirements, and that has
4 implications on what type of shutdown risk analysis we can
5 need to make decisions about it.
6 So that's being brought in here in terms of
7 recommendations. I've got one more slide, and then, I will
8 turn it over to Erasmia.
9 Basically, the approach of this insights report
10 was to go out and do a fair amount of information
11 collection. We've gone out and reviewed NRC and industry
12 risk studies. We've gone out and talked to licensees,
13 consulting engineering groups to see what they're doing.
14 We've also interacted with national to find out what's going
15 on in other places. The last couple of slides in the
16 presentation will be specific international activity that
17 we're involved in through our research program. One of the
18 working groups that we have there is specifically concerned
19 with shutdown risk.
20 So all of this -- in addition, we had a public
21 workshop awhile back, trying to get information on
22 perceptions of shutdown risk and the issues they saw. So
23 we're taking all of this and trying to say, now, based on
24 all of this information, what are our observations, and
25 then, what do we see as research needs.

1 With that, I'll turn it over to Erasmia to talk
2 more about the specific program.
3 DR. POWERS: The question that comes to mind
4 almost immediately is, well, why would you think that there
5 is a big risk associated with low power and shutdown
6 operations? We may see that it may be the latest sandbox
7 for the PRA practitioners to play in, but why wouldn't you
8 just assume that the risk is small? The plant is off; I
9 mean, you let it decay for a little while before you do
10 anything to the plant, you can get the decay energy down
11 quite a bit. Anything that does happen, you pretty much
12 have the easiest opportunity to detect and to intervene in
13 all of the material, in the issue, so why would you think
14 there have been incidents that have occurred within the
15 international nuclear community where you would have a plant
16 that is shut down engaged in an accident of any type?
17 MR. CUNNINGHAM: Sitting here say 10 or 12 years
18 ago, I think the common knowledge at the time would have
19 been what you said. There doesn't seem to be much of an
20 issue of shutdown risk for all of the variety of reasons.
21 There have been a series of events not involving damage of
22 the fuel but certainly losses of residual heat removal,
23 decay heat removal, oiling in the core and that sort of
24 thing that I think 7 or 8 or 10 years ago first brought this
25 to people's attention. Some issues at Diablo Canyon; the

1 French studies; the Votgle incident of -- whenever that was,
2 a few years ago.
3 I think that the reason that people now see the
4 importance of shutdown risk comes from a couple of --
5 several factors. One is in some portions of shutdown
6 operations, the amount of water that you have over the core
7 is relatively small. Even though your decay heat is down,
8 we can get situations such as mid-loop operations where you
9 don't have a lot of water covering the core. Coupled with
10 that passage, you can be in situations where the amount of
11 -- the number of pieces of equipment available to provide
12 water is down to perhaps a minimum. Certainly, a few years
13 ago, this was the case for shutdown people; they were doing
14 maintenance; they take pieces of equipment out of service.
15 So, you've got reduced redundancy.
16 In some circumstances, you also have this
17 happening with the containment, so you've given up some of
18 your barriers. In addition, you've got a lot of other
19 things going on in the plant; a lot of people in there doing
20 maintenance of things, so there is potential for inadvertent
21 draindowns; inadvertent human actions that can compromise
22 the core.
23 So I think it's the recognition that all of those
24 things are coupled together in some parts of shutdown
25 operations that have led people to be more concerned about

1 shutdown risk and have led to the results that you'll see in
2 a little bit, which is a lot of people seeing a similar type
3 of answer, which is shutdown risk is something we have to
4 seriously consider.
5 DR. POWERS: I think with every incident you say
6 -- if I were an argumentative type, which I'm not --
7 [Laughter.]
8 DR. POWERS: -- I would cite as that same incident
9 as an example of see how easy it is to recover from these
10 events; how easy it is to detect what's going on; how easy
11 it is to reconfigure things promptly and get the plant back
12 to a safe situation when you've had a perturbation of it.
13 MR. KING: Let me add a couple of things. You
14 have more time when you're in a shutdown condition, when the
15 heat is down, to respond to whatever happens. That's true.
16 But the thing that -- when we had the workshop, we had
17 utilities come in and tell us that they were worried about
18 some of the shutdown states, not the whole shutdown period
19 but certain things that they do in that shutdown period
20 worried them enough in South Texas -- who is the one that
21 said this -- that what they do is they don't do anything
22 else in the plant. They make sure that they have dedicated
23 people monitoring inventory, monitoring residual heat
24 removal when they're in certain shutdown configurations,
25 because they know that the risk is fairly high from the

1 analysis they have done.

2 They know -- again, they have response time, but

3 it's not like days to respond. They may have, you know, an

4 hour to respond, and they don't want to let that time slip

5 by if something would happen. So, they manage to, in

6 certain situations, because they think they are risky.

7 The other thing that worries me a little bit is,

8 as the utility industry goes into restructuring, the

9 competition becomes more and more aggressive; the shutdown

10 periods are going to be compressed just for economic

11 reasons, and therefore, the advantage you buy by letting the

12 decay heat drop off before you do -- the utility may not

13 take advantage of that as much as they do -- they have in

14 the past.

15 DR. KRESS: Let me ask you about that decay heat,

16 given your increased response time. I haven't looked at the

17 decay heat curve in awhile, but I recall that over the time

18 frames we're talking about for shutdown, your decay heat

19 might decrease by a factor of a third. I'm not sure if

20 that's right, because I haven't looked at it in a long time.

21 That doesn't sound like a big improvement in time for, you

22 know, for things to boil off and for the heat-ups.

23 And so, I'm not sure you gain a lot of time over

24 the time frames you're talking about for shutdown. Is my

25 recollection right on that, or do I have to go back and look

1 at the curve?

2 MR. KING: As I recall at the workshop, what the

3 utilities say was about the first 100 hours or so after

4 shutdown is really where they have enough decay heat that

5 they don't have a whole lot of response time, and that's the

6 time period we're worried about. Once you get beyond that,

7 and they get a little more comfortable in having enough time

8 to respond; again, I don't have the decay heat; I don't

9 remember exactly either. We can get that information for

10 you.

11 DR. KRESS: Yes; well, it's been policies have

12 looked at decay heat, and I'm not sure.

13 MR. KING: Dana, if you wanted some specifics, we

14 could talk to some specific events that have occurred at

15 shutdown if you wanted to.

16 DR. POWERS: Well, I guess maybe I could go

17 through the litany of shutdown events fairly easily. But I

18 think in the United States and maybe in some of those

19 abroad, but I still think I stand on my argument that I can

20 just as easily cite these events as proof that we've got a

21 handle on this, our shutdown risk, as you can cite it saying

22 there should be more, because in every case, a successful

23 outcome -- everything was done fairly easily.

24 DR. APOSTOLAKIS: I think there is another issue

25 here that perhaps changes your argument. I noticed in the

1 report, and I think the understanding here is that when we
2 say risk from low-power shutdown operations, we're talking
3 about core damage primarily, it seems to me that we cannot
4 ignore the fact that the agency now has the new oversight
5 process with the cornerstones, and the agency has said very
6 explicitly that they worry about initiating events; they
7 worry about the integrity of their mitigating systems and so
8 on.
9 So, the question I'm raising is whether we should
10 be using those metrics to decide whether low-power shutdown
11 operations are important rather than core damage frequency,
12 and if I look at those, then, I think Dana's argument is not
13 as strong because there have been initiating events. We
14 have lost water during those operations, right? We recover
15 from it, but the agency has said very clearly that the
16 number of initiating events should be less than X, so if you
17 have states who are -- you actually have initiating events,
18 you certainly worry about them. This is a defense and depth
19 issue at the highest level, the structuralist approach.
20 And I noticed in the report that you guys wanted
21 to take back that the comparison, the comparisons are always
22 at the core damage frequency, and I'm not sure that's a good
23 thing to do anymore.
24 DR. LOIS: But even on the basis of core damage
25 frequency, I guess if you look at the numbers, they are

1 pretty comparable, and then, I guess the argument such as we
2 had an initiating event, therefore we -- but we managed it
3 could be used also for full power. And from a PRA
4 perspective, on an hourly basis, studies show that CDF is
5 sometimes even higher than at full power; that that has been
6 demonstrated from, you know, almost every study.
7 In addition to I'd like to kindly remind the
8 committee that the staff has never thought that low-power
9 shutdown is insignificant. You remember the low-power
10 shutdown rulemaking activities, et cetera, et cetera; the
11 fact that we don't have a rule doesn't mean that we have
12 considered the shutdown risk as insignificant.
13 DR. APOSTOLAKIS: I don't disagree with you,
14 Erasmia, but all I'm saying is that with the new situation
15 now, where one part of the agency is really relying on the
16 cornerstones to do something that is extremely important,
17 namely, to risk-inform the oversight process, it seems to me
18 that it would strengthen your argument if you involved that
19 one.
20 DR. LOIS: As a matter of fact, it's one of our
21 recommendations here. When I get to recommendations, you'll
22 see that one of the things that we consider, since the
23 industry has been using as a risk metric boiling frequency
24 or time to boil, et cetera, we are thinking that probably we
25 should look into that as one aspect.

1 DR. SEALE: May I raise another slant, if you
2 will, on this question, and that is as we realize the
3 pressures to compress out each times and so on, there will
4 be greater consideration of situations in which you will
5 take systems out of service; you will do maintenance when
6 you're in a less than full protection systems arrangement.
7 The only way that that can be done with integrity is to be
8 able to make a realistic assessment as to the safety
9 insignificance of the systems that you've taken out of
10 service under those circumstances, and you can't do that
11 unless you consider the configuration of the plant in which
12 that takes place, which is, in this case, the shutdown mode.
13 So it's just the integrity of the process of
14 identifying the safety significant and the non-safety
15 significant systems that requires a reasonable assessment of
16 the shutdown risk.
17 DR. BONACA: I'd like to also point out one thing.
18 I know the comparisons that we see in the report that was
19 given to us; they're comparing the CBF alert; there is no
20 discussion of uncertainties, and I do believe that certain
21 risks for low-power and shutdown are much higher because I
22 think that the actions that are dominated by other actions
23 and by the fact that many of these activities, for example,
24 are -- at times, there are surprises for the operator,
25 because they are one of a kind activities. They are not

1 repeat activities that you perform at the time.

2 For example, you can remember the -- the reason

3 the generator is switching off and going out; and what is

4 actually by design. And I just wonder if, you know, we

5 could discuss a little bit the insights that we have on the

6 issue of uncertainties, because that uncertainty alone for

7 me on the various things and trying to understand better

8 what the risk really is.

9 DR. APOSTOLAKIS: Now, this is a very interesting

10 observation, because the way we handle uncertainty is

11 through defense and depths. We are weakening defense in

12 depth at the low-power and shutdown modes, and yet, we have

13 higher uncertainty. Now, that's something we should not

14 like, don't you think? We are affecting at least one of the

15 cornerstones of the --

16 DR. KRESS: You would think those are the wrong

17 directions.

18 DR. APOSTOLAKIS: Yes.

19 DR. KRESS: But we still haven't defined how much

20 difference in depth we need for a given amount of

21 uncertainty.

22 DR. APOSTOLAKIS: No, but if I take as a point of

23 departure the power operations, and I say, well, since we

24 operate that way, then, maybe that's sufficient defense in

25 depth for this kind of uncertainty. Now, I'm moving into a

1 situation where the uncertainties increase, and some of my
2 cornerstones are suffering. So that doesn't look like a
3 good way to go.
4 DR. KRESS: No; you have to keep in mind that
5 uncertainties also have to be averaged over time if you're
6 going to --
7 DR. APOSTOLAKIS: Well, we will see over that.
8 The average in process is something that we will discuss.
9 DR. KRESS: Okay; but it does.
10 DR. APOSTOLAKIS: Today.
11 DR. SHACK: Well, it also comes up in the
12 discussion that you've been beating for awhile that, you
13 know, you introduce distortions by introducing
14 conservatisms.
15 DR. APOSTOLAKIS: Sure.
16 DR. SHACK: And that's one of the conservatisms
17 I've always heard about the low-power shutdown PRAs is that
18 they're unduly conservative, and therefore, you may distort
19 your picture. Again, the specific question was -- I somehow
20 recall something or other that the 91.06 guidance was sort
21 of ignored when we did the PRAs, because it wasn't
22 mandatory. You know, everybody seems to do it because it
23 wasn't required by regulation.
24 DR. LOIS: Well, as I get into the presentation,
25 you'll see that currently, the industry is involved in the

1 defense in depth and PRAs at the same time, and they have
2 the capability to literally model this specific outage, and
3 I don't think that's the case -- you know, people may help
4 me out here -- but in actuality, they start out with a
5 defense in depth and then complement the insights through
6 the specific --
7 DR. SHACK: That's how I was wondering if your PRA
8 numbers, which purport to cite that the risk of low-power
9 and shutdown, in fact, include the 91.06.
10 DR. LOIS: But it's -- what's happening is you're
11 getting into an outage-based, and you evaluate it depending
12 on the defense in depth on the --
13 DR. SHACK: That's the configuration management.
14 DR. LOIS: And the same configuration is being
15 modeled through your period.
16 Donnie, you want to --
17 MR. WHITEHEAD: This is Donnie Whitehead from
18 Sandia National Laboratories. To answer your question, the
19 NRC studies that were conducted in the early nineties were
20 conducted before -- or approximately at the same time -- as
21 the issuance of 91.06, okay? So therefore, they probably do
22 not incorporate all of the activities that are carried out
23 in 91.06. However, they were, at the time, the current --
24 you know, the current industry practices. The analyses that
25 are conducted by the utilities currently do use 91.06 as a

1 measure of defense in depth, and I would expect that the
2 probabilistic analyses that are part of many of the
3 configuration risk management practices would involve, you
4 know, heavily depend upon the information that's available
5 from 91.06.
6 What we have here is something that has evolved
7 over time and currently, if you're being able to perform a
8 PRA, it would only be prudent to use the information that's
9 available from 91.06. So I think, you know, I think we've
10 evolved over time, and I think at this point, you know, that
11 information would be used.
12 DR. BONACA: One observation that I would like to
13 make about, you know, defense in depth, when we have defense
14 in depth and the operators that use them it's time; we have
15 time. There is time. If you go to the operators, that's
16 what you hear about shutdown: we don't need to because we
17 have time. And the point I want to make is the one of time
18 is being shortened more and more, but we see averages which
19 are so accelerated that, you know, by definition, there is
20 an erosion of defense in depth. I don't have to define
21 another, you know, proportion of the specific components,
22 but the time element, which is the one always invoked by the
23 operators as available and power, you know, you don't have
24 it when you have a shutdown is being eroded.
25 And again, I don't know how much that drives

1 uncertainty. To me, that drives it a lot, because you begin
2 to not understand how things will function or not function,
3 and I think that's an area that I would like to see. I
4 don't think much work has been done there to understand it,
5 or if I can see it in the draft new reg.
6 MR. KING: And I agree. The mindset is we've got
7 time, and now, they don't have time. Things may not happen
8 as rapidly as they should.
9 DR. BONACA: It matters if they have 40 or 50 days
10 to 20 days, 17 days.
11 DR. APOSTOLAKIS: Yes, but this is because they
12 are doing fewer things, so it is not clear to me that that
13 really affects this construct.
14 DR. BONACA: Yes, but then, you get down to the
15 point where you have critical path, okay, where you can't
16 compress anymore. You see, before, you could come down and
17 eliminate work and easily compress the time. Then, you get
18 to the point where you have essentially compressed time that
19 you cannot compress any further. And now, you have such a
20 pressure on the operators. Now, to introduce anything else
21 there that, you know, now, I am voicing this because as part
22 of the interview process, we have been interviewing some
23 people in the industry. That has been raised to me by two
24 people.
25 MR. KING: It's not only reduced time; it's

1 reduced staffs. You look at what's happening as
2 deregulation takes place; it's a lot of staff reductions.
3 In the UK, they just put out a licensing condition for their
4 plants to stop the erosion of staffing on their nuclear
5 plants. They now -- any additional staffing or staffing
6 changes have to be approved by the regulator, okay, because
7 they were concerned that the staffing levels, not only the
8 staffing levels were low but the people who were there on
9 the staff didn't have proper training; were not familiar
10 with the plant; they may be coming from another plant. They
11 weren't familiar with the responsibilities.
12 So it's not only quantity; it's quality as well.
13 And there's that similar concern that that may be valid in
14 this country.
15 DR. POWERS: Suppose that things are very
16 hazardous during shutdown operations, such that the CDF for
17 a given plant doubled; you calculate the CDF for operations,
18 and it's 2 x 10-5, and when you include the shutdown
19 operating modes, it's very hazardous, it doubles it to 4 x
20 10-5. Does that change anything?
21 MR. CUNNINGHAM: I think that at least one
22 implication it has is that if your people are trying to
23 decide where best to perform maintenance of equipment, they
24 make decisions to what -- is it better do it at shutdown, or
25 is it better to do it at power that the insight that you

1 could have isn't so much that it's doubled as it's equal,
2 and so, you may find that it's better to, in terms of
3 optimize or better prioritize your maintenance activities to
4 switch it around and do it during different parts of --
5 during parts of the year, if you will. So that's at least
6 one thing to have real implications for --
7 DR. SEALE: Along those lines, it would be
8 interesting to take a traditional 60-day outage; list all of
9 the things that are done by way of maintenance and so forth
10 during the outage and then take a current 25-day outage and
11 look at which items were moved over into the online
12 maintenance category and which ones were retained in the
13 shutdown maintenance area.
14 I have a suspicion that the hairy ones were the
15 ones that were left in the shutdown mode, and the easy ones
16 were the ones that were done in the online mode, and so,
17 it's not just a question of the change in the time that's
18 involved. I think if you looked at it carefully, you'd see
19 that the things that are left are the most likely big risk
20 items. It's a suspicion.
21 DR. APOSTOLAKIS: One last question, and I will
22 let you go on. Low-power shutdown are modes 4, 5, 6?
23 DR. LOIS: I guess 5 is the core shutdown, and 6
24 is the --
25 DR. APOSTOLAKIS: So why don't we let Erasmia go

1 on with one more slide, and then, we will interrupt her
2 again?
3 [Laughter.]
4 DR. LOIS: I'm counting on that. I know that you
5 are going to talk amongst yourselves, and I guess the
6 objectives here are the objectives of our visits and
7 information gathering activities, and they are to collect
8 information regarding the significance of low-power shutdown
9 risk and what methods and tools are out there to assess it
10 and then evaluate the information with respect to its
11 usefulness for incorporating the risk, low-power shutdown
12 risk into regulatory decision making, risk-informed
13 regulatory decision making.
14 On a high level, I guess we kind of covered that.
15 We even today, we see potentially important events,
16 operational events, reports. We have cited a few of them.
17 We see events in 1998, 1999, et cetera. The risks are
18 comparable, and they characterize the most risk-dominant
19 plants operational states are those that have high -- the
20 plant has still high -- and the reduced inventory.
21 The risk contributors tend to be plant-specific,
22 and looking at this, it appears that it is just plant
23 outages and refueling outages may not be the only
24 risk-significant outages.
25 A little bit more detail regarding operational

1 events. Loss of outside power; loss of coolant; loss of --
2 what is it -- and shutdown cooling are the events that we
3 see happening across plants. Causes, again, tend to be
4 plant-specific, and it appears that the biggest contributor
5 is human error and procedural problems. That's from my
6 operational event point of view.
7 DR. POWERS: Still, you have these events that
8 occur, but what is used to detect -- the recovery is fairly
9 easier to occur. I mean, why do they defend risk-important
10 if they're so easy to detect? It was the great quote, I
11 think, after the River Bend event, well, it was just a
12 little steam bed generator. And it's because of that, you
13 can see them easily, and you see something is wrong and
14 correct it very quickly. How come they become
15 risk-significant?
16 DR. LOIS: I guess the -- I will let people help
17 me out here. The risk-significance comes when evaluating
18 the event and the potential that if it's not detected in
19 time, what it could have involved like any other initiating
20 event.
21 DR. POWERS: It seems to me that the reason these
22 things become risk-significant is because you don't give any
23 credit for the heroic action in the PRA or unproceduralized
24 actions in the PRI.
25 MR. KING: Let me ask Warren to give you a couple

1 of specifics.

2 DR. LOIS: Yes; I guess here with the --

3 MR. LYON: We had an event some time ago at Hope
4 Creek in which no one recognized at the time that they had a
5 mode change. It took them about two to three weeks before
6 they really determined that they had had a mode change. We
7 had another event at Oyster Creek a few years before that
8 where they went for -- as I recall -- over a day before they
9 realized that they had an overtemperature issue.

10 DR. POWERS: I just take those, and they bolster
11 my point, is that it if it went for two weeks, and it didn't
12 amount to a darn thing. Nothing happened. They didn't know
13 they had a mode change for two weeks, and it didn't make any
14 difference. Similarly, they have an overheating condition;
15 it went on for a day, and they didn't recognize it. It
16 still made no difference.

17 MR. LYON: You are correct in your assessment in
18 my two examples that those weren't overly risk-significant.
19 Let me go back for a moment to the one that really opened
20 our eyes. When I go through this, I want it understood that
21 in my judgment, this would not apply today, but I am
22 referring to the Diablo Canyon event, where as it unfolded,
23 I afterwards calculated it would have taken about two days
24 when everyone could have essentially walked away and done
25 nothing before the core uncovered.

1 However, had the event initiated about a half an
2 hour later, in my judgment, we would have had core uncovery
3 in about an hour and a half, and in my judgment, there was a
4 very high probability that it would have progressed to core
5 damage with the containment open and no on-site ability at
6 that point to get the containment closed. So that was a
7 real eye-opener to us.
8 DR. SEALE: It strikes me that when we look at
9 events, we're not only able but willing to identify
10 personnel errors as contributors to the initiation. When we
11 look at recovery actions, we seem to lose sight of the
12 important roles of individuals, the heroes, if you will, who
13 knew the system well enough and understood the processes
14 well enough to take the unproceduralized steps necessary to
15 terminate the event.
16 What we're talking about here is a climate in
17 which more and more of those heroes are going to be fishing,
18 because they're going to be retired, and the crew is going
19 to be smaller and so on. So, I guess when heroic
20 intervention is a part of the response that keeps the plant
21 safe, we ought to recognize that that's not necessarily a
22 given.
23 DR. APOSTOLAKIS: Even if it were, I wouldn't want
24 to rely on that.
25 DR. SEALE: That's what I mean.

1 DR. APOSTOLAKIS: Okay.

2 DR. LOIS: Another point I want to make is
3 although we're talking about risk-significance here, the
4 perspective is risk-informed regulation, and therefore, what
5 we're looking at here is if licensees come in, and they
6 would like to change the design basis on the basis of
7 risk-significance, then, we have to have an analysis of the
8 risk and a good comprehension of what's involved, and it's a
9 little bit different, slightly different idea why you care
10 about low-power shutdown, because you can take -- you can
11 manage it.

12 DR. APOSTOLAKIS: If I consider the five
13 cornerstones, those were initiating events, mitigating
14 systems, pressure boundary and emergency preparedness, four,
15 is it fair to say that at low-power and shutdown, the first
16 three are compromised to some extent?

17 DR. LOIS: That's what the studies show.

18 DR. APOSTOLAKIS: Now, emergency preparedness
19 probably is not affected.

20 DR. KRESS: It probably shouldn't be a
21 cornerstone.

22 DR. APOSTOLAKIS: What?

23 DR. KRESS: It probably shouldn't be a cornerstone
24 anyway.

25 DR. APOSTOLAKIS: But I'm thinking now what

1 they're using. So the pressure boundary is compromised in
2 what way? Sometimes --
3 MR. CUNNINGHAM: Again, you can be in a situation
4 where the head is off.
5 DR. APOSTOLAKIS: The head is off and the
6 containment is off. The mitigating system is compromised?
7 DR. SIEBER: You can take a whole division out.
8 DR. APOSTOLAKIS: You can take a whole division
9 out.
10 Initiating events, we've seen many of those, so
11 clearly, something is going on here. So here is a
12 situation, without going into details, where three out of
13 the four cornerstones -- and according to Dr. Kress, the
14 fourth one shouldn't even be a cornerstone -- one way or
15 another are compromised. So it seems to me it is an
16 important problem. I mean, we can't say in one place that
17 this is important and another place no, because of heroic
18 actions.
19 DR. LOIS: In fact, in South Texas, when they get
20 in the middle of it, they have now -- Donnie, you can
21 describe it better -- they have this alertness going on all
22 over the place. They have signs; they have sirens, and
23 everybody knows what is this idea.
24 DR. APOSTOLAKIS: That is a cost-cutting idea of
25 human awareness, I guess.

1 DR. LOIS: In addition to -- in San Onofre, they
2 take the CDF estimates as part of their bonuses. If they
3 thought that low-power shutdown is not an important part of
4 it, they wouldn't include it, so I don't know if it has a
5 full-blown, very detailed PRA. So there is no one in the
6 industry who would argue that low-power shutdown risk is
7 insignificant.
8 DR. APOSTOLAKIS: Is it fair also to say that if
9 they look at the number of initiating events over the last
10 10 or 15 years, most of them have occurred during those
11 modes? Except for normal transience. I mean, I looked at
12 the ATHEANA report, the ATHEANA report a year or so ago --
13 more than a year or so -- looking at the events that have
14 occurred. Most of them were low-power shutdown, weren't
15 they?
16 MR. CUNNINGHAM: They were looking at them in a
17 certain context, in a context for errors of commission.
18 DR. APOSTOLAKIS: Well, you remember well.
19 MR. CUNNINGHAM: In that sense.
20 DR. APOSTOLAKIS: In that sense, yes.
21 DR. SEALE: Several years ago, Jack Rosenthal made
22 a presentation where he used the convening of an AIT as the
23 criterion for significant events, and about half of the
24 cases where AITs were convened involved shutdown
25 configurations.

1 DR. APOSTOLAKIS: I don't think the criterion here
2 should be the actual number that people estimate and make a
3 decision whether to investigate further based on the
4 magnitude of the number. The fact that three of my most
5 important cornerstones are compromised is sufficient enough
6 reason for me to try to understand it. I don't care what
7 the numbers are.
8 MR. KING: That is, in effect, what we are doing
9 is to try to understand it better to see what else needs to
10 be done.
11 DR. APOSTOLAKIS: If anything.
12 Erasmia, what else do you have to say?
13 DR. LOIS: I guess this bullet here, that some
14 studies indicate that sometimes, bringing the plant,
15 shutting down the plant for maintenance may not be less
16 risky than keeping it online for performing maintenance in
17 case that you lose some safety systems, et cetera; that's
18 the bullet that we have uncovered. And then, regarding the
19 effect of radioactive releases, the NRC studies covered it
20 somehow, and they came up to be significant, as significant
21 as from full power, however, primarily, people are doing
22 just level one analysis. They haven't done a lot of level
23 two.
24 The Seabrook study had kind of inconclusive
25 results. However, one thing that comes up all the time is

1 that the containment status is important.

2 DR. APOSTOLAKIS: Now, why do you claim that LERF

3 and early fatalities may not be appropriate risk measures?

4 DR. LOIS: I will let Dr. John Leonard to respond

5 to that. Oh, okay.

6 MR. CUNNINGHAM: If we go back to the discussions

7 that we had at the time of Reg 1174 development, what we're

8 trying to sort out is what does LERF mean when you were --

9 you could potentially have the containment open. LERF was

10 derived, anyway, from the context of full-power operations,

11 where you have an energetic pressurization for the

12 containment and the potential for, if you will, structural

13 failure of the containment. How do you apply that to a

14 situation where the pressure boundary may not be quite

15 there? I think one of the key issues there is do you need

16 to rethink the definition of something for shutdown

17 conditions?

18 DR. APOSTOLAKIS: Well, could it be similar to the

19 V sequence there, where you bypass it?

20 MR. CUNNINGHAM: Well, again, that is involving a

21 -- the circumstances are somewhat different in the sense

22 that one, you've got a structural failure of the pressure

23 boundary in the V sequences. It's the valves --

24 DR. APOSTOLAKIS: Yes.

25 MR. CUNNINGHAM: -- rather than the structure

1 itself.

2 DR. APOSTOLAKIS: Yes.

3 MR. CUNNINGHAM: But you've also got a lot of

4 energy behind that, and again, in shutdown conditions, you

5 may not quite have the highly disruptive forces.

6 DR. WALLIS: What is the boundary? If you've got

7 the release from containment, it doesn't really matter

8 whether it is because it failed or was left open.

9 MR. KING: It does.

10 DR. WALLIS: Why?

11 MR. KING: Because the timing is different and the

12 mix of --

13 DR. WALLIS: You're still releasing.

14 DR. APOSTOLAKIS: Yes, but is it early? That's

15 what you were questioning?

16 MR. CUNNINGHAM: It's the early aspect of it is an

17 important consideration.

18 DR. APOSTOLAKIS: And why wouldn't it be early

19 here? I mean, there is no containment.

20 DR. WALLIS: Early compared with what?

21 DR. APOSTOLAKIS: Well, the definition is within 3

22 hours afterwards.

23 DR. WALLIS: Of what?

24 DR. APOSTOLAKIS: Of core damage.

25 MR. CUNNINGHAM: Core damage.

1 DR. WALLIS: Well, it's pretty damn early if the
2 containment is open.
3 MR. CUNNINGHAM: The LERF definition is by and
4 large a definition related to the magnitude of the source
5 term release and the timing of that release fairly quickly.
6 The circumstances of the shutdown condition in terms of the
7 combination of those effects are going to be different. You
8 might have the containment open, but you might not have the
9 release occurring -- the magnitude of the release may be a
10 somewhat different -- the characteristic of that release is
11 somewhat different.
12 DR. APOSTOLAKIS: So it's the large that you're
13 attacking.
14 MR. CUNNINGHAM: Maybe it's the large.
15 DR. WALLIS: I've been told many times that it
16 doesn't matter how large it is, because it's large enough.
17 MR. CUNNINGHAM: The large early release
18 definition was also tied into the ability to evacuate people
19 before they are exposed.
20 DR. APOSTOLAKIS: Right.
21 MR. CUNNINGHAM: Again, the accidents you're
22 getting here are different in those types of
23 characteristics. So you might -- it just, strictly
24 speaking, that LERF definition that we came up with isn't
25 really right for these circumstances, and what we're

1 thinking is we need to come up with some better surrogate to
2 be the equivalent of it.
3 DR. APOSTOLAKIS: And that will be equivalent to
4 or a surrogate for prompt fatalities again?
5 MR. CUNNINGHAM: It would be a surrogate for
6 public risk, if you will.
7 MR. KING: That's one of the questions.
8 Well, the LERF was tied to the early fatality QHO.
9 DR. APOSTOLAKIS: Right.
10 MR. KING: That's where it was derived from.
11 DR. APOSTOLAKIS: Right.
12 MR. KING: When you get into the shutdown
13 condition, the timing is different; the mix of fission
14 products is different. Would it be more appropriate to tie
15 it to the late fatality QHO? Because maybe you don't have
16 enough release to get an early fatality, given that there's
17 still emergency planning.
18 So that's the question. I don't have an answer
19 for this, but those are the things that we're kicking
20 around.
21 DR. KRESS: I think those are good questions.
22 DR. APOSTOLAKIS: Yes.
23 DR. KRESS: And I think they're legitimate. But
24 it seems to me like the fraction of time that the
25 containment is open during low power and shutdown is the

1 time when you have a LERF. I mean, you use that fraction --
2 conditional containment failure probability is one during
3 that period, and your CDF is whatever the CDF is. So it's
4 that fraction of the time that translates into a LERF.
5 Since it's standard here, you could use that fraction. And
6 you could probably assume things like the early fatalities
7 probably just as equivalent to what they would be at
8 low-power -- I mean at full power.
9 The driving force is about the same, and the mix
10 of fission products and the biological effectiveness, it
11 doesn't change that much over the time period.
12 DR. APOSTOLAKIS: So what is your conclusion?
13 DR. KRESS: My conclusion is that you could almost
14 use a LERF that's pretty much like the one you have now,
15 using the fraction of time that the containment is open as
16 your measure of when it's a large early release.
17 MR. KING: What you're saying is you've got to
18 have CDF 10-5 or lower when the containment is open.
19 DR. KRESS: That's what I'm saying, yes, exactly.
20 DR. LEHNER: Could I comment on that, just if I
21 may? John Lehner from Brookhaven National Laboratory.
22 As Tom King was saying, I mean, the other issue is
23 that LERF, the way it's define or sort of implied for full
24 power involved prompt fatalities, and even though the
25 containment may be open, later on in the shutdown accident,

1 you're volatile to let the -- off so you're probably -- the
2 standard calculations won't show you a prompt fatality, but
3 you will still get latent cancers, so that's why that
4 measure may be more relevant than the LERF measurement.
5 DR. KRESS: Well, you have a point there, but I
6 think you have to think about our ingression accidents, too,
7 at full power.
8 DR. LEHNER: What the composition of a --
9 certainly --
10 DR. KRESS: It's still up for grabs.
11 DR. LEHNER: Exactly; that's very true.
12 DR. APOSTOLAKIS: So essentially what you're
13 saying is that someone has to look into it.
14 MR. KING: Yes.
15 DR. BONACA: Before you just move on, the second
16 to last bullet can be misinterpreted; even in the report, it
17 somewhat can be misinterpreted. It gives the impression --
18 I could read it as saying that I could do all of my
19 maintenance at power because there is -- which is not the
20 case, except in components for which doing maintenance at
21 power is equal or even less than doing it in the shutdown
22 condition, and that, although it is important, what I am
23 saying is that it is a component base that in general --
24 DR. LOIS: It's a generalized statement, yes.
25 DR. BONACA: And the statements I see in the NUREG

1 also have the kind of confusion in it. I could interpret
2 that, fine, from now on, I'll never shut down the plant
3 except to refuel, and I'll do all my maintenance at power,
4 and that's not really what message you want to give there,
5 right?
6 DR. LOIS: Exactly; it would be on the specific
7 case. It just depends --
8 DR. BONACA: For some components --
9 DR. LOIS: For example, if you lost shutdown
10 cooling --
11 DR. BONACA: Yes.
12 DR. LOIS: -- and you have -- you are asked by the
13 technical specifications, you have to have the plant shut
14 down while you don't have shutdown available, and this is a
15 kind of a strange situation, and there are some technical
16 specifications that we would have to look at.
17 DR. BONACA: I was reading it, and I would say in
18 some cases, in fact, they're comparable and even higher at
19 shutdown condition; therefore, it's recommended that you do
20 it, in fact, at full power right away. I just wanted to
21 point out that I was a little bit confused about the
22 statements in the NUREG, and maybe you ought to review them
23 for that.
24 DR. APOSTOLAKIS: Bullet number four, human
25 actions, it seems to me, again, based on the analysis that I

1 have seen from various NUREGs and the incidents that have
2 occurred that these human actions and associated
3 uncertainties are different from the ones one normally deals
4 with during power operations. Essentially here, what we're
5 talking about is this ability of people to create initiating
6 events during the various activities that they are doing,
7 and in one of your earlier view graphs, you said that -- you
8 mentioned efficient procedures.
9 I am not sure that the model like ATHEANA, as it
10 is currently structured, can deal with these particular
11 actions, because ATHEANA starts with a human failure event
12 and then analyzes the context and so on. ATHEANA does not
13 look at normal operation and ask what can go wrong. It says
14 given that this is wrong, now, what is it that led? Yes; it
15 doesn't start with normal operations. So, it does not ask,
16 for example, how can we create an initiating event?
17 MR. CUNNINGHAM: Well, since we're going to talk
18 about ATHEANA tomorrow, this may be a good topic for that.
19 DR. APOSTOLAKIS: I will raise it tomorrow, too.
20 MR. CUNNINGHAM: Okay.
21 DR. APOSTOLAKIS: But I think the human failure
22 event is given to the ATHEANA analysts from the PRA, or they
23 participate in the derivation. They are dealing primarily
24 with recovery actions. The accident sequence, how can we
25 recover from it? So the various failures to recover, you

1 know, they analyze well.

2 Now, take Wolf Creek. They were supposed to do

3 certain things on Friday; postponed into Monday; they did

4 notify other people. Other work was going on at the same

5 time. Valves were opened independently. All of a sudden,

6 you have a flow path to the RWST. That's not an event

7 ATHEANA right now is structured to analyze, is it?

8 MR. WHITEHEAD: John Whitehead from Sandia labs.

9 My understanding of the ATHEANA process is that's

10 exactly what it's structured to identify.

11 DR. APOSTOLAKIS: No.

12 MR. WHITEHEAD: Now, I will admit to you that

13 probably, the past events that have been examined by the

14 ATHEANA process have been more on the order of responding to

15 events that have already occurred, but the process, as laid

16 out, is very beautifully structured to allow one to search

17 for those kinds of conditions that would influence the

18 operators to, you know, to perform a specific action.

19 DR. APOSTOLAKIS: No, no, I don't think so.

20 MR. WHITEHEAD: That's my interpretation of it.

21 DR. APOSTOLAKIS: I think the human failure event

22 must be defined, and then, ATHEANA analyzes the ways it can

23 get there. And again, tomorrow, we can ask the experts.

24 So, my point is, though, and I think Erasmia

25 touched on this when she said the fission procedures, I

1 would have expanded this, and I think what really matters
2 here during shutdown, especially given all the things that
3 you have mentioned: smaller staff, pressure to do things in
4 a shorter period of time, if there is anywhere where
5 management and organizational factors would be important, it
6 would be here.
7 MR. CUNNINGHAM: In fact, I wanted to point out --
8 DR. APOSTOLAKIS: It's here.
9 MR. CUNNINGHAM: Yes.
10 DR. APOSTOLAKIS: Not in ATHEANA. In ATHEANA,
11 there would be one of the many things that would contribute
12 to the error-forcing context, but here, I think they play
13 the dominant -- the dominant role, and you really don't know
14 what you're going to get, you see? ATHEANA is not looking
15 blindly for things to go wrong. The human failure event
16 more or less has to be defined in the context of some
17 recovery action.
18 And I know that's true. I mean, the four
19 reviewers say that; the report says that; you start with the
20 human failure event, and you're looking for unsafe actions.
21 Then, they become, you know, pretty loose.
22 MR. CUNNINGHAM: One of the reviewers.
23 DR. APOSTOLAKIS: Yes.
24 MR. CUNNINGHAM: I guess the question then becomes
25 how they'd react to that in the ATHEANA.

1 DR. APOSTOLAKIS: ATHEANA does not look at normal
2 operations and produce a number of things that can go wrong
3 as a result of things that are happening during normal
4 operations. It doesn't do that. It starts with an event
5 risk.
6 MR. CUNNINGHAM: Normal operational.
7 DR. APOSTOLAKIS: Yes, so if you look at normal
8 shutdown operations, ATHEANA will not look for things that
9 can go wrong. ATHEANA will say ah, they are losing water.
10 Now, we get in; you know.
11 MR. CUNNINGHAM: There is some initiating event.
12 DR. APOSTOLAKIS: Exactly.
13 MR. CUNNINGHAM: I understand the difference.
14 DR. APOSTOLAKIS: So that is the difference.
15 DR. BONACA: One observation I want to make on
16 this issue was what's the purpose of tomorrow. I know we
17 have ATHEANA, but what is the presentation -- I believe that
18 in this particular shutdown condition, that's where
19 organizational effectiveness will break down, in the sense
20 that there, you have even from the balance among
21 departments, how operation is controlled, the outage, who is
22 responsible, how people will work together. All those
23 elements --
24 DR. APOSTOLAKIS: Yes.
25 DR. BONACA: -- are dominant in these issues,

1 because control, of course, is a fundamental issue.

2 DR. APOSTOLAKIS: That's right; control of work

3 and the timing and interfaces and who does what.

4 DR. BONACA: And that's something that, you know,

5 it occurred to me as I was reading your document, that it's

6 clear to me now where different things --

7 DR. LOIS: That is feedback from the industry and

8 the people that we are talking is that the issue of

9 initiating event during a shutdown condition needs to be

10 more closely examined.

11 DR. APOSTOLAKIS: Yes.

12 DR. LOIS: That's an area that we have to -- it

13 doesn't have too -- but we should look into; also, the issue

14 of procedures, where you guard into an initiating event.

15 DR. APOSTOLAKIS: All the work processes that take

16 place there, that's where you look. I mean, the Wolf Creek

17 event essentially comes down to the fact that they did not

18 notify some central office there that they had postponed

19 that work from Friday to Monday. So those guys would have

20 told them look: don't do it because, you know, these other

21 guys are going to be doing something else on Monday morning.

22 That's all, and that's not something that's within ATHEANA

23 right now -- without putting down ATHEANA; don't

24 misunderstand me.

25 MR. CUNNINGHAM: When we get back to the

1 discussion on research, possible research topics --
2 DR. LOIS: Yes.
3 MR. CUNNINGHAM: -- we'll talk about HRA, and it's
4 by no means, in our minds, constrained to analyzing this in
5 the context of ATHEANA. It's much more open in our mind.
6 DR. APOSTOLAKIS: Right.
7 MR. CUNNINGHAM: The issue of work processes; very
8 legitimate as an issue in human reliability analysis.
9 DR. APOSTOLAKIS: No, but I think it's important,
10 and I really want to get the ATHEANA developers'
11 perspectives tomorrow as to what exactly ATHEANA can do,
12 what classes of events ATHEANA treats and what other classes
13 it does not treat, at least in its present form, and I don't
14 -- my impression is, and it's not just an impression, is
15 that you have to have something going on for ATHEANA to
16 intervene and look at the possibly human actions and the
17 forcing contexts and so on, okay?
18 But how that something was created, I'm not sure
19 ATHEANA is the right place.
20 MR. CUNNINGHAM: It's a topic for discussion with
21 the committee at some point on the future of human
22 reliability analysis.
23 DR. APOSTOLAKIS: Yes.
24 MR. CUNNINGHAM: And again, it's much broader than
25 ATHEANA.

1 DR. APOSTOLAKIS: Right.

2 MR. CUNNINGHAM: It's what should we be doing, and
3 that's somewhere, we ought to get into that discussion
4 anyway.

5 DR. APOSTOLAKIS: Anyway, I thought that was a
6 point, you know, because of the fourth bullet there worth
7 mentioning.

8 DR. LOIS: Almost done.

9 DR. APOSTOLAKIS: You're on 10.

10 DR. LOIS: Regarding tools that are being used,
11 our industry is using to evaluate low-power shutdown risk,
12 primarily, they do what we call configuration risk
13 management, and therefore, the objective is to determine and
14 evaluate your next outage, and for that purpose, they use
15 the NUMARC guidelines, and utilities that do have PRAs, they
16 augment their insights with the PRA.

17 Now, one thing that came across is that the
18 industry feels comfortable with the NUMARC guidelines. They
19 think that they achieve the safety margins they need.
20 However, they do get important insights from doing -- by
21 using their PRA. Primarily, the PRA is helping them to
22 optimize their schedule. They can literally feed in
23 different kinds of schedules in their software and come up
24 with CDFs or time to boil, whatever, and then, they compare
25 it, and they decide which way to go.

1 DR. WALLIS: How much does this bullet augment
2 defense in depth? You mean that you use PRA as your measure
3 of your defense in depth, and then, you can tell if you've
4 augmented it? So the defense in depth is now being measured
5 through PRA?
6 DR. LOIS: What I'm trying to say here is that
7 your basis for configuration control management is your
8 defense in depth, the NUMARC guidelines.
9 DR. WALLIS: And because that's such a vague
10 thing, it's useful to have PRA so that you know the extent
11 of that.
12 DR. LOIS: The PRA, then, once you've identified
13 -- the defense in depth approach does not allow you to
14 compare different kinds of schedules to figure out which one
15 would be more optimal. So with a PRA, you can do that. You
16 can say I'm going to have this system, this system, this
17 system and play things around so that you can come up with
18 an optimal configuration, which would be optimal from both
19 safety and schedule perspective. That capability is not in
20 defense in depth, and I guess it's --
21 MR. WHITEHEAD: John Whitehead. Let me add to
22 that. In one sense, what the use of PRA does is to allow
23 you to identify varying degrees in defense in depth. The
24 defense in depth tools that they used will say okay, your
25 defense in depth is marginal, or it's adequate or

1 acceptable. Calculating the results from the PRA will give
2 you some idea of which configurations, you know, may be more
3 marginal than another, because you might have three
4 configurations, both of which show up in the defense in
5 depth approach as marginal, but one of them is a better
6 configuration to be in, and that's the kind of information
7 that you get from the PRA tool, and that's what their -- you
8 know, most of the utilities are using them for is to
9 optimize and make sure that they, you know, have as much
10 safety --
11 DR. APOSTOLAKIS: But which PRA are they using?
12 They don't have much of low-power PRAs.
13 MR. WHITEHEAD: Actually, they do. There are
14 various levels of PRA now.
15 DR. APOSTOLAKIS: For a few modes.
16 DR. BONACA: But what this is, really, a PRA
17 measured defense in depth; what I mean is that they evaluate
18 changes in core damage probability, okay, as a sensitivity
19 to --
20 DR. APOSTOLAKIS: But only for mid-loop
21 operations, for example.
22 DR. BONACA: Yes.
23 DR. APOSTOLAKIS: In the BWRs. They don't have
24 PRAs for all the modes.
25 DR. BONACA: That's right; so what you do is you

1 do focus --

2 DR. APOSTOLAKIS: Yes.

3 DR. BONACA: -- ATHEANA on a very limited PRA.

4 DR. APOSTOLAKIS: Very limited.

5 DR. BONACA: What I'm saying is that the PRA, it
6 is a very good tool to measure defense in depth if you look
7 at variation and core damage probability.

8 DR. APOSTOLAKIS: Yes.

9 DR. BONACA: It's a different kind of defense in
10 depth from, you know, two trains versus non train, but I
11 think it's actually very effective to do that.

12 MR. WHITEHEAD: What we have to remember here is
13 that these tools primarily are being used for outage
14 management or outage planning, and so, yes, they are mostly
15 limited to cold shutdown and refueling states, but those are
16 the states that are currently being examined, and there's,
17 you know, so it's appropriate that they concentrate on those
18 areas. As we'll probably discuss later, there is no reason
19 why that couldn't be expanded to other areas, but for
20 configuration risk management, since they're only interested
21 in those areas, they only have to have a PRA for those
22 specific areas.

23 DR. LOIS: In addition to -- my comprehension is
24 that the defense in depth NUMARC guidelines cover only plant
25 outages. Am I wrong? That's my understanding. NUMARC

1 guidelines don't cover every outage there is.

2 DR. APOSTOLAKIS: Which page? Do you remember

3 which page of NUMARC 91.06 they say that PRA is only a two

4 -- is it from the title or --

5 DR. WALLIS: There was only a --

6 [Laughter.]

7 DR. LOIS: I will jump in --

8 DR. APOSTOLAKIS: I noticed, though, I looked at

9 all your view graphs. You don't have any numbers anywhere,

10 and I had a comment on the numbers.

11 DR. LOIS: That number is --

12 DR. APOSTOLAKIS: 10-3 and, you know --

13 DR. LOIS: CDFs?

14 DR. APOSTOLAKIS: CDFs.

15 DR. LOIS: No, we don't.

16 DR. APOSTOLAKIS: You tell me when would be

17 appropriate to make my comment. You will?

18 DR. LOIS: Yes, I will.

19 DR. APOSTOLAKIS: Okay.

20 DR. LOIS: But right now, what do you want me to

21 do?

22 DR. APOSTOLAKIS: After you sit down, right?

23 [Laughter.]

24 DR. POWERS: Before we go on to this view graph,

25 I've got a question I would propose. Suppose I am a

1 resident of Brown's Ferry, and they're about to enter into a
2 nuclear outage, and they have -- and I feel an obligation to
3 look over their shoulders to see if they're making a correct
4 decision, and in particular, they've run around, and they've
5 found there are two ways to do this, the operations they
6 want to do. One of them results in two orange categories,
7 and the rest are all green in one setup. The alternative is
8 a red category, but everything else is green.
9 And I call up my senior reactor analyst for Region
10 IV -- Region II --
11 [Laughter.]
12 DR. POWERS: And I say, you know, clearly, the
13 right way to make the decision between two oranges and all
14 greens versus one red and all greens is based on risk, so I
15 ask the senior reactor analyst for the region which one of
16 these is the more risky outcome? How does that senior
17 reactor analyst make an answer, provide an answer to me?
18 [Pause.]
19 DR. WALLIS: He uses different -- because he
20 doesn't know how red red is. It could be much bigger;
21 therefore, he knows that the oranges aren't reds, so that
22 would be the decision, avoid the red.
23 DR. POWERS: See, you would have to be asking it
24 in -- and they're going to make a decision, but I'm -- my
25 job in this world is to assure protection of the public

1 health and safety, and so, I feel an obligation to be
2 prepared to interrogate these fellows on the answer that
3 they came up with.
4 MR. CUNNINGHAM: I suppose there are two things in
5 there. One is how many oranges or yellows equals a red,
6 which is an issue when you -- the oversight process in
7 general: when does something become -- a combination of
8 events become so serious that you trip some sort of concern?
9 I can't answer that. I'm not sure. I know people are
10 thinking about that, but I don't know what's been going on.
11 DR. POWERS: Well, I think the answer is this
12 reactor analyst is no more help than the guy next door.
13 MR. CUNNINGHAM: A senior reactor analyst is
14 presumably -- is valuable because of the broader training
15 that he's seen and the broader experience that he has. He
16 brings together, I guess, two things. The NRSRAs, there are
17 two things that happen. One is they're more trained in PRA
18 and that sort of thing, so that that adds something to it.
19 The other part of it is they're senior people, and they are
20 brought into these positions not just because they know
21 something about PRA but because of the quality of the
22 perspective that they bring to it. So in that sense, in a
23 very general sense, I think that's what the SRA would bring
24 to it. Is he going to be able to do something very
25 quantitative in that area?

1 DR. BONACA: It seems to me that the only way that
2 the inspector could find out that information would be to go
3 to the PRA person in the utility if they have a PRA that
4 they are using, even if it is -- because in parallel to
5 ORAM, often times, they have these limited models, and at
6 least -- I don't think the staff can do that. That's an
7 issue we have raised: how is the staff able to evaluate,
8 and the answer is I don't think they are.
9 DR. POWERS: What we're saying is that in this
10 area, and I picked Brown's Ferry for a reason; they do have
11 shutdowns in their PRA, and the staff is being outgunned --
12 DR. BONACA: Yes.
13 DR. POWERS: -- by the licensees, and, in fact,
14 the licensees are perfectly capable of snowing the staff by
15 saying yes, we're going to make a decision between two
16 oranges and a red; I can go to two oranges because we've
17 done this PRA, and we're not going to show it to you, but
18 we've done it, and we have a quantitative analysis. See
19 this? We're going to go this way.
20 There's literally nothing that the NRC can do to
21 protect the public health and safety on that kind of a
22 decision, because they're --
23 DR. BONACA: What I'd say that, you know, the --
24 typically, when you compare two configurations, the
25 evaluation that the plant may present to you is transparent

1 enough to show you when there is a dependency, when there
2 isn't a dependency that often times, it's up to that point;
3 okay, here, there is a dependency, and there, there is not.
4 So, I agree with you totally that the staff cannot do that,
5 but I'm saying that it's hard to snow anyone, because if you
6 ask a question, you know, the dependencies come out right
7 away, and, you know, there has to be a reason why you have
8 two yellows there and a red, and it typically has to do with
9 those dependencies so --
10 DR. SEALE: It does seem to me rather interesting,
11 though, and I'm not trying to get you more work, Mark,
12 although it may sound like it -- that in an agency which is
13 lauding its increased dedication to the use of risk-informed
14 methods in making decisions that we have something like the
15 evaluation process where the question of one red versus two
16 yellows and so forth is being argued, as you say, but the
17 people who are involved in the PRA process don't have the
18 slightest idea of what those arguments are being based on.
19 I mean, if risk is going to mean anything, and you're going
20 to use it, then, damn it, use it.
21 MR. CUNNINGHAM: Just to be clear, this individual
22 PRA person is not particularly tied into that process.
23 There are other PRA people around the agency who are, who
24 tend to be more in NRR.
25 DR. SEALE: I'd be interested to see what the risk

1 basis is.

2 DR. POWERS: I agree. I think what we're doing to

3 our senior reactor analysts out in the field is criminal.

4 We are quickly getting them put into the position --

5 DR. SEALE: Hanging them out to dry.

6 DR. POWERS: -- where they are being asked to make

7 judgments about actions by groups of people who just have

8 superior technology, vastly superior technology to them.

9 MR. KING: One of the things that's on our plate

10 to develop over the next couple of years are low-power and

11 shutdown models for the ASP program that the senior reactor

12 analyst could use to analyze situations. They don't have

13 tools today to do it.

14 DR. POWERS: They cannot. They have no way to

15 independently evaluate -- even things like -- which are

16 pretty qualitative thing, and yes, I can sit down and write

17 out the criteria, and ORAM, just based on what's on its

18 Website.

19 DR. SHACK: But the fact is a senior reactor

20 analyst doesn't have anything equivalent to it.

21 DR. POWERS: But then, you would have to always

22 argue that he's got a PRA that's at least as good as anybody

23 else's, and I just don't find that as a terribly practical

24 matter.

25 DR. SHACK: I don't know why I would have to argue

1 that.

2 DR. POWERS: Because again, if it came down to two

3 PRAs, then, which one are you going to believe? You believe

4 the better one, you know, if you have to have a number to

5 make the decision.

6 DR. SHACK: I guess I'm still not following

7 something. If the --

8 DR. POWERS: You're going to recompute the number

9 that the licensee computed. Well, if you get a different

10 result than he does, it comes down to which, you know, which

11 number is better, which model is better.

12 DR. SHACK: The other thing is most of the time --

13 DR. POWERS: No, I don't think it does. I mean, I

14 think very seldom do you have any decisions made based on

15 the discrepancies between two numbers.

16 DR. SHACK: Well, it sounded to me like that's

17 what you were arguing for it, that you wanted to have a

18 number.

19 DR. POWERS: No; I think I want the capability to

20 assure myself that the plans that the licensees are

21 undertaking for a shutdown operation do, in fact, protect

22 the public health and safety. And I think it doesn't make

23 any difference at all whether the number is 2 x 10-4 or 3 x

24 10-4 in making that decision. It's much more than that.

25 DR. SHACK: I don't agree with that.

1 DR. SIEBER: Right now, though, we're in an area
2 of deterministic regulation. If you look from the
3 standpoint of a resident inspector, he is not going to
4 prospectively tell the utility or the licensee how to run
5 his plant. He is not in the plant management business. On
6 the other hand, the utility is required to obey all of the
7 technical specifications and commitments, and under a
8 deterministic framework, that's sufficient to assure the
9 protection of the public health and safety.
10 When you move into probabilistic types of
11 risk-informed regulation, that's when the NRC needs to be
12 able to prospectively look at planned events to make sure
13 that the regulations that are risk-informed actually apply
14 and do minimize risk to the public. So right now, whether
15 you have a PRA or don't have one for shutdown risk from the
16 legal standpoint doesn't make any difference.
17 DR. APOSTOLAKIS: Isn't it a fundamental question,
18 though? If you have a matrix that uses colors, and based on
19 various combinations leads to certain actions on the part of
20 the utility and on the part of the NRC that you would like
21 to know what is the rationale --
22 DR. SIEBER: Right.
23 DR. APOSTOLAKIS: -- behind these colors and the
24 combinations?
25 DR. SIEBER: Right.

1 DR. APOSTOLAKIS: I think that's what it comes
2 down to.
3 DR. SIEBER: Right.
4 DR. BONACA: Well, the point that you were making
5 before is, however, again these protections for the licensee
6 would have an explanation of why you would get the yellow or
7 the red, and most of the time, I believe the question is go
8 through the licensee. The explanation is pretty -- always
9 engineering-wide. I mean, he is going to pull it out of
10 dependency to why this component cannot be removed by this
11 time, because it will happen this other way, and I know
12 resident inspectors ask those questions. They go and ask
13 barely those questions about, you know, why are you doing
14 this rather than something else? And so, there is that
15 process that is taking place now.
16 It doesn't mean that the NRC, in fact, has the
17 capability to influence in any way or to perform any
18 independent assessment. Much is based on the experience of
19 the resident inspector and the person you can ask.
20 DR. POWERS: The problem I'm forecasting is more
21 and more, a licensee is going to be able to come back to the
22 resident inspector with an answer that he's not capable of
23 interpreting.
24 DR. BONACA: And that's possible, yes.
25 DR. POWERS: And he's going to come back and say

1 that we've looked at it, and we've got a Delta CDF of 2 x
2 10-16 or something like that, and the guy is going to call
3 up his senior reactor analyst and say does this seem
4 reasonable to you? And nobody is going to have the
5 capability to answer that.
6 DR. BONACA: That is correct.
7 DR. APOSTOLAKIS: That is correct.
8 Have we finished with this? Are you done?
9 DR. LOIS: Yes.
10 DR. APOSTOLAKIS: For the record, Dr. Uhrig joined
11 us a few minutes ago.
12 Now, the next view graph, I think, will take some
13 discussion, and I propose we break now and reconvene at
14 10:15.
15 [Recess.]
16 DR. APOSTOLAKIS: Okay; Erasmia, you want to
17 continue there?
18 [Pause.]
19 DR. LOIS: Because we were talking about tools, I
20 just thought that -- do you mind if I go into this slide?
21 Because I'm not going to cover anything else about tools
22 from now on, so I'm just --
23 DR. APOSTOLAKIS: Well, the only thing on page 11
24 is this time average CDF and condition --
25 DR. LOIS: I'm not going -- I'm going to come to

1 page 11 after this.

2 DR. APOSTOLAKIS: Oh, okay, okay, sure.

3 DR. LOIS: I just wanted to talk about -- because
4 the statement before was that the -- we do CRM, utilities do
5 CRM mostly, and they have developed tools for both the
6 defense in depth concept and for quantitative analysis, and
7 these are the tools. ORAM was developed specifically for
8 outage management, and about 65 utilities have ORAM. About
9 40 of them have the capability to do quantitative analysis.
10 Now, safety has evolved to shutdown configuration control
11 management from full power configuration control management
12 tools, and I guess about 12 utilities have safety oriented
13 -- about 6 or so EOS. So the message here is that clients
14 do expand themselves to incorporate PRA modeling for
15 low-power and shutdown.

16 DR. APOSTOLAKIS: So most utilities, and 65 of
17 them do not use PRA?

18 DR. LOIS: About 65 have ORAM. ORAM has two
19 modules: the defense in depth, and it has its own PRA
20 modeling. It's not like --

21 DR. APOSTOLAKIS: Ah.

22 DR. LOIS: -- you use the full power. You can
23 model your outage by creating your fault trees, your system
24 dependencies from scratch, and about 40 utilities have that
25 capability.

1 DR. APOSTOLAKIS: Okay.

2 DR. LOIS: Now, some people have both. San Onofre
3 has ORAM and safety module. South Texas does the same. So
4 there is an overlap there. But I guess what's important
5 here to get out is that utilities have more and more
6 capability to do PRA analysis on low-power and shutdown,
7 specifically plant outage, refueling outage.

8 DR. SEALE: Would you help me? Does ORAM have in
9 it, buried down in the details, an assessment of the risk
10 significance of the individual SSCs?

11 DR. LOIS: I will allow --

12 MR. WHITEHEAD: Donnie Whitehead.

13 Generally, the level of detail to which the ORAM
14 PSSA models are developed to are to train level detail; that
15 is, they would not have individual components in their
16 failure for probabilities associated; it would just be a
17 model of the system based upon trains and the dependencies
18 amongst the trains. So I'm not sure that they could -- that
19 ORAM could provide, you know, provide individual SSC
20 importance.

21 DR. SEALE: Okay; thank you.

22 DR. LOIS: So now, and another point that I wanted
23 to make was on the tools that ideally, these tools have
24 capability to model any level of detail and, I guess, any
25 type of plant operational state, but that's just depending

1 on the resources people want to -- there are no constraints
2 from the software perspective.
3 Going back to insights we got for the significance
4 of low-power shutdown risk, now, this is your time to ask
5 the question why we don't have 10-3s here, I guess.
6 DR. APOSTOLAKIS: Well, the thing that -- and I
7 think we've discussed this more than a year ago, people had
8 been struggling with the comparison, how best to compare the
9 core damage frequency during these modes of operation with
10 power risk, which, of course, is expressed in terms of
11 number of events per year, per reactor year. So, you see
12 things like, you know, what if the plant were at mode 5,
13 say, throughout the year? Then, the core damage frequency
14 is this, and it's comparable to the power core damage
15 frequency, and people are calling it instantaneous and so
16 on.
17 First of all, the word instantaneous is not
18 appropriate. They are all conditional core damage
19 frequencies. One is conditional on being at power; the
20 other is conditional at being at mode X. Seems to me the
21 best way to compare these things is -- and they are all
22 time-averaged, by the way -- the best way to compare is not
23 on a per-hour basis or on a per-year basis. The best way is
24 to find the probability of core damage, which I believe one
25 of the regulatory guides does for the temporary conditions

1 that we have a -- yes, 5 x 10-7, I believe, for the
2 probability, not the frequency.
3 So if the plant is for a number of days in this
4 particular mode, then, you find its CDF, then, the product
5 of it -- and again, somebody has to look whether it's fair
6 to multiply the CDF, the conditional CDF by the time,
7 because the CDF may change with time, and I think it's noted
8 in the report that these conditional CDFs are indeed
9 functions of time if, you know, because decay heat, for
10 example, decays.
11 But let's say roughly, one would have to multiply
12 that CDF by the duration of that mode, and that should be
13 compared with the probability of core damage at power
14 operations. It's the probabilities we should be comparing,
15 because that's the only common unit. Everything else is
16 really artificial. To say I will reduce everything or
17 renormalize everything on a per-hour basis, so I take the
18 power CDF per year and divide it by 8,760, whatever, hours
19 and then take the mode 6 CDF and divide it by the
20 appropriate duration to say oh, now, I have two CDFs that
21 are on a per-hour basis; therefore, they are comparable.
22 I don't think that's right.
23 DR. LOIS: Well, George, when we come to
24 recommended work, one issue is how do you develop -- how do
25 you define what we call baseline model? And we kind of have

1 a couple of concepts here, and probably, we would like to
2 have your input.
3 DR. APOSTOLAKIS: I just gave you my input.
4 DR. LOIS: Yes.
5 DR. APOSTOLAKIS: I think the probability is the
6 appropriate way to do it, and the agency has recognized this
7 in another context; the risk-informed guide for technical
8 specification changes; when the outage time is evaluated, we
9 have a goal of 5 x 10-7, as I understand, for the
10 probability during that time.
11 As I say, the thing that makes it a little more
12 complicated here is that the CDF may not be constant
13 throughout that period, so somehow, we have got to account
14 for that, but that's a further epsilon, you know.
15 DR. WALLIS: George, there's a great opportunity
16 for a cost-benefit. I mean, the benefit to the utility of
17 short outage time is economic, but if they get into a higher
18 risk probability, you should put a price on it. Then,
19 there's a way to optimize.
20 DR. APOSTOLAKIS: Yes; I only addressed the
21 question of comparison. Now, you are going beyond that.
22 You are going beyond that.
23 DR. WALLIS: I think it's pretty simple what
24 you're saying; it's straightforward.
25 Otherwise, how do they have a way of trading off a

1 bit more risk with a bit more economic benefit?

2 DR. APOSTOLAKIS: Yes.

3 DR. KRESS: If I have a core damage frequency at

4 full power based on a year --

5 DR. APOSTOLAKIS: Right.

6 DR. KRESS: -- and the way I convert that to a

7 probability is to multiply it by one year.

8 DR. APOSTOLAKIS: Roughly, yes.

9 DR. KRESS: If I have a core damage frequency for

10 a low-power shutdown, that's manualized; the way I convert

11 that to a probability is to multiply it by one year. I

12 don't understand the difference between what you're saying

13 and using the CDF frequency. Why is the probability any

14 different with the frequency?

15 DR. APOSTOLAKIS: Because the frequency -- see, my

16 objection is to annualizing the mode 5 frequent CDF you get,

17 because that assumes that you're in that mode throughout the

18 year.

19 DR. KRESS: No it doesn't.

20 DR. SHACK: It's the wrong way to average. Nobody

21 does it that way.

22 DR. LOIS: No.

23 DR. APOSTOLAKIS: No, but they compare them,

24 though; they don't average them. They compare them that

25 way.

1 DR. LOIS: My understanding is --

2 DR. APOSTOLAKIS: Oh, yes; oh, yes.

3 DR. LOIS: My understanding is that if you are on
4 mivelope, you may get into a 10-3 phase, but then, what you
5 do is you calculate for how long you've been in that -- on
6 that phase, and you divide by the amount of years, so you
7 come out on a yearly frequency; if you assume that you're on
8 10-3 for a whole year there, you would be 10-3. You don't
9 have 10-3 low-power shutdown risk, because for a few hours,
10 you were on that. So actually, you do calculate
11 probability.

12 DR. APOSTOLAKIS: No.

13 DR. BONACA: You have it on page 2-6.

14 DR. APOSTOLAKIS: Yes; 2-6 doesn't do that.

15 DR. BONACA: Per calendar year basis --

16 DR. APOSTOLAKIS: Yes.

17 DR. BONACA: -- the average risk --

18 DR. APOSTOLAKIS: Right.

19 DR. BONACA: -- as it compares to numbers.

20 DR. APOSTOLAKIS: It says CDF for pulse 5 is 2 x
21 10-6 per year; for full power, it's 4 x 10-6 per year. So
22 it assumes that you are in pulse 5 for the whole year.

23 [Chorus of nos.]

24 DR. APOSTOLAKIS: What does it assume?

25 DR. SEALE: It's a year of operation.

1 DR. KRESS: It means you're in it for the amount
2 of time you're in it.
3 DR. SEALE: That's right; an operation is --
4 DR. APOSTOLAKIS: No, no, no, no, no, no; what
5 does it mean that you're in it -- this is per year.
6 MR. WHITEHEAD: This is Donnie Whitehead. Let me
7 see if I can explain that. The way those numbers are
8 calculated are based on a per calendar year basis. And so,
9 the calculations already include the fact that the plant is
10 only in that particular mode for a specified fraction of the
11 year, like 0.03. That number, then, allows you to compare
12 directly with a core damage frequency from full power;
13 again, excuse me, making the assumption that not correcting
14 for the fact that you're in full power operation for, say,
15 80 percent of the year doesn't really, you know, doesn't
16 really significantly impact the results.
17 But in reality, if you wanted to make a strict
18 comparison, then, you should use the appropriate factor for
19 the power. But since it's --
20 DR. APOSTOLAKIS: No, but that's not my problem.
21 MR. WHITEHEAD: -- close to 1, it's okay.
22 DR. APOSTOLAKIS: But then, no, no, no, what you
23 are saying is inconsistent with what the other report says,
24 because the report goes on on page 2-7 and says to avoid
25 overestimating the risk from being in pulse 5 for one year,

1 per hour results from the pulse 5 analysis should not be
2 directly scaled; in other words, one cannot simply multiply
3 the per hour results by the number of hours in a year and
4 have the correct estimation of either CDF or risk.
5 DR. SEALE: They don't.
6 DR. KRESS: Nobody does that.
7 DR. SHACK: But it's confusing, because it makes
8 it sound as though they do.
9 DR. SEALE: Yes.
10 DR. APOSTOLAKIS: Yes.
11 DR. BONACA: It's badly written.
12 DR. APOSTOLAKIS: yes.
13 DR. BONACA: That's not the way it's explained,
14 because I understood the same thing.
15 DR. APOSTOLAKIS: Yes.
16 DR. BONACA: And I was really concerned about
17 that.
18 DR. SHACK: They get a fairly decent definition by
19 the time you get to page 3-4.
20 DR. APOSTOLAKIS: Well, let's see.
21 DR. BONACA: The other thing is that look, clear
22 on the front page is how many days really you are in a
23 shutdown condition. Some plants have a 12-month cycle and
24 maybe a month outage, and some plants have a 2-year cycle
25 with a 15 or 28 day outage. So there is a big difference

1 there, and I'm not sure that you can easily reflect -- I
2 mean, then it may make a difference of, well, not an order
3 of magnitude but close.
4 DR. SHACK: Well, that does come down to this
5 difficulty of defining a baseline outage when all outages
6 are --
7 DR. BONACA: And I agree with that.
8 DR. SEALE: Yes.
9 DR. SHACK: That's a little different.
10 DR. BONACA: But it has to be a way it has to be
11 explained, because this is not clear.
12 DR. SEALE: Yes, but it's simplifying the
13 mathematics by not taking into account the fraction of a
14 year that you're in full power operation.
15 DR. APOSTOLAKIS: Yes.
16 DR. SEALE: You may, in fact -- you may confuse
17 the issue as to what you're talking about. It probably
18 would be smarter to take a point A and --
19 DR. KRESS: That's such a simple correction.
20 DR. SEALE: Yes, right.
21 DR. APOSTOLAKIS: But that's not the issue.
22 DR. SEALE: But the fact that you don't sort of
23 reinforces the idea that you're going to assume that you're
24 in shutdown mode for a year, and you're not.
25 DR. KRESS: It shouldn't be.

1 DR. APOSTOLAKIS: Well, I can -- I saw those words
2 here on this report on the past assuming that the thing is a
3 whole -- in that mode for the whole year, and I'm objecting
4 to that.
5 DR. SHACK: Well, I must confess, I sort of read
6 around that about four times before I figured out those
7 words were just firing for effect.
8 DR. SEALE: Yes.
9 DR. APOSTOLAKIS: So in any case, so what you're
10 saying is that when you say that the CDF from pulse 5 is 7 x
11 10-9 per reactor year, you have already included the fact
12 that the plant is in pulse 5 for a fraction of that year.
13 DR. LOIS: Exactly.
14 DR. APOSTOLAKIS: Okay.
15 MR. WHITEHEAD: Yes, I thought that we had been
16 careful to represent the numbers on a per calendar year
17 basis, and I believe that, you know, the documentation does
18 represent that, but you're probably correct. It would be a
19 little bit -- it could describe in the report better exactly
20 how we calculate the numbers if that would be appreciated.
21 DR. APOSTOLAKIS: That would help me a lot.
22 MR. WHITEHEAD: Okay.
23 DR. APOSTOLAKIS: That would help.
24 MR. WHITEHEAD: That, we should be able to do.
25 DR. LOIS: But the point of the slide was that

1 people are doing different things. For example, when PLG
2 does a low-power shutdown PRA, it would do for the average
3 risk, while the plants, the utilities, they calculate a risk
4 or a fuel core damage for that particular outage.
5 DR. APOSTOLAKIS: Yes.
6 DR. LOIS: That's what --
7 DR. APOSTOLAKIS: But also --
8 DR. LOIS: This tells the story for what's
9 happened.
10 DR. APOSTOLAKIS: But all of them are
11 time-averaged, though, in a different sense. They're simply
12 conditioned on different things.
13 Now, on page 11, 2-11, it says that at River Bend,
14 a cumulative risk for a 21-day outage could be as high as
15 the yearly at power risk. So this tells me that they are
16 multiplying the 21-day CDF times the 21 days, and they
17 compare that with a power CDF times the year, and they are
18 comparable. Am I doing something wrong here? Because as
19 the cumulative risk for a 21-day outage. And the other
20 thing is if in these 21 days, they go through different
21 configurations, shouldn't you --
22 DR. WALLIS: You integrate.
23 DR. APOSTOLAKIS: And I think you guys are
24 objecting to the integration.
25 DR. WALLIS: No.

1 DR. APOSTOLAKIS: That's why --
2 [Chorus of nos.]
3 DR. APOSTOLAKIS: So what are you objecting to?
4 DR. KRESS: You're the one who is objecting.
5 DR. APOSTOLAKIS: No, I want to integrate. I love
6 integration. You know, that funny symbol?
7 DR. SHACK: The problem is the way they organized
8 the document. They talk about that time windowing much,
9 much later in the document.
10 DR. APOSTOLAKIS: But my point is you cannot take
11 -- I mean, how many modes does a plant go to when it --
12 DR. SHACK: It varies.
13 DR. APOSTOLAKIS: -- goes down from power until it
14 goes back up?
15 MR. WHITEHEAD: The plant operating stage?
16 DR. APOSTOLAKIS: Yes.
17 MR. WHITEHEAD: It -- somewhere between, say, 14
18 and 455.
19 DR. APOSTOLAKIS: Okay; okay, fine. So for each
20 one, now, I can calculate a CDF.
21 MR. WHITEHEAD: That is correct.
22 DR. APOSTOLAKIS: Okay; so, I guess what I'm
23 saying is instead of taking each of the CDFs and finding the
24 appropriate fraction of time and then compare with power, it
25 seems to me a total estimate of the probability of something

1 going wrong for the 21 days that would be the integral of
2 time times the appropriate CDFs would be the appropriate
3 probability to compare with the power probability. Is that
4 what is being done? I know it can be done but --
5 DR. WALLIS: What else could be done to make
6 this --
7 DR. APOSTOLAKIS: What else could be done, Graham,
8 is to go to page 7, for example, and compare pulse 5 CDF
9 only with the power.
10 DR. SHACK: But I think what they do as a
11 practical matter is assume that most of the risk is in --
12 DR. KRESS: Because that's where it's in --
13 DR. SHACK: So, yes, that's the conception that
14 they do what you do, and then, they say it's dominated by
15 this particular fraction.
16 DR. KRESS: Yes, it's close to the area under the
17 curve.
18 DR. LOIS: As a matter of fact, the risk for most
19 of pulses is zero. For the biggest part of the outage, the
20 risk is zero.
21 DR. WALLIS: The risk is never zero.
22 DR. APOSTOLAKIS: Then, let me go to page 2-8.
23 DR. LOIS: Insignificant.
24 DR. APOSTOLAKIS: I agree, then, that you guys
25 know what you're doing, but it's not stated well.

1 DR. LOIS: Page 8?

2 DR. APOSTOLAKIS: It says the instantaneous risk
3 at CERI during mid-ploop is at least comparable to that from
4 full power. On a per-hour basis, they give numbers.

5 DR. SHACK: That's okay, too, George.

6 DR. APOSTOLAKIS: That's okay.

7 DR. KRESS: You can divide by any time limit you
8 want to. As long as you're dividing each by the same time,
9 you can do it on a per hour, per year, per 10 years.

10 DR. APOSTOLAKIS: I don't think this is
11 appropriate.

12 DR. KRESS: You're really comparing probabilities.

13 DR. APOSTOLAKIS: Yes; you should be comparing
14 probabilities.

15 DR. SEALE: That's what you're doing when you do
16 the per hour.

17 DR. APOSTOLAKIS: I know, but the point is if I'm
18 in that state for 20 minutes and in the other state for 365
19 days, it seems to me I'm missing something major.

20 DR. SEALE: Then they may be equal per hour, but
21 they're not equal when you integrate over a whole year of
22 operation.

23 DR. APOSTOLAKIS: But this, then, is a misleading
24 comparison.

25 DR. KRESS: George, I think you have a good point

1 there. I think you're saying that a high probability over a
2 short time --
3 DR. APOSTOLAKIS: Yes.
4 DR. KRESS: When you integrate it is not the
5 same --
6 DR. APOSTOLAKIS: No.
7 DR. KRESS: -- as a low probability over a long
8 time, even though the error is the same; no, that's a good
9 point.
10 DR. APOSTOLAKIS: And that's exactly what I want
11 to use as a basis for comparison.
12 DR. KRESS: But I don't know -- there's no theory
13 at the moment that will let you adjust those things.
14 DR. APOSTOLAKIS: I know; it's easy for them to do
15 it, because they know the duration; they know the CDF; they
16 can do it.
17 DR. KRESS: But you have to have a functional
18 between the CDF and the time.
19 DR. APOSTOLAKIS: They can do it numerically.
20 It's not a problem. Those guys can do it.
21 MR. KING: We can do it either way. It's just a
22 question of what makes more sense.
23 DR. KRESS: Add another equation in there, George.
24 MR. WHITEHEAD: Yes; I mean, you're right, George.
25 We can -- the calculations are very easy to do, and in

1 actuality, I believe the utilities provide numbers in
2 various formats. They provide probabilities for each
3 particular, you know, a slice of the outage. They provide a
4 cumulative, you know, over the entire outage and so forth
5 and so on. The question becomes what becomes the most
6 appropriate, you know, measure to prepare against, and, you
7 know, at the time most of these documents were written,
8 people wanted to provide an answer based upon a per-year
9 basis.
10 It's not to say, you know, that we couldn't or
11 shouldn't change the comparison that we -- you know, that
12 we're going to go forward with, you know, from this point
13 forward.
14 DR. KRESS: You ought to do it on a per-year
15 basis, because that's what we're used to.
16 DR. APOSTOLAKIS: Well, I think there are two
17 issues here. First of all, let's not call anything
18 instantaneous, because there's nothing instantaneous.
19 They're all conditional, okay?
20 MR. WHITEHEAD: I hope you can.
21 DR. SHACK: I don't understand you, George. It
22 can be conditional on -- it might have slipped in.
23 DR. APOSTOLAKIS: But it's not. It's time-average
24 then. So the conditional -- what is of interest, I mean,
25 just to summarize here, what is of interest may be two

1 things: the conditional probability, the unconditional
2 probability -- sorry; the conditional probability being in
3 shutdown mode; probability, okay, which means CDF times time
4 and compare that with the conditional probability of power,
5 given year of power, probability.
6 Now, I can see how a CDF itself, on a per-hour
7 basis, could be of interest in the sense that as Tom said,
8 you know, it's really the integral of time times the peak,
9 but maybe there are certain peaks you don't want to
10 tolerate.
11 DR. LOIS: Exactly.
12 DR. APOSTOLAKIS: But that should be very clearly
13 stated, that you are calculating now the conditional CDF on
14 a per-hour basis, and if the agency decides to do something
15 about it, that's fine. You don't want to get to 0.5, for
16 example, even for an hour, okay?
17 DR. WALLIS: Well, CDF has units of 1/T, and it
18 doesn't matter what T is. It can be continuous or variable.
19 DR. KRESS: It may matter, and that's the reason
20 you want to put it. It's the only reason you would want to
21 catch.
22 DR. APOSTOLAKIS: Of course, it matters.
23 DR. KRESS: Well, George, let me ask you: if I
24 had a CDF at some level for one day --
25 DR. APOSTOLAKIS: Yes.

1 DR. KRESS: -- and multiply the two together --
2 DR. APOSTOLAKIS: Yes.
3 DR. KRESS: -- to get a -- and then, if I had a --
4 if I had a CDF divided by 365 level for a whole year, do you
5 believe those two risks are the same? Because the integral
6 of the curve is exactly the same.
7 DR. APOSTOLAKIS: The integrals are the same.
8 DR. KRESS: Yes.
9 DR. APOSTOLAKIS: Yes.
10 DR. KRESS: I thought you were saying that the
11 high risk for the short time is not the same risk as the low
12 one at the long time and that therefore, you need a cap on
13 the short risk or something, or you need to look at --
14 DR. APOSTOLAKIS: That was my second comment, that
15 you may want to put a cap on the second risk.
16 DR. KRESS: The only reason you would want to is
17 if you view those two things as different.
18 MR. CUNNINGHAM: Since they're becoming -- is for
19 a short-term, high consequence or high CDF conditions, are
20 you risk averse, if you will, and you want to make that a
21 more serious condition than the mathematics would otherwise.
22 DR. KRESS: Yes.
23 DR. APOSTOLAKIS: You may want to do that.
24 DR. WALLIS: It is risky to have a peak, because
25 you might under unexpected circumstances get stuck there.

1 When you're in the peak, you're pretty nervous, because you
2 don't want to spoil around. That really needs to be --
3 DR. APOSTOLAKIS: But on the other hand, this may
4 be an artificial peak, because as the staff told us half an
5 hour ago, at South Texas, for example, everybody at the
6 plant has been alerted to the fact that now we are in a
7 particular thing, and the PRA cannot include that. That's a
8 fundamental point.
9 DR. SEALE: So you tie compensatory measures --
10 DR. APOSTOLAKIS: Right.
11 DR. SEALE: -- to the level of the instantaneous
12 risk.
13 DR. APOSTOLAKIS: Right; but it's not
14 instantaneous!
15 [Laughter.]
16 DR. WALLIS: All risk is instantaneous.
17 DR. LOIS: These peaks are calculated based on
18 their PRA, not based on the defense in depth approach.
19 DR. APOSTOLAKIS: Yes, I understand that.
20 So I think we're in agreement, then, that's
21 sometimes violated.
22 [Laughter.]
23 DR. APOSTOLAKIS: But we are in agreement.
24 DR. WALLIS: We're doing calculus I first
25 semester.

1 DR. APOSTOLAKIS: If you go to the commission, and
2 you want to argue that the contribution to risk from LPSD
3 operations is comparable to that from power operations, what
4 numbers are you going to show?
5 MR. CUNNINGHAM: What metric do you use?
6 DR. APOSTOLAKIS: Yes, what metric do you use? In
7 my view, you should be using the probabilities. Then, the
8 next step would be now, an additional insight, because, you
9 know, we really don't believe that something that's very
10 sharp for a short period of time is the same as something
11 else; an additional insight is that the CDF, during these
12 operations, perhaps is way too high, and we may want to
13 think about it, whether that is acceptable, even for such a
14 short period of time.
15 These two numerical results seem to convey the
16 message.
17 DR. BONACA: As we have done for online
18 maintenance, where we said it is manager; if it is too high,
19 don't do it --
20 DR. APOSTOLAKIS: Yes.
21 DR. BONACA: -- too much. So, but I think in
22 general, I think it's a good point. I think we have to be
23 very clear of two things: one, what this comparison means,
24 okay? And I got confused, too, and I understand -- second,
25 again, the issue of presenting them without an assessment of

1 uncertainty at all or a brief discussion is a real
2 additional problem in my mind, you know, that it didn't put
3 them in the right perspective, and I was trying to compare,
4 when I was reading the report; I just couldn't convince
5 myself that there was --
6 DR. KRESS: Yes; the implied assumption is the
7 uncertainties are about the same. Otherwise, you have to do
8 something.
9 MR. WHITEHEAD: Let me address that issue.
10 Currently, most of the utilities perform analyses -- perform
11 analyses do not perform uncertainty analyses using their PRA
12 model. There were three studies that were performed that
13 did have some uncertainty information associated with them.
14 Those were the Grand Gulf and Surrey analyses performed by
15 the NRC and the Seabrook study that was performed by the
16 utility, and that information could be provided, but most of
17 the work that's currently done for outage management does
18 not involve uncertainty calculations.
19 DR. BONACA: I'm just saying that if we go in
20 front of the commission and have to plead for additional
21 funding for low-power and shutdown, we'd better have a
22 clearer presentation of what these numbers mean and the
23 associated uncertainty.
24 DR. APOSTOLAKIS: I think there are two issues
25 that I would raise. One is what we just discussed, and

1 second, I would not limit it just to core damage frequency.
2 The agency cannot do one thing in the oversight area and
3 another in the low-power shutdown. So I think it's a
4 powerful argument to say that the agency has declared four
5 cornerstones as being important, and three of them are
6 compromised during these conditions to some extent, okay?
7 So, I mean, the argument Dr. Powers raised, you
8 know, I can always hand do them. But you already have
9 violated one of the cornerstones. You've got an initiator,
10 okay? So, why are you going after the utilities in the
11 oversight process when their initiating event is greater
12 than seven per year, and here, you're losing water, and it
13 doesn't really matter because you recover from it? It's the
14 issue of consistency.
15 DR. BONACA: It's like the cornerstone which is
16 shutdown which is not in those cornerstones. I mean, if I
17 have to make a judgment for the value of the cornerstones
18 right now for shutdown conditions, I would say a fundamental
19 one is missing, which is time. It somehow has to be
20 translated into some attribute that I don't think is there
21 right now.
22 DR. APOSTOLAKIS: Well, yes, there is an
23 assumption of steady state operation in the way things have
24 been presented.
25 DR. BONACA: There's something missing in there.

1 I agree that --

2 DR. APOSTOLAKIS: But that's not quite a

3 cornerstone. Time itself is not a cornerstone, but it's a

4 significant determinant of the response.

5 DR. KRESS: George, one problem I have with this:

6 when you say you need to pay balanced attention, say, to the

7 cornerstones, we don't have a good notion of what balance

8 means. What you're really saying is you need to allocate

9 the overall risk among the cornerstones. But we don't know

10 how to make that allocation.

11 DR. APOSTOLAKIS: Correctly, I agree, but I

12 already have a basis, because the staff has told me that

13 they don't want to see more than seven, I believe, unplanned

14 trips per year.

15 DR. KRESS: That's an allocation.

16 DR. APOSTOLAKIS: That's an allocation.

17 DR. KRESS: Yes.

18 DR. APOSTOLAKIS: But they're already doing it.

19 Now, whether it's right or wrong is something else. And

20 then, they have certain unavailability bounds for the

21 various systems, and then they have the special -- yes.

22 DR. KRESS: They already have said what does the

23 balance mean.

24 DR. APOSTOLAKIS: Exactly. And in fact, for the

25 initiating events, they say, you know, we really don't

1 expect to see any locus, so we are putting a number of the
2 transients, the trips, and here, we have incidents where we
3 didn't have locus, but, I mean, water was flowing in the
4 wrong direction.
5 DR. KRESS: Out instead of in.
6 DR. APOSTOLAKIS: Now, I think, Erasmia, you have
7 to use your judgment as to which view graphs you want to
8 skip.
9 [Laughter.]
10 DR. APOSTOLAKIS: Because the way we're going, you
11 would never finish.
12 DR. LOIS: I think in preparing, getting into what
13 work we're going to --
14 DR. APOSTOLAKIS: Do you want to go to that
15 because you have methods? Number 16?
16 DR. LOIS: Okay; I can do that.
17 [Pause.]
18 DR. APOSTOLAKIS: Sixteen.
19 DR. LOIS: Okay.
20 DR. POWERS: I have glanced ahead a little bit in
21 the graphs. Why are we persisting to the internal fires as
22 an initiator that falls into an external event category
23 rather than any internal event?
24 DR. APOSTOLAKIS: Which one is the first word?
25 DR. SEALE: Fires.

1 DR. POWERS: Fires.

2 I mean, I know why this was done historically.

3 DR. APOSTOLAKIS: Yes.

4 DR. POWERS: But I don't know why we are

5 persisting to maintain this fiction.

6 DR. APOSTOLAKIS: I believe it's for the same

7 reason: the ACRS wants to say that we always have the

8 benefit of the documents referenced.

9 [Laughter.]

10 DR. APOSTOLAKIS: That was the argument given to

11 me for historical reasons.

12 DR. POWERS: I don't think so. I think it's the

13 nature of the --

14 DR. APOSTOLAKIS: Or minor --

15 DR. POWERS: In essence, it's a lot like a tornado

16 or seismic event in the sense that it doesn't -- it attacks

17 multiple -- and it --

18 DR. APOSTOLAKIS: No, I think --

19 DR. POWERS: I think it has features in common

20 with external events.

21 DR. APOSTOLAKIS: Yes.

22 DR. POWERS: Much more than what we call internal

23 events.

24 DR. APOSTOLAKIS: Yes, it's the way it's treated.

25 You have, in the internal events, you have the initiating

1 events that start an event tree. The so-called external
2 events do not really act as an initiator that starts an
3 event. You take the existing event risk, and then, you say
4 if I have a fire now, which one of these are affected.
5 DR. POWERS: Yes, that's the basic one.
6 DR. APOSTOLAKIS: And if I have an earthquake,
7 which ones of these are affected? So it's sort of the big
8 potential common cause failures, and it's treated as such,
9 so unfortunately, they called it external events. It's
10 really handling certain events that have the potential of
11 inducing great dependencies separately, but by calling them
12 external, you're right: it's --
13 DR. BONACA: And the methodology has been driving
14 disaggregation of those.
15 DR. APOSTOLAKIS: Yes.
16 DR. BONACA: But really, again, I agree with the
17 point that, you know, fires and internal floods, I mean,
18 it's something so specific to the plant that you can't
19 compare it with seismicity, okay because --
20 DR. APOSTOLAKIS: But they don't initiate the
21 sequences in the same way that locus do.
22 DR. BONACA: It's the dominant --
23 DR. POWERS: I bring it up in this context, and I
24 think that fire is a very likely initiator during shutdown,
25 because so much is taking place in a fire, and you can have

1 wild swings, and your transient combustibles, and your
2 potential igniters --
3 DR. APOSTOLAKIS: Sure.
4 DR. POWERS: And it seems to me that to exclude it
5 when you're shut down risks underestimating what the
6 significance of shutdown is to the plant's risk profile.
7 DR. KRESS: I don't think you want to exclude it.
8 DR. APOSTOLAKIS: It can't be excluded.
9 DR. KRESS: You can't exclude it.
10 DR. APOSTOLAKIS: Are they excluded?
11 DR. POWERS: Yes; they've universally been
12 excluded.
13 DR. APOSTOLAKIS: No.
14 DR. POWERS: With no counterexample to it.
15 DR. APOSTOLAKIS: Except for the laboratory
16 analysis, right?
17 MR. CUNNINGHAM: Yes.
18 DR. APOSTOLAKIS: At Seabrook. Seabrook included
19 external analysis. I remember that explicitly.
20 MR. CUNNINGHAM: And it included fire. And it
21 included internal fires.
22 DR. APOSTOLAKIS: Yes, yes.
23 DR. POWERS: I know of no case where shutdown risk
24 assessments have been done that included fire as an
25 initiator.

1 DR. LOIS: The NRC study did. As a matter of
2 fact, the Surrey study identifies fire as a very important
3 initiator.
4 DR. POWERS: I know of no risk analysis that's
5 been run for shutdown events that includes fire as an
6 initiator.
7 DR. LOIS: Not for shutdown? The Surrey study did
8 not?
9 DR. POWERS: I know of none that did.
10 DR. LOIS: Yes; low-power shutdown, the Surrey
11 study did, and it proved to be one of the most important
12 ones.
13 DR. APOSTOLAKIS: Again, it's not treated as an
14 initiator in the sense that you start an event tree. The
15 moment you have the fire, you look at the event trees from
16 the internal events and say which ones of these are
17 affected, so which initiating event from the standard list
18 is the one I have now? In other words, did the fire create
19 a loca? Then, I go to the loca event tree. Did it create a
20 transient? I go to the transient event tree. But I will
21 not treat it as an initiating event in the traditional
22 sense.
23 DR. BONACA: Or what kind of mitigating
24 probabilities that --
25 DR. APOSTOLAKIS: Yes.

1 DR. BONACA: -- in the tables.

2 DR. APOSTOLAKIS: It's a big common mode failure,
3 because it affects also the -- where is the -- do you have
4 the -- please, where is it? I can't find it now but -- tell
5 me which page.

6 MR. BEARD: Page 2-7 is where we talk about the
7 fire events at Surrey, the internal fire event at Surrey.

8 DR. APOSTOLAKIS: Internal fires are the most
9 important events at Surrey because of the physical
10 separation issues. So, they did include it.

11 MR. WHITEHEAD: Yes; Donnie Whitehead. I mean,
12 both of the NRC studies on low-power shutdown did analyze
13 fire event, the internal fires internal to the plant. Also,
14 there were numerous of the international studies on
15 low-power shutdown included internal fires and floods. Some
16 of those also found that those initiating events were
17 important contributors to the overall core damage frequency.
18 So, I believe that, you know, there have been cases where,
19 you know, these have been examined and found to be important
20 contributors. The question becomes whether or not, you
21 know, you're proposing what to do in the future, whether or
22 not you would include those type of events, and it would
23 seem appropriate to at least consider those type events,
24 because they have been found to be important.

25 DR. LOIS: However, in the workshop, we heard that

1 fire and flooding is not important, because there is time to
2 mitigate it, and it's a lot of fiddling around, and
3 therefore, if you have fire or flood, it would be caught.
4 So the, I guess, industry perspective is that it may not be
5 -- these initiators may not be as important.
6 So shall i go ahead here?
7 DR. APOSTOLAKIS: Yes.
8 DR. LOIS: The Reg Guide 1174 provides for the use
9 of qualitative assessments for risk informed regulation, and
10 therefore, we look into the possibility of including
11 qualitative arguments for risk in -- as a basis in decision
12 making for Reg Guide 1174 purposes or Part 50.
13 We thought we would start with the one that the
14 plants are using, the defense in depth. These are the
15 weaknesses that, from a regulatory perspective, from a
16 risk-informed perspective, the fact that you don't have
17 calculation of -- you don't have quantitative risk metric,
18 therefore, you cannot do the ranking, as Dr. Lyon pointed
19 before. You don't know how red red is. There is a planned
20 plant variability in the defense in depth. The licensees
21 have the flexibility to determine themselves the reds and
22 the oranges, et cetera.
23 And also, the utilities grade themselves for how
24 well they adhere to the guidelines. So these are some of
25 the issues that -- the weaknesses that are embedded in the

1 qualitative --

2 DR. APOSTOLAKIS: So even from the -- from what

3 you said, I get the impression that you're saying that 1174

4 cannot be used for requests that involve low-power shutdown.

5 But wouldn't it be fair to say that this weakens the

6 utilization, the degree to which 1174 can be utilized even

7 for power operations? Because an important piece is

8 missing, so if I want, for example, to evaluate, to extend

9 allowed outage times, and I don't have the low-power

10 shutdown contribution, then, I really don't know where my

11 CDF is, so if I go to figures three and four and my LERF, I

12 already don't know what to enter as the figure. And then,

13 when I calculate the delta CDF, it's not clear to me whether

14 the calculation is accurate.

15 In other words, it makes the --

16 MR. CUNNINGHAM: That is correct.

17 DR. APOSTOLAKIS: -- whole risk informed

18 regulatory approach much weaker now, even for cases where

19 there is no shutdown situation.

20 MR. CUNNINGHAM: That's right. That's where you

21 have to go back and qualitatively convince yourself that the

22 change you're talking about doesn't really impact -- isn't

23 impacted by the shutdown risk and that that risk is somehow

24 not going to move you up above the fuzzy areas on the right.

25 DR. APOSTOLAKIS: Right.

1 MR. CUNNINGHAM: Yes; that is correct.

2 DR. APOSTOLAKIS: But that's more difficult if I

3 don't have a --

4 MR. CUNNINGHAM: That is correct.

5 DR. APOSTOLAKIS: -- PRA.

6 MR. CUNNINGHAM: That's kind of --

7 DR. APOSTOLAKIS: Yes.

8 MR. CUNNINGHAM: -- what Erasmia is alluding to

9 there, that if we want to take a qualitative approach --

10 DR. APOSTOLAKIS: Okay.

11 MR. CUNNINGHAM: -- then you've got those

12 weaknesses.

13 DR. LOIS: And therefore, we have to do some work

14 on how to incorporate qualitative approaches into

15 risk-informed. However, we don't have any thoughts yet for

16 the qualitative approach.

17 Also, reflecting what has been done right now in

18 the industry, we thought that as a first cut, we could --

19 what we called use a limited scope PRA for a risk-informed

20 purposes, and that limited scope would include only plant

21 outages, and from those plant outages would be those modes

22 that have reduced the water inventory.

23 However, they would include transition between

24 code shutdown and refueling, because we think that

25 transition risk may be as important. Also, it would address

1 this spent fuel risk. So, it's a little bit more -- it's a
2 limited scope, but it does not quite reflect what's
3 happening in the industry right now, because I guess most of
4 the plants do not assess transition or spent fuel, although
5 the tools have the capability to do that.
6 DR. APOSTOLAKIS: Now, judging from our
7 discussions with the various commissioners, one thing is for
8 sure: they don't want to see the staff propose a new major
9 study ala 1150 for low power shutdown. They're not
10 convinced that this is something we need.
11 I think what you need is a more focused approach,
12 and, for example, you need a view graph that says this part
13 of the problem is done satisfactorily right now by the
14 laboratory work of a few years ago or by the Seabrook PRA or
15 whatever. The reason why I mention Seabrook is that my
16 understanding is that it is the most complete one, external
17 events and so on, goes all the way to letter three. That's
18 what you guys say here.
19 So what is it I don't like about the Seabrook PRA
20 that I want to improve upon and then identify those issues
21 that you feel need some work? Judging again from at least
22 my personal impression from what the commissioners have been
23 saying, that would go a long way towards gaining support
24 from them.
25 DR. LOIS: So, then, that's what we do here,

1 George? This slide represents an approach, and then, we go
2 in and say what we need if we are going to adopt this
3 approach or this methodology for some parts of risk informed
4 regulation, then, what do we need to do on that?
5 DR. APOSTOLAKIS: But what I'm saying, Erasmia, is
6 it would strengthen this slide if you referred specifically
7 to existing studies. For example, why do you want to do
8 plant outages only? Nobody else has done it? You may very
9 well say and this PRA has done a pretty good job; all we
10 have to do is improve it in these areas.
11 DR. LOIS: Yes.
12 DR. APOSTOLAKIS: Then, if I were to vote on this,
13 I would say gee, you know, maybe it's worthwhile doing, but
14 right now, I don't get that feeling that you are building on
15 the state of the art.
16 MR. CUNNINGHAM: Erasmia's got two or three
17 different what she calls approaches here, and she's building
18 on -- because she's doing two or three approaches, because
19 she's building on the two or three approaches that are out
20 in the industry today: the qualitative approach that she
21 was talking about is used in outage management today. This
22 is a description of a way some utilities manage their risk
23 in outages, but you're right, and what we're trying to do is
24 exactly what you say. If we want to build on that to be
25 able to use it in risk informed regulation space, what do we

1 need to do?

2 DR. APOSTOLAKIS: But I'm trying to be

3 constructive here, Mark. I'm saying it would help you a lot

4 if you referred specifically to existing PRAs and said okay,

5 there is a need for shutdown modes with reduced water

6 inventory, but the French have done it; it seems to be a

7 reasonable job; we'll take that.

8 Now, our guys are not doing it, but the

9 methodology is there. That's what I'm saying.

10 DR. LOIS: Okay; I guess we can clarify this point

11 if we go to slide 23.

12 DR. POWERS: I guess I'd like to understand,

13 George, if you say gee, let's not do a big NUREG 1150 study

14 on shutdown risk, and I say gee, why would George say that?

15 We learned an awful lot from NUREG 1150. Those guides are

16 thinking an awful lot about risk. Why wouldn't I be very

17 excited about having something like NUREG 1150 applicable to

18 shutdown events, applicable to fire events? I think I

19 would. So why is it no, I don't want to do that.

20 DR. APOSTOLAKIS: Let me tell you why. I think

21 there are two reasons. First of all, I'm not really saying

22 don't do it. I think there are two issues that I need to

23 clarify here. The commissioners will never approve that if

24 I go there and just say that. Second, what I'm saying is

25 you can do that, but you can specify the methods that are

1 ready to be used for that, so the impression that the
2 commissioners will get will not be that you are starting,
3 you know, almost from scratch, because then, the magnitude
4 of the effort will be very large.
5 But if you say yes, it would be great to have a
6 new 1150 for these kinds of equivalents, for these kinds of
7 modes, but look: 70 percent of this has already been done;
8 all we have to do is take those methods, those results,
9 evaluate them, of course, make sure we are convinced, and
10 then, we need development only in this 30 percent; I think
11 that will go a long way towards giving you the necessary
12 resources.
13 DR. LOIS: And that is not reflected in the
14 report, I understand, but as Mark said, we went a little bit
15 beyond that, and the issues that I'm going to discuss as
16 proposed work, most of it is guidance development; for
17 example, this is how one will use the full power models for
18 shutdown risk. Most of the utilities do use their full
19 power models. However, there are some -- there is a need
20 for guidance on how you would do that on a more appropriate
21 way.
22 So that is an aspect which would need work.
23 However, it is not like doing another 1150 except --
24 DR. POWERS: I guess I'm really having trouble
25 understanding why let's not do another 1150. When I

1 consider 1150 did a great deal to clarify what the risk
2 profiles of representative classes of plants are. I mean,
3 we learned a lot. We learned furthermore where the
4 uncertainties were that would affect the outcomes. And that
5 seemed like a very, very valuable thing.
6 Now, my reluctance for undertaking a big 1150
7 study right now is we have not done the equivalent of the
8 IREP studies of shutdown events yet. We've got it
9 technically in the state that we could do 1150.
10 DR. APOSTOLAKIS: Again, I don't think that the
11 final goal is different, the way I see it and you see it.
12 All I'm arguing here, all I'm trying to do is give advice as
13 to what the best strategy would be to have the commission
14 approve the necessary resources so that the staff would do
15 this. Now, 1150, if you go back, you know, I don't think --
16 I mean, there were some studies, notably in the Zion, Indian
17 Point and so on that looked a little more seriously into
18 level two phenomena but nothing like what 1150 did.
19 Here, you can say yes, my goal is to have an 1150
20 type of study, but with the same breath, you're saying a lot
21 of it has already been done. I'm not starting --
22 DR. POWERS: Somebody is going to have to persuade
23 me that a lot of it has been done.
24 DR. APOSTOLAKIS: Because there was no discussion
25 of it today. You see, I read here that Seabrook has done a

1 level 3 full-scope PRA, and that's mentioned in passing,
2 okay? I'm sure they've done more than that, okay? It
3 included fires; it included everything else. So what is it
4 that they did? And what is it that you don't like? What is
5 it that you don't like about it, and you feel you have to do
6 it from scratch?
7 DR. POWERS: I mean, we've had this conversation
8 with our French colleagues, and I would say that they viewed
9 their work on shutdown risk as scoping and exploratory and
10 not a definitive tour de force of the subject. I certainly
11 heard the people claim a tour de force on their risk
12 analysis. I'm not sure these things bear much scrutiny.
13 DR. APOSTOLAKIS: Why?
14 DR. POWERS: I think we can find deficiencies.
15 DR. KRESS: I think Dana has a good point, and I
16 think it would be a lot easier at this time to do an 1150,
17 because you have the base that you started from for full
18 power, and I think you can draw a lot to do another 1150 for
19 shutdown.
20 DR. POWERS: I worry, because I know what people
21 think of when they think of an 1150. It's huge numbers of
22 studies that went on --
23 DR. KRESS: But what are you going to put into an
24 1150 for shutdown? You're going to put down uncertainties
25 on the fission product releases? Are you going to put in

1 uncertainties on the initiating events? You know, a lot of
2 those uncertainty ranges are going to be about the same, and
3 I think you can do a lot with what you already have, and you
4 don't have to worry about uncertainties on the containment
5 failure. You approach it a different way. So, you know, I
6 think it would be a lot easier to do. But one of the things
7 that bothers me that I don't see in a thing like these
8 approaches, and that's let's take the case of one kind of
9 risk-informed regulation; that is, the 1.174 type, where
10 last sea comes in and says I want to make this change.
11 So you have to enter into -- one of the things you
12 have to do is enter into your matrix and say what's the CDF,
13 and what's the delta CDF? And that's one of the things.
14 Now, in order to do that in terms of low-power and shutdown,
15 you're going to include those in this matrix, you'll have to
16 ask yourself what does this change to the plant that's being
17 proposed do to my lifetime, my whole lifetime, 40 years, of
18 shutdowns in terms of changing the risks? You have no way
19 at the moment of knowing how to account for future unplanned
20 and planned shutdowns, because they're not planned more than
21 one shutdown at a time, not for the lifetime. You have to
22 figure out some way in a risk informed world to account for
23 changes to the plant that are going to affect the whole risk
24 profile for its lifetime, and I don't see this in the
25 concept anywhere. And that's what bothers me.

1 DR. SEALE: What bothers me is I'm trying to
2 figure out what dog will hunt in today's jungle.
3 DR. APOSTOLAKIS: Which is my problem.
4 DR. SEALE: And the one that will is risk
5 informing Part 50. That's the commitment that exists. We
6 ought to ask ourselves what elements of shutdown risk
7 evaluation you need in order to make risk -- make Part 50
8 risk-informed. You get to the concerns about making
9 comparisons, because that's integral to a 50.59 type process
10 or things like that. All of the elements are there, but I
11 don't think you can call it an 1150 replication, because
12 there's just a lot of baggage with that, but if you ask
13 yourself what it takes to risk inform Part 50, then, you get
14 to the pieces that you need to do the job, and you're doing
15 it in a way that is consistent with the dedication -- well,
16 with the marching orders that the staff has received from
17 the commissioners.
18 DR. APOSTOLAKIS: If I read your report, page 3-2,
19 some traditional LPSDPRA applications have covered planned
20 and forced outages in addition to refueling outages to get
21 the comprehensive risk profile. An example of this is the
22 industry study performed by PRG for the Gösgen plant in
23 Switzerland, which consisted of a level one and two analysis
24 for both internal and external events.
25 Now, that intrigues me. If I look at this, I'm

1 willing to bet that with these view graphs alone, you will
2 have three commissioners voting no, because there is nowhere
3 there anything that tells me that there is a study for
4 Gösgen that does all these things and that you're going to
5 build on it, and I've heard it many times from Diaz and
6 McGaffigan: they don't want to start a major study. They
7 want to know what specific things the staff should do to
8 make sure that it reaches a state of understanding of
9 low-power and shutdown that will allow it to use it in 1174
10 and others.
11 So when I see a sentence like this that plays no
12 role in the presentation, I think you're following the wrong
13 approach. I think you should say there is this study there;
14 we looked at it. There are certain things we like; certain
15 things we think we ought to do better, but to have this
16 dynamite sentence that they looked at planned and unplanned
17 outages, level one and two analysis for both internal and
18 external events, so what? We dismiss it?
19 DR. LOIS: So, then, George, I'm not quite sure
20 what is your point here.
21 DR. APOSTOLAKIS: My point --
22 DR. LOIS: Whether or not we've learned that, we
23 propose actually -- our approach is to --
24 DR. APOSTOLAKIS: But you are not saying anywhere
25 there in your view graphs which parts of the existing

1 studies you think are good enough, so you will not do any
2 work on them.
3 But most of the work that we propose is not method
4 development.
5 MR. CUNNINGHAM: It's an excellent point. We're
6 talking about all of the things that are needed, but we're
7 not talking about the things that are already sufficient --
8 DR. APOSTOLAKIS: That's right.
9 MR. CUNNINGHAM: -- if you will.
10 DR. APOSTOLAKIS: And maybe you did that already
11 in your private deliberations.
12 MR. CUNNINGHAM: Yes, that's right.
13 DR. APOSTOLAKIS: But as a third observer now --
14 MR. CUNNINGHAM: Yes.
15 DR. APOSTOLAKIS: -- I don't get that feeling. So
16 what I'm saying is you have to make sure the commissioners
17 understand that you will use a lot if, of course, you
18 approve of what's already out there.
19 MR. CUNNINGHAM: Yes.
20 DR. SHACK: That's sort of assuming that you know
21 what you want to do. I thought the point of these view
22 graphs was to try to decide what you could do if you had
23 this.
24 DR. APOSTOLAKIS: If you had this? What do you
25 mean?

1 DR. SHACK: What could I do towards risk informing
2 regulation if I only had qualitative stuff? What could I do
3 towards risk informing regulation if I had a limited scope
4 understanding? What could I do towards risk informing
5 regulation if I had the whole nine yards?
6 DR. APOSTOLAKIS: That's a different --
7 DR. SHACK: That's a different question.
8 DR. APOSTOLAKIS: Yes.
9 DR. SHACK: But I think -- I thought that was the
10 question they were trying to set up here is what could I do
11 if I had this?
12 DR. APOSTOLAKIS: Nothing.
13 DR. SHACK: No, you want to tell me how do I get
14 to the whole nine yards? That's a whole different question,
15 you know. Do you need to get to the whole nine yards? Can
16 you do enough?
17 DR. APOSTOLAKIS: But if you go to the recommended
18 work a few slides later, again, maybe that's where my
19 comments belong.
20 DR. SHACK: Right.
21 DR. APOSTOLAKIS: But you don't see anywhere a
22 recognition in writing, because I think Mark is right. I
23 mean, those guys thought about it. I don't see any evidence
24 in writing here on the view graphs that they will build upon
25 what's out there. So when I see that the PRA, especially

1 for the Swiss, which consisted of level one and two analysis
2 for both internal and external events, I would like to know
3 why can't I pick that out? It was done by an American
4 contractor, anyway, and use that.
5 DR. BONACA: You did also for Seabrook, so already
6 there --
7 DR. APOSTOLAKIS: There you are.
8 DR. BONACA: -- there was an understanding of, in
9 fact, since the systemics of the two plants are quite
10 different, there will be different lessons learned there.
11 DR. APOSTOLAKIS: For example, you say here
12 initiating events. Maybe if you --
13 DR. LOIS: I guess that's what they're going to
14 say. The key point here is guidance. When we propose to
15 develop guidance, the assumption is that we know how to do
16 it, and therefore, what we provide here is how one would
17 like standards or a NUREG that would tell how would you do a
18 good job, and this is because of these insights we got from
19 the studies referenced in chapter two. So, then, there is
20 no method development in this area because --
21 DR. APOSTOLAKIS: Well, I don't know that; you
22 have to tell me that, you see.
23 DR. LOIS: Yes; I'm sorry.
24 DR. APOSTOLAKIS: I don't know that.
25 DR. LOIS: I mean --

1 DR. APOSTOLAKIS: And if I look at the last
2 bullet, it says common cause failure analysis: examine
3 applicability of full-power CCF. Why? Examine
4 applicability of the Gösgen PRA.
5 DR. LOIS: Sure.
6 DR. APOSTOLAKIS: Not full power.
7 DR. LOIS: Okay.
8 DR. APOSTOLAKIS: Then, you are telling me that
9 you are already aware of this, and you are going to go and
10 see, does this apply?
11 DR. LOIS: Yes.
12 DR. APOSTOLAKIS: And if it applies, I don't have
13 to do anything.
14 DR. LOIS: So, then, for the purpose of this
15 discussion, we got your point, George. However, when we
16 recommend work as guidance development, the assumption is
17 that we feel comfortable with the methods existing, and
18 therefore, we need only clarification on how it should be
19 done.
20 DR. APOSTOLAKIS: For me at least.
21 DR. LOIS: I recognize that.
22 DR. APOSTOLAKIS: I strongly recommend that you
23 use as much as you can from your review, and whenever you
24 refer to something, say and a lot of work has been done
25 there, or we will examine, like you say there, the

1 applicability of what the Swiss did. In other words, we are
2 truly building on what's out there, and you are, of course,
3 very free to disagree.
4 I think it's a matter of communication, but I know
5 of three commissioners who if they see this will be
6 negative.
7 DR. LOIS: Okay.
8 DR. APOSTOLAKIS: And frankly, if I were one of
9 them, I would probably be myself.
10 DR. LOIS: Okay.
11 DR. APOSTOLAKIS: Unless I talked to you in
12 private, and you explained to me that -- you know,
13 communicating is very important, especially when people walk
14 into the room being on the negative side, as I think these
15 three are.
16 DR. LOIS: Okay; so, here, we clarify it. Shall
17 we go ahead?
18 DR. APOSTOLAKIS: So, tell us about the next
19 recommended work.
20 DR. LOIS: Okay; I guess the next recommended work
21 is on the HRA, and the point that we would like to make here
22 is that typically, people are using the methods that are
23 used for full power, and we heard the complaint that it is
24 not applicable, and probably, the estimates are all very
25 pessimistic because the times allowed in the full-power PRAs

1 are small, et cetera.

2 So our feeling is that probably what needs to be
3 done here is clarification, because most of these -- some of
4 the full-power HRA methodologists do allow for long times
5 that it appears that it's not clear in there, in people's
6 heads, how one would use it, and the other is, of course, to
7 investigate what we should do for the human error to
8 initiate abnormal events and look at ATHEANA and then
9 perform additional work if we find that it's necessary.

10 DR. APOSTOLAKIS: I think ATHEANA can be used very
11 well in low-power shutdown operations to do what it does
12 well for power operations; in other words, given the
13 initiator, you've had human failure events; analyzes the
14 hell out of them. But as you pointed out earlier, the work
15 processes here really may create unhealthy situations is not
16 exactly something that ATHEANA right now does.

17 In fact, one of the commentors again on ATHEANA
18 said that it's hard for him to see how management and
19 organizational factors can be included in this current
20 format, and maybe they don't really belong there, but in
21 this case, where, you know, a lot of things are happening
22 that are not little things, that's where these things get
23 important.

24 DR. SEALE: Could I ask a detailed question: do
25 we have available performance estimates for things done by

1 staff who are trained members and so on versus contractors
2 who come in from the outside? Is that kind of distinction
3 recognized here? And should it be?
4 DR. APOSTOLAKIS: It should -- it will be
5 recognized if they start doing what we just discussed.
6 DR. SEALE: Yes, and as a matter of fact, the
7 thing that comes out of that, it seems to me, is you need
8 supervision of a trained staff member overseeing anything
9 that a contractor does.
10 DR. APOSTOLAKIS: That's one of the arguments that
11 the industry has used in arguing for online maintenance.
12 DR. SEALE: Yes, oh, yes.
13 DR. APOSTOLAKIS: We could relieve our staff from
14 a lot of the work that has been during outages, so we don't
15 need as many contractors. So this is one of the
16 unquantified benefits of online maintenance. But there is
17 no quantitative, serious evaluation of this.
18 DR. SEALE: Yes.
19 DR. LOIS: So, then, going back to your point
20 here, we have things that we can build upon in existing
21 methodologies and some things that we probably should
22 explore further.
23 DR. APOSTOLAKIS: Yes.
24 DR. POWERS: When you look at a plant, and you say
25 gee, I'm going to do the risk assessment here on this plant,

1 you have a pretty good idea of what things look like when
2 the plant is operating, not only for the next operational
3 cycle but for 20 operational cycles down the stream. You
4 have a pretty good idea of what that plant is going to look
5 like when it's operating.
6 That's not really the case for shutdown, it seems
7 to me; that I know what the next shutdown event is going to
8 look like pretty well, because people are probably working
9 on planning it right now as we speak. But I have no idea
10 what the 19th next shutdown is going to look like, because
11 there will be other, different demands on things that will
12 have to be done. I don't see how that gets factored into
13 these things that you're talking about as future work on the
14 PRA, the fact that the shutdown events are not carbon copies
15 of each other, even as planned right now, and the unplanned
16 shutdowns, Lord knows what they look like.
17 How do you handle that?
18 DR. LOIS: I guess PRA always -- I'm sorry.
19 MR. CUNNINGHAM: I just wanted to clarify
20 something. I'm not sure I understand what you mean. Are
21 you talking about variability in outages themselves or
22 variability of the events that occur during outages?
23 DR. POWERS: I'm saying that -- I may be -- what I
24 know is that my planned outages right now, I'm going to take
25 fuel out, and I'm going to put fuel back in; I'm pretty sure

1 that that's going to happen, and I know all about that. I
2 know what I have to do to take fuel out, and I know what I
3 have to do to take fuel in. But while I'm doing that, I
4 also tend to do maintenance on lots of things that need to
5 be maintained.
6 Some of those things, I know very well, because
7 I'll do it every single outage. Some of those things, I
8 will do only every fifth or sixth or tenth outage, and so,
9 any given outage is going to look different as far as what's
10 available and what's not available; what stresses there are
11 on one group of operators versus another group of operators.
12 Everything is going to be different.
13 DR. BONACA: And they will change as you go.
14 DR. POWERS: And they change as we go along,
15 evolve. I want to see recognition here, you know, of that
16 difference.
17 DR. APOSTOLAKIS: I think I didn't communicate it
18 very well. That's what I meant when I said that ATHEANA is
19 not equipped to handle that; that you really have to deal
20 with the way work is being accomplished. The complicating
21 factor that you just raised is that you may not even know
22 what work needs to be done for some of these, but the plants
23 do not do things ad hoc. They have work processes; they
24 don't always call them that way, programs and work
25 processes. So if there is a need for something to say oh,

1 this is what we're supposed to do, and they follow this
2 sequence.
3 Now, what complicates things, I think, is the
4 timing. But one of the most important things that I
5 learned, at least from looking at the operating experience,
6 is that you really have to know at any one time what work
7 processes have taken place at the plant and what changes to
8 the configuration have been affected precisely because they
9 are trying to do this piece of work, and Wolf Creek is a
10 good example.
11 DR. BONACA: One thing that drives clearly the
12 risk is you're making a plan at the beginning, and that will
13 involve a certain number of modes or configurations, okay?
14 If you went -- when you see a lot of changes happening to
15 the original plan for whatever reason -- it may be
16 management that says do it fast, so do this first and pull
17 out that -- there is almost a correlation between events
18 that occur and the amount of changes that you have in the --
19 I mean, number of modes, there is a correlation between what
20 happens. I don't know -- you know, I really don't know if
21 -- I don't know if that can be or where that can be treated.
22 But anyway --
23 DR. SHACK: Coming back to the bigger picture, it
24 seems to me that, you know, you're doing this request for a
25 number of reasons. One is that I think to me, when I see

1 what they recommended here, at least implicitly in their
2 head, it seems to me most of this is aimed at assuring
3 themselves that the quality of the PRAs that the licensees
4 are using to manage their outages are good. So to me, most
5 of this work would look like it would build towards just
6 assuring themselves that what these guys are doing with
7 their PRAs are pretty good, and so they're looking at those
8 weaknesses.
9 There's this question of how do I decide where I'm
10 at in 1174? There's the question of how do I give the
11 senior reactor analysts the ability, the tools, to judge?
12 To me, those are kind of almost three different things, and
13 when you're recommending the work, you kind of have to
14 decide which of those higher level goals you're really
15 aiming at at the time. And, you know, at the moment, I
16 would say that what I see up there looks like it's focused
17 on assuring the quality of the PRAs that the licensees are
18 using, which doesn't strike me as an unreasonable thing to
19 be doing.
20 It doesn't address all of the questions one might
21 ask.
22 DR. APOSTOLAKIS: But given the current situation,
23 okay, funding, commissioners and so on, no matter how noble
24 your goal is, the question of how you get there is critical,
25 because if you tell them that you're going to do all of

1 these things to get there without anything else, there is a
2 very high probability --
3 DR. SHACK: But first, you have to know where
4 you're going.
5 DR. APOSTOLAKIS: Yes, but they seem to know,
6 though. They seem to know. They can rephrase it a little
7 better.
8 DR. SHACK: To me, you know, I think I've seen us
9 aim off at a couple of different roads here. Now, a lot of
10 what you're doing, of course, is useful for all three major
11 things.
12 DR. APOSTOLAKIS: Okay; so what do we recommend,
13 then, to the staff to structure -- let's say they have to
14 make a presentation to some real decision makers, not
15 advisors. First is the goal: what are you trying to do
16 here, okay?
17 DR. KRESS: What are the benefits?
18 DR. APOSTOLAKIS: Yes; so, what are the goals?
19 The goals, as you just said, is to have a PRA.
20 DR. WALLIS: Why do you have those goals?
21 DR. APOSTOLAKIS: What? Well, there has to be
22 some sort of an ultimate achievement.
23 DR. WALLIS: A benefit. What's the need?
24 DR. APOSTOLAKIS: Well, the need is, first of all,
25 that the way 1174 is now, this is a major hole. You can't

1 really use 1174.

2 DR. WALLIS: And you feel that hole is important?

3 DR. APOSTOLAKIS: Well, it is the jewel of the

4 crown of the regulations.

5 DR. SHACK: I'd put it the other way around. What

6 I want to be sure is when the licensee does a PRA of his

7 shutdown, it means something.

8 DR. APOSTOLAKIS: Yes.

9 DR. SHACK: So, well, to me, that's the most

10 important thing --

11 DR. APOSTOLAKIS: Actually, I would change it

12 slightly to say when they use ORAM and all of those things,

13 they should really know what they're doing, and the way to

14 do that is with a PRA. And Dana's point that the staff

15 should have the tools to evaluate what the licensee is doing

16 is a relevant point here.

17 DR. BONACA: Assume that I could make a point that

18 the risk that we're talking about needs some

19 characterization, okay? I could identify some

20 sensitivities. I made an example before of the relationship

21 between events and the numbers of mode changes that should

22 take place, and I don't know if there is a basis. I have a

23 very strong suspicion. If you have a number of

24 characterizations of the type that you could draw from a

25 study of this nature, the benefit would be very obvious in

1 my mind. I'm trying to go back to the issue of the benefit.
2 There are things we can draw upon to understand so that we
3 can all learn from that, because the utilities have not done
4 that. The utilities are using it ad hoc, but they have not
5 determined, for example, the issue, again, if there is one,
6 and I believe there is one, and there is a correlation
7 between the way you change modes, et cetera, so many times
8 and the events that you get, right?
9 And so, I think the benefit issue is very
10 important to me.
11 DR. APOSTOLAKIS: Okay; I suspect that we're
12 getting into the discussion among ourselves now, so let's
13 stop for awhile; we'll get to that and give Erasmia one last
14 chance to give one of her view graphs, and I think the view
15 graph we have not talked about and introduces something kind
16 of new is number 28. Everything else, I think one way or
17 another, we have discussed.
18 DR. BONACA: I also propose again that we will
19 give the gold medal to Erasmia for the patience she has
20 shown.
21 DR. APOSTOLAKIS: Especially given her heritage,
22 being patient is not something --
23 [Laughter.]
24 DR. APOSTOLAKIS: -- that is a clear
25 characteristic from that part of the world.

1 DR. LOIS: Thank you; I accept the --

2 DR. APOSTOLAKIS: So tell us why you think

3 transition risk is important, contrary to the evidence you

4 have seen, Bob, the last few years.

5 DR. SHACK: I better not rush to just.

6 DR. APOSTOLAKIS: What transition?

7 DR. LOIS: I guess it was just about the

8 discussion that -- your discussion right now, that this is

9 the change within, from one power level to another,

10 transition, but also, as within a configuration, as people

11 do the realignment, this is where the errors probably occur.

12 DR. APOSTOLAKIS: Has anybody done a transition

13 risk analysis?

14 DR. LOIS: I guess -- yes?

15 MR. WHITEHEAD: Donnie Whitehead; let me address

16 that. There have been studies, and we reported a couple of

17 them both from the NRC and industry studies that account for

18 the first one that we talk about here; that is, modeling the

19 risk associated with moving from one operational state all

20 the way down to some lower operational state or from power

21 operation down to shutdown.

22 The second concept in transition risk, I believe,

23 has not been examined, and at this point in time, we are

24 unsure as to whether or not, you know, it is important; I

25 mean, what we are proposing here is that this area be

1 investigated; that is, where are the places where initiating
2 events might occur? This, you know, this is very likely
3 that it could be in the actual physical changing of or
4 transitioning of the plant from, say, train A of RHR to
5 train B of RHR, positioning of valves from one state to
6 another state, especially if there are combinations of
7 actions going on.
8 So that's where we're -- that's where we think
9 that we need additional work to examine to see whether or
10 not this is important. The other, like I said, it has been
11 looked at.
12 DR. APOSTOLAKIS: Do you suspect that it is
13 important? On what basis?
14 MR. WHITEHEAD: Well, because of events that have
15 happened in the past, where indicate, I think you had
16 indicated one where activities were postponed from one to
17 another, and then, from one day to another day, and then,
18 people come in and start in on the activities that they
19 believe that they need to, you know, to perform. I mean,
20 what we're looking for here is to try to identify, you know,
21 what are the interactions amongst the human events that must
22 take place to actually move the plant from one state to
23 another state, and, I mean, the answer is we do not know if
24 they're important. We suspect that it's possibly that
25 they're important, and we've seen events where, you know, an

1 initiating event occurred because of conditions like this.

2 DR. APOSTOLAKIS: I remember the BMW owners' group

3 a couple of years ago when they were arguing, oh, what was

4 it now? That the plant should not be shut down. They

5 include the transition risk in their calculations, and what

6 struck me then was that that number was pretty high, and on

7 the basis of that, they were arguing that it's better to

8 extend the AOT and do things at power rather than shut down

9 because this particular piece of equipment has been down

10 longer than the allowed time.

11 MR. WHITEHEAD: That's the first concept --

12 DR. APOSTOLAKIS: Right.

13 MR. WHITEHEAD: -- in transition risk, yes.

14 DR. KRESS: I'm not sure I understand. If I'm

15 going to do a risk assessment of a plant, I've got to find a

16 configuration in that plant, and then, I've got to go into

17 my PRA and put in all the failure rates and initiating

18 events and come out with a number.

19 There is no transition here. If I want to do it

20 for another configuration that has changed, then, I change

21 the PRA to this new configuration. If I'm going to ask

22 myself what's the transition risk, it's actually embodied in

23 one or the other in that second state, and you have to ask

24 yourself the mere fact that I changed from this state to

25 that one must have affected something in my PRA. It must

1 have said I either do not have this configuration like I
2 thought I had or I have a different failure rate for
3 something or a different something.
4 So it ought to be -- the transition risk ought to
5 be embodied some way in your look at the given --
6 DR. APOSTOLAKIS: I guess what they're saying is
7 it's not the initial and final states that matter. There is
8 a certain period of time between the initial and final when
9 things are changing.
10 DR. WALLIS: It's like landing an airplane.
11 Flying and being on the ground are very different for the
12 pilot.
13 [Laughter.]
14 DR. APOSTOLAKIS: So they are making a
15 distinction. This doesn't happen in a small delta P, when
16 they reconfigure the plant and, you know, to go from one
17 state to another, it takes a certain period of time.
18 DR. KRESS: PRAs are not differential equations.
19 You cannot do that in a PRA.
20 DR. APOSTOLAKIS: No.
21 DR. KRESS: You want to divide it up into little
22 time increments and --
23 DR. APOSTOLAKIS: Well, we don't know what you're
24 going to do, but maybe there is a period of a few hours when
25 certain things are happening, and maybe the existing tools

1 are not good enough. I mean, we are into pushing event
2 risks and fault risks to the limit. I mean, there are
3 static tools that represent logical relationships, and we're
4 using them everywhere, and time is important.
5 DR. BONACA: It changes it, it may cause
6 initiating events that you never consider in any other
7 period of initial or final configuration, just because
8 something is happening there; a system is out of service.
9 DR. KRESS: Like I said, you're changing something
10 that -- you fix a configuration, and you put an initiating
11 event frequency or a failure frequency or a configuration.
12 So the research you have to do there doesn't have anything
13 to do with the PRA.
14 DR. APOSTOLAKIS: But you have to look for these
15 initiating events. That's what they are saying, that
16 somebody has to look.
17 DR. WALLIS: I don't agree that those lines --
18 repair really should be a dynamic thing in which everything
19 is a function of time and so on; that's a very sophisticated
20 PRA.
21 DR. KRESS: That is a different PRA than what we
22 have now.
23 DR. APOSTOLAKIS: That's different; that's a
24 second generation PRA.
25 DR. KRESS: You may be right; it ought to be a

1 different equation.

2 DR. APOSTOLAKIS: Mike, do you want to say

3 something?

4 MR. MARKLEY: I just was going to say something.

5 DR. APOSTOLAKIS: Come to the microphone.

6 MR. MARKLEY: Just from my inspector experience,

7 it seems to me --

8 DR. APOSTOLAKIS: Who are you, Mr. Markley?

9 MR. MARKLEY: I used to be somebody else, but Mike

10 Markley with the ACRS staff.

11 I think it's mostly, you know, at least from, you

12 know, inspector time is that the opportunities for more

13 human errors occur, and that's really where it goes through

14 the roof, that the equipment really hasn't changed for the

15 most part, but the mere process of changing things and

16 taking people out of their daily routine and having them do

17 things that they haven't done in 18 months or so creates

18 opportunities.

19 I mean, just something as simple as taking the

20 generator off the grid causes safety system actuation with

21 the diesel if you don't do it properly and turn one wrong

22 knob. So there are just unique opportunities and things

23 that you don't realize about the equipment as well. Two

24 rods don't fully insert in a core in post-operating cycle

25 rod drop tests. What does that mean? They're just --

1 DR. KRESS: So figure out how much time you're in
2 the transition; fix the PRA configuration at some average
3 thing and input different failure.
4 DR. APOSTOLAKIS: But now, you're telling them how
5 to do it.
6 DR. KRESS: But the problem is what are you going
7 to input, and the input has to do with you don't know what
8 these new changes to the failure rates and the initiating
9 events are.
10 DR. BONACA: The big problem is that there is an
11 issue about how you transition, and you can model it. The
12 bigger issue is you're doing so; you have a lot of
13 preparation ahead of time. You have literally a month and a
14 half or two where everything is being reviewed, okay?
15 Now, you get into with the legal staff, and the
16 decision is made that something cannot be done. You go back
17 a step, so you can do something, do some work before, and
18 now, you have narrow windows of evaluations; you have shift
19 changes, and you have maybe only one individual reviewing
20 something and dressing it off. So all I'm trying to say is
21 that now, that mode change that happens as a change process
22 as you are in the outage triggers all of the events that
23 Mike Markley was pointing to, okay? In addition to the
24 transition, you have unplanned transitions, and if really,
25 one could understand the risk of that and understand the

1 correlation that there is between those things and risks and
2 how you can model it, for example, it would be a
3 justification for better understanding what should not be
4 done and ultimately what should not be done in that
5 configuration.
6 DR. APOSTOLAKIS: Okay; I'm just -- I think you're
7 almost done, but I'm just curious on page 31. As part of
8 this project, you plan to check a republic. Which republic
9 are you checking?
10 [Laughter.]
11 DR. LOIS: I'm sorry about that. I'm sorry about
12 that.
13 DR. APOSTOLAKIS: Okay; I think we should thank
14 Erasmia for her patience.
15 DR. POWERS: I think there's --
16 DR. APOSTOLAKIS: I think we should discuss it
17 among ourselves now.
18 DR. POWERS: I think there are still some
19 omissions from the work that has to be done. It seems to me
20 one of the first steps that one has to do in thinking about
21 a probabilistic risk assessment, one has to find out what a
22 criterion for success and failure is. And it's not evident
23 to me that the criteria for success and failure in shutdown
24 are the same as they are in power operations. And in
25 particular, I see -- I look at things that go on during

1 shutdown, and I said gee, we finally recovered fuel and then
2 covered it back up, that would be okay. I wouldn't have any
3 trouble with that.
4 It's not evident to me that it's okay under
5 shutdown conditions, and I guess my point is --
6 DR. APOSTOLAKIS: What is the appropriate metric
7 for that?
8 DR. POWERS: Yes; do we need to understand what
9 the success criteria are for these shutdown events?
10 DR. APOSTOLAKIS: Okay.
11 DR. POWERS: Do we understand what the
12 consequences are of failure for achieving a success pathway?
13 For instance, I guess there has been talk about the release
14 pathways or the release mechanism. A pressurized plant for
15 an accident in the power, you usually conceive of a fairly
16 violent release of radioactivity when the containment fails,
17 and you track it as a plume, whereas with the containment
18 open and what not, you are probably going through the aux
19 buildings, for the most part, for a power accident, you
20 would give no credit for decontamination of the aux
21 buildings, because we knew the velocities were so high
22 powered, you would probably be knocking them down anyway,
23 and resonance times were going to be pretty low.
24 Now, I think the resonance times are high, and
25 decontamination probabilities are very high in the aux

1 buildings. That element seems to be missing from this.

2 DR. APOSTOLAKIS: Let's put some structure to this

3 discussion.

4 First of all, thank you very much, Erasmia. You

5 can sit down now.

6 The first question is does the committee feel that

7 the full committee should write a letter? Can you turn off

8 the -- any feeling that we need to write a letter or stay

9 silent? The staff is requesting a letter, by the way.

10 DR. KRESS: In December?

11 DR. APOSTOLAKIS: Yes, in December, commenting on

12 all of this and maybe offering some advice. Are the members

13 reluctant to write a letter?

14 DR. POWERS: How many pages long?

15 [Laughter.]

16 DR. APOSTOLAKIS: All right; so, the first answer,

17 then, is yes, we will write a letter.

18 Now, I want to ask you a point of procedure.

19 DR. SHACK: Is there any particular urgency to the

20 letter? I mean, if it slipped --

21 DR. APOSTOLAKIS: They are sending something in

22 December to the commission.

23 MR. CUNNINGHAM: We owe a commission paper with

24 this plan in December to the commission by current

25 schedules.

1 DR. APOSTOLAKIS: So, the question is this: shall
2 we go around and have each member express his views about
3 what ought to be in the letter? Or shall we first talk
4 about some general issues like the goals of the research,
5 what are we trying to achieve, methodology and then give
6 members opportunity to -- how do you want to structure this?
7 Because we don't have much time.
8 DR. SHACK: Are we going to see the commission
9 paper before we write the letter?
10 MR. CUNNINGHAM: I suspect the commission paper
11 itself will be just a summary of what you've got already.
12 DR. SHACK: Of this document. And this
13 unreleased, unreleasable document is actually a reasonably
14 accurate reflection?
15 MR. CUNNINGHAM: I think the place we really need
16 to think in that document is the recommendations part of it.
17 We've heard a lot of good information today, and that's the
18 part that --
19 DR. APOSTOLAKIS: I'd like something much earlier
20 than that.
21 DR. WALLIS: I don't think you can sell this
22 program if you use what you have at the moment. I think
23 you've got to answer the kind of questions that Dana has,
24 the kind of questions the commission is going to have, and
25 all these details that we get into here are not going to

1 make any difference to that. That's my impression.

2 DR. APOSTOLAKIS: If you could get a postponement,

3 it will benefit you.

4 MR. CUNNINGHAM: Okay.

5 DR. APOSTOLAKIS: Because if the report reflects

6 the presentation, I'm not sure that the commission will be

7 positive.

8 DR. SEALE: I just think you have to make the

9 point that these are things you have to do in order to

10 deliver on your commitment to risk-informed Part 50.

11 DR. APOSTOLAKIS: Well, okay, let's start without

12 them. What should be the goal? What is the need for this

13 kind of research? Can we go around?

14 Bill? You can pass if you wish, but you raised

15 the issue.

16 DR. SHACK: No, I see you'd have multiple goals

17 for this one.

18 DR. APOSTOLAKIS: Okay; what are they?

19 DR. SHACK: You know, as I say, one, to assess

20 what the risk management that the -- right, I mean, that's

21 clearly directly related to --

22 DR. APOSTOLAKIS: Assessment and management of

23 what? Of the utilities?

24 DR. SHACK: That the utilities are performing. I

25 mean, that seems to me the absolute most direct connection

1 to public health and safety. These people are making
2 decisions.
3 DR. APOSTOLAKIS: Okay; what's next?
4 DR. SHACK: The next is to -- you need this in
5 order to continue with your risk-informing Part 50 or even
6 1174, you know. And you do have to know where you are on
7 the axis.
8 DR. APOSTOLAKIS: And the third? Is there a
9 third?
10 DR. SHACK: The third, I think is Dana's point of
11 view that, you know, the commission itself needs insights
12 and perhaps tools. Now, if you can't afford all three of
13 these, you know, then, we have a prioritization problem.
14 DR. APOSTOLAKIS: The commission needs insights
15 for what?
16 DR. SHACK: They can make judgments on what the
17 utilities are doing, the tools.
18 DR. APOSTOLAKIS: For what?
19 DR. SHACK: No, tools says -- you're assessing the
20 tools that the utilities are using.
21 DR. APOSTOLAKIS: Yes.
22 DR. SHACK: Well, the other part is to have your
23 own tools so that you can essentially do an assessment also.
24 DR. APOSTOLAKIS: Which will tell you how good
25 what the utilities are doing is.

1 DR. SHACK: But you make an independent -- you
2 know, the question is is this important enough that you
3 require independent assessment?
4 DR. APOSTOLAKIS: I think they're related but --
5 DR. SHACK: I wouldn't say that they're
6 independent.
7 DR. APOSTOLAKIS: No?
8 DR. SIEBER: No, the utility can -- may or may not
9 decide to do shutdown risk assessment or choose whatever
10 tools they want, and then, they manage risk that way. The
11 commission, however, needs to have the tools to be able to
12 arrive at generic conclusions about certain phases of
13 shutdown operations so that they can decide whether not only
14 risk informing Part 50 but what's the adequacy of the
15 deterministic regulations that exist right now, because it's
16 always going to be a hybrid, and they need to have some kind
17 of a risk-informed ability to determine whether the
18 regulations are adequate or not.
19 DR. SEALE: Tom King mentioned the ASP program.
20 DR. APOSTOLAKIS: Yes.
21 DR. SEALE: The need to provide the inspectors
22 with the tools they need in order to make reasonable
23 judgments about risk and the shutdown mode.
24 DR. APOSTOLAKIS: Well, this is part of assessing
25 the risk management that --

1 DR. SEALE: Yes, but that's again a commission
2 commitment down the road, and in order to do that, you need
3 risk informed information about shutdown.
4 DR. APOSTOLAKIS: The way I see it from what I
5 hear is that there are two issues, really. One is --
6 DR. SHACK: You've got all the way to go around
7 the table.
8 DR. APOSTOLAKIS: But it's going to be repeated,
9 so let me focus it a little bit. One is contribute to the
10 current efforts to risk-informed Part 50 and use 1174, and
11 the other one has to do with what the utilities are doing
12 right now, and that has several parts: is it good enough,
13 right? Do we have the capability to independently evaluate
14 it? You know, all these are parts of this. So there are
15 two major goals that I heard so far.
16 Tom, any comments on this?
17 DR. KRESS: I think those are the two goals.
18 DR. APOSTOLAKIS: Bob?
19 DR. UHRIG: Just that this is important, because
20 the order of magnitude of the risk is comparable to normal
21 operations. In spite of the motivation --
22 DR. APOSTOLAKIS: How do I argue with that? It's
23 comparable? There is a suspicion that it is. There is
24 evidence that it may be.
25 DR. UHRIG: Yes, but that's not a goal.

1 DR. APOSTOLAKIS: That's not a goal.

2 DR. UHRIG: No, but it is an issue that --

3 DR. APOSTOLAKIS: But it relates to -- Jack said,

4 regarding the adequacy of the existing regulations --

5 DR. UHRIG: That's right.

6 DR. APOSTOLAKIS: -- that risk may be high.

7 DR. UHRIG: And the other issue is whether you

8 want to say anything about the ASME effort on

9 standardization PRAs should or should not include this.

10 DR. APOSTOLAKIS: That's not a goal right now.

11 That may be a little later. It's not a goal.

12 DR. UHRIG: Okay.

13 DR. APOSTOLAKIS: Mario?

14 DR. BONACA: My problem is with the second

15 recommendation. My point is that right now, the utilities

16 are only doing a very detailed evaluation when they see the

17 big picture, lessons learned, okay? Of what the drivers are

18 of risk during shutdown. We know that inventory is

19 important; power is important. The question is what is

20 happening out there that drives risk? And, you know, we

21 make some discussion here about motivations. There are some

22 issues there that, you know, have not been looked at in a

23 comprehensive fashion, and certainly, 1150 did that for

24 power. We don't have any equivalent.

25 DR. APOSTOLAKIS: So the insights that the PRA

1 provides are --

2 DR. BONACA: Generally, insight from the lessons

3 learned about all these different facts.

4 DR. APOSTOLAKIS: Dana?

5 DR. POWERS: Are we going to look at the goals?

6 DR. APOSTOLAKIS: Okay; so, I am sorry.

7 DR. WALLIS: You never asked me.

8 DR. APOSTOLAKIS: I never asked you? Professor

9 Wallis?

10 DR. WALLIS: Well, it seemed to me that if your

11 goal is to risk-inform Part 50, if that's the goal, and I

12 don't know if this really is the goal, then, what you need

13 to do is figure out what you need for adequate PRAs in these

14 situations. I don't think, however, this is going to sway

15 the commission. I think that risk-informing Part 50 isn't

16 such a wonderful thing that you do everything no matter what

17 in order to risk inform everything. You've got to figure

18 out what matters.

19 I don't think the case is really being made that

20 this is a crucial place to put --

21 DR. APOSTOLAKIS: Yes; for example, the option two

22 that the staff is pursuing now, which really deals with the

23 scope of the regulations, clearly --

24 DR. WALLIS: You need to have the right tools if

25 you're going to risk inform. What are the tools you need in

1 order to understand the PRA?

2 DR. APOSTOLAKIS: You clearly need a ranking of

3 SSCs under all the configurations, so clearly, this is a

4 major hold, yes, yes.

5 DR. SIEBER: Again, this is administrative in

6 nature, but you do have an enforcement policy that's

7 risk-informed right now, and most of the violations that are

8 written are written during outages on different things that

9 happen. So if you're going to risk inform that to determine

10 whether it's cited or non-cited or civil penalties, you've

11 got to have a basis, and right now, you don't.

12 DR. APOSTOLAKIS: So risk inform the enforcement

13 process.

14 DR. SIEBER: Yes or policies.

15 DR. KRESS: When you say risk-inform, the

16 regulations are included in that.

17 DR. APOSTOLAKIS: I think that we can emphasize

18 that.

19 Okay; it seems to me that we are done with this.

20 We'll have another opportunity to discuss the letter; don't

21 worry about it. This is just advice to the poor fellow who

22 has to write the first draft.

23 Shall we go to the tools, or do you want to go to

24 open discussion and then, after the tools, go to the open

25 discussion, in other words, the various recommendations of

1 what to do and so on?

2 The floor is open for any comment you want to

3 make.

4 DR. WALLIS: What can you do with the present

5 tools, and what are you losing?

6 DR. APOSTOLAKIS: Well, that was exactly my point,

7 that I want to see the --

8 DR. WALLIS: How can you make the quickest --

9 DR. APOSTOLAKIS: What can you do --

10 DR. SEALE: With what you've got.

11 DR. WALLIS: With what you've got.

12 DR. SEALE: The first question.

13 DR. WALLIS: Why are you dissatisfied, and where

14 are you dissatisfied, and what is the cost of all of this?

15 DR. APOSTOLAKIS: Why do more? Yes, justify why

16 you need to do more, right? In an explicit way.

17 DR. WALLIS: Yes.

18 DR. KRESS: See, George, we made the point in an

19 earlier letter that there are two types of PRA in this

20 context. One is for configuration risk management, and the

21 other is for risk informing the regulations. In my opinion,

22 those things are very different animals, very different. I

23 think the tools that are out there are mostly for

24 configuration risk management that the industry has. I have

25 a problem with those that are the same as Dana's. I don't

1 think we -- the oranges and the reds and the greens have
2 been well-quantified in terms of the risk, so I have a
3 problem with those.
4 But I don't think they help us very much at all in
5 risk-informing the regulations, and I think we need a new
6 type of tool for that, and it involves this comment I made
7 about you have to know -- you have to project the risk over
8 the lifetime of the plant if you're going to risk-inform the
9 regulations. If you're going to project the risk over the
10 lifetime of the plant for shutdown conditions, you will have
11 to have some representation of what those are, and I don't
12 know. We don't have the database; we don't have the tools
13 for analyzing them. We don't have the effects of the
14 various configurations over the lifetime of the plant, and I
15 think the development of the tools in that area is where you
16 really need a strong look at them.
17 DR. APOSTOLAKIS: I am not willing to make such a
18 strong distinction between configuration risk management and
19 risk informing the regulations. I mean, if you -- I don't
20 think you need a different PRA to do this.
21 DR. KRESS: I think you can write a shutdown risk
22 using the configuration risk management tools, but I don't
23 think you can write a shutdown risk rule.
24 DR. APOSTOLAKIS: Right.
25 DR. KRESS: But I don't think you can risk-inform

1 the whole body of regulations with that kind of
2 configuration.
3 DR. APOSTOLAKIS: No.
4 DR. KRESS: I don't think it's useful.
5 DR. APOSTOLAKIS: Jack?
6 DR. SIEBER: It seems to me that PRA and power
7 operation versus shutdown risk are two completely different
8 things. From standpoint that the shutdown risk is dominated
9 by human events, in my opinion, there are 17,000 valves in a
10 PWR and probably an equal number of switches, circuit
11 breakers and so forth. When you shut down the plant and go
12 from mode one to mode six, you're going to move about half
13 of them to put on all of these clearances and so forth, and
14 every outage that I've known in every plant usually has five
15 or six valving errors in the process of the posting of
16 clearances, reconfiguring the plant to start back up, and
17 when you change modes, you run through places where you
18 don't have a lot of margin, like steam generator level
19 control, low-powers.
20 I mean, how many plant trips have there been?
21 200? 300 from that? And so, I see all this transition
22 analysis and human factors analysis as dominating everything
23 as opposed to a full power PRA.
24 DR. APOSTOLAKIS: That was the genesis of ATHEANA,
25 by the way, was a low-power shutdown.

1 DR. WALLIS: You have delta functions; you have
2 probabilities. Every time someone throws a switch, it might
3 be the wrong switch.
4 DR. SIEBER: That is correct.
5 DR. APOSTOLAKIS: So you should use --
6 DR. SIEBER: It might even be the wrong unit.
7 DR. WALLIS: That's true.
8 DR. SIEBER: Or a wrong trend, you know.
9 DR. APOSTOLAKIS: So the nature of the beast is
10 different, and it's time dependent.
11 DR. SIEBER: Yes, and you have to identify where
12 these key points are, you know. You change divisions
13 halfway through the outage so you can --
14 DR. APOSTOLAKIS: Okay.
15 DR. SIEBER: -- maintain one side or the other.
16 And you use the one to stop.
17 DR. POWERS: Initially, it just really eludes me
18 here. There are huge potentials for errors, and they
19 manifest themselves, and we've had lots and lots of events
20 that have merited more discussion. We haven't melted any
21 fuel yet. And the question that is not clear to me is why
22 not? Why haven't we melted fuel given all this potential,
23 given the lack of regulations of this, safety regulations
24 that exist in here, we haven't melted any fuel. I mean, and
25 during power operations, I have melted fuel at least once.

1 DR. SIEBER: I think things move fairly slow.
2 DR. POWERS: Right.
3 DR. SIEBER: They're relatively self-identifying,
4 and there is no huge pressure and temperature.
5 DR. BONACA: That is a good point to be made. As
6 we are going to shorter outages, that time becomes more --
7 DR. WALLIS: Then, you need some criterion for
8 saying when the time is too short.
9 DR. BONACA: I think you made this out to be --
10 DR. KRESS: That may be considered a goal right
11 there.
12 DR. BONACA: We should put that inside the letter,
13 too, because, I mean, things are changing there.
14 DR. WALLIS: I think someone should really make an
15 estimate; suppose the shut time is cut in half the time?
16 Now, what is the risk?
17 DR. BONACA: That's not enough, because you have
18 to really --
19 DR. WALLIS: I can make a case to the commission
20 that --
21 DR. APOSTOLAKIS: That's not enough. You have to
22 know which activities have been moved to power operations.
23 You know, just to say I cut the time is not informative
24 enough, I don't think, for a risk assessment.
25 Okay, we agreed on that. Any other point?

1 [No response.]

2 DR. APOSTOLAKIS: There will be a point there

3 about building on existing technology.

4 DR. SIEBER: Must be.

5 DR. BONACA: Yes, and by the way, that is a very

6 important point, the point you were making before. There is

7 information.

8 DR. APOSTOLAKIS: Pardon?

9 DR. BONACA: Of course, it's all for PWRs, but I'm

10 saying that, for example, even though the issue was talked

11 about before, lessons learned for other drivers --

12 DR. APOSTOLAKIS: Now, regarding the goals, this

13 issue of the cornerstones, should we mention it there?

14 DR. KRESS: Well, couldn't we mention the

15 consistency?

16 DR. APOSTOLAKIS: Yes, consistency.

17 DR. WALLIS: The main goal has been --

18 DR. KRESS: Yes; I think that's what Bill Shack

19 said.

20 DR. SIEBER: Well, there is a tradeoff between do

21 you maintain the concepts of the goals, or are you willing

22 to trade that because you have more time to react? You

23 know, you ultimately react --

24 DR. SHACK: It's almost a given. You have to

25 grade those things.

1 DR. APOSTOLAKIS: Yes, that's right.

2 DR. SHACK: That's why you shut down, I mean,

3 because you want --

4 DR. SIEBER: I'm convinced that --

5 DR. APOSTOLAKIS: Yes, but I mean, you just don't

6 dismiss it because you have to. There must be something

7 else --

8 DR. KRESS: Yes.

9 DR. APOSTOLAKIS: -- that you are doing right.

10 DR. SHACK: You're shutting it down.

11 DR. KRESS: You can maintain safety without having

12 to shut down.

13 DR. WALLIS: In order to get to a safer condition.

14 DR. KRESS: But it would be nice to have one so

15 you can, you know, have assured yourself of what margins, to

16 assure yourself of what levels of safety you maintain.

17 DR. BONACA: A quick question about what are the

18 cornerstones to the applicable, valid, to the shutdown

19 conditions.

20 DR. APOSTOLAKIS: Should we revise the

21 cornerstones?

22 DR. SIEBER: There may be new ones.

23 DR. BONACA: There may be new ones.

24 DR. SEALE: Are the existing ones sufficient?

25 DR. BONACA: And by definition, you are taking out

1 certain cornerstones.

2 DR. APOSTOLAKIS: Good point; good point. No, I

3 agree, because I think Jack's elaboration was very good, you

4 know, that you are doing a few things to the current

5 cornerstones, but on the other hand, you have longer times

6 to respond; your radioactive inventory is not as high, blah,

7 blah, blah, blah, blah.

8 DR. WALLIS: What are you doing? Are you advising

9 the commission, or are you advising the staff?

10 DR. APOSTOLAKIS: We are advising, I think, the

11 EDO at this point or the commission itself.

12 DR. POWERS: At our last meeting with the

13 commission, we offered our low-power shutdown, we ran out of

14 time and didn't have the opportunity to, so I think that --

15 and they indicated still an interest in that. So I think

16 even if they were written to the EDO that we have to

17 recognize by answering questions that they may have had.

18 DR. APOSTOLAKIS: Are you sending a SECY?

19 MR. KING: It's a SECY. Generally, when we give

20 you our SECY to look at, you write to the EDO, but you can

21 write to the commission if you want.

22 DR. KRESS: I think somewhere in there, we may

23 have to discuss uncertainties, too.

24 DR. APOSTOLAKIS: Yes, yes, yes; don't worry about

25 that.

1 DR. WALLIS: What is your expected output? Are
2 you writing a letter in order to have the commission make
3 certain decisions? What are you --
4 DR. POWERS: We have previously written to the
5 commission, telling them that we thought shutdown was a
6 significant area.
7 DR. WALLIS: And you didn't get very fa.
8 DR. POWERS: And that they should consider doing
9 some examinations of their capabilities to do risk
10 assessments during them. And at the same time, we also told
11 them that the proposed rule was not acceptable to us,
12 because we didn't understand enough about the shutdown
13 experience to write a useful rule.
14 DR. APOSTOLAKIS: This effort --
15 DR. WALLIS: So what we're trying to do now is
16 support the staff's effort to get more information? Is
17 that what we're trying to do?
18 DR. APOSTOLAKIS: Yes.
19 DR. WALLIS: So it has to be sold.
20 DR. APOSTOLAKIS: Yes.
21 Anything else?
22 [No response.]
23 DR. APOSTOLAKIS: Now, regarding the staff's
24 presentation at the full committee meeting, you have now
25 what? Two weeks?

1 MR. KING: Yes, two weeks.

2 DR. APOSTOLAKIS: Can you try to address some of

3 these concerns --

4 MR. KING: Yes.

5 DR. APOSTOLAKIS: -- and not show the same

6 presentation? What are the goals? How you build on

7 existing information and maybe do some of it and say this

8 is, for example, how we're going to do it?

9 MR. KING: We need to sharpen up our

10 recommendations.

11 DR. APOSTOLAKIS: Yes.

12 MR. KING: Because that's really what we owe the

13 commission: what do we propose to do in the future?

14 DR. APOSTOLAKIS: What is it that's already being

15 done satisfactorily, and what is it that you feel ought to

16 be worked on? I think that is really the key evidence.

17 MR. KING: Yes; try to focus the presentation that

18 way.

19 DR. APOSTOLAKIS: Great; how much time do they

20 have, Mike?

21 MR. MARKLEY: Hour and a half.

22 DR. APOSTOLAKIS: Hour and a half. So we're not

23 going to see any of the documents from you before we write

24 the letter.

25 MR. KING: No.

1 DR. APOSTOLAKIS: So we will not have the benefit
2 of the document listing.
3 [Laughter.]
4 DR. APOSTOLAKIS: Anything else that a member
5 wants to raise?
6 [No response.]
7 DR. APOSTOLAKIS: The staff?
8 [No response.]
9 DR. APOSTOLAKIS: Members of the public?
10 [No response.]
11 DR. APOSTOLAKIS: Well, this meeting is adjourned.
12 [Whereupon, at 12:11 p.m., the meeting was
13 concluded.]
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REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

NAME OF PROCEEDING: MEETING: RELIABILITY AND PROBABILISTIC RISK ASSESSMENT

PLACE OF PROCEEDING: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Jon Hundley

Jon Hundley

Official Reporter

Ann Riley & Associates, Ltd.