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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

May 3, 2007

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on May 3, 2007, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

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

1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

5 542nd MEETING

6 + + + + +

7 THURSDAY,

8 MAY 3, 2007

9 + + + + +

10 ROCKVILLE, MARYLAND

11 + + + + +

12 The Committee met at the Nuclear
13 Regulatory Commission, Two White Flint North,
14 Room T2B3, 11545 Rockville Pike, at 8:30 a.m.,
15 William J. Shack, Chairman, presiding.
16 COMMITTEE MEMBERS PRESENT:

17	WILLIAM J. SHACK	Chairman
18	SAID ABDEL-KHALIK	Member
19	GEORGE E. APOSTOLAKIS	Member
20	J. SAM ARMIJO	Member
21	MICHAEL CORRADINI	Member
22	THOMAS S. KRESS	Member
23	OTTO L. MAYNARD	Member
24	DANA A. POWERS	Member
25	GRAHAM B. WALLIS	Member

1 ACRS STAFF PRESENT:
2 JOHN GROBE
3 PAUL LOESSER
4 MIKE WATERMAN
5 BILL KEMPER
6 STEVE ARNDT
7 RICK CROTEAU
8 MARY DROUIN
9 MARTY STUTZKE
10 JOE BIRMINGHAM
11 EILEEN McKENNA
12 JOHN MONNINGER
13 CHRISTIANA LUI
14 DON HELTON
15 NATHAN SIU
16 ROB TREGONING
17 BRIAN SHERON
18 STU RUBIN
19
20 ALSO PRESENT:
21 KIMBERLY KEITHLINE
22 TONY HARRIS
23
24
25

I-N-D-E-X

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

2 (8:31 a.m.)

3 CHAIRMAN SHACK: The meeting will now come

4 to order.

5 This is the first day of the 542nd meeting

6 of the Advisory Committee on Reactor Safeguards.

7 During today's meeting, the Committee will consider

8 the following: digital instrumentation and control

9 system matters, Commission paper on staff's

10 recommendation to make a risk-informed and

11 performance-based revision to 10 CFR Part 50, status

12 of the development of an integrated long-term

13 regulatory research plan, ACRS members' issues

14 associated with the technology neutral framework for

15 future plant licensing, and proposed ACRS reports.

16 This meeting is being conducted in

17 accordance with the provisions of the Federal Advisory

18 Committee Act. Mr. Sam Duraiswamy is the Designated

19 Federal Official for the initial portion of this

20 meeting.

21 We have received no written comments or

22 requests for time to make oral statements from members

23 of the public regarding today's session.

24 A transcript of portions of the meeting is

25 being kept, and it is requested that the speakers use

one of the microphones, identify themselves, and speak with sufficient clarity and volume so they can be readily heard.

I will begin with some items of current interest. One thing, I note that we have a package on items of interest, and there's a number of speeches from the Commissioners in there, including one from Commissioner Lyons on computer modeling and simulation, something that many of the members have interest in.

There is also a number of interesting SRMs on security assessments and the proposal to include aircraft impact design requirements for new reactors, and we are going to look at those.

We are going to have a training session today on the use of the bank card for members between 11:30 and 11:45, so don't run away.

PARTICIPANT: No, that's tomorrow.

PARTICIPANT: That's Friday.

CHAIRMAN SHACK: That's Friday, on Friday. I'm sorry.

MEMBER MAYNARD: I have a day to prepare now.

(Laughter.)

CHAIRMAN SHACK: It's the travel card.

1 MEMBER WALLIS: That's the regular one we
2 all have?
3 CHAIRMAN SHACK: Yes.
4 MEMBER CORRADINI: Which we don't use.
5 CHAIRMAN SHACK: Well, that's what we will
6 be trained on.
7 The other item is this is the last full
8 Committee meeting for Ralph Caruso, a staff member.
9 He has been with the NRC for 27 years and four years
10 with the ACRS staff, and he will be retiring on
11 June 1, 2007. Mr. Caruso has provided outstanding
12 technical support to the Committee in reviewing
13 numerous complex technical issues in the areas of
14 thermal hydraulics, reactor fuels, extended power
15 uprates, and PWR sump performance.
16 His detailed knowledge of the regulatory
17 process and technical issues have been very helpful to
18 the Committee in its review of several matters. His
19 dedication, hard work, attention to details, ability
20 to identify significant issues of importance to the
21 Committee, his outstanding contributions and loyalty
22 to the Committee, are very much appreciated.
23 We would like to thank Ralph and wish him
24 good luck on his future endeavors. He has some
25 interesting plans for retirement.

1 (Applause.)

2 MEMBER POWERS: Well, that is just a

3 provocative ending statement.

4 (Laughter.)

5 CHAIRMAN SHACK: We will just leave it

6 there.

7 Our first topic this morning is digital

8 instrumentation and control system matters, and George

9 will be leading us through that.

10 MEMBER APOSTOLAKIS: Thank you, Bill.

11 You will recall that we met with the

12 Commission last October, and the issue of digital I&C

13 was raised by the Commission. Following that meeting,

14 we received a staff requirements memorandum where it

15 was stated that the Committee should provide its views

16 to the Commission staff's effort related to digital

17 instrumentation and controls. The Committee should

18 consider potential means for providing reasonable

19 backup, if appropriate.

20 So the purpose of today's meeting is to

21 review what the staff is doing in this area, and then

22 write a letter during this meeting responding to the

23 Commission's SRM.

24 There was a Subcommittee meeting on

25 April 18th. We had Said present, Tom, and Mario, and

me, where we had presentations by the staff, more detailed presentations than what we will hear today, on what is happening. And I must say there will be a lot of new stuff this time for the full Committee, because now that there is an expressed interest from the Commission, things are happening at the higher level and we'll hear about the Steering Committee that was formed. So --

MEMBER MAYNARD: For the record, I was at the meeting also.

MEMBER APOSTOLAKIS: I'm sorry.

MEMBER MAYNARD: That's all right.

MEMBER APOSTOLAKIS: I'm sorry. You were, yes. Otto was there.

Okay. So without any further ado, I will turn it over to the staff. Who will be the -- Jack?

Yes, I'm sorry, Otto.

MEMBER MAYNARD: I just wanted to get it on the record, George.

MEMBER APOSTOLAKIS: Next time I should write the names down.

Oh, yes, NEI goes first. I'm sorry, I'm sorry, I'm sorry, I'm sorry. Boy, I'm sorry all the time.

(Laughter.)

1 MEMBER CORRADINI: Do you need some
2 coffee?
3 MEMBER APOSTOLAKIS: So we have Ms.
4 Keithline, right?
5 MS. KEITHLINE: Yes. And Mr. Tony Harris.
6 MEMBER APOSTOLAKIS: Okay.
7 MS. KEITHLINE: Good morning. I'm
8 Kimberly Keithline. I've been at NEI now for almost
9 a year. I came from the Naval Reactors Program. Tony
10 and I, on behalf of the nuclear industry, appreciate
11 the opportunity to be here this morning, as well as we
12 also appreciate the opportunity to participate with
13 the staff on the efforts that they are going to
14 describe to you over the next couple hours.
15 These efforts to resolve issues related to
16 digital instrumentation and control and human factors
17 are very important to the nuclear industry, especially
18 with the resurgence of nuclear power and the new
19 plants that are coming along. We also recognize,
20 though, that they are very important to existing
21 plants, where people are realizing the need to upgrade
22 from analog systems to more modern digital systems.
23 We recognize that the scope of these
24 efforts is very large, and that there are resource
25 constraints, both at the NRC and within the industry.

1 So we are working with the NRC staff to prioritize our
2 efforts, to look at which ones are most urgently
3 needed. And during the month of May we will be
4 working closely with them in six different groups to
5 focus our efforts and prioritize our actions for
6 resolving them.
7 MEMBER APOSTOLAKIS: What criteria are you
8 using for prioritization?
9 MS. KEITHLINE: We're looking at what the
10 industry's needs are near-term for both new plants and
11 existing plant upgrades, what key decision points are
12 coming along at various times that -- where this
13 additional improved guidance may be very valuable in
14 helping both the industry and the NRC through the
15 review process. So we are trying to get input from
16 vendors and utilities about what their real needs are.
17 MR. HARRIS: Yes. Dr. Apostolakis, Tony
18 Harris, NEI. A lot of what we're trying to do is to
19 -- in herding our cats -- is to find out from each
20 individual what they are actually planning on doing,
21 what kind of technology they are planning on using,
22 and what kind -- when and what type of submittals they
23 will be making. A lot of it is for new plants.
24 We have a little bit of a unique
25 challenge, both from a staff perspective and from our

1 perspective, that we are having to deal both with new
2 plants and existing plant upgrades. But to look and
3 see what is coming down the horizon from the near term
4 and what type of technology and more unique designs
5 might be put forward.
6 MEMBER APOSTOLAKIS: Are you also thinking
7 in terms of some longer term research?
8 MR. HARRIS: Yes. Yes, we are.
9 MS. KEITHLINE: Yes. Although --
10 MEMBER APOSTOLAKIS: Kimberly is not so
11 sure.
12 MS. KEITHLINE: Well, much of the effort
13 right now is focused on defining what is really needed
14 near term, but we do recognize that there are long-
15 term needs, especially from the standpoint that going
16 digital is not going to solve the obsolescence issues,
17 so there will be a need to continually deal with
18 obsolescence. And in the digital world that may be
19 different from the analog world.
20 Most of our efforts so far have been
21 focused on the "what's needed very soon" just to get
22 through the new plant COLs that are coming up.
23 MEMBER APOSTOLAKIS: Okay.
24 MR. HARRIS: But you will -- Tony Harris
25 again, NEI. You will see in the project plan some

1 longer term items, including research initiatives.

2 MEMBER APOSTOLAKIS: Which project plan is

3 it?

4 MS. KEITHLINE: The NRC's project plan

5 that --

6 MEMBER APOSTOLAKIS: Oh, the NRC I know.

7 I'm talking --

8 MS. KEITHLINE: Yes.

9 MEMBER APOSTOLAKIS: -- about you. I know

10 what the NRC does.

11 MS. KEITHLINE: Oh. The way we're working

12 this project is that the NRC owns the plan, because

13 it's their efforts, and they have been very good about

14 asking for our input, suggestions, feedback into their

15 plans. So it's almost a joint plan, but technically

16 not so because they need to maintain their

17 independence.

18 MEMBER APOSTOLAKIS: So they are paying

19 for it to be independent, right?

20 MS. KEITHLINE: I'm sorry. They are?

21 MEMBER APOSTOLAKIS: They are paying for

22 it.

23 MR. HARRIS: I think we wind up paying for

24 it in the long run, so I -- I saw my bill.

25 (Laughter.)

1 MEMBER APOSTOLAKIS: Okay. Let's go.

2 MS. KEITHLINE: Okay.

3 MEMBER APOSTOLAKIS: It's interesting,

4 though, you are not having any separate efforts at

5 this point.

6 MR. HARRIS: No, we do. Through EPRI we

7 have a Digital I&C Subcommittee that is working on

8 other efforts as well. And what our focus is is to

9 try to look at the needs. If they hit the regulatory

10 space, then we look for opportunities to collaborate

11 with the staff and not duplicate efforts.

12 MEMBER APOSTOLAKIS: So there are research

13 projects going on sponsored by EPRI.

14 MR. HARRIS: Yes.

15 MEMBER APOSTOLAKIS: Okay. That's good to

16 know.

17 MS. KEITHLINE: I would like to point out

18 we had a meeting yesterday, an NRC public meeting,

19 with their Steering Committee. And it was a very

20 productive meeting I think. We identified several

21 things that we need to do in the very near term.

22 We've got a lot to do with them, and among the

23 industry, in the next month to really prioritize our

24 efforts and actions and lay out exactly what is going

25 to happen.

1 One concern that I have is that we
2 discussed -- given the resource constraints and the
3 timing issues, it may be necessary in some cases to
4 take a two-step approach, to take a conservative
5 approach to the first step, maybe issue some guidance
6 that is more conservative than we all want to
7 eventually up with. And then, over the next months,
8 years, come up with maybe more flexibility in terms of
9 how we could approach some of these issues.
10 I understand why that may be needed. We
11 need to keep in mind as we consider that option that
12 the new plants in particular are trying very hard to
13 standardize their plants. And so we'll need to think
14 carefully about which ones the two-step process will
15 work for and where that may not be very beneficial
16 because if they design to the much more conservative
17 approach they are probably not going to have the near-
18 term opportunity to upgrade things if they are trying
19 to maintain standardization.
20 MEMBER APOSTOLAKIS: Now, why did you say
21 that's a concern of yours? The NRC staff doesn't want
22 to do it that way?
23 MS. KEITHLINE: No. One idea that has
24 been presented --
25 MEMBER APOSTOLAKIS: Oh, it's just being

1 discussed. I mean, there's no disagreement about it,
2 because it sounds reasonable to me that you do have --
3 MS. KEITHLINE: It's reasonable as long as
4 it doesn't -- it may not be practical in some regards
5 for new plants.
6 MEMBER APOSTOLAKIS: Oh, okay.
7 MS. KEITHLINE: That's the concern.
8 MEMBER APOSTOLAKIS: Okay.
9 MS. KEITHLINE: That's the concern. But
10 it's just something that we've started discussing, and
11 I think we need to think very carefully about as we go
12 forward. That's al.
13 MEMBER APOSTOLAKIS: Thank you.
14 MS. KEITHLINE: Yes. Anything else?
15 MR. HARRIS: No, I think that's all.
16 MS. KEITHLINE: That's all. We don't want
17 to take up much time, because we know the staff has a
18 lot to cover with you this morning. If you have any
19 other questions, we'd be happy to answer them.
20 MEMBER APOSTOLAKIS: But at the
21 Subcommittee meeting, though, you also talked about
22 other things. What are your views on this diversity
23 and defense in depth issue? I mean, that's a hot
24 item. I mean --
25 MS. KEITHLINE: That's --

1 MEMBER APOSTOLAKIS: -- do you agree with
2 the way the staff is going, or you are reserving
3 judgment, or what? Where are we?
4 MS. KEITHLINE: To some extent, we are
5 reserving judgment. The staff -- we have -- we
6 believe this is a very important issue, diversity and
7 defense in depth. The staff has some near-tern
8 research underway that they intend to help them --
9 that will help develop some more objective review
10 criteria for diversity and defense in depth
11 evaluations.
12 We think that is very important. Over the
13 next few months, that will be coming together, and
14 we've got at least one, maybe more, vendors,
15 utilities, interested in providing some test cases,
16 their design concepts, that could be tested against
17 some review criteria to see both how well those new
18 review criteria help the NRC and how well they work
19 with industry. And we think that's a very important
20 effort.
21 MEMBER APOSTOLAKIS: So this fits nicely
22 in your earlier concept of a two-step approach. It
23 seems to me this is a conservative thing to do, so
24 we'll have something in five months that will be a
25 first step. And then, in the longer term, we'll

1 probably refine this?

2 MR. HARRIS: I think --

3 MS. KEITHLINE: Well, the problem with

4 that -- a potential problem with that is that if --

5 taken to an extreme, you know, the ultimate

6 conservative approach for diversity and defense in

7 depth could be to require -- and this is just a

8 possibility -- a complete diverse actuation system

9 with all of the safety and protection functions, and

10 make that an analog system. That would be one extreme

11 that would definitely be conservative from a diversity

12 standpoint.

13 Now, is that maybe the best longer term

14 solution for a new plant? It might not be. But if

15 the plants need to design their new plants that way

16 now, it's going to be very difficult for them to

17 change over the next few years while they are trying

18 to maintain standardized approaches to their plants.

19 It will be more difficult for utilities to decide to

20 upgrade later on.

21 MR. HARRIS: I think that -- Tony Harris

22 at NEI again. I think what we're trying to do is to

23 -- to the extent practical, develop what would be a

24 reasonable approach. And we recognize, you know,

25 coming in from a nuclear standpoint, from a commercial

1 nuclear power industry, there is not in the United
2 States a whole lot of history. But there are other
3 industries, and to the extent we can learn from them,
4 and understand how they've addressed diversity, we
5 have to do that, and we have to take advantage as much
6 as possible without ultimately retrofitting.
7 MEMBER APOSTOLAKIS: Mr. Harris, I've been
8 hearing this, not necessarily from you, for three
9 years now. And I never see any slide that says, "And
10 this is what we learned from other industries." When
11 is this happy day going to come?
12 (Laughter.)
13 That's my major complaint. I mean, there
14 is all of this history out there, and we don't see a
15 systematic review that says, "This is what happened at
16 Ariane 5. These are the lessons learned, but they
17 don't apply to us because ..." or "they apply to such
18 and such a system in nuclear facilities because ..."
19 Unless we do that, it seems to me we'll always be
20 talking at the 10,000-feet level. Is that something
21 that EPRI is doing right now?
22 MR. HARRIS: Yes. One of the things that
23 we have as an industry talked about and have been
24 working on is a plan to look back through history and
25 research.

1 MEMBER APOSTOLAKIS: That would be
2 extremely valuable, I mean, if you guys are doing it.
3 Mr. Marion --
4 MR. HARRIS: I would also say, sir, that
5 in a couple of the research projects there are similar
6 aspects, and we are --
7 MEMBER APOSTOLAKIS: Yes.
8 MR. HARRIS: -- looking to collaborate
9 with the staff on those as well.
10 MEMBER APOSTOLAKIS: Absolutely.
11 MR. HARRIS: So it's really important.
12 MEMBER APOSTOLAKIS: Now, last time at the
13 Subcommittee meeting, Kimberly, you and Mr. Marion
14 said that there will be a series of technical papers
15 coming out of your shop in the next few months on the
16 issue of diversity and defense in depth?
17 MS. KEITHLINE: Right. And in some of the
18 other areas, recognizing that there are resource
19 constraints at NRC, we're willing to provide
20 recommendations, white papers, where it may be
21 helpful. And in the area of diversity and defense in
22 depth, there are I think eight problem statements, so
23 several areas we are trying to address.
24 MEMBER APOSTOLAKIS: So you are already
25 doing this.

1 MS. KEITHLINE: And we have started
2 working on some of those yes. We're meeting with the
3 staff and the task working group next Wednesday to go
4 through each problem statement and make sure we've
5 identified who is doing what, when it's going to
6 happen, and how we're going to get to the end states
7 on those.
8 MEMBER APOSTOLAKIS: Well, that would be
9 great. I hope at some point you will brief the
10 Committee as well.
11 MS. KEITHLINE: Okay.
12 MR. BANERJEE: Well, what are these eight
13 problem areas?
14 MR. HARRIS: Which ones, the --
15 MS. KEITHLINE: For the diversity and
16 defense in depth? And I think the staff -- is the
17 staff going to go --
18 MEMBER APOSTOLAKIS: The staff will go
19 over it in detail.
20 MR. BANERJEE: Oh, they will?
21 MEMBER APOSTOLAKIS: Yes, it's the staff's
22 definition.
23 Are there any questions for the NEI
24 representatives from the Committee?
25 MR. HARRIS: And, again, let me -- I'd

1 point out, if you look through the staff's plan, each
2 of these task working groups, it's not just limited to
3 those eight in diversity. There are others that are
4 pretty significant items, including one I would bring
5 your attention to in human factors. And it basically
6 goes between communications and human factors, and
7 that's the use of both safety and non-safety
8 information on video display units, how that would go
9 about. Is it even acceptable that we would control
10 safety-related components or systems from the non-
11 safety VEU, so --
12 MEMBER APOSTOLAKIS: Great.
13 MEMBER POWERS: Why is that a question?
14 MR. HARRIS: Why is that a question? It's
15 a matter of, first off, should you do it, you know,
16 from a operations standpoint. Secondly --
17 MEMBER POWERS: Well, the answer is
18 unequivocally no, see? So now, why is that a
19 question?
20 MR. HARRIS: Well, why would it be a no?
21 That's what we would --
22 MS. KEITHLINE: It's a question, because
23 some of the vendors are currently designing systems
24 for new plants that would do some of that.
25 MR. HARRIS: Right.

1 MS. KEITHLINE: And so it's an issue that
2 needs to be addressed.
3 MEMBER POWERS: Always had absolute
4 separation between safety and control. That has been
5 done since HT-1 accident.
6 MS. KEITHLINE: And that's one that we
7 definitely need to converge on, whether the answer is
8 yes, no, or something --
9 MEMBER POWERS: The answer is no now. Why
10 would you raise that -- why would you raise -- I mean,
11 how do you approach the question in anything except
12 the answer being no? I mean, I know of no
13 counterexample.
14 MS. KEITHLINE: And that's one where we're
15 really getting started on writing up the why it would
16 be useful and what the issues would be that would need
17 to be resolved. It's one where the vendors -- some of
18 the vendors have started heading down that path, so we
19 feel that it's one that needs to be resolved somehow,
20 and the answer --
21 MEMBER POWERS: There has to be some basis
22 for thinking that you could resolve it. I mean, what
23 did I tell you? I said the answer is no, because I
24 know absolutely that we have always demanded
25 separation between safety and control.

1 Now you're telling me you're going to
2 bring them together. Maybe not the most important --
3 bringing them together -- but certainly bringing them
4 together, why would you think you can -- I mean, what
5 is the philosophical basis that says this is okay?
6 MR. HARRIS: The philosophical basis --
7 you know, from an operator standpoint, certainly
8 moving from panel to panel in a human factors arena --
9 MEMBER POWERS: I mean, that's what I'm
10 looking for is to say --
11 MR. HARRIS: Right.
12 MEMBER POWERS: -- okay, it's a bigger
13 hazard to have this guy moving between two screens
14 or --
15 MR. HARRIS: Yes.
16 MEMBER POWERS: -- something like -- how
17 do you know that?
18 MEMBER MAYNARD: Well, I think in other
19 industries that it found that once you're able to go
20 to the --
21 MEMBER POWERS: Do you know of any
22 industry that can contaminate land for thousands of
23 years?
24 MEMBER MAYNARD: Yes. As a matter of
25 fact, a particular one -- military, aviation. There's

1 -- you've got the chemical industry.

2 MEMBER POWERS: I know of no chemical that

3 can survive the environment for thousands of years.

4 Reactive chemical.

5 MEMBER MAYNARD: But there are -- I'm not

6 going to go into the military aspects and stuff, but

7 there are other aspects that can. But I still say

8 that with the later technology and different things

9 that sometimes you can actually improve safety by

10 incorporating some of the things and doing some things

11 different than maybe you've done in the past.

12 I don't think it should just be a closed

13 subject where you just say a flat no. I think that it

14 would require a lot of justification, and I think that

15 needs to be justified.

16 MEMBER POWERS: And I'm asking them how

17 they're going to go about doing the justification, and

18 he started down a path that seems promising to me.

19 And he says, "Okay. Well, I've got a guy going

20 between two screens. It's not as safe as the guy just

21 working one screen." And I asked, "How do you know

22 that?"

23 MEMBER MAYNARD: Well, a lot of it is

24 based on some human factors research. I don't have

25 all of the information in front of me right now. We

1 can bring that -- if you'd like to have that as a
2 topic, we can bring the right folks here for you. I'd
3 rather do that than --
4 MEMBER APOSTOLAKIS: Okay. Any other
5 questions?
6 (No response.)
7 Thank you. You kept up with the NEI
8 tradition of not having any handouts, I see.
9 That's --
10 MS. KEITHLINE: That's right.
11 MEMBER APOSTOLAKIS: Now we go to the
12 staff.
13 MR. GROBE: Good morning. My name is Jack
14 Grobe. I'm Associate Director in the Office of
15 Nuclear Reactor Regulation for Engineering and Safety
16 Systems. Previously, you have been comfortable with
17 Brian Sheron here. I'm just a little bit smaller and
18 a little bit grayer.
19 We're going to talk about two subjects in
20 detail, some detail today, but the Subcommittee
21 requested that we give somewhat of a broad overview of
22 what the Steering Committee is all about, why it came
23 into existence and how it's functioning. I'll provide
24 that brief introduction, and then turn it over to the
25 staff to discuss in more detail digital issues and

1 risk issues.

2 I'd like to introduce the staff that's
3 here today -- Paul Loesser from NRR, Mike Waterman
4 from Research, and Steve Arndt from Research. We
5 provided you two documents ahead of time, a set of
6 slides. There's a tremendous amount of detail on the
7 slides, of course not as much as we went through with
8 the Subcommittee. But I'm asking the staff to try to
9 limit their presentation on the two detailed subjects
10 to 30 minutes to allow for approximately 30 minutes
11 for questions and answers. I'm not planning on going
12 through all of the detail that's in the slides.

13 We also provided you a draft of the
14 project plan that the Steering Committee is
15 developing. It is broken up into six subcategories.
16 We call them task working groups, and there is details
17 under each of those task working groups of the
18 specific problems that we're refining and what our
19 plans are to deal with those.

20 Last November, we met with the Commission
21 to discuss digital instrumentation and control. The
22 Commission also met with a panel of the industry folks
23 to discuss their questions and concerns and issues
24 regarding digital instrumentation and control.
25 Following that Commission meeting, we received a staff

1 requirements memorandum that provided direction to
2 form a Steering Committee.
3 The purpose of the Steering Committee was
4 to gain alignment with the industry on what the issues
5 are, to assess what might be the critical path,
6 particularly for new reactors and operating reactor
7 retrofits, and address certain technical issues. At
8 that Commission meeting, I believe there were three
9 issues that were causing significant concern for the
10 industry that they expressed. One was a very
11 substantial retrofit at one nuclear plant that was
12 under review. That review was proceeding, but was
13 very complicated.
14 Secondly, some level of anxiety regarding
15 preparation for new reactors, particularly completion
16 of simulators, control room simulators, to support
17 operator training. If you talk -- if you start with
18 the day they anticipate completing construction and
19 beginning operation, and you start backing up the
20 dates, you come to late this decade when the
21 simulators have to be functional.
22 And there was a third issue that I just
23 lost. It will come back to me. It's a senior moment,
24 I apologize.
25 But the Steering Committee was formed by

1 the Executive Director for Operations in January.
2 This not only affects new reactors and operating
3 reactors but also affects fuel cycle facilities, and
4 as well as our security issues. So there are senior
5 executives from all five of the major program offices
6 -- NMSS, NSER, NRR, NRO, and Research -- on the
7 Steering Committee.
8 Slide 6 contains the members of the
9 Steering Committee. I chair the Committee. Mike
10 Mayfield, Director of Division of Engineering from
11 NRO, is on the Committee; Mark Cunningham, Director of
12 the Division of Fuel Engineering and Radiological
13 Research is on the Committee; Joe Gitter, Deputy
14 Director of Fuel Cycle and Safety and Safeguards, from
15 an NMSS perspective; and Scott Morris, Deputy
16 Director, Division of Security Policy from a cyber
17 security perspective rounds out the Committee.
18 The purpose of the Committee is to
19 interface with the industry, ensure that we have a
20 clear understanding of what the issues are with
21 respect to retrofit and licensing of digital control
22 systems in our licensed facilities, to ensure that the
23 offices are effectively coordinating on resolution of
24 these issues, oversee the resolution of technical
25 issues, promptly identify any policy or regulatory

1 roadblocks to resolution of the issues, and monitor
2 the line organization's implementation of the
3 resolution of these activities.
4 The Committee has forced six what it calls
5 "task working groups." Each of these task working
6 groups is led by a manager in the appropriate program
7 office, has a number of staff from the appropriate
8 program offices supporting the task working group.
9 You can see on this slide the titles of
10 the various task working groups. They have conducted
11 multiple public meetings with the industry to help
12 refine the problem statements that are contained in
13 the draft project plan, ensure we get input from the
14 industry on what their concerns are.
15 I want to emphasize that our current
16 licensing guidance and standard review plan is
17 adequate and has been used effectively to license the
18 application of digital technology at nuclear plants.
19 The challenge is that it's in some particular
20 technical areas, most notably communications,
21 diversity and defense in depth, and risk.
22 The guidance is not specific enough, as
23 this technology is evolving rapidly to give
24 predictable guidance to the industry on what the staff
25 views as acceptable and what may not be acceptable.

1 And as I mentioned earlier, one plant is going through
2 a significant retrofit of their reactor protection
3 system and emergency core cooling system
4 instrumentation and control, essentially a complete
5 replacement with digital upgrades.
6 And in going through that review process,
7 it became clear that we could be more predictable for
8 the industry and more efficient for our staff if we
9 had additional guidance in these areas. So this whole
10 effort is to make us more predictable and efficient
11 and effective. There is no concern with the safety of
12 the current retrofits that are in our operating
13 reactors today.
14 As Kimberly mentioned, the industry has
15 been supporting each of the TWGs with a variety of
16 staff from utilities, EPRI, vendors, to ensure that we
17 have clear understanding of what the industry's issues
18 are -- industry's issues are, and we're addressing
19 them appropriately.
20 MEMBER APOSTOLAKIS: Before we leave this,
21 I think there is, as I said earlier talking with NEI,
22 there is a box that it seems to me affects all six of
23 these boxes. And personally, I would like to see it
24 emphasized. And this is the identification of
25 potential failure modes based on the experience from

1 other industries and our experience.

2 Maybe it's buried, some of it, under risk-

3 informed digital I&C. But I don't see how you can do

4 a diversity and defense in depth evaluation without

5 understanding the failure modes.

6 I really think you ought to pay attention

7 to it, much more than the attention it's getting now.

8 And maybe have a box of -- a dependent cause for all

9 of these, feeding into all six boxes possibly,

10 understanding how things can go wrong. I mean, that's

11 the most fundamental thing -- trying to understand how

12 things -- because, you know, there is some work out

13 there. There is a lot of analysis and evaluation of

14 what happened in other industries, especially NASA and

15 the European applications.

16 But as I said earlier, I don't see a

17 lessons learned document that says, you know, this is

18 what happened, there was a combination of human error.

19 The poor software appears to always do what it was

20 designed to do. It's just the context within which it

21 operated that led you to do something that turned out

22 to be wrong.

23 So I really think we would benefit from

24 this. In fact, I would call it a near-term need to do

25 it as quickly as possible, draw these lessons, and

1 then start talking about the three Ds and other
2 things.
3 MR. GROBE: Appreciate your question. It
4 isn't buried, but it is part of the risk-informed
5 digital I&C task working group. Office of Research
6 has an extensive research plan in the digital I&C
7 area. I hope the Committee has a copy of that. If
8 not, we'll make sure that you get it. And part of
9 that is identifying failure modes and effects for
10 digital.
11 One of the challenges that we face, and
12 Kimberly mentioned it, is that we have new reactor
13 applications that are expected to be in-house later
14 this year. Many of these issues are going to require
15 more than several months worth of work to resolve, and
16 there's a very close relationship between risk,
17 communications, and defense in depth.
18 And it may strategically be more
19 appropriate to insist on a diverse independent backup
20 system to deal with some of the uncertainties where
21 we're still doing research and we won't have these
22 questions resolved for a year or two years. So those
23 are the particular interrelationships between the
24 various task working groups that the Steering
25 Committee is thinking about.

1 MEMBER APOSTOLAKIS: But my suggestion is
2 to give it more importance. I know there is some work
3 going on, but to give it more importance and show it
4 on a slide like this.
5 MR. GROBE: Okay.
6 MEMBER APOSTOLAKIS: Because, for example,
7 if the context that involves other failures leads the
8 software to do the wrong thing, it's not clear to me
9 that if I have diverse software, they would not all do
10 the wrong thing, if something else is the driver.
11 If the inputs are the driver, you know, if
12 you have different manufacturers, separate, they may
13 all end up doing something that's wrong. I don't know
14 whether that's true. From what I'm reading, it might
15 be. So that's what I'm saying. Give it more
16 importance, if you could.
17 MR. GROBE: Okay. Thank you.
18 MEMBER APOSTOLAKIS: Okay.
19 MR. GROBE: On the next two slides I've
20 just listed the task working groups and a brief
21 statement of what their focus is. As you notice,
22 there is nothing under diversity and defense in depth
23 and risk-informed digital I&C. That's because at this
24 point I think I'd turn it over to the staff to discuss
25 those two areas in more detail.

1 MEMBER APOSTOLAKIS: Why is the last
2 bullet important? Or was --
3 MR. GROBE: Licensing process?
4 MEMBER APOSTOLAKIS: Human factors
5 engineering regulatory guidance.
6 MR. GROBE: I'm sorry.
7 MEMBER APOSTOLAKIS: Is that something
8 that is very important at this point? It might be;
9 i'm not saying it's not. But, I mean, considering the
10 other issues that you have to face --
11 MR. GROBE: The transition from a
12 traditional control room to a digital control room
13 involves, of course, different human factors issues,
14 man-machine interface issues. And those issues have
15 to be resolved.
16 As far as priorities, in my mind, on the
17 short term, to support the retrofits that we
18 anticipate this year and the new reactor applications
19 we anticipate this year, the most important of these
20 is diversity and defense in depth.
21 MEMBER APOSTOLAKIS: Yes.
22 MR. GROBE: And the industry is working
23 hard now on prioritizing these and making sure that
24 they have the input that we need on what their
25 priorities are and what their timeframes are.

1 MEMBER WALLIS: But this final bullet,
2 this human factors control room, is that something
3 that's new because of I&C, or do you have already a
4 lot of guidance about human factors in the control
5 room?
6 MR. GROBE: We have plenty of guidance on
7 human factors in the control room. Much of it is not
8 sufficient to provide clear guidance for how to apply
9 those concepts in a digital environment.
10 MEMBER WALLIS: Something different about
11 I&C, digital --
12 MR. GROBE: Oh, yes. Instead of your
13 traditional panels and annunciators -- I was up in
14 Pennsylvania yesterday at Westinghouse and saw a
15 demonstration. They had a scaled-down version of the
16 control room simulator. It's not fully modeled yet,
17 but the two engineers worked through a steam generator
18 tube rupture, and neither one of them left their chair
19 -- the reactor operator and senior reactor operator.
20 A very, very different environment.
21 MEMBER WALLIS: It all seems better.
22 MR. GROBE: There is tremendous advantages
23 to digital technology, as far as the efficiency of
24 activities in the control room. But it raises
25 questions regarding our guidance on how to apply the

1 guidance we have for traditional control rooms to a
2 new environment.
3 At this time, I'd like to turn it over to
4 Paul and Mike to talk about diversity and defense in
5 depth. And as I mentioned, we'll try to keep their
6 comments to 20 minutes or so.
7 MR. LOESSER: I think we can do that.
8 First of all, our safety concern --
9 MEMBER APOSTOLAKIS: I forgot, I'm sorry
10 -- I have another question. And I'm willing to be
11 corrected, by the way. The last three years or so
12 every time we meet with the staff to discuss digital
13 issues there is always a plan to be reviewed. And
14 that's what we're doing today as well.
15 When will these plans start producing
16 something? Is that why the Steering Committee was
17 formed, to give it more momentum? Because, you know,
18 two years ago -- about two years ago the Committee
19 wrote a letter on a digital I&C plan, and we said we
20 liked it, as I recall. Two years later we are
21 presented with another plan.
22 I mean, I have seen progress, by the way,
23 in all fairness, in the risk-informed part. I mean,
24 we had the presentation, and we have another one
25 today. Is it because you don't think the Committee is

1 interested, so we are not presented with progress in
2 other areas? Or, I mean, when will we stop hearing
3 about the plan?
4 MR. GROBE: I have not known the Committee
5 to not be interested in any topic, so we're certainly
6 willing to present the results. The plan you refer to
7 was the research plan that I mentioned earlier, and
8 that's an extensive research plan. There has been
9 work underway. I think the Subcommittee heard a
10 little bit of the results in its last meeting, and
11 we're going to provide -- some of our presentation
12 today includes results of that research.
13 The Steering Committee was formed to
14 ensure that all of the offices were effectively
15 integrated. Two years ago, we had a research plan.
16 Two years ago, we didn't have any combined operating
17 license interest. November of 2005, it appeared that
18 we might get three combined operating licenses. Now
19 we're an order of magnitude higher than that.
20 So the need for prompt, integrated
21 resolution of these issues has taken on a much higher
22 priority, and that's the purpose of the Steering
23 Committee -- to ensure all the offices are effectively
24 integrated in bringing these issues to closure on a
25 timely basis.

1 In the draft project plan you have there
2 is what I would refer to as a set of Level 1, high-
3 level milestones and deliverables. There is no due
4 dates in the project plan, and we have -- the task
5 working groups have been working on dates for
6 resolution of each of these. Most of the short-term
7 due dates are this year.
8 And the public meetings that each task
9 working group is going to be conducting this month
10 will be to refine those due dates, make sure they're
11 achievable and appropriate to meet the needs of the
12 industry and the staff. And we'd be glad to meet with
13 you on a regular basis to discuss progress.
14 MEMBER APOSTOLAKIS: I think that would be
15 a good -- we'll start with Subcommittee if necessary.
16 MR. GROBE: Okay.
17 MEMBER APOSTOLAKIS: Okay. Thank you.
18 Paul?
19 MR. LOESSER: Back to me. When
20 considering our safety concern, there was a
21 November 8th SRM to the ACRS where you were asked to
22 take a look at digital instrumentation and consider
23 the possible means for providing reasonable backup, if
24 appropriate.
25 Our concern is that if an error in common

1 software could cause all channels to the protection
2 systems to fail in those channels where this software
3 is being used. Consolidation of many safety functions
4 into a single four-channel system increases this
5 concern. You would now lose not only one protected
6 function but possibly many.
7 We still consider that high-quality
8 software --
9 MEMBER APOSTOLAKIS: On this point,
10 though, again, it's not clear to me what it means,
11 though, that software will malfunction, because if I
12 look at the operating experience it does not
13 malfunction. It does what it's supposed to do. It's
14 getting the wrong inputs.
15 So unless we really look at the past
16 experience and draw some lessons, it seems to me we
17 will not have a very solid approach with the D3 issue.
18 I don't -- why should the -- I mean, there
19 are some instances where the software itself
20 malfunctions, but if you look at the major accidents
21 the whole thing does whatever it's supposed to do.
22 But somebody forgot something, somebody -- you know,
23 some sensors failed.
24 MEMBER ARMIJO: Somebody changed
25 something.

1 MEMBER APOSTOLAKIS: Sorry?

2 MEMBER ARMIJO: Well, it does if somebody
3 changed something.

4 MEMBER APOSTOLAKIS: Somebody changed
5 something. So you say that it malfunctions. I don't
6 understand this. I mean, this is --

7 MR. LOESSER: In many of the cases, it
8 does what the programmer designed it to do, but that
9 may not be what the plant had intended it to do due to
10 a misunderstanding of the requirements. There have
11 been some just flat programming errors where someone
12 made --

13 MEMBER APOSTOLAKIS: Sure.

14 MR. LOESSER: -- a mistake.

15 MEMBER APOSTOLAKIS: Yes.

16 MR. LOESSER: There have been cases where
17 there are unanticipated instances, as you point out,
18 something they didn't consider when they wrote this
19 program, and that puts it into unknown space and the
20 program is now being asked to handle something that
21 was not considered.

22 MEMBER APOSTOLAKIS: So you are calling
23 all of these malfunctions?

24 MR. LOESSER: Yes. And we're not --

25 MEMBER APOSTOLAKIS: It's not just

1 software that --

2 MR. LOESSER: We're not trying to -- we're

3 not trying to isolate it at this level. What we're

4 trying to say is things can happen where the intended

5 safety function does not occur.

6 MEMBER APOSTOLAKIS: Ah, that's -- yes,

7 exactly. And that's where, again, you can draw a lot

8 of lessons.

9 MR. LOESSER: And this can happen in all

10 four channels at the same time.

11 MEMBER APOSTOLAKIS: I agree.

12 MR. LOESSER: Whereas, in the older analog

13 systems, it tended to be wear, so you would lose one

14 channel at a time. With these, if you consider a

15 common mode failure, you can lose it all. And if you

16 put all your safety functions into one system, you

17 could conceivably lose every safety function in the

18 plant all at the same time due to a malfunction.

19 MEMBER ARMIJO: Have you reviewed the

20 operating experience of the more modern Japanese

21 plants who have used digital I&C for a long time to

22 see what their experience has been, what kind of

23 errors they've had that are unique to digital systems

24 versus --

25 MEMBER APOSTOLAKIS: Yes.

1 MEMBER ARMIJO: -- analog systems and
2 gotten some lessons from them that --
3 MR. WATERMAN: This is Mike Waterman. I'm
4 in the Office of Research, and I'm the Program Manager
5 for our diversity research we're conducting now. Is
6 this May? Yes. Later this month I'm going to Europe
7 to talk to European regulators about their experience
8 with diversity and common cause failures and their
9 plants, and later this year I believe I'm slated to
10 head west to talk to the Japanese, the Koreans, Thai
11 Power, and our counterparts over in those countries to
12 find out how they're doing.
13 So have we done it yet? No. Are we
14 planning on doing it in the very near future? Yes, we
15 are.
16 MEMBER ARMIJO: I would urge you to do it
17 right away, because that's real experience.
18 MR. KEMPER: If I could offer -- this is
19 Bill Kemper from the Office of Research. We also have
20 an international conference planned right here in
21 June, June 19th through 21st. We've invited over 30
22 countries to come in and talk specifically about this
23 issue -- common cause failures associated with digital
24 systems, experience in their nations with their
25 nuclear programs, etcetera.

1 MEMBER APOSTOLAKIS: But it would be nice,
2 before we take any major action on the diversity
3 issue, to have a document someplace, a NUREG or
4 something, that has a list of past incidents in the
5 space industry, in the nuclear industry, and other
6 industries, a description of those to the extent
7 possible, and some lessons learned and possible
8 transfer -- possibly transferring these to the nuclear
9 industry.
10 I think that will be extremely
11 educational, because, I don't know, some of you guys
12 have a lot of experience and a lot of things come to
13 your mind. But I think having things like that on
14 black and white, I mean, it will really help
15 everybody.
16 And then, we can address issues of what it
17 means that the software malfunctions, what it means
18 that we may lose all the functions, what it means --
19 and another thing is I really like this idea that
20 ATHEANA has promoted of the error-forcing context,
21 because I think these things here lead to some
22 malfunction as a result of the whole context or the
23 whole sequence of what is happening.
24 So talking to those guys for five minutes
25 wouldn't hurt, by the way, and -- but it would be nice

1 to see such a white paper. I mean, and, Bill, I know
2 how these conferences are. I mean, people will come,
3 they will -- may give you one example. They may talk
4 about it. But, I mean, a systematic evaluation --
5 Brookhaven did something for you sometime ago.
6 You can build on that and go into more
7 detail, so there is a basis. I mean, it's not -- they
8 collected a lot of information, as I recall, and they
9 drew some conclusions. But going more deeply into the
10 failure modes would really be a great thing.
11 Steve? I'm sorry.
12 MR. KEMPER: I'm sorry. It's Bill Kemper
13 again. I just wanted to amplify on what you just
14 said, George. In conjunction with nuclear sector,
15 we're also indicting other non-nuclear sectors as well
16 to speak at this international conference. And we
17 intend to have a specific sit-down discussion before
18 and after the meeting with the international
19 participants to really get into the details of their
20 experience in common cause failure.
21 MEMBER APOSTOLAKIS: You can ask them to
22 give you information as to where you can find actual
23 descriptions of what happens.
24 MR. KEMPER: Exactly. And, of course, you
25 know about COMSYS, you know, the COMSYS, the

1 international program.

2 MEMBER APOSTOLAKIS: It's really a great

3 thing to have.

4 MR. WATERMAN: The other usefulness of

5 that approach, Dr. Apostolakis, is the errors can

6 generally be classified as a specification error.

7 When you nail it down, well, this was an error in

8 specification, this was an error in implementation,

9 this was an error in design also, once we get a handle

10 on where the majority of the errors seem to be

11 arising, that also allows NRR to start focusing its

12 efforts on a more concentrated basis on, for example,

13 specification, system requirement specification.

14 If it's an implementation error, I think

15 we're getting pretty close to addressing all of that

16 with the system development platforms. But design

17 errors and things like that, if we can start

18 portioning out and focusing our resources, the limited

19 resources we have, in the areas that seem to have the

20 biggest chance for failure, I think we'd --

21 MEMBER APOSTOLAKIS: So you agree with me?

22 MR. WATERMAN: -- do better to -- oh,

23 absolutely.

24 MEMBER APOSTOLAKIS: Thank you very much.

25 Steve has wanted to say something for a long time.

1 MR. GROBE: I was going to say --

2 MEMBER APOSTOLAKIS: Oh, okay.

3 MR. GROBE: -- we've now completed the

4 first two bullets on the first of 10 slides in Paul

5 and Mike's presentation. And unless it's critical, I

6 think we need to move on.

7 MR. ARNDT: I just wanted to mention that

8 -- to answer Sam's question, there was a small study

9 done on the Korean plants, and that study indicated

10 that at least in early implementation individual

11 systems actually had a higher failure rate.

12 Now, some of that might have been

13 familiarity and things like that, but that's the one

14 data point which --

15 MEMBER ARMIJO: That's the sort of stuff

16 I'm looking for. You know, what's the experience

17 that's unique to digital I&C as compared to analog?

18 And, you know, what are we doing about it?

19 MEMBER APOSTOLAKIS: There have been

20 studies here and there. All I'm saying is somebody

21 has to put everything together, and then say something

22 about their applicability to nuclear facilities.

23 MR. ARNDT: Okay.

24 MR. LOESSER: Okay. We still maintain

25 that high-quality design is the most important method

1 to defend against common mode failure. However, even
2 with that, it can occur.
3 MEMBER WALLIS: It seems like circular
4 reasoning. I mean, high-quality design established
5 doesn't lead to failures, and so the definition of
6 "high-quality design" I don't think it adds anything.
7 MR. LOESSER: A problem we see is that no
8 matter how high quality the design is, and no matter
9 how much care is spent, there can still be subtle --
10 still be certain failure probabilities. We can reduce
11 this with high quality, but we can't totally eliminate
12 it. And the 1997 NAS study basically confirmed this.
13 MEMBER APOSTOLAKIS: Right.
14 MR. WATERMAN: Boy, this slide has
15 gotten --
16 MEMBER WALLIS: There isn't a law that
17 says that you have to have some residual failure
18 probability, though. It's just that people aren't
19 smart enough. Is that what it is?
20 MR. LOESSER: I think it's not so much
21 people aren't smart enough, but the systems are so
22 complex these days that no one person can understand
23 everything in one of the modern digital systems. It's
24 proportioned up and errors still occur.
25 MEMBER WALLIS: But it always works.

1 MR. LOESSER: That's what?

2 MR. GROBE: It must be an Apple product,

3 not a --

4 (Laughter.)

5 MR. WATERMAN: The next slide is -- some

6 time ago, over my years with the NRC, I've repeatedly

7 heard from the industry that digital systems seem to

8 be more reliable than systems they are replacing. And

9 so it just occurred to me, well, when -- it's a

10 relative term. What do they mean by "more reliable"?

11 So what I did was I got into -- this was

12 my own initiative on the weekends, if you will. I dug

13 into the archives of the operating experience report

14 database and started doing some keyword searches on

15 words such as computer and SPDS and things like that.

16 The OER database is a database of reports that are

17 required to be called into the NRC, 10 CFR 50.73-type

18 reports on anything that would, among other things,

19 prevent an operator from mitigating an event, for

20 example.

21 In SPDS, obviously, if that doesn't work,

22 they can't monitor their critical safety functions,

23 and so they might impede their ability to mitigate a

24 LOCA or some design basis event.

25 So I dug up some initial just counts.

1 There's 340 events shown on the slide here. There
2 were a lot more hits than 340 -- I had to read all of
3 those things -- and pretty much weeded it out to that.
4 And I presented this at the Subcommittee, and there
5 were some really excellent comments at the
6 Subcommittee, and I've gotten some good comments from
7 my management about, well, this doesn't really say a
8 lot other than numbers, right?
9 And so I went back. Somebody had asked
10 me, "Well, how many systems are installed? Can you
11 normalize that data?" I did a rough normalization
12 this morning. I don't know how many systems are in
13 there, but I could make an estimate that back in '88
14 there were probably about 300 digital systems that
15 were reportable.
16 If you look at safety parameter display
17 systems, that's one in every plant. Right? So that's
18 about a hundred. There's 65 plant sites, I think, or
19 something like that. So you've got emergency
20 response, sound the sirens, get everybody out of
21 there. There's about 65 of those systems.
22 There's about 65 security systems that run
23 the site, so you can have access to critical equipment
24 and things like that. And so I figured, well, okay,
25 about maybe 300 systems in '88. The industry has been

1 continuously improving their systems trying to make
2 them more and more safe, more and more reliable, and
3 so looking back at '06 I figure there's probably now
4 about maybe 600 systems, give or take, I don't know,
5 that are reportable. Give or take, I don't know, 50
6 or 60, didn't really matter.
7 And what I wanted to see by doing that
8 was, well, are things getting better? Are we learning
9 from our mistakes, if you will? And what I found was
10 that, yes, we are. Early on we got a lot of failures,
11 as you see. Probably a lot of those are SPDS out
12 there in 1989 and systems being newly installed. And
13 as they mature, you know, the failures keep getting
14 corrected, and they become more and more reliable.
15 And out in the year 2006, it looks like
16 it's planing out to about, you know, one percent or
17 maybe two percent of installed systems failures per
18 year. So, you know, if you got 600, what does that
19 mean? Well, you can read the graph there.
20 MR. GROBE: I want to make sure that the
21 Committee doesn't interpret this as any sort of a risk
22 analysis. This data is extremely raw.
23 MEMBER CORRADINI: That's okay. Raw data
24 is very nice. I like raw data.
25 MR. GROBE: It hasn't been normalized by

1 any -- for example, the industry performance has
2 improved dramatically over this period of time. So
3 this was not LERs 50.73; it was 50.72 reports to the
4 operating center. And the thresholds for those
5 reports have changed during these two decades, so --
6 MR. WATERMAN: About 1998.
7 MR. GROBE: Yes, it's very difficult to
8 use this data for anything meaningful.
9 MEMBER CORRADINI: Could you repeat your
10 last thing that you said that -- in '98, what changed
11 over? I'm sorry.
12 MR. GROBE: We revised and more risk-
13 informed our reporting requirements in 50.72 and
14 50.73.
15 MEMBER CORRADINI: There might actually be
16 more reporting after that point?
17 MR. GROBE: No, less.
18 MEMBER CORRADINI: Less reporting.
19 MR. GROBE: Less. So it's very difficult
20 to use this data in an interpretive fashion. It's
21 simply presented for the purpose of indicating that
22 digital systems do have problems, you know, they're
23 not perfect. I don't think any of us thought they
24 were, but it's data.
25 MEMBER CORRADINI: Just so I understand

1 the Y-axis, it's number of events normalized or total
2 number of events?
3 MR. WATERMAN: That's total number of
4 events. And just this morning I wrote some little
5 numbers in on my -- I didn't have time to update the
6 slide, but --
7 MEMBER CORRADINI: So just let me say it
8 back to you, so I understood what you were saying.
9 that back in '88, when the SPDSs started up and other
10 things started up, you were on the order of 300 or
11 less, 200 to 300. And in '06, you were on the order
12 of double that.
13 MR. WATERMAN: Yes, roughly double that.
14 You know, my --
15 MEMBER CORRADINI: These are just raw
16 numbers of observed events, given the trip points,
17 just like an instrumentation system that you change
18 your bandwidth as to what you report and what you
19 don't report, blah, blah, blah.
20 MR. WATERMAN: That's right.
21 MEMBER CORRADINI: Okay.
22 MR. WATERMAN: Yes. In '98, I think they
23 raised the threshold by saying, look, if something
24 that could mitigate an event failed but its redundant
25 component is still there, you can still mitigate the

1 event. So why report it?

2 MR. BANERJEE: What are the yellow lines?

3 MR. WATERMAN: The yellow lines is the

4 little history of our formulation of D3 policy and our

5 SRP guidelines.

6 MR. GROBE: I think he's talking about the

7 ones on the bottom.

8 MR. WATERMAN: Oh. The ones on the bottom

9 -- the ones on the bottom, I just call out different

10 years where different types of failures have occurred

11 in systems such as in 1988. That was a reactor

12 protection system failure that occurred at South Texas

13 Unit 1. It was a software error in all four data

14 processing system computers. That would have caused

15 all four primary coolant loop calculated T-hots to

16 fail, which would have defeated various tech spec

17 required actuations.

18 MR. GROBE: It just gives you an

19 indication of some of the more interesting events and

20 what system they involve.

21 MR. BANERJEE: For that, yes.

22 MR. GROBE: And that's useful.

23 MR. WATERMAN: That's like a software

24 failure. There's a -- let me see here. Turkey Point,

25 that was a self-testing error in the software.

1 MR. GROBE: I don't think we need to go
2 through all of them.
3 MR. WATERMAN: Okay. But anyway, what I
4 really wanted to get a handle on with this data wasn't
5 the numbers themselves but I wanted to confirm what
6 myself is -- is diversity in defense in depth really
7 such a big issue? I mean, are we just running around
8 chasing our tails on this?
9 And it appears, just from the number of
10 failures that continue to occur, that, yes, maybe we
11 ought to be paying attention to that. So I just
12 needed that reassurance myself to be a little bit
13 more --
14 MEMBER APOSTOLAKIS: I think the real big
15 issue is how much of that you need, not whether it's
16 needed.
17 MR. GROBE: Exactly.
18 MR. WATERMAN: Yes.
19 MEMBER APOSTOLAKIS: What exactly you
20 need. I don't think the industry is willing to take
21 as much as we want, because last time they told us
22 that they don't want to see any risk in any of this.
23 Not NEI. Not NEI. NEI didn't say that.
24 MR. ARNDT: But the other point you
25 indicated was that you wanted to see whether or not

1 the sort of heuristic arguments that people were
2 making, that digital systems are more reliable than
3 analog systems, is true. And you can only do that if
4 you have a similar plot --
5 MR. WATERMAN: Absolutely. That's
6 absolutely true, and I'm just --
7 MEMBER APOSTOLAKIS: This is not really --
8 MR. WATERMAN: -- mine doesn't do that.
9 MEMBER APOSTOLAKIS: This is not accident
10 conditions, Mike. This is not representative of what
11 we are trying to do here, right?
12 MR. WATERMAN: That's right.
13 MEMBER APOSTOLAKIS: We're trying to put
14 some diversity there to mitigate accidents, right?
15 MR. WATERMAN: Those systems are all
16 systems that would be required to mitigate accidents,
17 though, had an accident occurred. I mean, you do want
18 the sirens to go off.
19 MEMBER APOSTOLAKIS: It's interesting.
20 MR. WATERMAN: It's interesting. You
21 know, there's times when I wish that plot didn't
22 exist.
23 MEMBER APOSTOLAKIS: Okay.
24 MR. WATERMAN: For my benefit.
25 MEMBER ARMIJO: It's amazing. I think

1 it's great. I think it's a great plot.

2 MR. LOESSER: To summarize our current

3 policy, based on a SECY paper and an SRM, we asked

4 licensees to assess the diversity and defense-in-

5 depth, analyze each postulated common mode failure, to

6 demonstrate adequate diversity. And that if a common

7 mode failure could disable a safety function, then a

8 diverse means is required to perform that or a

9 different safety function to mitigate the same

10 accident or transient.

11 And since common mode failures are beyond

12 design basis, this can be a non-safety system if the

13 safety is of sufficient quality. And we also asked

14 for a set of independent and diverse displays and

15 controls in the main control room to provide for

16 manual system level actuation.

17 One of the questions that came up earlier

18 -- these independent displays and controls could be

19 non-safety, so there has to be a method of having

20 these non-safety controls actually actuate a safety

21 function. And this is one of the concerns about

22 having a safety and non-safety mix at some point.

23 MEMBER APOSTOLAKIS: It's interesting.

24 First, I hope that members notice the dates there --

25 safety from '93, the whole stuff is from '93. And

1 then, all this discussion about failure modes is
2 related to the second point there, postulated common
3 mode failure. What do you postulate?
4 MR. WATERMAN: Okay. The next slide we're
5 going to talk about task working group issues that
6 we're going to be taking on.
7 MEMBER ABDEL-KHALIK: If we go back to the
8 previous slide please --
9 MR. LOESSER: Yes.
10 MEMBER ABDEL-KHALIK: -- the third point,
11 you sort of assert that common mode failures are
12 beyond design basis events.
13 MR. LOESSER: Yes.
14 MEMBER ABDEL-KHALIK: Can you say that for
15 additional systems at this time?
16 MR. LOESSER: That is the decision that
17 was made by the Commission back in '93.
18 MEMBER ABDEL-KHALIK: But can you --
19 MR. LOESSER: Are you asking for a
20 personal opinion or a staff policy?
21 (Laughter.)
22 MEMBER ABDEL-KHALIK: Given all the
23 discussion that we're having regarding diversity and
24 defense in depth for digital I&C systems, can you make
25 that assertion as the starting point for the

1 discussion?

2 MR. GROBE: The basis for the Commission

3 decision, as I understand it at that time, was focused

4 on what was perceived at the time as the probability

5 of a common mode failure resulting in an accident.

6 And there were some discussions that occurred, and it

7 was perceived at that time that it was an extremely

8 unlikely event. And my understanding is the

9 Commission concluded, based on a variety of inputs,

10 that this type of failure should be treated as beyond

11 design basis.

12 MEMBER ABDEL-KHALIK: Thank you.

13 MEMBER MAYNARD: That's consistent with

14 how we handle any other safety systems. Anyway, if

15 you identify a common mode failure, that you're

16 basically required to declare both systems inoperable

17 and take whatever actions that are there by the tech

18 specs. So the handling of this is the same as what --

19 MR. GROBE: I would suggest that this

20 philosophy is equivalent to the way the Commission

21 established policy in ATWS. It was a beyond design

22 basis event, but something of substantive concern such

23 that we have expectations in the area of ATWS. But

24 it's not considered a design basis event.

25 MEMBER APOSTOLAKIS: So if --

1 MR. GROBE: The Commission was
2 establishing a similar philosophical approach to this
3 common mode failure of digital systems. If it's
4 something of concern, we should have specific
5 guidelines and expectations, but it's beyond design
6 basis.
7 MEMBER APOSTOLAKIS: If they were
8 considered design basis, what would you do?
9 MR. GROBE: How would it be handled
10 differently?
11 MEMBER APOSTOLAKIS: Yes.
12 MR. GROBE: There would need to be safety-
13 grade capability to accommodate common mode failures.
14 MR. LOESSER: The diverse system that we
15 talk about in Section 3, 2.3, would have to be safety-
16 grade as opposed to non-safety. And in addition, the
17 analysis of the accident would have to be done on a
18 worst-case timing basis as opposed to best estimate.
19 MEMBER APOSTOLAKIS: So you would have to
20 consider the sequence where the digital I&C is part of
21 it, and do the standard design basis regulation.
22 MR. LOESSER: Yes.
23 MEMBER POWERS: How difficult would it be
24 to apply the single failure criteria to the systems to
25 avoid common mode failure criteria? I mean, it would

be very confused.

MEMBER APOSTOLAKIS: Yes. Common mode failure -- common cause failure is not a single failure.

MEMBER POWERS: But you would have to have single failure approved systems to prevent common mode -- or to accommodate common mode failure.

MEMBER MAYNARD: And it would be too trying for --

MEMBER POWERS: Really interesting.

MEMBER MAYNARD: You'd have to have two trains of a completely --

(Laughter.)

The fact that common mode failure isn't a design basis doesn't mean that we're -- that the industry is not required to mitigate for some of these, like that's what the ATWS is and stuff like that. So it doesn't mean that you're not required to mitigate.

MEMBER WALLIS: Do we know what "safety grade" means for digital systems?

MR. LOESSER: Yes.

MEMBER WALLIS: Ye?

MR. LOESSER: The safety grade requires that it be designed in accordance with Appendix B,

1 they follow the requirements of 603 as required by
2 50.55(a)(h).
3 MEMBER WALLIS: All this applies to
4 digital but not problem, right?
5 MR. LOESSER: There's always a problem.
6 Any time you are required to do things to an exacting
7 standard, it's more expensive and more difficult than
8 going down and buying something at the local
9 instrumentation shop. Yes, it's difficult, and it's
10 expensive to meet the requirements of safety-grade
11 equipment.
12 MEMBER WALLIS: This makes the digital
13 system better because it's safety grade?
14 MR. LOESSER: We think it reduces the
15 probability of failure, yes.
16 MEMBER WALLIS: Okay. Thank you.
17 MEMBER APOSTOLAKIS: But there is no real
18 evidence of that. I think you're right, we do think
19 that.
20 MEMBER WALLIS: Do you all have a safety-
21 grade Mac like this, that's better than this Mac here
22 in some way?
23 MEMBER APOSTOLAKIS: Under certain
24 conditions it probably is.
25 MR. WATERMAN: Environmental qualification

1 or -- I'd say it probably --

2 MEMBER WALLIS: But the digital plot

3 itself is probably --

4 MR. LOESSER: Well, even there, if this

5 was a safety-grade Mac, if you would, the operating

6 system would have been carefully examined to look for

7 flaws. The security applications thereof would have.

8 Now, it --

9 MEMBER WALLIS: Do we know how to do that?

10 Well --

11 MR. LOESSER: It would also impose --

12 MEMBER WALLIS: I'm a bit suspicious about

13 whether you really know how to determine whether it's

14 safety grade or not.

15 MEMBER APOSTOLAKIS: Can we move on?

16 MR. LOESSER: Yes.

17 MEMBER APOSTOLAKIS: So these are the

18 kinds of things that you have to address. When will

19 we see some preliminary thoughts on these things?

20 MR. GROBE: I expect the project plan

21 would be finalized this month. That's my hope. And

22 it will have specific dates, and we can set up

23 periodic meetings with the Subcommittee to update you

24 on the status.

25 MEMBER APOSTOLAKIS: You mentioned earlier

1 that you have to take some action regarding the
2 three D by the fall -- by fall?
3 MR. GROBE: That's the goal, yes.
4 MEMBER APOSTOLAKIS: So I would -- are you
5 coming to us before you do that or after you do that?
6 MR. GROBE: Yes. You'll notice in the key
7 milestones it includes consideration of going to the
8 Committee to review generic requirements as well as
9 the Advisory Committee on Reactor Safeguards.
10 MEMBER APOSTOLAKIS: Okay. So in three,
11 four months we're going to see some answers to this.
12 MR. GROBE: Yes.
13 MEMBER APOSTOLAKIS: Good. Can we move
14 on?
15 MR. WATERMAN: The working group scope --
16 as you can see right there -- is identify our existing
17 requirements and how they're working. The research
18 that I'm doing is to identify acceptable diversity
19 strategies within the realm of diversity and defense
20 in depth.
21 MEMBER APOSTOLAKIS: Would these
22 strategies, Mike, be independent of the system you are
23 looking at? Again --
24 MR. WATERMAN: Yes.
25 MEMBER APOSTOLAKIS: -- if I have a simple

1 actuation system, and if I have a more complex system
2 that controls the function, would these strategies be
3 different?
4 MR. WATERMAN: I would expect strategies
5 to be different, depending upon the system that you're
6 designing for. And what the research is doing isn't
7 trying to develop a strategy, but actually try to
8 develop several different strategies. As you recall,
9 in the Subcommittee meeting -- and it got lost out of
10 this. I had that color wheel, if you will --
11 MEMBER APOSTOLAKIS: Yes.
12 MR. WATERMAN: -- of the six NUREG/CR-6303
13 diversity strategies and the diversity attributes and
14 the criteria associated with that. And the objective
15 of the research that's ongoing right now, and it has
16 already come up with some preliminary results which
17 we'll talk about here in a minute, was to try to
18 identify, are there particular diversity strategies
19 that have been used around the world that are shown to
20 be kind of -- to be effective?
21 MEMBER WALLIS: I'd like to suggest this
22 strategy is the wrong approach. The strategy is a
23 means to an end, and you should define the end. End
24 is performance-based. There are various ways to reach
25 it. A strategy itself may look good on paper, but it

1 may not work. So it's just a means to achieving
2 something else, which is much more important.
3 MR. WATERMAN: Well, what shall I call it?
4 MR. GROBE: The complexity is -- that's
5 what our current guidance does today. It defines the
6 end state. The devil is always in the details, and
7 what we're trying to do is to provide more
8 descriptive --
9 MEMBER WALLIS: Just like saying I went
10 through the right motions, but if you didn't get the
11 right answer, then --
12 MEMBER APOSTOLAKIS: They mean more than
13 that, though.
14 MR. GROBE: I think a better description
15 is a more complete characterization of our
16 expectations in the area of diversity.
17 MR. WATERMAN: Combinations of diversity
18 attribute criteria that -- is what we're actually
19 seeking, and it's not combinations that we invent
20 ourselves, but it's -- what I'm trying to do is look
21 at what's going on in other industries and in the
22 nuclear industry, and what have other people found to
23 be especially --
24 MEMBER WALLIS: As a measure of how well
25 these work.

1 MR. WATERMAN: How well they work. And if
2 we find some trends that, hey, look, everybody is
3 using different microprocessors, that would be
4 something we would recommend licensees do if they're
5 going to build --
6 MEMBER APOSTOLAKIS: We don't have a lot
7 of time, so --
8 MR. WATERMAN: Okay.
9 MEMBER APOSTOLAKIS: -- find a different
10 word. But I think there are two things that are
11 missing there -- again, the failure modes; and,
12 second, we have asked the staff in the past to develop
13 a classification of functions that digital I&C would
14 participate in.
15 So, you know, actuation, control, and
16 whatever else. And it seems to me those two items are
17 needed everywhere and here as well. So before you
18 move on to the -- to identify acceptable D3 measures,
19 you really have to do that.
20 MR. GROBE: This really goes back to what
21 Kimberly was describing as the two-step process. The
22 research in the risk area is not going to be done in
23 the next couple of months. And the question is: what
24 approach do you take on diversity and defense in depth
25 in light of the uncertainties and the lack of data in

1 various areas? And that's what we're struggling with
2 right now.
3 MEMBER APOSTOLAKIS: I know. I mean, if
4 you have problems with the completeness and soundness
5 of the approach, it doesn't seem to me that the step
6 one would be very useful. That's my problem. I mean,
7 it's one thing to know that you are doing something
8 that's conservative, and quite another to have
9 somebody say, "Well, I'm not sure it's conservative."
10 MR. GROBE: I understand. I understand.
11 MEMBER APOSTOLAKIS: So we have to really
12 think about this part.
13 MEMBER ABDEL-KHALIK: The conceptual
14 difficulty I have is that I have a report here by the
15 National Academy that concludes that their appears to
16 be no generally applicable effective way to evaluate
17 diversity between two pieces of software performing
18 the same function. And yet what you want to do here
19 is define adequate diversity, which implies that you
20 will quantify diversity, which is inconsistent with
21 this statement.
22 So I just want sort of a clear response
23 from you as to whether or not you agree with the
24 National Academy report.
25 MR. GROBE: I don't know that we were

1 intending to quantify diversity. Let me just give one
2 example and then I think maybe we can move on. I'm
3 not a software engineer, I'm not a digital I&C expert,
4 but this resonated with me.
5 And that is that if you're trying to
6 define or you're trying to achieve diverse software,
7 you would give the same problem to two different
8 software design teams, where there's a central entity
9 that is overseeing those design teams and insists that
10 each team puts restrictions on how the team can solve
11 the problem.
12 So you ensure that the two design teams
13 utilize different techniques in developing the
14 software to accomplish the goal. So you truly have
15 two sets of software that were designed with what I'll
16 call intellectual diversity. They solve the problem
17 differently, and you have some controls in place to
18 ensure that they solve the problem differently.
19 So in a sense, you have some diversity in
20 the thinking that went into how to solve the problem.
21 Those are the kinds of concepts that are being tossed
22 about.
23 MEMBER KRESS: Said, we discussed this in
24 the Subcommittee, and the thing I got out of it was
25 that what they would do is develop attributes of what

1 diversity meant. And these would be -- then, they'd
2 have standards for these attributes. They wouldn't
3 quantify them. They would use judgments as to whether
4 the standards had been met for the various attributes.
5 And, you know, that's about as far as you can when you
6 can't really quantify it.
7 MEMBER CORRADINI: So if I could just ask
8 -- so just to reflect on that, so what you're saying
9 is the diversity will be defined based on attributes
10 of development and process of development, not on
11 testing of the software.
12 MR. WATERMAN: Well, testing is one
13 approach where you can have different testers and
14 different test programs, for example. That's one of
15 the attribute criteria in --
16 MEMBER CORRADINI: But that wouldn't prove
17 diversity or lack of -- that would just prove it works
18 by a certain test.
19 MR. WATERMAN: Yes. By difficult test.
20 For example, submit it to fault injection testing.
21 MR. GROBE: Why don't we go on to
22 Slide 17. And it gives a broader perspective on
23 diversity, and maybe we can help --
24 MR. WATERMAN: But I'd like to iterate
25 that what Dr. Apostolakis says is very important. If

1 you don't know where the failures are, then how do you
2 know that the diversity approaches or strategies,
3 whatever you want -- how do you know that those
4 strategies are really the appropriate strategies?
5 If you have a lot of failures in
6 specifications, then it would seem that one of your
7 diversity attributes ought to be specification,
8 diverse specifications.
9 MR. GROBE: Mike, you've got two minutes
10 to cover the next three slides.
11 MR. WATERMAN: We have ongoing research
12 right now that is being conducted by Oak Ridge
13 National Lab to try to answer the question: how much
14 diversity is enough? And we've gotten some
15 preliminary results out of that.
16 Now, we have six diversity attributes
17 identified in NUREG/CR-6303, which was written by Gary
18 Prekshaw out of Lawrence Livermore National Lab back
19 in the mid-'90s. And those attributes are design,
20 equipment, function, the human diversity, which I call
21 life cycle process diversity if you will, system
22 diversity, and signal diversity and software diversity
23 are the six attributes.
24 What we did is we went out first to
25 different agencies and different industries and asked

1 them, "What are you doing about diversity?" And we
2 looked at NASA, who obviously are in control of the
3 space shuttle, the International Space Station, their
4 contribution to it. We looked at the Johnson Space
5 Flight Center, Mission Control there.
6 We went to FAA and said, "What are you
7 doing about flight control systems in your tower?"
8 Things like that, tower control systems. "What are
9 you doing for diversity?" Looked at some airline --
10 airplane manufacturers, airbus, the A-320, took a look
11 at what they're doing for diversity in our flight
12 control/avionics systems.
13 We also took a look at the Boeing 777 to
14 see what they are doing for diversity in their
15 avionics system. Then, we took a look at DoD, and,
16 first, we thought, well, let's take a look at what
17 they're doing in the subs. They've got nuclear
18 reactors, right? Well, most of that stuff is
19 classified, so we sort of had to abandon that
20 approach, because we wouldn't be able to publish the
21 results. But we take a look at DoD battlefield
22 management, if you will, how do you integrate a
23 battlefield.
24 Now, we also took a look at electrical
25 grids -- you know, how do you manage electrical grids,

1 so that it doesn't go down, you know, on a software
2 error? And then, we also look a look at the chemical
3 industry, petrochemical industry.
4 And the green shaded boxes here are the
5 types of diversity that are applied for these various
6 systems here. Now, over in that right column you'll
7 notice those little hash marks, slash things there.
8 What that represents is all of those different types
9 of diversity are used in the chemical industry. It's
10 just not universally accepted in the chemical
11 industry.
12 One company may use equipment diversity.
13 Another company may use software diversity. So it's
14 -- so there's no way to pin it down to "the chemical
15 industry does this."
16 MR. GROBE: The message the Committee
17 should receive from this -- I want to make sure that
18 there's no inference that one green box going
19 horizontally across the page is interpreted as
20 equivalent to the next one. It just means that the
21 space shuttle and the space station both have
22 attributes of functional diversity. They may be
23 completely different attributes that are considered.
24 The other message that you should get from
25 this is there is no standard on this whatsoever across

1 any industry.

2 MR. WATERMAN: The next step on those

3 results is to tunnel down into, for example, design

4 diversity on the FAA flight controls internally and

5 find out, well, okay, you're using design diversity.

6 What kind of design diversity are you using? And find

7 out, are they using design diversity that involves one

8 attribute or another criteria?

9 MR. GROBE: Let's move on.

10 MR. WATERMAN: Moving on to the next, we

11 also took a look at primarily the European nuclear

12 reactors and tried to determine, what are they doing

13 about digital system diversity in their plants? And

14 we came out with some preliminary results on that.

15 For example, looking at Sizewell, and you

16 can see -- now, the slashes in this plot are a little

17 bit different than the slashes in the last one. The

18 slashes in this plot for Dukovany, Beznau, and Paks

19 are -- as you recall, the European plants use graded

20 safety systems graded A, B, and C.

21 We have graded here in the United States,

22 too -- safety grade or it's not safety grade. but in

23 the European plants, it's safety grade A, safety grade

24 B, and safety grade C. Now, all the green shading you

25 see there are safety grade A systems. The --

1 MR. GROBE: Which is equivalent to our
2 safety-related.
3 MR. WATERMAN: The more lightly shaded
4 boxes are credit for safety grade B, and which
5 provides some diversity there, because the safety
6 grade B may be using different equipment, for example.
7 So that is --
8 MEMBER APOSTOLAKIS: Maybe we can discuss
9 the possible approaches, Mike, and -- you know,
10 and --I'm sure you will come back with the same stuff
11 in a different context in the future. So let's --
12 MR. WATERMAN: We're looking forward to
13 that.
14 MEMBER APOSTOLAKIS: All right.
15 MR. LOESSER: On possible approaches for
16 addressing D3, we've looked at this and some of the
17 initial thoughts here -- not initial, we've been
18 thinking about for a long time, is that, first of all,
19 diversity and defense in depth requirements should be
20 the same for new plants and for current operating
21 plants.
22 Second of all, that there should be
23 sufficient diversity to mitigate adverse effects of
24 protection system malfunctions in the presence of a
25 single failure and all non-detectable software

1 failures. That for safety functions that do not
2 incorporate within themselves adequate diversity to
3 prevent a common cause failure, common mode failure,
4 provide diverse automated backup safety system
5 functions.
6 And fourth is the same as the existing one
7 -- provide displays and controls in the main control
8 room for manual actuation of the safety equipment to
9 manage the plant's critical safety functions.
10 MR. BANERJEE: What does the third bullet
11 mean exactly? Not incorporate sufficient --
12 MR. LOESSER: There are some designs that
13 have inherently within them a certain degree of
14 diversity. An example was the B&W Star system that
15 had two separate processors on each board. There have
16 been some other proposal systems, and certainly they
17 could be deliberately designed, such that diversity is
18 built into the one system. And if that's the case we
19 wouldn't --
20 MR. BANERJEE: And common mode failure
21 would knock both of them out?
22 MR. LOESSER: Yes, that's correct. And if
23 that is actually true, and a system like this is
24 proposed, then they wouldn't need a diverse system
25 because the issue we're worried about -- common mode

1 failure -- is already taken care of.

2 MR. BANERJEE: That means that these two

3 systems would be -- have to be sufficiently diverse in

4 some way.

5 MR. LOESSER: That's correct. And that

6 would have to be -- that's part of what Mike's

7 research is on what is sufficiently diverse. That was

8 the previous two slides. What do other countries do

9 for diversity?

10 MR. BANERJEE: Well, I noticed you didn't

11 put Canada, which uses two completely different

12 shutoff systems, clearly diverse.

13 MR. WATERMAN: Excuse me. This is Mike

14 Waterman. Yes, we looked at Darlington --

15 MR. BANERJEE: Right.

16 MR. WATERMAN: -- SDS, shutdown system 1

17 and shutdown system 2. It didn't show up on this

18 plot, but we have looked at that. I believe they used

19 formal methods on that to verify that they were

20 sufficiently --

21 MR. BANERJEE: They don't have computer --

22 digital I&C. It's still --

23 MR. WATERMAN: Yes. No, I think it's

24 digital in shutdown system 1 and 2. They use formal

25 methods to validate the -- that they were correct.

1 MEMBER APOSTOLAKIS: They use the formal
2 methods, you're right. A variation of formal methods,
3 but also a lot of testing under different conditions.
4 Yes, it was really a very nice piece of work.
5 MR. WATERMAN: Yes. It was one heck of a
6 project, to tell you the truth. I was somewhat
7 involved on the outside watching.
8 MR. GROBE: I want to emphasize on this
9 slide that this is not a staff recommendation. These
10 are just some things that we're thinking about. And
11 this is -- not contrary, but different than the
12 current Commission policy.
13 MR. WATERMAN: But keeping in mind on that
14 first bullet, the Commission policy, when it was
15 written, made the assumption that current operating
16 plants, they had their main control board laid out
17 there. It was all analog. They had a diverse system
18 already. Go ahead and put in a digital system.
19 You've still got your analog backup.
20 Well, then, plants decided, well, we've go
21 to replace that stuff, too, it's getting old. So that
22 changed the whole game. Now you have a plant come in,
23 says, "Well, we need new RPS, we need new ESFAS, and
24 we're going to change out all of our main control
25 boards and make that digital, too." Well, gee, that's

1 just like a brand-new plant, right?

2 And so, then, the diversity issue that

3 we're applying the diversity -- the requirements that

4 we're applying to new plants probably ought to be

5 applied to existing plants, too, because, I mean,

6 what's the difference. And that wasn't captured in

7 the original SECY position.

8 We're trying to just bring that out now

9 that, hey, if a plant is going to get its whole plant,

10 they probably ought to consider putting in a diverse

11 actuation system, if they don't have enough to --

12 MEMBER APOSTOLAKIS: Okay. We have 18

13 minutes.

14 MR. GROBE: Yes. Steve Arndt is up to the

15 challenge.

16 MEMBER APOSTOLAKIS: You guys are too

17 slow.

18 MR. ARNDT: I'm going to talk to you a

19 little bit about the issues associated with risk-

20 informing digital instrumentation control licensing,

21 which are very significant. And I'm going to go

22 through the first three or four slides very quickly,

23 on basically background and status.

24 I want to emphasize before I go forward,

25 the three things that George mentioned earlier in the

1 presentation -- understanding operational experience,
2 understanding lessons learned on what we have tried to
3 do, and categorization of the digital systems -- are
4 all part of this work. Could we do more? Could we do
5 it better? Certainly. And I'll bring those in as
6 they come.
7 We've been looking at this for a number of
8 years. The basic issue is our current regulatory
9 position is entirely deterministic. We've actually
10 looked at trying to risk-inform it in the past and
11 said we're not ready yet. We look at the process, we
12 look at testing, design, and based on that make a
13 determination of adequate protection.
14 The PRA policy statement encourages the
15 staff to look at risk-informing, to the extent
16 supported by the state of the art. And, of course,
17 one of the big issues is: what is the state of the
18 art, and what does the state of the art need to be for
19 us to take the step to risk-inform?
20 As I said, currently, we don't use risk-
21 informing type methods in our reviews of I&C. There
22 has been a very small amount of risk insight type
23 discussions, but none of that has been formally
24 included in any of the license submittal reviews.
25 MEMBER WALLIS: That means you have no

1 measure of the likelihood of failure.

2 MR. ARNDT: No. It means we're not using

3 it as a --

4 MEMBER WALLIS: But deterministic doesn't

5 give you any measure of the likelihood of failure, so

6 what is it -- you have no idea of the probability of

7 failure. Is that correct?

8 MR. ARNDT: We do not use it as an

9 integral part of our licensing decision.

10 MEMBER WALLIS: If I asked you what it

11 was, you couldn't tell me what the probability of

12 failure was.

13 MR. ARNDT: No. I could tell you what the

14 probability was, but I wouldn't include it in my

15 regulatory decision.

16 MEMBER WALLIS: All right. So you do have

17 a way to calculate it.

18 MR. ARNDT: I have ways of estimating it.

19 The issue is: am I certain enough of that mechanism

20 to use it in a regulatory decisionmaking process? And

21 that's the big issue.

22 For new reactor reviews, particularly the

23 design certs, we've looked at how plants have

24 incorporated digital systems and common mode failure

25 software and other issues into the design cert PRAs

1 that have been presented so far. These are relatively
2 high level. As you know, digital I&C and human
3 machine interfaces in the current design certs are
4 very general. Most of that has been pushed to the
5 DACCS.
6 What they've done is they've looked at --
7 used standard fault tree/event tree methods, varying
8 levels as low as circuit board level, hardware data
9 derived from some generic or proprietary databases,
10 and some uncertainty analysis and important studies to
11 give a general feel for what the issues were.
12 Our reviews of those have reemphasized the
13 importance of diversity in these systems to mitigate
14 some of these uncertainties, both in terms of methods
15 in data as well as what's actually being put out
16 there.
17 There is a myriad of modeling challenges
18 associated with doing this. I won't go through all of
19 them in detail. This has been discussed in the
20 literature and in heated debates in conferences and
21 meetings for the last 10 years. Software reliability
22 is, of course, a very big issue, common mode failure
23 is a big issue, the failure data is an issue, time
24 dependencies and how important they are.
25 One of the big issues that we're just now

1 really starting to get a handle on these systems -- a
2 lot of them -- the significant fraction, if not the
3 majority of the software and the hardware, is fault
4 detection, diagnostics, things like that.
5 Well, that's wonderful, because it will
6 stop failures from propagating, but could also cause
7 failures. And there's several examples at Turkey
8 Point. Load sequencer is an example where because the
9 system was in diagnostics and didn't trip back into
10 the regular mode when it got a demand signal, it had
11 a failure. So there's black and white associated with
12 this. And how do you model that and have confidence
13 that your model is reasonable is a big challenge.
14 In developing this, there is also some,
15 how do you deal within the regulatory space? The
16 acceptance criteria and the PRA quality standards are
17 fairly general and don't talk to these issues
18 specifically. And we don't know exactly whether or
19 not we want to add additional guidance on that or not.
20 Another thing --
21 MR. BANERJEE: Is there any sort of
22 requirement to also give guidance on how these things
23 should be tested? I mean, modeling is one aspect.
24 MR. ARNDT: Yes.
25 MR. BANERJEE: But testing is another.

1 MR. ARNDT: From a deterministic
2 standpoint, if you look at the requirements in 603 and
3 the branch technical positions and things like that,
4 we basically have a life-cycle process that you have
5 to do, which include testing, both testing as you
6 develop it, testing as you integrate it, and
7 independent verification and validation afterwards,
8 both in terms of paper reviews and testing reviews.
9 MR. BANERJEE: But these would be
10 specified in terms of some sort of range of parameters
11 which go outside the normal. I mean --
12 MR. ARNDT: If you start looking at
13 operational reliability, which of course this effort
14 is looking at, yes, you're exactly correct. How you
15 convince yourself that you understand what the
16 operational profile, which is the -- in software
17 speak, that you understand it properly, and you
18 understand what may or may not happen if you go
19 outside the expected things.
20 There's a couple of ways of dealing with
21 that, the most powerful of which is to go out and
22 specifically test it. And I'll talk about that in two
23 or three slides. That's one of the ways we're looking
24 at developing reliability models based on actually
25 physically testing it outside its bounds. There are

1 other ways -- analytical ways of doing that, including
2 formal methods and other things.
3 MR. BANERJEE: Well, the reason I'm asking
4 this, I'm involved in some -- ranking some very large
5 software packages for completely different reasons.
6 But the way that gets tested -- part of it is you just
7 distribute it to a whole lot of people, and they'll
8 think up incredibly diverse ways to bring it down, you
9 know, this beta testing phase. None that you've ever
10 dreamed of, by the way.
11 And eventually it -- the system becomes
12 robust over a period of years, as this experience gets
13 fed back and things get -- so if you sit and try to
14 define how you're going to test it, most of the time
15 you won't think of all the ways it can go wrong.
16 MR. ARNDT: Yes. And there's -- there are
17 modeling methods that look at how you test it and what
18 you test and how it gets better over test, or worse,
19 which can happen. And that's one of the big issues
20 associated with software reliability modeling.
21 MR. WATERMAN: And one of the things you
22 do when -- one of the things that is done on a high-
23 quality system is, as the requirements are being
24 developed, the requirements are weighted against, can
25 you test that requirement after the system is built to

1 ensure that the requirement has been met?

2 Now, that's one of the things I look for

3 when I review a digital system and development effort

4 is: are the test plans being developed in concert

5 with the requirements, or are they being developed

6 after the design has been done? If they are being

7 developed after the design has been done, there's

8 always that question of, well, did you really test

9 everything?

10 And so that's one of the things that

11 should be done on a high-quality system is every

12 requirement must be assessed from the standpoint of

13 what is the acceptance of that requirement? How do I

14 test that requirement to be sure that it is met?

15 MR. BANERJEE: It is relatively

16 standardized. Experience just starts to feed back

17 over a period of time. If each system is different

18 now, it's going to be a hell of a job.

19 MR. ARNDT: And so far each system has

20 been different.

21 MR. BANERJEE: Yes.

22 MEMBER CORRADINI: So I guess -- I know

23 you want to get to the end, but I just had a question

24 to follow up Sanjoy's. So in this area of software

25 testing, I guess the place -- I'm just wondering, has

1 the staff thought about going to a place where I would
2 check with software testing first? Have you gone to
3 an expert at Microsoft and at Apple in terms of --
4 some of their things actually do work. Some of their
5 things actually do work.
6 But in terms of how they do internal
7 testing, similar to what Sanjoy is saying in terms of
8 beta testing --
9 MR. WATERMAN: Well, we have done some of
10 our own research with the University of Virginia on
11 the fault injection type of testing. That was done by
12 Dr. Barry Johnson, and we're still interacting with
13 them on the development of that process. And he has
14 had some fairly good success using fault injection
15 testing methodology.
16 MEMBER CORRADINI: Okay.
17 MR. WATERMAN: But the suggestion to go
18 out to industry I think is an excellent suggestion.
19 MEMBER CORRADINI: I mean, unless it
20 somehow is proprietary in how they do the testing, it
21 seems to me that that would be a useful way to go
22 after what Sánjoy is talking about in terms of beta
23 testing, because that's what is done in industry.
24 MR. WATERMAN: I think we should also be
25 looking to the Department of Defense and the FAA who

1 do mission-critical type software development. There
2 is some -- you would almost call it mission-critical
3 applications that Microsoft develops, but if you talk
4 to somebody who is actually developing a trigger
5 device for a nuclear weapon, that's high-quality
6 software. And how they go about testing may be
7 something that we could apply to the nuclear industry,
8 too.
9 MR. GROBE: Okay. Let's move on.
10 MR. ARNDT: Okay. In terms of both the
11 short-term and long-term strategy, let me take just a
12 couple of seconds here. The industry has some issues,
13 and the NRC has some issues, and, of course, the
14 general community has some issues in the whole area.
15 In developing the task working group in this area, we
16 focused in on two short-term and one longer term
17 issue.
18 The two short-term issues are based on
19 regulatory decisions we want to make right now. One
20 is to better clarify what is required in terms of the
21 Part 52 PRA in digital system modeling, both the
22 design certs that we haven't processed yet, and, more
23 importantly, in the COL applications.
24 The second issue is: can we use some
25 information like Professor Wallis and I were debating

1 at the beginning of this, to help us use the risk
2 insights in current operational reactor reviews? How
3 do we do that, and how far are we comfortable using
4 those reviews? In both these areas, the industry is
5 going to provide us their thoughts in terms of white
6 papers, based on experience, and what they think the
7 state of the art is, and what they think we can do.
8 We're going to look at our internal
9 processes. We haven't done a lot of this stuff, but
10 we have looked at it a little bit. We're going to
11 look at the research output to date, which I'll talk
12 about very briefly in a second here, and also take all
13 that put together and write some interim guidance on
14 these two issues. These are actual regulatory
15 decisions we want to make today with as much
16 information as we think we have.
17 In the longer term, we want to develop a
18 comprehensive risk-informed decisionmaking strategy
19 equivalent to the 1.174 process, which would allow us
20 to do robust analysis for a number of different
21 regulatory decisions. This is a higher threshold, so
22 we want to have a much better understanding.
23 So in that longer term, we're going to
24 look at, what are the current capabilities, and what
25 are the advantages of going to more advanced

1 techniques? We're going to look at the best
2 practices.
3 As Professor Apostolakis mentioned
4 earlier, we've gone to NASA and to the transportation
5 industry and to the French and to the Finns and to the
6 Germans and other people and looked at what they're
7 doing.
8 We also want to test these things in a
9 specific benchmark-type study, and we have two systems
10 that are -- have different characteristics -- again,
11 going to George's comment on you want to understand
12 the characteristics of the system. One is an RPS and
13 one is a feedwater control system, and then, based on
14 all of this information, develop some long-term
15 regulatory guidance.
16 So again, very quickly, we're looking at
17 both the capabilities of current traditional modeling
18 methods and the advantages of advanced methodologies.
19 We're in the process now of reviewing and developing
20 acceptance criteria for the attributes of a
21 traditional modeling method. As part of that, we
22 looked at the AP1000 PRA. We're currently looking at
23 the ESBWR, vendor PRA, we've looked at PRA that was
24 done on the ESFAS system for a Korean plant.
25 We're going to peer review this. We're

1 going to bring it to the Committee to look at and
2 develop that. In the dynamic area, for various
3 reasons we're a little bit further ahead on that, and
4 we've already published one report on best practices
5 and made some recommendations on possible ways of
6 doing this.
7 We decided, based on that review, that the
8 two methods that are most powerful and most practical
9 are dynamic flow graph methodologies and Markov
10 modeling, integrated into a traditional PRA using a
11 mapping technique. If you're interested, I'll point
12 you at a lot of papers on the theory associated with
13 that.
14 What we found is that although this
15 presents a lot of technical challenges right now, it
16 is feasible. Now, the real issue is: can we make
17 that more practical? And as George mentioned earlier,
18 is it necessary for all the different systems? The
19 big issue here is: what is the actual requirement
20 based on the attributes of the systems?
21 You want to be able to model it to the
22 point where you capture all of the unique aspects of
23 the digital systems.
24 Some of the issues that we have that need
25 to get resolved if we're going to use the traditional

1 modeling methods, as the industry would like us to do,
2 is dealing with understanding the failure modes and
3 how to model those failure modes, both in terms of the
4 level of detail to capture them, in terms of the
5 potential failure modes, the propagation of failures,
6 which is a very difficult thing to model, particularly
7 because of its timing issues, as well as its modeling
8 issues, because that's not something you traditionally
9 model in a beta factor. You can, but it's not an easy
10 thing to do.
11 You also have issues with parameter data
12 and, of course, the big elephant in the room, the
13 software reliability models.
14 So where do you --
15 MEMBER WALLIS: I'm a little puzzled. I
16 know you've got no time, but I think you have to be
17 able to model these failure modes, and so on.
18 MR. ARNDT: Absolutely.
19 MEMBER WALLIS: You're doing the right
20 thing. What I'm worrying about is how all of the
21 other people can make their decisions without
22 understanding the failure modes.
23 MR. GROBE: And that gets back to the
24 level of diversity --
25 MEMBER WALLIS: Yes, but that's just talk.

1 I mean, if you understand the failure modes, you're
2 just talking about it.
3 MR. GROBE: Right.
4 MEMBER APOSTOLAKIS: It's really
5 important, Jack. It has to be done as soon as
6 possible. It doesn't have to be perfect, but it
7 really is a major input to this.
8 MR. ARNDT: Okay. The issue -- where we
9 are right now, and where we think we're going. The
10 two short-term intermediate guidance tasks -- we're
11 going to use what we know and try and get the best
12 situation we can for the decisions we have to make
13 today. Those are going to be done six months, a year,
14 and we're currently working out the details with NEI
15 and other stakeholders.
16 In the longer term, I'll go back and
17 reiterate the four points to put a point on it. It
18 may be possible to use traditional modeling methods if
19 we can overcome some of the limitations, and the
20 industry has some ideas that they are providing to us
21 as well. The dynamic methods, the advanced methods,
22 are capable of modeling the unique aspects, but they
23 are challenging to implement. But we think, at least
24 in principle, that that's possible.
25 The two other issues are, as we move

1 forward on this, we don't want to make this PRA
2 technology-specific. We want to make -- develop the
3 attributes of a model that would be acceptable, things
4 like you have to be able to understand cross-
5 communications, you have to be able to model the kinds
6 of failures we've seen, and things like that, which
7 may drive you to a particular technology or not, or
8 modeling methodology or testing methodology.
9 One of the nice things about the dynamic
10 methodology that I didn't talk about is that we're not
11 modeling hardware and software separately. We're
12 doing a states-based model of the system. It doesn't
13 matter whether bit flips in the memory or there was a
14 wrong line in the code. If you go from one state to
15 another, you get there.
16 And the last part is developing a
17 mechanism to categorize the digital systems to help us
18 assign attributes to required systems. And we're very
19 preliminary at this point. We're looking at the
20 systems importance and systems complexity, and how
21 much interaction it has with the system and the kind
22 of decisions the system is going to be required to
23 make as ways to build up a categorization scheme. But
24 that's still very preliminary and we're not ready to
25 present that.

1 MR. BANERJEE: So are the main failure
2 modes of interest mainly to do with the software part
3 of this, or are you also concerned about --
4 MR. ARNDT: Not necessarily. I mean,
5 that's one of the unique aspects. But there is --
6 MR. BANERJEE: The rest of the stuff you
7 know, right, or not?
8 MR. ARNDT: The issue here is complexity.
9 That's the biggest problem. Software makes it easy to
10 make it complicated. You can make software very
11 simple, but most people don't for a lot of different
12 reasons. But there is also issues like interactions
13 between the hardware and the software, the issue of --
14 you can do a lot more in complex communications with
15 a digital system than you can in --
16 MR. BANERJEE: In very simple-minded
17 terms, the software can fail by itself? It can fail
18 in interactions with the hardware, and then the
19 hardware can fail by itself, I mean, in rough terms.
20 MR. ARNDT: In very rough terms, although
21 I'd be a little uncomfortable with that.
22 MEMBER APOSTOLAKIS: Don't forget the
23 human.
24 MR. BANERJEE: But the hardware failure
25 you already handle.

1 MR. ARNDT: We have a much better
2 understanding.
3 MR. BANERJEE: Right. What is of more
4 concern, the interactions between the software and the
5 hardware or the software itself?
6 MEMBER APOSTOLAKIS: No. The first one,
7 I think, right?
8 MR. ARNDT: That is probably the most
9 difficult to understand and to characterize. There
10 has been a lot more research and a lot more practical
11 issues associated with non-real-time software, simply
12 because there is so much more of it out there.
13 MR. BANERJEE: So you are saying the
14 problem is not QAing the software and making sure it
15 does everything right. It's the interactions with the
16 hardware.
17 MR. ARNDT: It is a problem, but it is not
18 as challenging.
19 MEMBER APOSTOLAKIS: And it has been
20 handled already where --
21 MR. ARNDT: There's a lot more information
22 out there.
23 MEMBER WALLIS: Well, there are also
24 accidents occurring to the software itself, like surge
25 and things, which have --

1 MEMBER APOSTOLAKIS: This morning I was
2 trying to type up something and it froze on me. It
3 was -- nothing to do with me. It has nothing to do
4 with me.
5 MR. BANERJEE: How would you do it with --
6 MEMBER APOSTOLAKIS: Can we wrap this up
7 now?
8 MR. ARNDT: Yes, sir.
9 MEMBER APOSTOLAKIS: I think you're done,
10 aren't you?
11 MR. ARNDT: Yes, we're done.
12 MEMBER APOSTOLAKIS: Any questions from
13 the Committee of an urgent nature?
14 MEMBER MAYNARD: I just want to -- in the
15 Subcommittee meeting they had presented some schedules
16 and upcoming things. I just wanted to make sure those
17 haven't really changed. You didn't present any
18 schedules today, but --
19 MEMBER APOSTOLAKIS: But Jack told us that
20 they have in this document that was handled us --
21 there are some schedules there. But they will be
22 refined, is that what you said?
23 MR. GROBE: One of the focuses of the task
24 working group's meetings this month are to ensure that
25 the schedules are aligned with the industry's and the

1 staff's needs. Some of those schedules may stretch
2 out; some of them may come in. And we hope to have
3 that done this month.
4 MEMBER MAYNARD: But I had offered a
5 compliment for having some schedules and things laid
6 out. I just wanted to make sure that hadn't gone
7 away.
8 MR. GROBE: No. No, no. It's just being
9 refined.
10 MEMBER MAYNARD: Okay.
11 MEMBER APOSTOLAKIS: Okay. Now, well,
12 thank you very much.
13 MR. GROBE: I'd just ask Mr. Hammer to
14 work with the staff and identify some appropriate
15 times for us to come back to the Subcommittee.
16 MEMBER APOSTOLAKIS: Wonderful. Yes,
17 thank you. Okay. Great.
18 MR. STONE: Will we be able to make a
19 comment, or are we going to get a --
20 MEMBER APOSTOLAKIS: I'm sorry?
21 MR. STONE: Will we be able to make a
22 comment as far as the industry?
23 MEMBER APOSTOLAKIS: Go ahead.
24 MR. STONE: I just wanted to make a
25 comment that --

1 MEMBER APOSTOLAKIS: Who are you, please?

2 MR. STONE: I'm Jeff Stone from

3 Constellation.

4 MEMBER APOSTOLAKIS: Would you identify

5 yourself?

6 MR. STONE: Jeff Stone, Constellation.

7 MEMBER APOSTOLAKIS: I'm sorry. Okay.

8 MR. STONE: We characterized the

9 challenges to traditional methods on his recent slide

10 there. Almost all of those challenges also applied to

11 dynamic methods, except for some of the communications

12 issues. I wanted to make that clear -- is that we

13 don't have data. The data is still a problem right

14 now with the dynamic methods. It's still a problem as

15 far as the software quantification, which may be

16 dominating failure. Well, I can't say that for sure.

17 And the level of detail -- you also have

18 to do a failure modes and effects analysis, whether

19 you're going to do a dynamic test or modeling or

20 whether you're going to do a traditional method. I

21 just wanted to make that clear.

22 MR. GROBE: It may be appropriate to point

23 out that the industry and the staff are not aligned,

24 primarily from a cost-benefit perspective, on the

25 importance of dynamic modeling to our future

1 understanding of how to deal with risk in digital
2 systems.
3 The industry believes that dynamic
4 modeling is not as viable a success path as the staff
5 believes, and that's one of the issues they're going
6 to sort out this month, hopefully.
7 MEMBER APOSTOLAKIS: And that's where we
8 need, again, the classification of functions. For
9 some functions it may be appropriate, but for others
10 it may not be. We really need those things.
11 Any other comments? We are scheduled --
12 well, we don't need that. Thank you very much.
13 We are scheduled to have a discussion
14 until 10:30. But then, in the afternoon, we are going
15 to have another discussion where you will advise me
16 regarding the letter. Do you want to do that now, or
17 just have a general discussion now, and then in the
18 afternoon we will become more specific? What do you
19 think?
20 CHAIRMAN SHACK: Let's do it that way. I
21 mean, give people a little time to think --
22 MEMBER APOSTOLAKIS: Yes.
23 CHAIRMAN SHACK: -- have the afternoon.
24 MEMBER APOSTOLAKIS: So we'll spend 10
25 minutes now. If anyone wants to say anything --

1 impressions.

2 MR. BANERJEE: I do.

3 MEMBER APOSTOLAKIS: Okay, Sanjoy.

4 MR. BANERJEE: All this seems very high

5 level to me. You know, it's not -- I'm used to more

6 practical things coming out, and I'd like to see some

7 concrete examples. Otherwise, I -- this is just sort

8 of words, you know. I didn't come away from this

9 really understanding what the problems were. It's as

10 simple as that.

11 MEMBER CORRADINI: I guess if you're

12 looking just for straight comments, I think the thing

13 that I -- maybe it was Sam that said it first, but I

14 guess I would agree with it -- is that we really need

15 to get some sort of industrial experience that are

16 non-nuclear or other country industrial experience on

17 nuclear side, in terms of how the digital I&C

18 performance is in comparison to analog systems.

19 I guess I'm -- this is not my area, and I

20 almost -- you've almost convinced me I don't want to

21 learn any more about it someway. But I really do

22 think if you're going to get specific about it, you'd

23 have to compare a certain class of functions and look

24 at what the digital system does in relation to the

25 analog system and industrial performance.

1 Otherwise, I don't -- you kept on
2 mentioning the need for failure modes in digital I&C,
3 but it seems that's the way you're going to get it
4 relative to real hard-nosed experience.
5 MEMBER APOSTOLAKIS: That's right.
6 MEMBER CORRADINI: And to me, that's the
7 most important thing, that --
8 MEMBER APOSTOLAKIS: For me, too.
9 MR. KEMPER: If I could -- this is Bill
10 Kemper. This is Bill Kemper.
11 MEMBER APOSTOLAKIS: Since the days of the
12 National Academy Committee, there have been debates
13 regarding the applicability of this and that and that.
14 And the reason has been, and still is, that there
15 isn't a single document that says this class of
16 digital stuff on reactors simply actuates a system.
17 This controls it. This does something else.
18 There are different levels of complexity.
19 So you are hitting people with a dynamic part that the
20 Subcommittee reviewed last time, and Steve alluded to
21 today, and they get scared. Who is going to do that?
22 Where is the data? Am I going to do this for the
23 reactor protection system? This is essential to
24 identify for which functions certain modeling needs
25 are required -- are present. And we haven't seen

1 those tests.

2 And to say that software malfunctions and

3 all that, it has to become more specific. You are

4 absolutely right. You have to look at what happened.

5 MR. BANERJEE: You have to have a logical

6 debate on how many angels can dance on the head of a

7 pin.

8 MEMBER APOSTOLAKIS: Or can be --

9 MR. BANERJEE: Until you get concrete

10 about -- and say this system, this system, this

11 system.

12 MEMBER APOSTOLAKIS: Right.

13 MR. BANERJEE: You know, this is --

14 MEMBER APOSTOLAKIS: Yes, we'll come back

15 to this. Any other --

16 MR. KEMPER: Yes. Could I make a comment,

17 please, if there's time?

18 MEMBER APOSTOLAKIS: Yes.

19 MR. KEMPER: Yes. Bill Kemper from the

20 Office of Research. I just wanted to make one comment

21 on the idea of making a direct comparison between

22 analog and digital safety systems and digital --

23 excuse me, protection systems and digital protection

24 systems.

25 Analog systems -- the way they're

1 designed, primarily the failures are discrete
2 failures, so generally you don't have in the analog
3 world a wholesale reactor protection system failure as
4 a result of discrete electronics failures. Whereas,
5 in the digital world, those systems now are software-
6 based. So one common mode failure that takes out the
7 software system for a reactor protection system will,
8 in fact, disable the entire system with one failure.
9 So it's very difficult to make a one-to-
10 one analysis, if you will, or comparison of analog-
11 digital protection, or safety system versus digital
12 safety systems
13 MEMBER KRESS: I agree, and I don't really
14 see the utility of making that comparison, frankly.
15 I don't know what you would do with the results.
16 You're going to go -- it's inevitable you're going to
17 go to digital I&C, and I just don't see the --
18 MEMBER APOSTOLAKIS: Yes, it's not a
19 matter of selecting.
20 MEMBER ARMIJO: No, no, it's electric.
21 You know, what you're -- what's the unique problem
22 that you have to --
23 MEMBER KRESS: But it doesn't seem to me
24 -- it doesn't seem to me like you get that out of a
25 comparison.

1 MEMBER POWERS: And we've been doing that
2 for -- what the unique problems -- I mean, Bill said
3 it.
4 MEMBER KRESS: That is the -- what else do
5 you need to do? What was my point.
6 MEMBER POWERS: Yes. I mean, how often do
7 we have to have that lesson? I mean, I -- for 10
8 years I've heard that lesson now.
9 MEMBER KRESS: So --
10 MEMBER POWERS: I've got the message.
11 MEMBER KRESS: So there seems to be a
12 disagreement among the Committee on that part of it,
13 but I certainly agree with you on the need to
14 determine the failure modes and identify them.
15 MEMBER APOSTOLAKIS: I have read a number
16 of them over the years, you know, what happened in
17 that area. You always learn something. I mean, it's
18 really knew. It's a -- and maybe this afternoon I can
19 speak one or two to --
20 MEMBER POWERS: We spent an enormous
21 amount of time looking at the Virginia class digital
22 systems, and they seemed to have come up with a
23 solution.
24 MEMBER APOSTOLAKIS: Who did?
25 MEMBER KRESS: The Virginia class.

1 MEMBER APOSTOLAKIS: Us?

2 MEMBER KRESS: Yes. We looked at that as

3 a Committee. We can't discuss it right now, but --

4 MEMBER POWERS: No. But, I mean, they did

5 seem to come up with a solution, and --

6 MEMBER KRESS: That's what I thought.

7 MEMBER POWERS: -- and so why can't some

8 perversion of that solution be pursued?

9 MEMBER APOSTOLAKIS: Did you say that you

10 are talking to the Navy, or you cannot talk to the

11 Navy?

12 MR. WATERMAN: We are not talking to the

13 Navy, because we really can't use the results. Most

14 of that stuff is classified.

15 MR. KEMPER: This is Bill Kemper. I have

16 been down to Naval Reactors. I have reviewed the --

17 what is it, the Los Angeles class I think, submarine

18 -- the safety analysis report myself. And, of course,

19 we can't say anything specifically, because that's all

20 classified information. But we're well aware of their

21 design criteria, and they -- and they do have a robust

22 system.

23 MEMBER POWERS: The Los Angeles class is

24 not nearly as good as the Virginia class.

25 MR. KEMPER: Maybe that was Virginia. I'm

1 sorry. I'm not sure. It is the latest one, anyway,
2 that we reviewed.
3 MEMBER POWERS: That was the Virginia
4 class probably.
5 MS. KEITHLINE: This is Kimberly
6 Keithline. I spoke with some representatives from
7 Naval Reactors last month, and they indicated that if
8 there were areas where we thought what they've done
9 could be helpful to the commercial industry that I
10 could go and talk to them about what they'd be able to
11 share.
12 Now, it may be very difficult because of
13 the classification. But if this is an area where
14 additional conversations may be helpful, there is an
15 open invitation. I'm just not sure --
16 MEMBER APOSTOLAKIS: I understand this
17 issue of classification. If there is a method for
18 handling the thing, the method is classified?
19 MR. KEMPER: The design is --
20 MEMBER APOSTOLAKIS: Steal it and present
21 it as your own.
22 (Laughter.)
23 MR. KEMPER: But then they would have to
24 put her in jail if she did that. The design itself is
25 classified.

1 MEMBER POWERS: But the approach -- I
2 doubt that the approach is classified.
3 MEMBER APOSTOLAKIS: Yes, I doubt it, too.
4 MS. KEITHLINE: I would need to discuss
5 that with -- to see what they'd be willing -- I'm in
6 a little bit of an awkward position because I know
7 what they do. But when I left I -- I can't just come
8 and discuss it, but I'll go talk to them about what we
9 can discuss, if anything.
10 MEMBER APOSTOLAKIS: Please.
11 MR. CROTEAU: Let me just add one more
12 thing. This is Rick Croteau. I'm in Research, and I
13 have been down there also. And I think, quite
14 frankly, we would be happy if the industry was willing
15 to do what the Navy would do, but I don't think
16 they're going to go there. All right? So I'll leave
17 that at that.
18 MEMBER POWERS: Well, we can always tell
19 the industry that -- do it this way, or do it the old
20 way. I mean --
21 MEMBER MAYNARD: Well, I believe -- first
22 of all, I think there are some good things going on.
23 I think that the Committee -- they do have some
24 milestones they did present to the Subcommittee, and
25 they are driving some things forward.

1 My concern is this has been going on for
2 some time. If we don't come to some conclusions soon
3 -- and I don't think we're ever going to have all the
4 answers, not going to ever feel 100 percent confident,
5 we're never going to get to a point where there is
6 zero risk.
7 I think at some point we're going to have
8 to say this is the information that we have and these
9 are the decisions we are going to make, provide the
10 guidance, because if we don't it's going to be done by
11 default, because things are moving forward. And we'll
12 come out with the guidance after the designs are
13 already done, which is probably not the best way to --
14 MEMBER POWERS: Right now, the basic
15 design is go ahead and put your digital reactor
16 protection system, put an analog backup.
17 MEMBER MAYNARD: And I believe that,
18 depending on what we talk about for analog backup --
19 I believe that there is a need for a diverse way to
20 shut the reactor down and do some things. I don't
21 believe that there is a need to have a complete
22 redundant safety-grade analog backup system to do
23 that. In fact, I believe that adds complexity and can
24 actually degrade safety overall as opposed to some
25 other methods that are out there.

1 But in any event, at some point decisions
2 need to be made and need to move forward. If we make
3 it too complicated, if we try to say, "Well, we're
4 just going to be overly -- we'll take the most
5 conservative position," that may not be the most
6 conservative position. That may be detrimental to
7 safety as opposed to being in favor of it.
8 MEMBER APOSTOLAKIS: So I would like to
9 stop here and continue in the afternoon.
10 MEMBER ABDEL-KHALIK: I would like to just
11 reinforce the point that was made earlier that, you
12 know, the problems at this stage, in my mind at least,
13 are conceptual rather than implementation-type
14 problems. And if somebody has come up with a way to
15 get over the conceptual hurdle, then, by gosh, we
16 ought to know about it and maybe we ought to get some
17 guidance from them.
18 MEMBER APOSTOLAKIS: Yes.
19 MEMBER MAYNARD: I don't believe that
20 we've really utilized the other industry information
21 as well as we -- nuclear power, the reactor
22 protection, and the control systems are really not at
23 all complex when you compare it to many of the other
24 systems that have been out there in other industries.
25 MEMBER APOSTOLAKIS: Exactly.

1 MEMBER POWERS: And if I had a dollar for
2 every time that has been said in this room, I would
3 have enough to pay for lunch, certainly. Or dinner.
4 Maybe even dinner.
5 MEMBER MAYNARD: I don't have to pay a
6 dollar for saying it again, though, do I?
7 MEMBER POWERS: Yes, you will. If you say
8 it again, it's going to cost you two bucks. Okay?
9 (Laughter.)
10 MEMBER APOSTOLAKIS: That is all, Mr.
11 Chairman.
12 CHAIRMAN SHACK: Are we finished?
13 MEMBER APOSTOLAKIS: Yes. Break for two
14 hours?
15 (Laughter.)
16 CHAIRMAN SHACK: Back at 10:45.
17 (Whereupon, the proceedings in the
18 foregoing matter went off the record at
19 10:30 a.m. and went back on the record at
20 10:49 a.m.)
21 CHAIRMAN SHACK: Let's come back into
22 session.
23 Our next topic is a Commission paper on
24 staff's recommendation to make a risk-informed and
25 performance-based revision to 10 CFR Part 50. And

1 that's Dr. Kress leading us through this.

2 MEMBER KRESS: Thank you, Mr. Chairman.

3 I just want to remind the Committee that

4 this is not about the technical issues associated with

5 the framework. This is about the staff's

6 recommendations on how to proceed or whether to

7 proceed with the rulemaking on risk-informing -- or

8 making it a risk-informed Part 53, and I think as well

9 as whether they should undertake any risk-informing of

10 specific regulations, like 50.46, for example.

11 So this is not about the technical issues.

12 This is just about those things. And with that, I'll

13 turn it over I guess to -- Joe, are you going to lead

14 off for the staff?

15 MR. BIRMINGHAM: Yes, thank you.

16 MEMBER KRESS: Okay.

17 MR. BIRMINGHAM: Good morning. I'm Joe

18 Birmingham in the Office of NRR and the rulemaking

19 section. With me is Marty Stutzke of NRO and Mary

20 Drouin from Research. Also with us is Eileen McKenna,

21 who has been NRR and just recently transferred over to

22 NRO, and John Monninger, also of Research.

23 It's a good thing to point out that this

24 is not on the technical issues in the framework, but

25 this is the -- on the recommendation. The purpose is

1 to provide the ACRS information on the staff's
2 recommendation on the reactor requirements for
3 advanced reactors, and also to inform you of the
4 stakeholder comments on the plan to risk-inform 10 CFR
5 Part 50 for future reactors, also on the policy issues
6 that were included in the ANPR, and the technology-
7 neutral framework itself.
8 Here's a brief history, starting in
9 January 2003. The Office of Research, advanced
10 reactor research plan recognized the need for a
11 licensing framework for advanced reactors. This was
12 based on the fact that the current reactor regulatory
13 structure focuses on lightwater reactors and it has
14 limited application to non-lightwater reactors.
15 Advanced reactors will have design and
16 operational issues that are different from lightwater
17 reactors. The current reactor regulatory structure
18 contains requirements that are not really applicable
19 to advanced reactor designs, and that it had evolved
20 with limited insights from PRA and severe accident
21 research.
22 We expect that PRA and PRA insights will
23 be an integral part of licensing of advanced reactors,
24 and after this program was begun to develop a risk-
25 informed performance-based regulatory structure that

1 could be technology-neutral to support future
2 licensing.
3 As an ANPR background, in January of 2006,
4 the Commission directed the staff to issue --
5 MEMBER APOSTOLAKIS: I am curious why
6 somebody took the trouble to say that "could be
7 technology-neutral." I thought it was. On the
8 previous slide. Clearly, this is something somebody
9 demanded, unless I'm wrong.
10 MS. DROUIN: I think that's just, you
11 know, it is technology-neutral.
12 MEMBER APOSTOLAKIS: It is.
13 MS. DROUIN: That word could have been --
14 would be technology-neutral. But I think it was
15 written that way because we're going back to 2003,
16 and, you know, it could be.
17 MEMBER APOSTOLAKIS: All right.
18 MS. DROUIN: Don't read any more into it
19 than that.
20 MEMBER APOSTOLAKIS: Okay.
21 MEMBER KRESS: It wasn't all that certain
22 back then --
23 MS. DROUIN: Back then.
24 MEMBER KRESS: -- that you could do it.
25 MR. BIRMINGHAM: Okay. On the ANPR, in

1 January 2006, the Commission directed the staff to
2 issue the ANPR, and to provide its recommendation on
3 whether, and, if so, how to proceed with rulemaking.
4 The Commission also requested staff seek stakeholder
5 input on three areas -- on the technology-neutral
6 framework, on the advanced reactor policy issues that
7 were included in the ANPR, and on the plan to revise
8 reactor requirements for advanced reactors.
9 The Commission directed the staff to
10 facilitate stakeholder participation by holding public
11 meetings, workshops, soon after the ANPR was issued.
12 In January of 2007, the staff began meeting with the
13 Advanced Reactor Steering Committee on its proposed
14 recommendation for reactor requirements for future
15 reactors.
16 We discussed options in light of
17 stakeholder comment that we should test the draft
18 requirements. We discussed the impact on design
19 certifications and combined operating licenses. Also,
20 the impact on the NGNP schedule and the impact on far-
21 term projects such as the GNEP.
22 In March of 2007, the staff completed its
23 preliminary review of stakeholder comment and drafted
24 a Commission paper.
25 MEMBER APOSTOLAKIS: So the advance notice

1 was issued when?

2 MR. BIRMINGHAM: March.

3 MEMBER APOSTOLAKIS: Of '06 or --

4 MS. DROUIN: No.

5 MR. BIRMINGHAM: May of '06? May of '06.

6 MS. DROUIN: May of '06.

7 MEMBER APOSTOLAKIS: May of '06.

8 MS. DROUIN: First of May.

9 MEMBER APOSTOLAKIS: So you went through

10 what the Commission required. You had workshops, you

11 had --

12 MR. BIRMINGHAM: Yes. We held a public

13 meeting to discuss with stakeholders what was in the

14 ANPR, and then we held a two-day workshop to collect

15 their comments, and also they made some presentations

16 and we went through the -- we furthered a lot. We got

17 a lot further with some early stakeholder input that

18 way.

19 MEMBER APOSTOLAKIS: So when you say

20 "staff discussed options," you are going come back and

21 tell us what the options were on these issues later in

22 the talk or --

23 MR. BIRMINGHAM: We could. What we are

24 going to tell you is what our actual final

25 recommendation is --

1 MEMBER APOSTOLAKIS: Okay.

2 MR. BIRMINGHAM: -- going to be.

3 MEMBER APOSTOLAKIS: Yes. Maybe the final

4 recommendation, then, we'll talk about.

5 MR. BIRMINGHAM: We went through several

6 variations and options with the Steering Committee,

7 but we determined not to go down those paths.

8 MEMBER APOSTOLAKIS: Okay.

9 MR. BIRMINGHAM: I wanted to let you know

10 who the stakeholder comments were from. As you go

11 through this list, you notice that it represents

12 primarily industry, industry vendors, industry codes

13 and standards groups. We did not actually get a lot

14 of public participation from what I would call the

15 general public.

16 I think that's partly because at this time

17 the general public probably doesn't have a vital stake

18 and interest in advanced reactors for them to be built

19 in the future. We expect that they'll get more

20 involved as we get closer.

21 MEMBER WALLIS: But there's no measure of

22 how well your plans go down with the public as opposed

23 to the industry, except through the --

24 MR. BIRMINGHAM: I think that's a

25 relatively fair statement. We've had a lot of public

1 -- general public participation on risk-informed
2 rulemakings that we were present. But when you start
3 talking about distant future, the public kind of
4 doesn't focus that way.
5 MEMBER APOSTOLAKIS: When you say
6 "public," do you mean the so-called intervenors?
7 MR. BIRMINGHAM: They would be part of the
8 public, general public, yes.
9 MEMBER APOSTOLAKIS: Is there anybody else
10 ever showing up?
11 MR. BIRMINGHAM: Oh, we did get a minor
12 comment from people like Dave Lockbaum that, you
13 know --
14 MEMBER APOSTOLAKIS: We are all part of
15 the general comment, you know.
16 MS. DROUIN: I mean, if you look at the
17 list there, the nuclear equipment quorum, that's
18 really a one-person --
19 MEMBER APOSTOLAKIS: Which one? Oh.
20 MS. DROUIN: Nuclear equipment quorum. I
21 don't remember his name, but it's not this huge
22 company. It's a one-person company, and that's the
23 name of his --
24 MEMBER APOSTOLAKIS: But they are all
25 industry-related people.

1 MEMBER ARMIJO: But everybody got a
2 chance, right? Everybody got --
3 MEMBER MAYNARD: And there are a number of
4 groups that monitor -- the fact that they didn't issue
5 comments doesn't necessarily show they support it or
6 don't support it, but they had an opportunity, and I
7 think by not providing any comments at least shows
8 they're willing to listen and wait and see what
9 happens.
10 MS. DROUIN: Well, and I will also add you
11 have to see that when you look at -- you've got it
12 from ASME and ANS. And on ASME and ANS, on the
13 Committee, it's not just industry.
14 MEMBER MAYNARD: Right.
15 MS. DROUIN: Because, you know, these
16 committees are balanced, you know, across the
17 different stakeholders. So you'll have people there
18 from perhaps an insurance agency. So in that way you
19 have received it indirectly from the professional
20 societies.
21 MEMBER APOSTOLAKIS: But I think there is
22 a real question here.
23 MEMBER WALLIS: What's very interesting,
24 though, is to me the requirements for future reactors,
25 and so safety requirements, fundamentally they're

1 imposed for the benefit of the public. They're not
2 imposed for the benefit of the industry. The people
3 with the biggest stake in all of these things are the
4 public, and somehow they don't get into the equation.
5 I'm sort of puzzled by that.
6 MEMBER APOSTOLAKIS: But at the same time,
7 though, I mean, the NRC staff goes out of its way to
8 announce these meetings. If they don't come, they
9 don't come. What can you do?
10 MEMBER KRESS: To some extent I think we
11 kind of keep in mind the public's interest in our --
12 MEMBER APOSTOLAKIS: I think we try to do
13 that.
14 MEMBER KRESS: We try to do that.
15 MEMBER APOSTOLAKIS: In all fairness, I
16 think the staff tries to do that, too.
17 MEMBER KRESS: And the staff tries to do
18 that.
19 MEMBER APOSTOLAKIS: In my mind, the
20 biggest public interest group when it comes to nuclear
21 power is the NRC staff.
22 MEMBER MAYNARD: I agree with that.
23 MEMBER CORRADINI: So can I go back --
24 don't go back a slide. I just had a question on the
25 last slide. Who is the Steering Committee? Did you

1 say that and I missed it?

2 MR. BIRMINGHAM: The Advanced Reactor

3 Steering Committee. It's an interoffice group

4 primarily from -- headed up by NRO.

5 MEMBER CORRADINI: So can you give me a

6 few names?

7 MR. BIRMINGHAM: Well --

8 MS. DROUIN: Tom Bergman.

9 MR. BIRMINGHAM: -- knowing who the --

10 MEMBER APOSTOLAKIS: Who is chairing it?

11 MR. BIRMINGHAM: Yes, who is --

12 MS. DROUIN: Tom Bergman.

13 MR. BIRMINGHAM: Tom Bergman is, but he's

14 sort of the new reactor office representative on there

15 for Borchard and David Holihan, for example. But then

16 you also have people on there from NMSS, and Research

17 is represented, NRR, and then you have -- as

18 necessary, other offices will participate.

19 It's an interoffice one but with --

20 MEMBER CORRADINI: You answered my

21 question as if it's a basketball team and there's five

22 starters and the starters rotate in. Is that true?

23 So you might have five --

24 MEMBER APOSTOLAKIS: No. It's like the

25 government of Switzerland. They do rotate.

1 MEMBER CORRADINI: Oh, okay. Fine.

2 MR. BIRMINGHAM: I don't think I'd put it

3 quite like that. I think you have sort of a main

4 core, and five starters tend to show up for all the

5 same meetings, but then you have additional people who

6 come off the bench.

7 MEMBER CORRADINI: Got it.

8 MR. ADER: Hey, Joe? Charlie Ader from

9 the staff.

10 MEMBER CORRADINI: Are you a starter?

11 (Laughter.)

12 MR. ADER: I'm a member of the Steering

13 Committee. Tom Bergman is chairing it. We're

14 transitioning. I'm going to end up chairing it

15 probably later this month. Farouk Eltawila from

16 Research; Mark Cunningham, Research; Mike Mayfield;

17 Joe Gitter from NMSS. I'm sure I'm forgetting

18 somebody else, but that's the main players.

19 MEMBER CORRADINI: Thank you.

20 MEMBER KRESS: On these stakeholders, I

21 would think what the PBMR people said would be very

22 interesting, because they seem to have the most

23 different reactor concepts of the --

24 MS. DROUIN: Well, you would have thought.

25 But the PBMR comments were about four pages, and they

1 deferred to the NEI comments, and they agreed with
2 what was in the NEI comments.
3 MR. BIRMINGHAM: I think it would be worth
4 bringing out, though, they were at the workshop and --
5 MS. DROUIN: Yes.
6 MR. BIRMINGHAM: -- you know, they had
7 quite a few comments at the workshop that they
8 offered, you know, and -- so we got quite a bit of
9 input from them, but they do have a slightly different
10 approach.
11 Okay. Let's get back to Slide 7, the ANPR
12 comment areas. We asked for comment on three areas --
13 the plan to risk-inform 10 CFR Part 50, the policy
14 issues including level of safety, integrated risk. We
15 requested feedback on the ACRS letter on those issues.
16 The area of defense in depth, the single failure
17 criterion, containment performance standards,
18 integration of safety, security, and emergency
19 preparedness, and the framework itself.
20 Any question on the depth that we went
21 into or anything on those issues?
22 MEMBER APOSTOLAKIS: So the framework
23 refers to the technology-neutral.
24 MEMBER KRESS: It refers to the document,
25 the NUREG.

1 MR. BIRMINGHAM: The document.

2 MEMBER KRESS: Are we back on the ACRS

3 letter?

4 MEMBER APOSTOLAKIS: What, we're going to

5 talk about these things at some point?

6 MR. BIRMINGHAM: Yes.

7 MEMBER APOSTOLAKIS: Okay.

8 MR. BIRMINGHAM: That's coming.

9 Stakeholder comments. As on the plan to risk-inform

10 10 CFR Part 50, stakeholders were generally very

11 supportive of the design of risk-informed

12 requirements, but strongly suggested that the staff,

13 one, not do anything that adversely impacts on the

14 near-term licensing and development of the design

15 certs and COL applications.

16 They asked that we continue the current

17 efforts for risk-informed rulemaking, such as the

18 local loop rulemaking.

19 MEMBER KRESS: Is that 50.46?

20 MR. BIRMINGHAM: Yes.

21 MEMBER APOSTOLAKIS: Yes.

22 MR. BIRMINGHAM: They also asked that we

23 develop preliminary draft requirements that they could

24 see and be able to discuss. We wouldn't be requesting

25 comment at that point, but it would be something that

1 we'd make available.

2 MEMBER APOSTOLAKIS: It's for limited

3 draft requirements imposed on future reactors?

4 MR. BIRMINGHAM: The preliminary draft

5 requirements that would be imposed on future reactors

6 that would be based from the framework.

7 MEMBER APOSTOLAKIS: So that's related to

8 the first sub-bullet of the second group, review and

9 approve non-LWR application?

10 MS. DROUIN: What they were talking about

11 here is they'd like to, in essence, see a draft

12 Part 50. And we'll talk about --

13 MEMBER APOSTOLAKIS: But then, they turn

14 around. They tell you approve non-LWR application

15 using Part 50/52.

16 MR. BIRMINGHAM: Correct.

17 MEMBER APOSTOLAKIS: That tells me that

18 they want to do what Exelon was proposing a few years

19 ago. We'll take Part 50, but because our reactor is

20 gas reactor, here are the changes we are proposing.

21 Is that different from developing preliminary draft

22 requirements?

23 MR. BIRMINGHAM: Yes. What they asked us

24 to do is develop what -- based on the framework, to

25 develop preliminary draft requirements and what we

1 expect that Part 53 would look like. They wanted the
2 opportunity to comment on that, to -- you know, to
3 understand better how that would affect future
4 reactors, and then they wanted sort of like a pilot to
5 use a non-lightwater reactor, which in this case would
6 probably be a high temperature gas reactor, and then
7 to use that as a pilot to test how well this would
8 apply to it and whether or not it would cover it
9 completely, whether appropriately, or, in their
10 opinion, whether we were too conservative.
11 MEMBER KRESS: It seems to me like if an
12 applicant, wanting to tailor the current Part 50 to
13 his reactor, having such draft requirements would be
14 useful to both you and the --
15 MEMBER APOSTOLAKIS: Isn't that what we
16 recommended also recently?
17 MEMBER KRESS: I think that was -- that
18 was within our recommendations.
19 MEMBER APOSTOLAKIS: If a framework can
20 apply to -- yes, okay.
21 MEMBER CORRADINI: I guess that's a
22 question I had. So this is in some sense in parallel
23 to the technology-neutral framework, and I guess the
24 response in the letter that was crafted essentially
25 suggests almost a test run -- a test drive. Yes,

1 okay.

2 MS. DROUIN: And that's what this was

3 getting at.

4 MEMBER APOSTOLAKIS: The letter never went

5 out, right?

6 MEMBER KRESS: I don't know. Yes, I think

7 it did.

8 MS. DROUIN: Your letter has been issued.

9 MEMBER POWERS: Could I understand better

10 why you would apply it to a reactor for which the

11 results are not known and not apply it to a reactor

12 for which they are known.

13 MEMBER KRESS: Like a lightwater reactor?

14 MEMBER POWERS: Sure.

15 MEMBER KRESS: That's interesting, because

16 they are an appendix in the NUREG where it actually

17 does attempt to do that. And I thought that was a

18 good idea.

19 MEMBER APOSTOLAKIS: Mary mentioned

20 Part 53. There is a 52. What's the difference? I

21 should probably know, but I know what Part 50 is, and

22 I know what Part 52 is. Is there a Part 53?

23 MS. DROUIN: No.

24 MEMBER APOSTOLAKIS: Ah, okay.

25 MS. McKENNA: This is Eileen McKenna from

1 the staff. Let me speak to that briefly. I think
2 what we're referring to here, and where it says
3 Part 50/52, is really talking process that you could
4 -- one could apply for a license under Part 50, when
5 under the construction permit or operating license
6 philosophy like we did in the past, or one could come
7 in under the Part 52 process for design certification
8 and potentially a combined license.
9 But in either case, in the -- whether you
10 are under 50 or 52, the technical requirements were in
11 Part 50. Here what we're talking about in Part 53 is
12 you would establish this new set of technical
13 requirements for -- that are more risk-informed and
14 performance-based instead of using the Part 50
15 requirements.
16 Now, whether -- what licensing process one
17 used with that is something I think that, you know,
18 whether we would embed within 53 the licensing process
19 requirements, or we would continue to use, say, the 52
20 licensing requirements, I don't think we've quite
21 settled in terms of what the -- exactly how the rule
22 language would look in that regard. But there's the
23 process elements and there's the technical elements
24 that you need to be clear.
25 MEMBER APOSTOLAKIS: There is no Part 53

1 right now.

2 MS. McKENNA: No, I think that was jus ta

3 term of --

4 MEMBER APOSTOLAKIS: Oh, okay.

5 MS. McKENNA: -- art.

6 MEMBER APOSTOLAKIS: Okay.

7 MS. McKENNA: To refer to --

8 MS. DROUIN: That's our internal term.

9 MS. McKENNA: I think to --

10 MEMBER APOSTOLAKIS: And now it's my

11 internal --

12 MS. McKENNA: Yes, I think it was to --

13 rather than trying to change Part 50, you would make

14 a new part.

15 MEMBER APOSTOLAKIS: It was an innocent

16 question.

17 MS. McKENNA: No, no, no. Didn't mean

18 anything by it.

19 MEMBER KRESS: I don't think Dana got a

20 good answer to his questions, why apply it to a non-

21 LWR reactor when you don't know how to compare the

22 results with anything. So could you address that

23 perhaps?

24 MR. BIRMINGHAM: I'm going to try, and

25 then I'm going to ask Mary to kind of correct me a

1 little bit. I believe that in developing the
2 framework that he actually did apply many of the draft
3 requirements that they thought applied to a lightwater
4 reactor, to see how they --
5 MEMBER KRESS: Yes. But I'd like to twist
6 the question around and say, "What would be the
7 purposes of applying it to, say, an HTGR or a non-
8 lightwater reactor?" What would you learn from that?
9 MR. BIRMINGHAM: Because the agency and
10 the staff are so lightwater reactor-oriented, we tend
11 to focus on things like ECCS and protecting the fuel
12 from, you know, being uncovered and so on. And yet a
13 high-temperature gas reactor where you could be --
14 have something totally different like pebbles, be a
15 pebble bed modular reactor where the concept of an
16 ECCS system or uncovering the core are totally
17 different.
18 And the staff isn't oriented that way in
19 the past. So applying it to a non-lightwater reactor
20 to see if we were -- had appropriately captured the
21 right requirements for this non-lightwater reactor and
22 that we covered the entire scope of what needed to be
23 done, and yet at the same time not imposed superfluous
24 requirements, that, you know, if you're trying to be
25 technology-neutral, would a, you know, ECCS system

1 make sense for a gas reactor? Of course, the answer
2 is probably no, but what do you need that -- to form
3 on it and do these risk-informed requirements to cover
4 that?
5 Does that kind of answer the question why
6 we would do it? It would -- it's a test case.
7 MS. DROUIN: I think what you have to look
8 is understand there is -- when you look at the
9 framework, you know, you can look at it for one area,
10 which is the probabilistic approach. That, you know,
11 is a major element of the framework. That we tested
12 against the LWR to see, okay, could you really use a
13 probabilistic approach for your licensing basis.
14 And we used that and applied it to an LWR
15 to see what would come out of it, and then how would
16 it compare to, you know, we have these already set-up
17 DBAs for this. And, you know, how did our events come
18 out compared to what they're currently licensed
19 against to see if that approach would work?
20 Bar that to -- the framework is also --
21 was criteria for developing not just your licensing
22 base event selection, but to create a whole set of
23 your technical requirements. You know, that would be
24 a replacement of the technical requirements of
25 Part 50. To apply that to an LWR, why would you want

1 to do that? I guess is my question, because --

2 MR. BANERJEE: But have you done it? Have

3 you done it?

4 MS. DROUIN: No.

5 MR. BANERJEE: Have you applied it to an

6 LWR to see if --

7 MS. DROUIN: No.

8 MR. BANERJEE: -- it works?

9 MS. DROUIN: I don't know what you would

10 see to work I guess. That's what I'm saying. The

11 part that you would want to see working is the risk

12 part.

13 MR. BANERJEE: Well, let me -- in my mind,

14 this is like a vehicle. And the first thing to do is

15 test it on the roads and then take it off road. And

16 this is supposed to work everywhere, right?

17 MS. DROUIN: No, no, I understand. But

18 what we have done -- what we have done is look at, you

19 know, what would be the requirements that would come

20 out of using the framework to create this Part 53, and

21 we compared that to here's the technical requirements

22 in Part 50, and how -- I mean, that isn't in a sense

23 testing it. I mean, you're looking at here are the

24 technical requirements for Part 50, here's the --

25 MR. BANERJEE: Then, you are testing it.

1 MS. DROUIN: In that sense, yes.

2 MEMBER WALLIS: Just showing that you come

3 up with the same requirements, which are the good

4 requirements.

5 MS. DROUIN: We were trying to see, you

6 know, where the differences were. Did we -- you know,

7 are they the same? Are --

8 MEMBER WALLIS: Are they any better, or

9 are they --

10 MS. DROUIN: All of that is what we look

11 at.

12 MEMBER APOSTOLAKIS: But, Mary, the way

13 I understand it, technology-neutral framework, it will

14 set high-level requirements. But then, for a specific

15 technology, you may go beyond what the framework says,

16 right?

17 For example, the framework right now is in

18 terms of dose, frequency of dose, right? It does not

19 refer to core damage, does it?

20 MS. DROUIN: It does not refer to core

21 damage.

22 MEMBER APOSTOLAKIS: Right. But it's

23 conceivable --

24 MS. DROUIN: Core damage is a lightwater

25 reactor term.

1 MEMBER APOSTOLAKIS: Right. It's
2 conceivable now, if I were starting from scratch and
3 I had lightwater reactors and other reactors, that for
4 lightwater reactors I would develop requirements that
5 involved core damage frequency. That's not
6 inconsistent with the framework, is it?
7 MS. DROUIN: No.
8 MEMBER APOSTOLAKIS: It's not.
9 MS. DROUIN: No.
10 MEMBER APOSTOLAKIS: So in that sense, I
11 agree with Mary. I don't think you could learn much
12 by applying it to lightwater reactors.
13 MEMBER MAYNARD: But I thought in a
14 previous meeting it had been applied to a lightwater
15 reactor to come up with requirements essentially the
16 same but there were some that this process would come
17 out that were a little different than what the current
18 requirements are -- some increase, some decrease. And
19 to me, that does provide you some useful information
20 to see whether the process provides protection of
21 health and safety of the public.
22 MEMBER APOSTOLAKIS: It seems to me you
23 would learn more by going to a non-LWR technology.
24 I'll give you an example. Three or four years ago the
25 proposed framework was in terms of release frequency

1 and core damage frequency. And there were goals, and
2 so on. Then, there was a debate. We got a letter
3 from the HTGR people, from Carl Fleming, and he said,
4 "You guys are talking about core damage frequency, and
5 I don't think that applies to me." Do you remember
6 that?
7 So you really learn by thinking about
8 application to non-LWRs, unless you --
9 MEMBER MAYNARD: I agree, George. I was
10 just saying I think they have already done -- I don't
11 think they need to do another lightwater reactor. I
12 think they've already done that.
13 MEMBER APOSTOLAKIS: I know they did that,
14 yes.
15 MEMBER KRESS: We'll on technical issues
16 now. I think we ought to get off of them, but let's
17 not dismiss the concept of core damage frequency for
18 any type of reactors. That's --
19 MEMBER APOSTOLAKIS: I'm not dismissing
20 it. I'm just saying that --
21 MEMBER KRESS: I just want to be --
22 MEMBER APOSTOLAKIS: No, but unless you
23 try to -- to see about applying it to another
24 technology, the issue may not even arise. That
25 doesn't mean you are going to dismiss it. But if you

1 keep doing it on LWRs, then we take it for granted
2 that these are quantities that have to be there. And
3 here is another case where some people disputed that,
4 and that's the kind of insight we want to get.
5 MEMBER KRESS: I think he disputed our
6 particular concept of what might constitute a CDF.
7 MEMBER APOSTOLAKIS: But the framework now
8 doesn't have that concept.
9 MEMBER KRESS: I know. But we'll get to
10 that this afternoon.
11 MEMBER APOSTOLAKIS: Okay. Okay.
12 MEMBER ABDEL-KHALIK: But just doing the
13 one-step of applying the framework to a non-LWR gas-
14 cooled reactor gives you a piece of information. You
15 don't have the other piece. You need to go through
16 the pain of trying to apply Part 50 to a non-LWR and
17 see all of the exemptions that you have to go
18 through --
19 MEMBER KRESS: Wonderful.
20 MEMBER ABDEL-KHALIK: -- and where you
21 would end up, and then you compare the two pieces.
22 MEMBER KRESS: That's precisely why we
23 recommended that they test it on the PBMR.
24 MEMBER ABDEL-KHALIK: Right.
25 MEMBER KRESS: Because you have both of

1 those elements.

2 MR. BIRMINGHAM: And I think you'll find

3 that that's what the stakeholders also agree, that we

4 should test it on a non-lightwater reactor, and that's

5 also what the staff agreed to.

6 MR. BANERJEE: So is the PBMR something

7 that -- I mean, you want to make this book also

8 useful, so is it expected that this reactor is going

9 to come up for some form of review?

10 MEMBER APOSTOLAKIS: I think the reason

11 why we recommended that in our letter was that we

12 already have a lot of so-called white papers from PBMR

13 that could be used for such an exercise. We already

14 had the mediations. It's not an obligation.

15 MEMBER KRESS: In the previous

16 application --

17 MR. BANERJEE: I know there's an

18 application, but --

19 MEMBER APOSTOLAKIS: But they do --

20 MR. BANERJEE: -- is there a likelihood of

21 this? I mean, why do we --

22 MEMBER KRESS: No. We've been telling

23 them that, yes, some -- at some point in time, yes.

24 MR. BIRMINGHAM: We have the pebble bed

25 and also DOE's NGNP, which is a high-temperature gas

1 reactor, which may or may not be pebble.

2 Let me move on a little bit, because I

3 think basically we've -- you're in agreement with

4 stakeholders, you're in agreement with staff and with

5 each other.

6 (Laughter.)

7 MEMBER APOSTOLAKIS: That's why it was

8 such a short discussion.

9 (Laughter.)

10 MR. BIRMINGHAM: With ACRS, you know, a

11 short discussion, five, ten minutes, or what -- what

12 the stakeholders suggested was upon receipt of a non-

13 lightwater reactor, whether it's pebble bed or NGNP,

14 that we review and approach the non-lightwater reactor

15 application using Part 50/52, as Eileen kind of

16 explained how that would work, that we evaluate these

17 preliminary draft requirements against the non-

18 lightwater reactor design, and that this would help us

19 refine the draft requirements before we initiate

20 moving.

21 MEMBER CORRADINI: So a parallel effort,

22 basically.

23 MS. DROUIN: Yes.

24 CHAIRMAN SHACK: Real licensing is done

25 50/52.

1 MR. BIRMINGHAM: Right. For the first
2 design.
3 CHAIRMAN SHACK: For the first design.
4 MEMBER WALLIS: I'm trying to understand
5 what's happening here. This isn't a plan to risk-
6 inform 10 CFR Part 50. This is a plan to see if there
7 should be a 10 CFR Part 53? Is that what we're --
8 MEMBER APOSTOLAKIS: Something like that,
9 yes.
10 MR. BIRMINGHAM: You can put it that way.
11 MEMBER WALLIS: Because the way Tom
12 presented it I didn't understand. That's what we're
13 talking about. I thought we were talking about all
14 efforts to risk-inform Part 50. If it's something
15 else --
16 MEMBER KRESS: I think that's in there at
17 some point. Now, we're -- these are the stakeholder
18 comments on the --
19 MEMBER WALLIS: It says specifically on
20 53.
21 MEMBER KRESS: Yes, but these are
22 stakeholder comments specifically on -- I think -- I
23 think their letter to the Commission also addresses
24 risk-informing at --
25 MEMBER WALLIS: Like 50.46, for instance?

1 MEMBER KRESS: Yes. So that comes -- they
2 will come up later on that.
3 MS. DROUIN: The ANPR had the topic of,
4 you know, should we go to rulemaking? And, if so,
5 how? And that was with regard to what we call this
6 Part 53.
7 MEMBER KRESS: Right.
8 MS. DROUIN: It could be a 53, it could be
9 an appendix to Part 50, but it was creating this whole
10 complete set of technical requirements for a non-LWR.
11 Also, in the ANPR was another topic was -- should we
12 continue with piecemealing Part 50, doing one
13 regulation at a time, should we take on new
14 regulations, should we stop where we are and just get
15 everything implemented? So those were two separate
16 topics in the ANPR.
17 MEMBER WALLIS: You don't really know how
18 effective or feasible Part 53 is until you try and
19 write rules that go along with it, do you?
20 MEMBER KRESS: Yes, that's --
21 MEMBER WALLIS: And you try to write the
22 document which would actually replace the --
23 MEMBER KRESS: Well, that would be the
24 purpose of the draft, to get it started.
25 MEMBER WALLIS: That's very different from

1 constructing a framework.

2 MEMBER KRESS: But the framework is what

3 guides you on how to make the rules.

4 MEMBER WALLIS: It might help.

5 MEMBER KRESS: I mean, I think you have to

6 start with a framework before you make the rules.

7 MR. BIRMINGHAM: Thank you.

8 The next part of the presentation is

9 actually on the policy issues that were in the ANPR,

10 and we asked for comments on, and Marty Stutzke is

11 going to cover that area.

12 MEMBER KRESS: I remind the members that

13 we had a letter on these two policy issues. It was

14 one of those kind of letters on the one hand, and on

15 the other hand --

16 MEMBER APOSTOLAKIS: I can't hear you.

17 What?

18 MEMBER KRESS: It was one of the ones for

19 which we had a --

20 MEMBER APOSTOLAKIS: Some of us and some

21 of --

22 MEMBER KRESS: -- ACRS member, instead

23 of --

24 MEMBER APOSTOLAKIS: That's a long time

25 ago.

1 MEMBER KRESS: It was a while ago.

2 MR. STUTZKE: Okay. With respect to the
3 policy issues on level of safety and integrated risk,
4 as Dr. Kress had pointed out, the ACRS had provided
5 its reviews in a letter. It's dated September 21,
6 2005. And it's an interesting letter where some of
7 the members said this and some of them said not this,
8 and --

9 MEMBER KRESS: Yes, I wouldn't
10 characterize that as interesting, but --

11 MR. STUTZKE: The context of the letter
12 was you all were being asked to comment on the staff's
13 SECY-05-130 where we had tried to deal with these
14 policy issues. With respect to the level of safety,
15 most of the commenters on the ANPR seemed to support
16 the idea that the minimum level of safety should be
17 established at the quantitative health objectives in
18 the safety goal policy.

19 What this slide doesn't say that we go
20 into in the letter is, however, there was no consensus
21 on the need or how to define subsidiary risk
22 objectives, like core damage frequency, large early
23 release frequency. The people that commented on it
24 said those need to be technology-specific. They
25 didn't think it could be done generically.

1 A number of the gas vendors said they
2 didn't think it was feasible to define subsidiary risk
3 objectives for these types of plants.
4 MEMBER KRESS: That's why you should --
5 MEMBER WALLIS: Do you mean by --
6 integrated risk is that several plants on the same
7 site or --
8 MR. STUTZKE: The idea of integrated risk
9 is multiple plants on a site.
10 MEMBER KRESS: Multiple modules.
11 MR. STUTZKE: It grew out of this concern
12 when you have pebble bed modules, six on a site, eight
13 on a site, whatever, how do you look at them. And we
14 broadened it by the time we had written SECY-05-130 to
15 realize we could be dealing with building new plants
16 on existing sites.
17 MEMBER WALLIS: So, in principle, if a new
18 plant meets the QHOs, that's all it has to do.
19 Everything else is subsidiary and derived --
20 MR. STUTZKE: No, that's the debate. And
21 there was no consensus among the public comments.
22 Some people were adamant that you need to add up the
23 risk from all the reactors, all of the --
24 MEMBER WALLIS: Well, that's a different
25 -- I mean, whether it's one or all, it's still QHOs.

1 MR. STUTZKE: That's right.

2 MEMBER POWERS: And so a reactor by itself

3 can be evaluated with respect to the QHO.

4 MEMBER KRESS: Boy, wonderful. I'm glad

5 to hear you say that.

6 MEMBER WALLIS: Well, how do you apply

7 this, then?

8 MEMBER KRESS: I didn't hear that.

9 MEMBER POWERS: I can't tell you whether

10 a reactor meets the QHOs.

11 MEMBER KRESS: That's exactly right, Dana.

12 MEMBER POWERS: There's just no way to do

13 it. You have to evaluate it in terms of what site

14 it's on.

15 MEMBER KRESS: Wonderful. Tried to say

16 that a hundred times.

17 MEMBER WALLIS: Isn't this why it's not a

18 very good measure?

19 CHAIRMAN SHACK: Let's not get into that

20 at the moment.

21 MEMBER KRESS: This is a subject we will

22 have this afternoon, once again. But Dana is exactly

23 right there, and I applaud the statement.

24 MEMBER WALLIS: That's why it's not used

25 now as a basic health objective, basic design

1 criteria?

2 MEMBER POWERS: No, it's not used now

3 because it goes well beyond the mandate that is given

4 in the Atomic Energy Act. The Atomic Energy Act only

5 requires adequate protection of the public health and

6 safety. QHOs go well beyond that.

7 MEMBER KRESS: Yes.

8 MEMBER WALLIS: If there were a definition

9 of adequate health and safety. Anyway, I guess we

10 have to move on, but --

11 MEMBER KRESS: Yes, yes.

12 MEMBER WALLIS: -- we seem to be making

13 some assumption here, which may not be valid.

14 CHAIRMAN SHACK: Well, they're only

15 reporting what they said. It's not an assumption.

16 MEMBER WALLIS: Okay. Okay. We're going

17 to get to the bottom line again.

18 MEMBER KRESS: I mean, the first sub-

19 bullet there is one of the reasons why you shouldn't

20 listen exactly to all the public comments and take

21 them for face value. You should examine them

22 carefully and make your own decision.

23 MR. STUTZKE: With respect to the

24 Committee's letter, I guess most people believe you

25 guys were asking the right questions. I'll remind you

1 in that letter you took the two policy issues and
2 framed it in the terms of seven questions, and a lot
3 of people thought that was beneficial, although there
4 was a commenter that said, "All of your concerns we
5 already addressed in the framework."
6 And as far as I know, that commenter
7 wasn't associated with development of the framework.
8 So they were saying it has already been done.
9 The staff's perspective on these policy
10 issues are we need to wait until we get further down
11 the road with the licensing strategy for NGNP, and our
12 pebble bed pre-application review that is ongoing,
13 before we look for some sort of generic or broad
14 resolution of these policy issues. We don't believe
15 we need them resolved in the near term, because we can
16 license all the future LWRs now without resolving
17 them. We have a path forward, pretty clear acceptance
18 criteria and guidelines, etcetera.
19 And the only other non-LWRs, you know,
20 that seem to be on the table now or within the realm
21 of consideration are the NGNP and the pebble bed.
22 MEMBER WALLIS: What does the Commission
23 think should be the basis for licensing future plants
24 in terms of minimum level of safety? Isn't that what
25 you have to go on?

1 MEMBER KRESS: Yes, I think they're asking
2 the staff's opinion of what that ought to be.
3 MEMBER POWERS: But isn't the need of the
4 Commission -- the staff has the option of defining
5 what the minimum level of safety is. Congress has
6 defined the minimum level of safety.
7 MEMBER WALLIS: But it's defined in such
8 vague terms that they can't be used. You have to have
9 an operational definition in terms of --
10 MEMBER KRESS: In terms of the Commission,
11 and Congress was very forthcoming in saying, "And we
12 leave it up to the Commission to decide what this
13 means," and they have. The fact that you don't like
14 the definition is a problem that particularly affects
15 you, not me. I like the definition.
16 MEMBER WALLIS: Yes. But if they
17 interpret it in terms of QHOs in an operational sense,
18 so you can now apply something quantitative, is
19 that --
20 MEMBER KRESS: The purpose is in terms of
21 meeting the current regulations. But when you get to
22 a Part 53, if we ever have one, then I think meeting
23 those regulations may mean something different than
24 meeting the current regulations. So the definition
25 may change if you have a Part 53. At least I think it

1 could.

2 MEMBER APOSTOLAKIS: I really don't

3 understand why people are so willing to say that the

4 QHOs should be used to establish the medium level of

5 safety. I mean, I can see that happening in the near

6 future, but the QHOs are frequencies, right?

7 MEMBER KRESS: Yes.

8 MEMBER APOSTOLAKIS: Per year, on a per

9 year basis.

10 MEMBER KRESS: Not necessarily.

11 MEMBER APOSTOLAKIS: They are applied to

12 individual plants or sites, right?

13 MEMBER KRESS: Individual sites.

14 MEMBER APOSTOLAKIS: So the total number

15 of sites has to play a role somewhere in the -- as

16 long as we're talking about 20, 30 new plants, that's

17 okay. But if we reach 500, 600, 700, is it still all

18 right? I don't know. I mean, that's a problem of

19 dealing with frequencies.

20 MEMBER KRESS: I think --

21 MEMBER APOSTOLAKIS: And everybody seems

22 to say -- to dismiss it. Oh, yes, well, the QHOs are

23 good enough. I don't think they're good enough if you

24 have 1,000 reactors.

25 MEMBER KRESS: Now you're referring back

1 to the discussion on safety goals in general.

2 MEMBER APOSTOLAKIS: Yes.

3 MEMBER KRESS: And I think it's a

4 legitimate question. I don't think they have to

5 answer that now.

6 MEMBER APOSTOLAKIS: No, but it has to be

7 noted, though.

8 MEMBER KRESS: It could be noted

9 somewhere, yes.

10 MEMBER APOSTOLAKIS: I think it should be

11 noted.

12 MEMBER KRESS: And I think the QHOs ought

13 somehow to relate to the total number of plants you

14 expect to be out there --

15 MEMBER APOSTOLAKIS: Right.

16 MEMBER KRESS: -- in the near future, or

17 the far future even. But I think they have -- I think

18 that was one of the considerations in where they set

19 the QHO level in the first place. And I don't think

20 it has --

21 MEMBER CORRADINI: It has an assumed

22 population in mind.

23 MEMBER APOSTOLAKIS: Well, yes, they knew

24 about the 100 units.

25 MEMBER POWERS: Yes, but there might be

1,000.

MEMBER KRESS: Yes. I think that what they -- what I started to say, I think they assume there might be about 1,000, and they decided on --

MEMBER APOSTOLAKIS: Did they say --

MEMBER KRESS: Now, the QHOs are inherently a cost-benefit consideration, but, you know, they didn't make the cost-benefit. They, instead, finessed that by saying, "Let's set it at such a level that although we don't know what the benefit is going to be, or the cost, we'll set it at such a level we're fairly confident that it meets any reasonable cost-benefit value for 1,000 plants." And this was an intuitive judgment.

MEMBER APOSTOLAKIS: Are you sure it was 1,000?

MEMBER KRESS: I think it was definitely 1,000. But -- and I think it was -- but it doesn't matter, because it was an intuitive judgment, that it was set at such a low value that we meet almost any reasonable cost-benefit --

MEMBER APOSTOLAKIS: But see, your problem, George, it's an individual risk. It's someone who hangs around the outside of a plant. He's not going to hang around 1,000 plants simultaneously.

1 MEMBER POWERS: He might well do so, if
2 you have -- their zones that can be affected overlap.
3 MEMBER WALLIS: But you limit it to 10
4 miles, so they're not going to overlap.
5 MEMBER POWERS: I think there are places
6 in Connecticut for Millstone, and had they built --
7 MEMBER APOSTOLAKIS: No.
8 MEMBER POWERS: -- they would have
9 overlapped.
10 MEMBER APOSTOLAKIS: No, but this --
11 still, the number of units matters, because you can
12 ask yourself, now, what is the probability that this
13 will happen anywhere in the United States?
14 MEMBER KRESS: Certainly the number of
15 units matters.
16 MEMBER APOSTOLAKIS: Yes, it matters.
17 MEMBER WALLIS: I don't think this is
18 going to be appropriate --
19 MEMBER APOSTOLAKIS: It's not an immediate
20 concern. We're not going to build 1,000 of those
21 tomorrow.
22 MEMBER WALLIS: I'm very surprised the
23 agency hasn't sort of looked at this in terms of
24 licensing reactors. It should be a real solid policy
25 statement about what it's going to be based on.

1 MEMBER APOSTOLAKIS: There is an
2 expectation that it will do better than this.
3 MEMBER WALLIS: Yes.
4 MEMBER APOSTOLAKIS: That's written
5 somewhere.
6 MEMBER WALLIS: Okay.
7 MEMBER KRESS: But we're not going to
8 rewrite the safety goals. I think QHOs are a
9 reasonable site-specific criterion at the moment.
10 MEMBER APOSTOLAKIS: At the moment, yes.
11 MEMBER KRESS: But I don't -- I agree with
12 you --
13 CHAIRMAN SHACK: Just remember that line,
14 Tom, we're not going to rewrite the safety goals.
15 MEMBER KRESS: That's right. We're not
16 going to rewrite them. We may want to augment them.
17 CHAIRMAN SHACK: Remember that this
18 afternoon.
19 MEMBER KRESS: But I want to stress once
20 again the safety -- the QHOs are a site characteristic
21 and they are not plant-specific things. And you
22 should be able to separate level of safety of plants
23 from site to a large extent but not entirely. We'll
24 leave that for this afternoon.
25 MEMBER APOSTOLAKIS: Yes, yes, yes. Well,

1 let's --

2 MEMBER KRESS: Let's move on.

3 MEMBER APOSTOLAKIS: So this slide is

4 different from ours.

5 MEMBER KRESS: Yes, they have two extra

6 boards.

7 MR. BIRMINGHAM: Mary Drouin said she

8 would like to address the next policy issue which is

9 on defense in depth.

10 MS. DROUIN: Okay. This goes back, this

11 particular policy issue, to SECY-03-0047, where we

12 first raised seven policy issues to the Commission.

13 And we had recommended to the Commission that a policy

14 statement be developed on defense in depth, defining

15 what it meant.

16 The Commission, in their SRM, came back

17 and said they agreed that development a definition for

18 defense in depth in a policy statement was a good

19 idea, but for us to consider, instead of issuing a

20 separate policy statement to revising the PRA policy

21 statement. So in the ANPR we raised this as a

22 question to stakeholders to get their input.

23 Did they like the idea of a policy

24 statement? If they did, you know, was it better to

25 have it in a separate one or in the PRA policy

1 statement? Generally, everybody supported, you know,
2 that we needed a policy statement.
3 Unilaterally, almost everybody -- I would
4 say,if not almost all of them -- did recommend that we
5 do not revise the PRA policy statement, that it be a
6 separate policy statement. And most of them felt like
7 because it was broader than PRA, and the PRA was
8 limiting, and it should not be tied to that.
9 You know, they did ask that, you know, we
10 have interaction with them as the development and that
11 would be absolutely, you know, in the development of
12 it that would -- you know, we would have public
13 meetings, etcetera, and doing this.
14 MEMBER KRESS: But your paper to the
15 Commission doesn't deal with this particular issue?
16 The one we're talking about today.
17 MS. DROUIN: Sorry?
18 MEMBER KRESS: Your Commission paper --
19 don't talk about this issue.
20 MS. DROUIN: Yes, it does. Yes, it does.
21 And the commitment we have in the paper is that we
22 will start the effort to develop a defense in depth
23 policy statement.
24 MEMBER KRESS: I didn't catch that.
25 MS. DROUIN: There's two commitments in

1 the SECY paper, and this is one of them.

2 MEMBER KRESS: Okay.

3 MS. DROUIN: So Marty is going to do the

4 single failure criterion, the next one.

5 MR. STUTZKE: All right. I would point

6 out we already have through a Commission SRM an

7 agreement or approval that we can seek a probabilistic

8 implementation of the single failure criteria. The

9 issues that were raised in this ANPR were oriented

10 towards, how do we actually implement them?

11 Most of the commenters did, in fact, favor

12 a risk-informed approach to implementing or to

13 revising the single failure criteria, but without a

14 great detail of how one would actually go about that.

15 There was at least one comment in there that said we

16 have to be careful, we need to realize that single

17 failure criteria doesn't just appear within the

18 Commission's documents, but it's embedded in the codes

19 and standards and things like this. So it's not as

20 simple as the staff waving its magic wand to make

21 something change like that.

22 In addition, there was another comment

23 that said perhaps we want to pursue --

24 MEMBER APOSTOLAKIS: Well, excuse me. So

25 that means that even if you develop a new Part 53, you

1 will have problems?

2 MR. STUTZKE: Well, what I'm saying is, as

3 you know, a large amount of our review is based on

4 licensing meeting codes and standards, for example,

5 from IEEE. So those standards, we would have to take

6 exceptions to them or something like that.

7 MR. BIRMINGHAM: There were comments from

8 some of the standards and codes committees that they

9 were working on a PRA-based approach to some of their

10 standards, and that -- you know, that those would be

11 potentially available in the future. But they were

12 not -- some of the committees pointed out, as you

13 already said, that it's embedded in their current

14 standards, and you couldn't just suddenly not make it

15 a requirement, because it would still be in the

16 standards.

17 MR. STUTZKE: Okay. All right. One of

18 the other comments here was maybe we should pursue I

19 guess rulemaking outside of this Part 53, but

20 rulemaking within Part 50 now to revise the single

21 failure criteria as a stand-alone.

22 Okay. With respect --

23 MEMBER WALLIS: It's really kind of a

24 stop-gap, because you didn't have a way of evaluating

25 frequency and consequence. A very approximate way of

1 taking a better account of uncertainties and
2 possibilities of something going wrong.
3 MR. STUTZKE: That's correct. I mean,
4 I --
5 MEMBER WALLIS: But if you know of a
6 better estimate of the probability of something going
7 wrong, then you ought to use it, right?
8 MR. STUTZKE: Right. I mean, I was
9 personally struck by the commenter that talked about
10 arbitrary redundancy requirements. Well, arbitrary is
11 in the eye of the beholder, right? And they were
12 imposed because of the uncertainties.
13 MEMBER KRESS: It wasn't necessarily
14 arbitrary, was it?
15 MR. STUTZKE: No.
16 MEMBER WALLIS: It's someone's guess.
17 MEMBER APOSTOLAKIS: No, it should impose
18 the redundancy. That's what it is.
19 MEMBER WALLIS: Yes. But it's still
20 someone's guess, so that's good enough.
21 MEMBER KRESS: Yes. And you have two
22 failure criteria.
23 MEMBER WALLIS: You have three or four or
24 whatever.
25 MEMBER APOSTOLAKIS: And, remember now,

1 single failure does not include human error.

2 MEMBER KRESS: Right.

3 MEMBER APOSTOLAKIS: Single human error is

4 not a single failure.

5 MR. STUTZKE: Okay. Next slide. With

6 respect to the containment performance standards, what

7 the staff had done inside the framework was propose

8 that we treat the containment as a part of the defense

9 in depth, and that we would have functional

10 requirements for containment performance.

11 We didn't get any general agreement with

12 this. Most of the commenters felt we should develop

13 some sort of containment functional performance

14 requirements at a high level that would be technology-

15 neutral, don't pre-determine the number of barriers

16 that we need, for example, like this. Then, take

17 those concepts and implement them on a technology-

18 specific basis.

19 A strong comment that came out was don't

20 necessarily presume that you need a pressure retaining

21 containment, if the risk is okay. Like that.

22 MEMBER WALLIS: Well, the containment

23 isn't there to contain pressure. It's there to

24 contain radioactivity.

25 MR. STUTZKE: Right. Right.

1 MEMBER APOSTOLAKIS: But isn't the issue
2 now also the external threats? That even if you don't
3 have a problem internally --
4 MR. STUTZKE: That's true. I mean, the
5 containment has functions other than to retain the
6 radioactivity, you know. It makes a good shield for
7 aircrafts, this sort of thing.
8 MEMBER WALLIS: And, also, you can't see
9 what's going on in the plant.
10 MEMBER POWERS: One struggles to
11 understand how a non-pressure retaining containment
12 would contain the noble gases.
13 MR. STUTZKE: It doesn't at the moment.
14 MEMBER MAYNARD: I was struggling with
15 that, too.
16 (Laughter.)
17 MR. STUTZKE: All right. This discussion
18 on this policy issue, too, it's inside the SECY paper.
19 It also talked about the probabilistic approach to
20 selecting licensing basis events, and so there were a
21 number of comments on the frequency consequence curve
22 that had been proposed inside the framework.
23 I guess the notable comment here was the
24 need to add a so-called CCDF curve, complimentary
25 cumulative distribution curve, to this. And the

1 notion -- well, the reason was -- stated was you want
2 to avoid situations where you would reject a design
3 because you had a single bad actor sequence coming up.
4 And I find that statement pretty remarkable, too.
5 MEMBER APOSTOLAKIS: Say again. What?
6 That you would do that?
7 MR. STUTZKE: By using the CCDF curve, you
8 would --
9 CHAIRMAN SHACK: Instead of --
10 MR. STUTZKE: -- instead of this
11 differential curve that we have, you could still
12 accept designs where you had a single sequence that
13 could cause problems, because you've smoothed it out,
14 you've integrated out the --
15 MEMBER WALLIS: CCDF is a measure of
16 effect on the public.
17 MEMBER APOSTOLAKIS: How do you know how
18 that --
19 MEMBER WALLIS: That's why it's a good
20 curve.
21 MEMBER KRESS: The problem with that
22 statement is you want to set your requirements such
23 that if you exceed them, if it's a single sequence,
24 then that sequence shouldn't -- you've got to do
25 something about that sequence.

1 MR. STUTZKE: Exactly.

2 MEMBER KRESS: Yes.

3 MR. STUTZKE: Exactly.

4 MEMBER KRESS: The requirements should be
5 -- I mean, maybe they're not so low that you've got a
6 lot of those, but you need to set them. So I think --
7 you know, I think that's one comment you want to sort
8 of --

9 MR. STUTZKE: My personal view is I think
10 we probably need to consider a CCDF curve but not for
11 the reason stated here.

12 MEMBER KRESS: Yes.

13 MR. STUTZKE: Just because it's a good
14 thing. But -- and we're in the process of talking
15 about how we could go about that, whether we need to
16 do it.

17 MEMBER KRESS: Yes. And I wanted to make
18 the point that a CCDF curve can be used as the -- as
19 a representation of CDF and LERF. And we may want to
20 discuss that at some point. But if you want those
21 concepts, which I think you need, for any -- any kind
22 of plant design that's technology-neutral, then I
23 think that's where you get those.

24 MR. STUTZKE: Yes, I'm well aware of your
25 notes that you gave us.

1 MEMBER KRESS: You're aware of my --

2 MR. STUTZKE: Oh, yes.

3 MEMBER APOSTOLAKIS: Is that something for

4 this afternoon?

5 MEMBER KRESS: Yes.

6 MEMBER WALLIS: Yes, it's valid because

7 it's a measure of the effect of the plant on the

8 public, which is really what you're basically trying

9 to do. It's not a regulatory tool, which is what your

10 other frequency consequence curve is. It's actually

11 a measure of the safety status of the plant.

12 Therefore, it's a very valid thing to have.

13 MEMBER APOSTOLAKIS: The containment is.

14 MEMBER WALLIS: CCDF. The usual frequency

15 consequence curve is a measure of the effect on

16 society of this plant, and that's what it's for.

17 MEMBER APOSTOLAKIS: Yes.

18 MEMBER WALLIS: On this statement --

19 CHAIRMAN SHACK: It's based on integrated

20 risk, however you define risk.

21 MEMBER WALLIS: It has nothing to do with

22 regulation.

23 MR. STUTZKE: Okay. Well, let's defer

24 this until this afternoon. I want --

25 MEMBER APOSTOLAKIS: Oh. Are you coming

1 back this afternoon?

2 MEMBER KRESS: Oh, yes. We're going to

3 discuss all these issues this afternoon.

4 MR. STUTZKE: The last policy issue that

5 was discussed in the ANPR was this integration of

6 safety, security, and energy preparedness. And in

7 general, stakeholders had problems --

8 MEMBER WALLIS: But you never did it in

9 the framework. Discussed it, but it never happened.

10 MS. DROUIN: This was in the ANPR,

11 because --

12 MEMBER WALLIS: It was in the ANPR, yes.

13 MS. DROUIN: We're responding to the ANPR

14 here. The Commission in several of their SRMs said

15 integrate this. So, and they did this in the SRMs

16 that told us to put it in the ANPR, so we solicited

17 stakeholder input. And this is not necessarily just

18 related to the framework. It was -- they had been

19 telling us, regardless of the framework, whether or

20 not to integrate these three things, so we sought

21 stakeholder input on this concept.

22 MEMBER WALLIS: So you're talking here

23 about the ANPR.

24 MS. DROUIN: Yes.

25 MR. STUTZKE: That's correct.

1 MEMBER WALLIS: Okay.

2 MEMBER APOSTOLAKIS: We don't even know

3 what "integration" means. What does it mean?

4 MR. STUTZKE: Well, the idea would be that

5 you would have to look at security -- how security

6 issues could in fact impact the reactor safety, or

7 vice versa.

8 MS. DROUIN: Or vice versa.

9 MEMBER APOSTOLAKIS: Oh, the interaction,

10 you mean?

11 MR. STUTZKE: The interaction between

12 these two.

13 MR. BIRMINGHAM: It sort of implies that

14 you would ensure the safety, safety, and emergency

15 preparedness interact seamlessly and that there's no

16 adverse impact by employing any one of them -- of any

17 of those actions.

18 MEMBER APOSTOLAKIS: So it does not mean

19 that I -- I mean, ideally, if I could calculate it,

20 that I would get a value for the contribution to risk

21 from security or insecurity, and value from safety and

22 then compare the two or put them together to compare

23 with some goal. That's not what it means.

24 MR. STUTZKE: That's not the intention.

25 MS. DROUIN: At least that's not our

1 interpretation. The Commission has not told us what
2 they mean by those words. But the words in the SRM
3 was just, "We should integrate safety, security, and
4 emergency preparedness. That is it. That's the only
5 guidance we've been given."
6 MEMBER APOSTOLAKIS: But they use the word
7 "integration."
8 MS. DROUIN: Right.
9 MR. STUTZKE: Right.
10 MEMBER ARMIJO: Didn't anybody ask them
11 what they meant? I mean --
12 MEMBER CORRADINI: Yes. I was going to
13 say, was there any discussion in the -- was there any
14 words in the open discussion that --
15 MR. MONNINGER: Yes. This is John
16 Monninger from the staff. I think some of the
17 thinking was that, you know, when compared to a
18 traditional operating reactors where a lot of the
19 security is focused on guards, guns, fences, that kind
20 of stuff, you know, if you are in the conceptual
21 design process, are there things that you can do in
22 the design now to improve security? Can you bury
23 certain features, certain safety features of the plant
24 in the bowels, such that it could not be exploited for
25 security-type issues?

1 So I think that is a lot of the emphasis
2 here. You know, do not -- not to say that security is
3 not known after, but is there something in the design
4 phase where you could more, you know, integrate your
5 approach? I mean, if you look at the -- you know, the
6 vulnerabilities of the plants, systems-wise, you know,
7 layouts, configurations, switch gear rooms, etcetera,
8 you know, you -- they have traditionally been looked
9 at from a safety perspective.
10 But, you know, where do you actually want
11 those, you know, raceways, you know, to be located
12 within the plant, such that they are not also
13 vulnerable from a security aspect. So I think that
14 was the general thinking.
15 MEMBER ARMIJO: Good thinking.
16 MEMBER KRESS: Well, once again, I view
17 those types of things as another design basis
18 accident. I mean, we've talked about design basis
19 threats, and with any kind of DBA or LBE you need
20 figures of merit that have to be met. And that's
21 where I have trouble trying to figure out what the
22 figure of merit is going to be.
23 If you don't have it in your FC curve you
24 have now, I view that as -- I figure that -- I view
25 that FC curve as sort of a figure of merit. And it's

1 not part of that, so if you're going to integrate, it
2 has to be integrated as a separate design basis
3 accident with a figure of merit. And I don't know
4 what that's going to be, but --
5 MEMBER APOSTOLAKIS: Why shouldn't it be
6 part of the FC curve? Is that another accident
7 sequence?
8 MEMBER KRESS: The design basis -- it can
9 be viewed as a design basis accident.
10 CHAIRMAN SHACK: Yes. I mean, if you
11 treat it as a design basis accident, you don't have to
12 worry about frequency. If you put it in the FC curve,
13 you have to come up with a frequency.
14 MEMBER KRESS: Yes, that's my point. You
15 don't have --
16 MEMBER APOSTOLAKIS: Then you put it in a
17 design basis.
18 MEMBER KRESS: Hmm?
19 MEMBER APOSTOLAKIS: Then, you put it in
20 the design basis.
21 CHAIRMAN SHACK: Well, that's a proposal
22 that did not make it through the Commission.
23 MEMBER APOSTOLAKIS: It did not.
24 CHAIRMAN SHACK: No, did not.
25 MEMBER KRESS: But the problem with -- you

1 can't have it on an FC curve, because you don't have
2 a frequency.
3 MEMBER APOSTOLAKIS: Or you may decide to
4 treat it completely differently.
5 MEMBER KRESS: Yes, which is what we do
6 now.
7 MEMBER APOSTOLAKIS: Not pursue it any
8 further.
9 CHAIRMAN SHACK: Treat it as a beyond
10 design basis accident.
11 MEMBER APOSTOLAKIS: Yes, and do certain
12 stylized things, and leave it there. Well, the FC
13 curve is below -- beyond design basis.
14 MEMBER KRESS: The CCDF is, but the FC
15 they use is a design basis --
16 MEMBER APOSTOLAKIS: You are defining the
17 licensing basis.
18 MEMBER KRESS: Yes.
19 MEMBER WALLIS: Yes. But the real FC
20 curve is beyond design basis.
21 MEMBER KRESS: Yes. Oh, it's all of it.
22 MEMBER WALLIS: It's all of it.
23 MEMBER KRESS: It includes the beyond
24 design basis.
25 MEMBER APOSTOLAKIS: Right. Okay.

1 MS. DROUIN: Okay. The last topic in the
2 ANPR was the framework. We had placed the framework
3 on the work site when the ANPR was published, and we
4 updated it in the middle of the ANPR comment period in
5 July. Probably I would say at least half of the
6 questions -- I mean, there was over I think like 80
7 questions. I don't remember the exact number in the
8 ANPR, and I know that probably a good half of them
9 focused on trying to get detailed comments from the
10 stakeholders on the framework document.
11 MEMBER WALLIS: The framework that was
12 sketched out in the ANPR wasn't quite the same as the
13 framework that appeared in NUREG-1860.
14 MS. DROUIN: It is the same one.
15 MEMBER WALLIS: It was exactly the same
16 thing?
17 MS. DROUIN: There was the initial one
18 that was done in May, and we had some holes in the May
19 version, and the version that was put on -- I think
20 the actual date was August 1st is the version that you
21 all have that he has been giving his comments on.
22 I mean, we have been revising it a little
23 bit through the public comments, but as the internal
24 document that only -- you know, we have, but the
25 version that's out there is the July version. I mean,

1 in general, you know, at a high level the comments
2 were all very positive.
3 We've got a lot of detailed comments on
4 the details, and we're still sorting through those to
5 see what -- do we need to make a change in the
6 framework document? But right now we're still on
7 schedule to publish the document in August of this
8 year.
9 There will be an appendix in the framework
10 that will go into detail summarizing all of the
11 stakeholder comments that we received and how they
12 were dispositioned, published, as I said, in the
13 summer of 2007.
14 The last part, you know, in the SECY paper
15 of where we're at is that, you know, this is a
16 notation paper. We do have a recommendation in
17 answering the initial question was, you know, whether,
18 and if so, how to proceed to rulemaking.
19 And our response at this point is that
20 what we're recommending is that the rulemaking -- and
21 when we talk about the rulemaking, we're talking
22 about, you know, creating either -- as I said, it's a
23 packaging thing. Whether it's a Part 53, you know, or
24 whether it's an entire appendix added to the current
25 Part 50.

1 But, you know, it's this complete set of
2 technical requirements for advance reactors -- that
3 that be deferred until, you know, we get experience
4 with the NGNP and GNEP, and that there is a paper that
5 will be going to Congress on the licensing approach.
6 And that will dictate, you know, the need for
7 developing this Part 53.
8 MEMBER ABDEL-KHALIK: If you just go with
9 the first green bullet here, and if you take one of
10 these non-LWR designs and go through with Part 50,
11 what do you gain from that experience? You would gain
12 the definition of the exceptions to Part 50. You
13 would identify those.
14 MS. DROUIN: That's right. For that
15 reactor --
16 MEMBER ABDEL-KHALIK: With that particular
17 design.
18 MS. DROUIN: That's right.
19 MEMBER ABDEL-KHALIK: Now, how would those
20 exceptions that you have identified in going through
21 this process for this non-LWR -- that specific non-LWR
22 design help you with the technology-neutral framework,
23 which is a higher level document?
24 MS. DROUIN: Well, let's -- when you say
25 a higher level document, I've tried to explain to

1 people that what we -- if you use the framework to
2 generate these new sets of requirements -- the new
3 set. The level of detail would be comparable to what
4 you see in the current GDCs. Everyone thinks it's
5 some higher thing, but it's not. It's at that same
6 level.
7 MEMBER ABDEL-KHALIK: Well, my
8 understanding is that you would have a higher level
9 document, in conjunction with detail-specific
10 requirements for --
11 MS. DROUIN: Well, I know people keep
12 saying -- but what I'm trying to tell you is that that
13 has never been the case. This Part 53 that would come
14 out of the framework would be comparable to the
15 current GDCs. They would just be technology-neutral.
16 And if you look at a lot of the GDCs right now, it
17 would not be too difficult to make them technology-
18 neutral, because --
19 MEMBER WALLIS: Right. Right. They look
20 very good now.
21 MS. DROUIN: Yes.
22 MEMBER WALLIS: But the framework doesn't
23 say anything about GDCs.
24 MS. DROUIN: GDCs is part of Part 50.
25 MEMBER WALLIS: Well, I'm surprised that

1 your framework never said that a lot of these GDCs
2 could be carried right over into --
3 MS. DROUIN: Well, it is in there.
4 MEMBER WALLIS: I didn't find it anywhere
5 in there.
6 MS. DROUIN: It's in Chapter 8, and
7 there's a whole appendix.
8 MEMBER WALLIS: It should be in Chapter 1
9 or something, when you're setting the stage for the
10 whole thing.
11 MS. DROUIN: You know, and what we've
12 tried to explain is that that's not the main -- the
13 real difficulty in the framework is the risk-informed
14 part.
15 MEMBER WALLIS: Well, the whole problem I
16 have with this program is what principle it's based
17 on, and if it's based on some of these GDCs, then, for
18 Heaven's sake, say so.
19 MEMBER APOSTOLAKIS: Well, let me
20 understand something. The question assumed from Said
21 assumed that you would license NGNP using Part 50 with
22 exemptions. Is that a correct assumption?
23 MS. DROUIN: Right now, that's the only
24 thing that exists. So unless you create and do some
25 rulemaking, you either are under Part 50 -- you're

1 under Part 50 or 52 for the process.

2 MEMBER APOSTOLAKIS: But why couldn't you

3 -- I mean, you have to approve the exemptions, right?

4 Maybe another idea would be to start with your

5 framework and try to develop appropriate rules,

6 borrowing as much as you can from Part 50 for NGNP.

7 MS. DROUIN: That is one -- I believe that

8 is one of the options that they are looking at in the

9 licensing process for NGNP.

10 MEMBER APOSTOLAKIS: So who is "they"?

11 MS. DROUIN: NRC and DOE.

12 MEMBER APOSTOLAKIS: So it's not clear,

13 then, how NGNP will be licensed. It's not automatic

14 to assume that --

15 MEMBER ABDEL-KHALIK: But this

16 recommendation -- but this implies that you're going

17 to use Part 50.

18 MEMBER APOSTOLAKIS: No. All they're

19 saying is wait until we have the experience with NGNP.

20 But it doesn't say what type experience it will be.

21 MEMBER KRESS: I think the framework in

22 the draft rule will give you guidance on how to apply

23 Part 50.

24 MEMBER CORRADINI: But I guess I viewed

25 this -- I just have to ask a question here. I view

1 this all in some sense ways to think behind the
2 scenes, but the rule is still 10 CFR 50. Period. So
3 if the rule is 10 CFR 50, the only empirical evidence
4 that it works is you go back to Fort St. Vrain, you
5 look at Chapter X, Y, and Z at Fort St. Vrain, and
6 either you follow those DBAs or, with your technique,
7 using the technology-neutral framework or some other
8 methodology, you would modify those DBAs.
9 And then, the staff would have to come up
10 with a rationalization, the reasoning, as to what goes
11 in and what comes out. Is that -- I mean, isn't
12 practically that what is going to be done? And if you
13 jump in with either it would be the NGNP or the PBMR,
14 those are just more ways to exercise the thinking
15 process. But in terms of pure empirical evidence, the
16 only thing I would go to is what you did historically,
17 because that actually did work under 10 CFR 50.
18 MS. DROUIN: Yes. And --
19 MR. BANERJEE: Where the
20 exceptions/exemptions you had to give for Fort St.
21 Vrain or Peach Bottom? Were there many, or are they
22 few?
23 MS. DROUIN: My understanding is that it
24 was quite a few, and it was a very tedious process.
25 MEMBER APOSTOLAKIS: But it also depends

on what the NGNP reactor -- who it --

MS. DROUIN: All I can tell you is that --

MEMBER APOSTOLAKIS: Would it be a pebble bed?

MS. DROUIN: That's not known yet.

MEMBER KRESS: Probably not.

MS. DROUIN: It's not known, and --

MEMBER KRESS: Probably not. It's more like a prismatic I think. More likely. I mean, I'm guessing, but --

MEMBER APOSTOLAKIS: You are guessing what, though?

MEMBER KRESS: It won't be a pebble bed.

MS. DROUIN: The DOE --

MEMBER APOSTOLAKIS: Westinghouse consortium I think is pushing for the pebble bed.

MEMBER KRESS: Yes, but there are other people pushing for prismatic.

MEMBER APOSTOLAKIS: Yes. But, I mean, it's not clear who is going to win.

MEMBER WALLIS: Mary, I'm really puzzled. I looked at 10 CFR Part 50, and it doesn't really -- it's not consistent. The framework goes into all this stuff about design basis accidents and safety significant SSCs, and none of that is in Part 50 --

1 MEMBER KRESS: No.

2 MEMBER WALLIS: -- that I could find. So

3 it's all in some other part of the regulation. It

4 doesn't -- it's not part of Part 50 itself. So how

5 can you apply Part 50 without all this other stuff

6 which your experience about how to apply it? You're

7 going to take all that other stuff and use it from the

8 NGNP, which is not in Part 50 itself.

9 MS. DROUIN: I don't want to get into the

10 NGNP.

11 MEMBER WALLIS: But see, that's the whole

12 thing that I have problems with. You can't just --

13 MEMBER APOSTOLAKIS: I think you have to

14 go --

15 MEMBER WALLIS: There's a whole lot of

16 experience and practice and habit, and so on, that

17 you've established in how you use it.

18 MEMBER CORRADINI: But I guess that's what

19 was my comment.

20 MEMBER WALLIS: Because that's what you're

21 going to use.

22 MEMBER CORRADINI: I guess that was my

23 comment. Knowing nothing, you would have to go back

24 to all of the experience and practice established for

25 the one plant that had helium --

1 MEMBER WALLIS: Right. And you had to go
2 back and --
3 MEMBER CORRADINI: -- that had a graphite
4 moderator that would --
5 MEMBER WALLIS: Two.
6 MEMBER CORRADINI: Two, whatever. I'm
7 sorry, two. But essentially you had to worry about
8 pressurized loss of flow accidents, depressurized loss
9 of flow accidents, air ingress, water ingress, and
10 those are the natural things that are going to kind of
11 pop out whatever technique you use.
12 MEMBER WALLIS: Do you go back to
13 experience, or you use something like this framework
14 in order to --
15 MEMBER KRESS: Well, the framework has to
16 identify classes of LBEs. And what he's saying is
17 right, you don't have any way to do that except what
18 has already been done and brainstorming it and
19 thinking about it.
20 MEMBER WALLIS: But Part 50 doesn't say
21 you have to have classes of LBEs and all that stuff.
22 That's something else that is laid on by the staff.
23 MEMBER APOSTOLAKIS: I don't understand
24 that. I mean --
25 MEMBER KRESS: Except that is the way it

1 has always been done under Part 50.

2 MEMBER WALLIS: that's the way it has

3 already been done, but I thought this was an

4 opportunity to do something different.

5 MEMBER APOSTOLAKIS: They will have done

6 a PRA, and I understand the pebble bed people have

7 already done it. Then, you go to the framework and

8 you define the LBEs. Now, that's easier said than

9 done, but at least you -- there is a way forward.

10 MEMBER KRESS: But LBEs don't come out of

11 the PRA.

12 MEMBER APOSTOLAKIS: Sorry?

13 MEMBER KRESS: There are additional LBEs

14 that don't come from the PRA.

15 MEMBER APOSTOLAKIS: Well, they could.

16 MR. BANERJEE: It's very hard to do a PRA

17 when you don't know what you're going to find.

18 (Laughter.)

19 But, look, with a pebble bed you could get

20 hot streaking, you can get all sorts of phenomena

21 you've never seen before. How the hell are you going

22 to do it?

23 MEMBER APOSTOLAKIS: But the PRA -- look,

24 they didn't do it in isolation. They had reviewers.

25 Somebody raised that issue, and they have an answer.

1 I mean, I assume --

2 MR. BANERJEE: I'm just raising these

3 issues. They could be 10,000 others.

4 MEMBER CORRADINI: But, I mean, just go

5 backwards, though, Sanjoy. How did they do --

6 MR. BANERJEE: Yes.

7 MEMBER CORRADINI: -- WASH 1400 with Surry

8 and Peach Bottom at the time, right? They essentially

9 developed a whole range of very conservative what-ifs

10 in terms of how the accident could release source --

11 could release fission products and then generate a

12 source term offsite. But in some sense in '72 it was

13 only the same --

14 MR. BANERJEE: I'm just saying I want a

15 PRA on this matter, you know, that --

16 MEMBER KRESS: That's the prime argument

17 for going to licensing basis event.

18 MEMBER WALLIS: Think of the evolution of

19 ECCS. I mean, you didn't have to have ECCS, and there

20 is all kinds of ECCS hearings and tremendous debate

21 before we came up with some kind of a criteria and

22 stuff for ECCS. Is this going to happen with these

23 other reactors?

24 MEMBER APOSTOLAKIS: I think we are

25 speculating now.

1 MEMBER KRESS: Yes.

2 MEMBER WALLIS: No, but you don't know

3 what can happen to them. So how are you going to

4 evaluate what all the accidents are?

5 MEMBER APOSTOLAKIS: At this point, we

6 don't --

7 MEMBER KRESS: Can't get away from --

8 MEMBER APOSTOLAKIS: I don't think -- I

9 mean, if you have a problem defining the signals

10 that's in the PRA, I just don't see how the

11 traditional design basis will have no problem. I just

12 don't see that. But it's the usual thing, you know,

13 beat on the PRA and you hurt a few people.

14 (Laughter.)

15 I don't understand that. Explain to me

16 why the incompleteness issue is more serious in the

17 PRA than in the other --

18 MEMBER POWERS: It's just so uncertain,

19 George.

20 MEMBER APOSTOLAKIS: What?

21 MEMBER POWERS: It's just so uncertain.

22 It's all very speculative.

23 (Laughter.)

24 MEMBER WALLIS: No, it's not. The PRA is

25 integrated with the design, and it --

1 MEMBER POWERS: Yes. But at least it's a
2 systematic search for things that can go wrong.
3 MEMBER KRESS: I think we've gotten off
4 the track.
5 MS. DROUIN: We're done.
6 MEMBER KRESS: You're done?
7 MS. DROUIN: We're finished.
8 MEMBER KRESS: Do you expect a letter from
9 us on this? Because I'm thinking about writing one.
10 But I --
11 MS. DROUIN: I will defer that to Eileen.
12 MS. McKENNA: Well, I think if you go back
13 to our first slide, we had indicated we were providing
14 it for the Committee's information. Obviously, the
15 Committee can do what it chooses, but we're not
16 specifically asking --
17 MEMBER WALLIS: Your bottom line is --
18 MEMBER KRESS: We would write one if we
19 were supportive.
20 (Laughter.)
21 MEMBER APOSTOLAKIS: No, no.
22 MEMBER WALLIS: Everybody said the bottom
23 line --
24 PARTICIPANT: Well, your last letter was
25 supportive, right?

1 MEMBER KRESS: Well, of course it was.
2 Yes. Yes.
3 MEMBER APOSTOLAKIS: If you have momentum
4 that way, yes, keep writing them.
5 MEMBER KRESS: Okay.
6 MEMBER ABDEL-KHALIK: Really, back to the
7 two requirements together, the implication is that
8 you're going to use current Part 50 to license one of
9 these machines, and then go back and reexamine this
10 technology-neutral framework.
11 MR. BIRMINGHAM: Kind of do it in parallel
12 with the licensing process and apply them as they went
13 along, so we, you know, would have an opportunity
14 maybe to request additional information. I don't know
15 if you could do it to -- you could do it at least --
16 MEMBER KRESS: A recommendation on defense
17 in depth or --
18 MEMBER ABDEL-KHALIK: It seemed to me when
19 I read this -- implied that you're going to do them in
20 sequence rather than in parallel.
21 MS. DROUIN: The licensing strategy is --
22 the licensing strategy -- whatever is decided on the
23 licensing strategy -- and right now there has been no
24 decision made on the licensing strategy. There is a
25 working group that has been put together with DOE and

1 NRC that is developing this licensing strategy.

2 It is the results of that licensing

3 strategy is what we will use to determine, you know,

4 if and how we should move forward.

5 MEMBER WALLIS: How does an applicant know

6 what to submit if he doesn't know what the strategy

7 for licensing is?

8 MR. STUTZKE: Okay.

9 MEMBER ARMIJO: Well, the PBMR people have

10 very clear guidance, right?

11 MEMBER WALLIS: Looked just like the

12 framework. They were sort of copying the framework

13 and --

14 MEMBER KRESS: No. I think they came

15 before the framework. But I think at this time, Mr.

16 Chairman, I'll turn it back to you.

17 MEMBER APOSTOLAKIS: Very good.

18 MEMBER KRESS: And I'd like to thank the

19 staff for a very interesting -- we'll have an

20 interesting discussion this afternoon.

21 CHAIRMAN SHACK: We'll adjourn for lunch

22 until --

23 MEMBER WALLIS: What's this training we

24 have to have?

25 MEMBER KRESS: That's tomorrow.

1 CHAIRMAN SHACK: That's tomorrow.

2 PARTICIPANT: Mr. Chairman, when do you

3 want us back?

4 MEMBER APOSTOLAKIS: 1:15, right?

5 CHAIRMAN SHACK: 1:15.

6 (Whereupon, at 12:05 p.m., the

7 proceedings in the foregoing matter

8 recessed for lunch.)

9 CHAIRMAN SHACK: It'S time to come back

10 into session. Our next topic is the Status of

11 Development of an Integrated Long-term Regulatory

12 Research Plan and Dr. Powers is going to be taking us

13 through this.

14 MEMBER POWERS: I guess -- I hope all the

15 members are aware that ACRS every other year, writes

16 a report on the NRC's Research Program. Those of you

17 that have some tenure on the Committee are aware that

18 in every one of our Research Reports we usually

19 include a paragraph or two that decries an absence of

20 longer term research and that so much of the research

21 is tied directly to issues of immediate regulatory

22 concern. And I can honestly say that our reports have

23 had some real impact since, after each one the amount

24 of longer term research seems to be curtailed a little

25 more and --

1 (Laugher)

2 -- and more of the research is focused on
3 immediate regulatory consensus. We can have some
4 confidence that that won't happen this time because I
5 don't think there's anything left to curtail. The
6 staff has, however, undertaken at the Commission's
7 request and not in response to our Research Report, an
8 effort to identify some longer term research and
9 they're here to discuss that with us. They did spend
10 a substantial fraction of yesterday talking to us
11 about what they had found in their efforts to identify
12 and I can say that the thrust of their examinations of
13 longer term research have not paralleled exactly the
14 kinds of things we were thinking about but certainly
15 a subset of them.

16 They have identified -- established some
17 criteria and identified some areas of research and
18 prepared a list of candidate research topics that have
19 yet to be prioritized but presumably would be.
20 Yesterday, we spent, as I said, the substantial
21 portion of the day just going through the list.
22 They've not developed any of these research topics
23 aside from the identification. And clearly they
24 cannot go through in that detail.

25 So we've asked them to provide a synoptic

1 account of both the processes they went through and
2 describe not each one of the research activities but
3 to give us some illustrative examples. So I'm sure
4 that they are prepared to answer questions on any of
5 the topics. You will get the complete list of topics
6 but their prepared comments will be on just a subset
7 of those. And with that, do I turn to you, Brian?
8 MR. SHERON: Yeah, I'll give some
9 introductory remarks. I'm Brian Sheron, Director of
10 the Office of Nuclear Regulatory Research. And first
11 I want to thank you for letting us be here today to
12 talk about this. For those of you that were here
13 yesterday, you'll probably hear something that sounds
14 a little similar but basically this was started -- I
15 had one of my periodics with the Chairman and he asked
16 me what the office was doing looking towards the
17 future and, of course, you know, I think our planning
18 horizon was basically the next three years which is
19 our budget cycle. And I explained what we were doing
20 and he said, "No," he says, "I'm talking about like
21 five, 10, 15 years from now, what challenges will this
22 agency be faced with and what are we doing to prepare
23 to meet that challenge".
24 And I said, "You know, we really hadn't
25 thought about it and really hadn't planned out that

1 far". And you know, I said that, "Had I done this
2 five years ago, I'd be planning for decommissioning
3 today". Things change and the like. And he
4 recognized that but he -- you know, he felt that we
5 should be -- he's a very -- I'll be quite honest.
6 He's a strategic thinker. He thinks the Commission
7 should be looking, you know, five, 10 years out to see
8 where we ought to be and I think he feels that the
9 Office of Research should be at least looking to see
10 what do we need to be prepared to deal with in the
11 long-term.
12 And so I took that as a challenge and said
13 that we would take a long look. He also was very
14 interested in providing. I think that's one of the --
15 to answer Dana's concern. You know, one of our
16 problems has always been that you know, when we focus
17 on the immediate needs, it pretty much eats up most of
18 the funding and the like. I don't think there's any
19 reluctance on the part of the Office to want to do
20 this longer term research. It's just been a matter of
21 priorities.
22 But anyway, we undertook this effort and
23 I asked Christiana Lui who is the Deputy Director
24 under Farouk Eltawila in DRASP, I asked her if she
25 would head this up and actually kind of took her out

1 of her job and made this a special assignment. We let
2 an SES Candidate Development Program individual come
3 in and act for her in her normal job. And Chris has
4 had the able of the staff here. Nathan Siu, Don
5 Helton and I guess -- is Rob here?
6 MS. LUI: Rob will join us shortly.
7 MR. SHERON: Okay, and Rob Tregoning
8 provided a substantial part of the help but I do want
9 to give credit to the rest of the research staff. One
10 thing I wanted to do was to get their collective
11 thinking on this. So I issued an e-mail to the entire
12 staff, soliciting their ideas on what areas we might
13 be looking at for long-term planning. And again, I'm
14 looking in the five, 10, 15-year range.
15 We also engaged the other offices within
16 the NRC to provide us with any candidates that they
17 had that they were foreseeing would be needed. We
18 were on kind of a tight schedule. I think the
19 Chairman, when he said it, I expected probably
20 something in a few weeks. We took a hard look at what
21 we could produce and we decided that to at least start
22 this, we would do a two-phrased approach. The first
23 was to try and get a package to the Commission by the
24 end of February. We missed that by a few weeks but
25 that was our goal. And really what we could do in

1 that short period of time, considering this started
2 right around the middle of December, so the first
3 thing you do is you write off the second half of
4 December because of holidays, which means you really
5 can't start into this until the beginning of January
6 and then when you look at concurrence chains, you
7 know, as I said, Chris had few negative days to
8 produce this report basically when you backed off.
9 But what we did is we wanted to first just
10 have an internal report based on what we found out,
11 what we could predict from the Office of Research as
12 well as the other program offices. And the idea was
13 to send that up to the Commission and also to use that
14 as at least a first shot as a planning wedge for
15 putting money in the budget in our '09 request for
16 this work. The Chairman did not want to go in with
17 just a blanket, you know, "Give me 5 of give me $10
18 million and don't worry, I'll do something good with
19 it." He wanted to have something concrete that we
20 could point to and say, you know, "We're requesting
21 this amount of money in the budget for this work", and
22 we would have at least something where we could point
23 to and say, "And these are the specific things that we
24 want to do."
25 The second step was once we sent this

1 initial cut of the report up to the Commission, would
2 be to engage other stakeholders which includes the
3 ACRS, industry, National Laboratories, universities,
4 foreign partners, and the like and to get their
5 insights on either if they think we're on the right
6 track, if there's things that we've missed, if we're
7 not focusing on the right stuff. We want to finish
8 that report, the second one by around July. I think
9 the end of July is our goal. And I want to emphasize
10 that this is a work in progress. This is a report t
11 that we think will be updated every year and used as
12 part of our planning for the budget process for the
13 coming year. So what we've identified is certainly
14 not cast in concrete in any way, shape or form.
15 We're looking for other input. If there
16 is work that turns out to be let me say higher
17 priority or appears to be more important, I think we
18 can make adjustments to work on that and perhaps, you
19 know, work on other things with a lower priority. But
20 that's our plan right now. We would very much value -
21 - I know that the commission, I sat through the last
22 ACRS meeting with the Commission and I think you all
23 had a request from the Commission to look and identify
24 long-term research. So, I hope may this helps you a
25 bit in terms of at least giving you, you know, a stack

1 of many to start with, but we certainly value your
2 input in terms of any suggestions or comments you have
3 on the report. You know, and to the extent that we
4 can get them included in this next version or even in
5 the following years, we would like, you know, to
6 dialogue with the committee on this.
7 I'm going to turn it over to Chris now.
8 Just, I have a 2:00 o'clock meeting, so I can probably
9 stay for about another 30 minutes or so. So if you
10 have any questions or you want to beat up on me,
11 you've got about 30 minutes and I'll give you that
12 opportunity. Otherwise, I'll turn it over to Chris.
13 MEMBER POWERS: Please go ahead, Chris.
14 DR. BANERJEE: Can we beat up on you while
15 talking to Chris?
16 MR. SHERON: Sure.
17 (Laughter)
18 MS. LUI: Good afternoon. My name is
19 Christiana Lui and I'm the Deputy Director for New
20 Reactor and Computational Analysis and I'm currently
21 on special assignment to lead in the development of
22 the long-term research plan as Brian has indicated,
23 and my team members are Nathan Siu, who is sitting on
24 my right-hand side. He's the senior level advisor for
25 PRA and Don Helton, he's the reactor assistance

1 engineer and also Rob Tregoning. He's going to be
2 joining us shortly. He's the senior level advisor for
3 materials.
4 I'll lead off this part of the
5 presentation by providing an overview and based on
6 like Dr. Powers introductory remark, based on
7 subcommittee's input yesterday, Nathan, Don and Rob
8 will go through sample technical topics identifying
9 the current version of the long-term research plan
10 later on.
11 We have set out to develop an agency-wide
12 long-term regulatory research plan that will focus on
13 new program areas and any emerging technology that my
14 have inter-nuclear applications as Brian has
15 indicated, that we're looking at a horizon of five, 10
16 or 15 years from now. And currently the plan is being
17 written at a level supporting budget formulation, so
18 it's a relatively high level description and also we
19 like to use this plan as a communication tool to other
20 regarding where we're going and the type of work that
21 we are looking at and the potential resource needs.
22 And as Brian has indicated also that we
23 intend to keep this as a living document that will be
24 updated periodically to incorporate new information
25 and also any kind of direction change based on the

1 industry, based on directions from the Commission and
2 based on other input that we receive along that way.
3 Yesterday we had a lot of discussion, we
4 tried to clarify the scope of the report. This
5 particular report focuses on anticipated future needs
6 which are not currently identified in other NRC
7 planning documents. For example, in the Office of
8 Nuclear Regulatory Research, we have operating plan.
9 An operating plan is really the master document that
10 lay out all the plan work. And we have research
11 ongoing in a lot of different technical areas such as
12 human factors, fire, instrumentation and control,
13 thermal hydraulics, severe accident, materials, PRA,
14 neutronics, radiation protection, environmental
15 assessment, structural, nuclear fuel and security.
16 And research plans currently exist for
17 certain topic area research program. A separate
18 research plan do not exist for all the technical areas
19 that research is currently performing work. Most of
20 our planning documents also focus on current near-term
21 regulatory needs rather than over the horizon or
22 forward looking from like five, 10 or 15 years from
23 now, so we have set out now to duplicate the
24 information that's currently in other planning
25 documents in the agency and really focus on areas

1 where there would be -- there will be possible work
2 from five -- looking at five, 10 or 15 years from now
3 the agency might need and that we should start looking
4 into those today.
5 And the information generated by
6 interacting with the other program offices and also
7 soliciting input from research staff internally at
8 this point in time, and that's why I indicated that
9 we're in the process of, for example, coming in front
10 of the ACRS and we'll also be going in front of the
11 ACNW to solicit your input and recommendations and
12 also we will be soliciting input from the external
13 stakeholders such as industry and the National Labs
14 and universities and also international partners.
15 Here are a couple of considerations that
16 when we set out to do these particular projects, what
17 we had in mind. The plan development schedule needs
18 to support the FY 2009 budget formulation. As Brian
19 indicated we want to put a planning wedge in our FY'09
20 budget, so the time lines to make sure that we will
21 produce some input on a timely basis to at least get
22 some ideas and some detail information into the budget
23 preparation process.
24 With this initial effort, we are mapping
25 out a process where we are developing the initial

1 version and that includes who we should be talking to,
2 what time line and what we can do with the information
3 that we receive and whether that can be incorporated
4 into the FY '09 version or it can be -- or it's more
5 appropriate to be considered in the future updates.
6 Also we're keeping this as a living document and the
7 topic areas and focus within the areas can be changed
8 as new information becomes available so it's a very
9 dynamic process. And also this document where we
10 identify new and different ideas, and once a
11 particular idea become mature enough, it will be
12 incorporated into other agency documents or there will
13 be research plan by itself so that it will continue,
14 there will continue to be a list of areas that will be
15 potentially worth exploring and it's different and the
16 maturity level does not warrant a separate document at
17 this particular point in time.
18 And during the process when we were
19 developing this particular version of the report, one
20 is we are on a pretty quick turnaround time and in the
21 past couple years we have not been in a mode thinking
22 about what the agency might be needing five, 10, or 15
23 years from now. So we have gotten -- even though we
24 have gotten a fair amount of input, a lot of input
25 really focus on current and near-term needs rather

1 than really looking at -- really looking at five years
2 and beyond. So we need to get people to start getting
3 into a mode of looking at what are really the future
4 that this agency may be facing.
5 And also there are people who are kind on
6 the sidelines because they are not quite sure whether
7 this is really going to be a fruitful endeavor. So
8 the success of our current -- our current effort is
9 going to be very indicative to the others regarding
10 how the process works, how serious the agency is in
11 taking -- is really thinking about funding forward
12 looking research. And if there are positive outcomes
13 coming out from this particular initial effort, we
14 believe that it will stimulate further participation
15 from both the staff and also other program offices.
16 The next two slides give you the topical
17 areas that we have identified that's currently in this
18 version of the report and they are divided into two
19 big program areas and the test facility and also
20 cross-cutting and emerging technologies that really
21 cuts across a number of different research areas
22 within the agency. And you see that some, it might
23 not be as clear from the presentation, but if you look
24 at your handout, there are five topics that are
25 involved and those are the ones we plan to discuss

1 with you in more detail this afternoon.

2 With that said, in the slide package, you

3 do have the material that describe each of these

4 topics in a little bit more detail and they are being

5 presented in the sequence that they are in the current

6 version of the report. As Dr. Powers indicated we

7 will be able to -- we are available to answer any

8 questions even though they may not be within one of

9 the five topical areas that we're going to discuss

10 with you further.

11 The two big program areas are the DOE

12 Global Nuclear Energy Partnership and the Plan --

13 MEMBER APOSTOLAKIS: Can we go back to the

14 previous slide? Is that the previous slide?

15 MEMBER CORRADINI: I think you want the

16 first of the proposed activities?

17 MEMBER APOSTOLAKIS: Yeah. That's not the

18 previous slide. I'll wait. Number 6.

19 MEMBER CORRADINI: The next slide.

20 MEMBER APOSTOLAKIS: That's the next

21 slide?

22 MEMBER CORRADINI: I think so.

23 MEMBER APOSTOLAKIS: I'll wait until

24 you're done then.

25 MS. LUI: Okay.

1 MEMBER POWERS: George, my instruction for
2 you is to follow the presentation.
3 MEMBER APOSTOLAKIS: I'm looking ahead.
4 I'm looking at five, 10, 15 years from now.
5 (Laughter)
6 MEMBER POWERS: The answer is, no, George.
7 MEMBER APOSTOLAKIS: I just wanted to
8 provide experiential evidence that Brian was right
9 earlier.
10 MR. SHERON: Much more mellow after lunch?
11 (Laughter)
12 MS. LUI: Okay, so coming back to where I
13 was, the two big program areas that we're looking at
14 are the DOE Global Nuclear Energy Partnership because
15 we have that indication from DOE that whether they are
16 going to be seeking an NRC license or not, the
17 facility that they're going to build, if they are
18 going to go through with this particular initiative,
19 they should be NRC-licensable.
20 And the next big program area is Reactor
21 License Renewal beyond 60 years. That's based on
22 recent interaction with DOE and industry pointed that
23 there is interest in that particular big program area.
24 The next category are the test facilities that we have
25 looked at and they include -- in this particular

1 category we have two particular proposals that have
2 been put on the table. One is the integrated
3 digitalizing of machine to base research facility.
4 The next one is the integral test facility for non-
5 light water reactors.
6 The next big categories include, as I have
7 said before, cross-cutting and emerging technologies.
8 In this particular big group we are in a lot of cases
9 are going to be doing scoping analysis looking at
10 where is the state of the art and where the -- where
11 the future direction might be and the likelihood of
12 certain technologies being employed by nuclear
13 industry so that we will get ourselves in the position
14 where we have the technical basis and the analytical
15 tools to do the necessary confirmatory review.
16 And that includes advanced analytical
17 capabilities, Slide Number 6, advanced application
18 technique and the best sensor technique to monitor the
19 plant standards or the site standards, offsite
20 mitigation, strategy, a general area of
21 nanotechnology, fire modeling and risk assessment for
22 advanced reactor and fuel cycle facilities and the
23 last category, formal decision analysis and methods.
24 And with that, I would stop at this point before we go
25 into the five highlighted areas for a more detailed

1 discussion and I can entertain questions at this
2 point.
3 MEMBER APOSTOLAKIS: Why did you choose
4 those areas for discussion?
5 MEMBER CORRADINI: It's the subcommittee's
6 fault. We said they could never go through all of
7 these today, so we suggested to pick a few
8 illustrative points.
9 MS. LUI: Yeah, we tried --
10 MEMBER APOSTOLAKIS: Why do you think
11 there is a need for HRA methods for advanced
12 facilities?
13 MS. LUI: I guess we start off with
14 questions.
15 MR. SIU: Yes, this was a topic where it
16 was recognized that the general framework for
17 performing HRA, we believe, is generally enough to
18 handle HRA for a wide variety of conditions, but when
19 you start applying these methods, whatever methods
20 you're using to different facilities with different
21 characteristics, then you start -- you have to look
22 and see whether those methods actually apply with the
23 underlying assumptions for the typical applications
24 you're making are appropriate for the new situation.
25 So if you're talking about new human

1 machine interfaces, if you're talking about new
2 processes or kinds of actions. Recovery actions can
3 be very different across these facilities. So it
4 wasn't to say that we would develop methods. Again,
5 as Chris indicated, there's a lot of scoping studies
6 here. We would be looking at the methods that we have
7 available, looking at the issues that arise associated
8 with new facilities and see if developments are
9 needed, that was the essence of the proposal.
10 MEMBER APOSTOLAKIS: Well, I guess the way
11 I look at this is, you know, you want to have some
12 capability to anticipate the issues not in the very
13 near future. If the issue arises and you have say a
14 gas-cooled reactor has different kind of requirements,
15 it will probably be handled when the situation arises.
16 I mean, it's not something it seems to me
17 that you have to worry about as a long-term issue. In
18 other words, I'm bringing up the criterion of --
19 MR. SIU: Understood, yeah.
20 MEMBER APOSTOLAKIS: -- whether something
21 enhances the capability of the staff in general, in
22 disciplines versus things that, yeah, they may happen
23 three years from now but if they happen, we'll take
24 action. There will be an NRR request or something so
25 I don't have to worry about it now.

1 MR. SIU: It's possible that could happen.
2 I guess looking at the history of how long it's taken
3 sometimes to address issues in this area, it's
4 obviously a challenging area, you well know.
5 MEMBER APOSTOLAKIS: I mean, you're going
6 to prioritize these at some point.
7 MR. SIU: Yeah, there's going to be a
8 prioritization but, yeah, this was put in partly
9 because we recognize sometimes it takes a long time to
10 address HRA and some of the more challenging PRA
11 issues. So if we waited until the point where we have
12 a design document we have to pass judgment on and then
13 we say, "Oh, my goodness, the tools we use aren't good
14 enough", that may be too late.
15 MEMBER APOSTOLAKIS: Advanced quantitative
16 risk methods, what exactly --
17 MR. SIU: We'll talk to that.
18 MEMBER APOSTOLAKIS: Yeah, we'll talk to
19 that. Now, how many decisions does the Agency make
20 every day, quite a few? Shouldn't this formal
21 decision thing be a high priority?
22 MR. SIU: Well, it's on the list. We
23 just, again, for purpose of discussion today, we were
24 going to limit our discussion, but it's in the report.
25 We have view graphs and will be happy to talk to that.

1 Maybe after we finish the other ones first.

2 MEMBER APOSTOLAKIS: And our of curiosity,

3 why do you care about advanced fabrication techniques?

4 What is the regulatory impact of that?

5 MR. HELTON: I think that's another one

6 we're going to highlight today, so --

7 MEMBER APOSTOLAKIS: But can you tell me

8 why you care?

9 MEMBER POWERS: Why don't you wait till

10 they get to the presentation?

11 MEMBER APOSTOLAKIS: All right.

12 DR. BANERJEE: I want to ask a more

13 general question. I understand the motivation, I

14 don't know what the Commission or the Chairman wanted

15 but what is your motivation, Brian, Chris, behind

16 this? Do you see -- let me say what's in my mind --

17 that you want to maintain a certain level of expertise

18 and science going on in areas that potentially might

19 be of importance, so you can react whatever the

20 requirement is, because very rarely is research going

21 to be done that will ever be directly applicable to

22 something in the long-term?

23 So is it capability you're trying to

24 maintain? What is it you're trying to do actually?

25 MR. SHERON: What we're trying to do is

1 anticipate where the industry may be heading in
2 certain areas. For example, digital I&C, Jack Grobe
3 has a task force going on right now and they're
4 scrambling to try and come up with criteria that the
5 industry can use because what we had in place the
6 industry did not want to follow for whatever reason
7 and we were not prepared to be able to sign off and
8 say whether or not what they were proposing was
9 adequate or not.
10 The industry really hasn't provided you
11 know, enough -- now you can argue and say, "Well, the
12 industry needs to justify", okay, but we need to get
13 ahead of the curve, okay? Material degradation is
14 another one. You know the years I spent in NRR was
15 always playing catch-up. Every day you came in you
16 found some -- you know, it was almost scary. You
17 know, what are they going to find today, type of deal,
18 as opposed to trying to get out ahead and say, you
19 know, where can I expect to find failures, okay?
20 As I said, you know, we're trying to do
21 like Inconel 690 and do accelerated aging and find out
22 is this stuff going to crack down the road? You know,
23 the industry is putting it in, they're telling us
24 it's, you know, the big savior. You know, it's a
25 tough material. We don't know where we're going to be

1 30 years from now. It's stuff like that, trying to
2 say, "Where do I have to be". Control rooms, digital
3 control rooms, if you see some of these pictures of
4 where control rooms are going to go, you know, from
5 these panels with annunciators and switches and all
6 this stuff to a screen.
7 You know, and the question is, you know,
8 what are the failure modes that we have to worry
9 about, okay. As Nathan was saying, what's the human -
10 - you know, the human performance element in there?
11 How do they respond, how do operators respond. So
12 these are things that we see coming -- or we think
13 we're going to see coming down the road and what we
14 want to do is get the agency position so we're not
15 playing catch-up.
16 In other words, when the industry shows up
17 with it, we want to be ahead of the game, we want to
18 at least be where we have knowledge of what they're
19 proposing, that we've done some work in the area, that
20 we may have guidance out there, you know, as opposed
21 to going, "Oh, my goodness, we've got to go learn
22 about this and make it up on the fly".
23 DR. BANERJEE: Right, but my point was --
24 sure that can be one motivation but at the deepest
25 level, you're trying to maintain your expertise so

1 that some unexpected thing comes along, not so
2 unexpected, say like sumps being blocked or something,
3 that you have the capability to react to it so that
4 you know, today, for example, we can't calculate how
5 much of the suspension drops out on the way to the
6 screen or something. But if you had the capability in
7 this sort of area, you could react fairly quickly and
8 be able to deal with that issue and help in the
9 confirmatory analysis that comes along.
10 MR. SHERON: Well, yeah, but the point is,
11 has the industry even proposed --
12 DR. BANERJEE: They haven't.
13 MR. SHERON: No, yeah, and I would -- you
14 know, and I'm not trying to point fingers to NRR but
15 I'm saying is that if the regulator doesn't need the
16 information in order to make a safety decision, okay,
17 I don't see why we have to go off and develop a
18 complete external program to --
19 DR. BANERJEE: Yeah, but that's shock
20 them.
21 MR. SHERON: Yeah.
22 DR. BANERJEE: I'm talking of something
23 where you choose disciplinary areas which potentially
24 have impact in the long term. There could be some
25 representative cases in each where you can see

1 potential applications but about 50 percent of the
2 time you're not going to really foresee what's going
3 to happen. So you have to just have the capability,
4 Panzer troops to go where they're needed, but you need
5 that tanks. You know, without them you're done.
6 So if you're like holding the Maginot Line
7 or something, it's -- yeah.
8 MR. SHERON: Yeah, I mean, the other
9 things we're trying to and I emphasize that, you know,
10 we do confirmatory research. It's not our job to
11 solve the industry's problems. You know part of it is
12 to just look and see where are there potential
13 problems, right, and to identify those early on to the
14 industry, so the industry can start to take action.
15 If they know where the NRC is going to have
16 difficulties and problems and if we can articulate
17 those clearly early on, then they can start and put in
18 place the appropriate research or development programs
19 that they need to provide the information to the NRC
20 when the time comes.
21 So to me that's another aspect of this
22 work we're doing. It's not necessarily to solve
23 industry's problems, but to just identify where are
24 there potential problems in these areas that are being
25 talked about, where are the hard spots that we're

1 liable to have difficulty with, okay. And then we can
2 engage with the industry and say, "These are areas
3 you're going to have to address if and when you come
4 in with this, you know, five years or 10 years down
5 the road".
6 We may decide to do our own confirmatory
7 research just to learn about it more, okay, but the
8 expectation is that the industry would be still
9 responsible for developing the technology.
10 DR. BANERJEE: Sure, of course. Because
11 I'm really looking for motivation but maybe --
12 MEMBER APOSTOLAKIS: Let's take an example
13 of what happened recently and see if you had this five
14 years ago what your response would have been. I think
15 it was Clinton that came in for an early site permit
16 and they had their new seismic analysis. Is that
17 Clinton?
18 MR. SHERON: Yeah.
19 MEMBER APOSTOLAKIS: And that seismic
20 analysis was new to the staff. It was done by some
21 distinguished people from the industry side and my
22 understanding is that eventually the NRC asked the
23 utility to go back and do a traditional analysis if
24 they wanted an answer any time soon, correct? That's
25 what the Chairman told me Monday.

1 MR. SHERON: Yes.

2 MEMBER APOSTOLAKIS: What would have been
3 different if you had done this five years ago? Would
4 you have been ready to review something like this
5 quickly and not be surprised or -- I mean, how would
6 things be different? That was a new methodology for
7 dealing with an issue that we know is there.

8 MR. SHERON: Well, if we knew that the
9 industry, for example, was developing a new
10 methodology -- in other words, a lot of this has to be
11 corroborative, okay. In other words, I can't foresee
12 what the industry is going to do if we don't know
13 where they're coming from, okay?

14 I mean, I would expect that if the
15 industry had a new methodology that they were working
16 on, one of the things we'd like to know is, "What are
17 you working on". You know, I would ask EPRI. "What
18 are the things you want, do you think you're going to
19 be coming in with in the next five years"? Okay,
20 they're doing a lot of work in NDE, underwater
21 welding, stuff like that, okay. I'd like to
22 understand, you know, is there going to be a proposal
23 coming in five years down to road, okay, or do you
24 expect one.

25 If they can give us that information, you

1 know, just like a seismic analysis method, okay, then,
2 yes, we can say, "Yes, we need to start and learn
3 about that". We need to understand it. We need to do
4 our own work. We need to be prepared so when they
5 come in, we don't sit there and say it's going to take
6 us three years to review this, to understand it and
7 review it and the like", and you know, "If you really
8 want something in the sort term, you're going to have
9 to go back and do it the conventional way".
10 MEMBER APOSTOLAKIS: But you don't know
11 now that the industry is working on these issues here,
12 right? No, you're just developing a list based on
13 what your --
14 MR. SHERON: Well, this is the
15 anticipation.
16 MEMBER APOSTOLAKIS: Yeah.
17 MR. SHERON: And like I think I said
18 yesterday is that as we look through these issues
19 during our first cut, we may find out that there's
20 nothing there. We may conclude, for example, on fiber
21 optics, you know, if the industry isn't going to move
22 towards fiber optics, then we may say, "There's really
23 no need to do any work on fire modeling at this time".
24 MR. SEXTON: I suspect this comes down to
25 maintaining really expertise, cutting edge expertise

1 in certain key areas, so you will have the flexibility
2 to move into you know, these new projects and new
3 developments easy and handle them very quickly. In my
4 mind, it comes down to this issue we've discussed in
5 the past about core competencies and how to do it.
6 MR. SHERON: Well, I think it's a little
7 more than that?
8 MEMBER APOSTOLAKIS: Huh?
9 MR. SHERON: It's a little more than that.
10 MEMBER APOSTOLAKIS: I'm sure it is.
11 MR. SHERON: We're trying to look a little
12 bit beyond the horizon, you know, and right now, I
13 don't think we're really pushing that, okay, but the
14 idea is to push that a little bit more and to see
15 what's coming down the road and to say, "What do we
16 need to do? Is there anything we should be doing to
17 prepare ourselves"? That's all.
18 MR. SIU: If I may, George, just a point
19 of clarification; in most of these areas actually we
20 do have a good idea where industry is going. We've
21 been in communication with them. Many of these topics
22 you'll see in the discussion. There is an industry
23 element to the proposal. So hopefully we're not just
24 guessing where things are heading.
25 MEMBER ARMIJO: Can this problem be

1 approached from a disciplinary perspective rather than
2 from an application perspective?
3 MEMBER APOSTOLAKIS: That's where I was
4 going.
5 DR. BANERJEE: Or a matrix perspective.
6 MR. SHERON: Sure.
7 MEMBER APOSTOLAKIS: Ultimately what
8 matters is the disciplines.
9 MR. SIU: Yeah, actually, what you're
10 seeing, the product, the initial version did start
11 from a discipline viewpoint. It got narrowed down to
12 a relatively small group and so it was organized in
13 this particular way but the points about the matrix
14 we've heard yesterday for example, as a presentation
15 tool, is something that I think we could use. But
16 actually, there was an effort to identify disciplines
17 and activities in the different disciplinary areas and
18 Chris actually mentioned some of these in her opening
19 remarks today.
20 MEMBER ARMIJO: Wouldn't that be much more
21 valuable in terms of, you know, long-term impact of
22 whatever you're doing? You're essentially developing
23 and maintaining expertise in specific disciplinary
24 areas?
25 MEMBER APOSTOLAKIS: I see it as a

1 complication of things. It seems to my by doing this
2 you are also identifying the disciplines where you
3 need to have expertise, so it's a back and forth.
4 MS. LUI: Correct. I mean, there are --
5 I mean, yesterday during our discussion with the
6 subcommittee, we did talk about organization of
7 information is challenge because on one hand, we want
8 to do that, because seldom we're dealing with a
9 particular issue that only involves on discipline. So
10 it's always multi-discipline involvement. And so
11 we're looking at the bottom line, what particular
12 issue that we're really trying to resolve and look at
13 what technical expertise that we need and then we can
14 go down to a level of detail where, okay, what
15 particular discipline needs to focus on what.
16 So in this particular case, we have chosen
17 a mixture presentation and one is a reflection of the
18 status of integration among the various technical
19 issues and also -- it's also a reflection of the
20 awareness that the various technical discipline does
21 exist and we need to maintain the field capability and
22 the tools in order to analyze the situation that we
23 believe we may be facing in five years or beyond.
24 DR. BANERJEE: Chris, what would be
25 helpful, I think at least to me, I don't know about

1 others, would have been if let's say on one side you
2 have the projects, on the other side you have the
3 disciplines, yeah, more or less like that, so that we
4 understand which are the areas which are most in
5 demand. So imagine that you take any one of these
6 project, say fire modeling or something, so this
7 involves that you have understanding of chemistry,
8 fluid mechanics, you know, some materials problems, so
9 maybe two or three areas are identified.
10 And then for something else you may have
11 probabilistic, whatever that field is called, I'm not
12 sure but, you know, you have a number of areas. So in
13 the end, you end up using these disciplines for each
14 of these projects. You're really identifying a set of
15 core disciplines which you need to have competence in.
16 Say the vibrations which break of these
17 seam dryers, you need to have materials, fluid
18 dynamics, acousics whatever.
19 MEMBER WALLIS: Are these competencies
20 within the agency or a subcontractor? Are you going
21 to subcontract some of this stuff?
22 MEMBER CORRADINI: It would be a
23 combination of both. It was just like when we were
24 talking about yesterday that they would have certain -
25 -

1 MEMBER WALLIS: I think what Sanjoy was
2 talking about, there seems to be something unique to
3 have within the agency.
4 MEMBER CORRADINI: But they would probably
5 be --
6 DR. BANERJEE: They have to manage this.
7 MEMBER WALLIS: You could always buy
8 something outside.
9 MEMBER POWERS: Well, there are cases
10 where you cannot and we have spoken to that many times
11 in our report. I think at this point, it's somewhat
12 useful for them to go ahead and go through their
13 examples and we can come back to the philosophical
14 approach. Now, what we did at the subcommittee is we
15 spent a little while going through these things and
16 eventually we said, "Okay, fair enough, the staff has
17 taken their approach and we will accept their approach
18 for what it is and comment on that", because we are
19 under the monkey to comment on long-term research
20 ourselves, independently of the staff and we'll do so
21 as part of our research report.
22 And so in the spirit of diversity and
23 response perhaps makes the chairman happier, I think
24 the staff should go ahead and present their look at
25 the elephant here and some examples of their look.

1 MS. LUI: Okay, so the very first example
2 that we have chosen to present and discuss in more
3 detail today is the license renewal beyond 60 years
4 and that would be Slide Number 10 in your package.
5 MR. TREGONING: I'm Rob Tregoning from the
6 Office of Research and I'm going to be talking about
7 the reactor license renewal beyond 60 years. A little
8 bit of background on this, this was a topic that,
9 again, was kicked around informally within the agency
10 for some time. There's been even some informal
11 discussions with the industry but actually we got some
12 major impetus around December when DOE came to us at
13 a senior management meeting and actually raised this
14 as a topic for potential mutual collaboration.
15 So at that time it raised it on our radar
16 screen as well as the radar screen of a lot of senior
17 management as something that was starting to look more
18 real. So from that perspective and the fact that this
19 would be a program area, potentially a major program
20 area, in fact it already is. License renewal is a
21 major program area already at the NRC, it was
22 something that --
23 MEMBER APOSTOLAKIS: What is, going beyond
24 60 years? Is that what you're calling major? Did I
25 miss something?

1 MR. TREGONING: We have license renewal
2 now that takes it up to 6- years.
3 MEMBER APOSTOLAKIS: License renewal, yes.
4 MR. TREGONING: This is talking about
5 beyond 60 years. So the objective of this work would
6 be to evaluate and update as necessary, the technical
7 basis for supporting the evaluation of possible
8 requests for license renewal beyond 60 years. Some of
9 the background we know to support the first round of
10 license renewal which we're currently really in the
11 midst of now, many of the plants have made very
12 significant modifications to their safety-related SSCs
13 or System Structures and Components. So that in and
14 of itself, does provide some impetus or impetus for
15 license renewal.
16 There are two regulatory statutes which
17 govern license renewal, 10 CFR 54 governs the safety
18 issues and 10 CFR 51 the environmental issues. There
19 are no regulatory limits in either of those which
20 preclude renewal or extension beyond 60 years. So
21 there's no regulatory impediment to it currently at
22 all. And I mention this informal DOE inquiry that we
23 got back in December about possible collaboration.
24 Now, since that time, we've actually -- we've had a
25 meeting with DOE in the spring where we discussed a

1 path forward.

2 Gene Carpenter is here and he's actually
3 the staff POC on this issue and what they've decided
4 at least in the near-term is DOE is going to be
5 meeting with the industry in the spring of this year.
6 They're going to be gauging intent as well as
7 evaluating some of the potential technical and
8 regulatory hurdles that exist and then after that,
9 there's going to be a determination and a working
10 group formed between DOE and NRC on proceeding jointly
11 with resolving some of the issues that are raised.
12 There's also a workshop scheduled for June where some
13 of the various aging issues are going to be raised.

14 And I think I mentioned the statutory
15 things that governed the license renewal. In terms of
16 technical basis, there's two prime reports. There's
17 the GALL report and the GEIS report and I know the
18 committee is familiar with both of those. GALL is the
19 Generic Agings Lessons Learned report. It governs the
20 maintenance programs and the management of aging that
21 the licensees have to demonstrate in their renewal
22 applications their upholding.

23 And then the GEIS, the Generic
24 Environmental Impact Statement, there are
25 supplementals to the GEIS report for every plant that

1 comes in that has their Environmental Impact
2 Statement. Next slide, please. So the uses of the
3 research would be to support modifications to the GALL
4 and GEIS documents as needed so that we have a
5 technical basis for extending the licenses beyond 60
6 years. And there might be some necessary compensatory
7 changes to related SRPs and reg guides to support that
8 but again the main focus is going to be at least
9 initially on the information that's in the GALL and
10 GEIS documents.
11 MEMBER WALLIS: These were subcontracted,
12 weren't they?
13 MR. TREGONING: I'm sorry?
14 MEMBER WALLIS: GALL was subcontracted
15 out?
16 MR. TREGONING: You know, I was not here
17 when GALL was done. I mean, there were aspects of
18 GALL that were certainly subcontracted out. I don't
19 know that the whole -- and Bill might be able to
20 answer. I -- the whole report wasn't subcontracted
21 out, was it?
22 MEMBER WALLIS: The whole thing was.
23 CHAIRMAN SHACK: Well, large chunks of it
24 were but, I mean, it was subcontracted, but it was a
25 very close interaction between staff and --

1 MR. TREGONING: Yeah.

2 MEMBER POWERS: Yeah, I would say that it
3 was much more of a staff product than a --

4 MR. TREGONING: The final product was,
5 yes, it was an accumulation of many of these sub-
6 projects.

7 MEMBER POWERS: It was an accumulation.
8 Thee are others that I would say, you know, was a
9 contractor product, but this I recall was a staff
10 product.

11 CHAIRMAN SHACK: Well, even piece by
12 piece, it varied in the level of which was done by the
13 contractor and which was done by us, but overall the
14 whole thing got -- I mean, it is an agency product
15 when you're all done because you know, the first draft
16 doesn't look anything like the current one.

17 MEMBER APOSTOLAKIS: But some of these
18 subcontractors are really an extension of the staff.
19 I mean, that's essentially what happens. They are
20 working with the staff for years.

21 DR. BANERJEE: You mean the National
22 Labs.

23 MEMBER APOSTOLAKIS: Yeah, yeah, the
24 universities don't have that fortune.

25 DR. BANERJEE: We've got misfortune.

1 MR. TREGONING: GALL itself is NUREG-1801.
2 So by that definition, it's a staff product.
3 DR. BANERJEE: Let me ask you, Rob, are
4 there really some fundamental issues that have to be
5 resolved in order to get to this 60 years, beyond 60
6 years, something fundamental about materials or some
7 understanding that we need?
8 MR. TREGONING: Well, there's nothing
9 fundamental that happens at 60 years plus one day.
10 DR. BANERJEE: No, but I'm talking about
11 qualitative changes, something happens?
12 MR. TREGONING: No, there's no -- you
13 know, aging of materials and other components is much
14 like aging of biological systems in that, you know, it
15 goes on and it can go on under the surface and then,
16 you know, things happen.
17 DR. BANERJEE: Hard to live beyond 100
18 years though, correct?
19 MR. TREGONING: Well, but --
20 MEMBER APOSTOLAKIS: The real question is
21 in this sub-bullet where it says, "Conduct scoping
22 study", I guess Sanjoy is trying to anticipate what
23 the study result --
24 DR. BANERJEE: I understand, you know,
25 there are some really exciting things.

1 MEMBER APOSTOLAKIS: Will there be -- I
2 mean, it's conceivable that after you do the scoping
3 study, you decide that the expertise basically exists,
4 so you don't need a research program.
5 MR. TREGONING: That's true.
6 MEMBER APOSTOLAKIS: Because everything
7 else like updating the SRP and so on, that can be done
8 when they issue a license.
9 DR. BANERJEE: So why did you select to
10 present this?
11 MR. TREGONING: There are some potential
12 things out there for -- we know -- and again, I
13 wouldn't call these new but some of the things and
14 some of the decisions that we made for the current
15 round of license renewal, we -- there were
16 conservative design and evaluation assumptions that
17 were still appropriate for 60 years. However, going
18 to 80 years they may not be appropriate and the
19 example I gave yesterday were a lot of the cumulative
20 usage factors for fatigue that have to be assumed in
21 the evaluation of components.
22 Now, in many cases, we were able to get
23 away with a very conservative analysis and it was okay
24 for 60 years. We may not be able to get away with
25 that same analysis for 80 years. So we'll need some

1 technical basis for demonstrating that at least
2 generically a slightly less conservative evaluation
3 would still be acceptable. So that's one example.
4 MEMBER APOSTOLAKIS: Assume now that you
5 find that from the scientific point of view there
6 aren't really any major challenges, but there will be
7 a lot of work updating the SRP, the goal and so on and
8 so on. If the agency decides to do that, which of
9 course, at some point it would have to, I hope that
10 that effort will not be part of this long-term
11 research.
12 MR. TREGONING: No, this is --
13 MEMBER APOSTOLAKIS: It would have to be
14 moved somewhere else as an agency need. Unless there
15 is a real technical issue here, this should not get
16 any resources.
17 DR. BANERJEE: Yeah, well, I was thinking
18 of his example of the human aging, well, obviously,
19 people are looking at the mechanisms which govern, you
20 know, the cell life cycle. There would be fundamental
21 issues there which lead you to understand why a cell
22 dies, why it lives, why it regenerates, the genetic
23 code that makes it happen and stuff like that. Are
24 there issues like that here that are required to be
25 elucidated or are there not?

1 MR. TREGONING: Yeah, and maybe I'll want
2 to stop with the biological analysis. Maybe that
3 wasn't a good analogy because that's a much more
4 complicated. Usually your analogies are supposed to
5 be simplifying analogies. I would say in that case I
6 probably erred but we certainly know that, again, with
7 many of these mechanisms -- we certainly know with
8 many of the corrosion mechanisms that they're driven
9 by, you know, usually three components; time, stress
10 and environment, right.
11 And we have a pretty good understanding of
12 many of these mechanisms as to what thresholds are.
13 However, we've been surprised quite often. PWSCC is
14 a good example in that you know, most of our -- you
15 know, PWSCC we have a lot of good laboratory data
16 talking about the temperature sensitivity of PWSCC
17 which is largely true. However, that doesn't mean
18 that lower temperature environments can't also lead to
19 that same sort of degradation.
20 And we've actually started seeing those in
21 some cases sooner than we may have anticipated. So,
22 you know, we have a lot of knowledge in this areas.
23 We're continuing to accumulate knowledge.
24 DR. BANERJEE: Rob, I was giving you a
25 lead-in. You should have said we need meso-scale and

1 MD simulations to better understand what's going on.
2 MR. TREGONING: You know, I'm an
3 engineering first. I think we can do things -- I
4 think we're developing a basis for this but I still
5 think we need to evaluate what additional work, if
6 any, maybe required.
7 MEMBER MAYNARD: I do think this --
8 MEMBER POWERS: If we have any hope of
9 getting through five, you might want to move on.
10 You're being way too slow.
11 MS. LUI: Okay.
12 MEMBER APOSTOLAKIS: Otto.
13 MEMBER MAYNARD: I do think this is an
14 important one because I think it's real because it's
15 something that is going to be needed. I think the
16 scoping will be able to narrow it down to where it's
17 not going to require a major effort but I think in a
18 couple of areas there is going to be a need to focus
19 some effort, reactor vessel, mostly it's going to be
20 materials issues, I believe, because we -- material
21 doesn't approve with age, so you know, it's how much
22 conservatism do you continue taking on.
23 So I think it's a good one. I think it
24 can be narrowed down.
25 DR. BANERJEE: So biologically, we

1 improve.

2 MR. TREGONING: Okay, just one final;

3 we've identified three areas, materials aging,

4 electrical aging and then environmental and rad

5 protection. Those are the three primary areas that

6 we'll be evaluating.

7 MS. LUI: Okay, the next topical area

8 starts on page number 14. And I just wanted to add,

9 while we're getting there, I just wanted to add one

10 more comment that, because we are always planning for

11 two years out of all occurrences, so we have to go

12 with the best available information to us at this

13 point in time and to project out two years from now

14 what kind of resource you might need. So it's not

15 cast in stone that that's exactly what we're going to

16 be doing and that's exactly the amount of resources

17 we're going to need. We always have opportunity to

18 come back and reprioritize but at the same time, what

19 we are providing to you right now is the best

20 information we have available and it's a very dynamic

21 process. So we can always change based on new

22 information.

23 MEMBER APOSTOLAKIS: But this seems to me

24 -- I must be missing something. You're talking about

25 facilities here.

1 MS. LUI: Correct.

2 MEMBER APOSTOLAKIS: So what exactly can

3 you do anticipating what's going to happen --

4 MEMBER POWERS: George, to be honest with

5 you, maybe you ought to let them go through it before

6 you ask the question because I think they'll clarify

7 it.

8 MR. HELTON: Actually, I'd say why don't

9 we treat that as the perfect segue into integral

10 effect test facilities. My name is Don Helton and I'm

11 from the Office of Nuclear Regulatory Research and

12 I'll attempt to answer that question and if I don't

13 then let me know and we'll continue to visit that

14 point. This effort is geared at looking at the

15 facilities that are our there and available for doing

16 large integral testing associated with advanced non-

17 LWRs. Those could be HTDRs, LMRs what have you. The

18 purpose for doing this would be to insure the adequacy

19 of the safety criteria that we're using to license

20 these facilities, to insure that we understand and are

21 comfortable with the tools the licensees are using as

22 the basis for licensing the facilities and to validate

23 our own tools for doing confirmatory analysis.

24 What we would focus on in fiscal year 2009

25 is the availability of those facilities, identifying

1 what facilities are out there and what they can be
2 used for and then also identifying what needs we have
3 in terms of testing, in terms of confirmatory testing
4 to get at those needs that I've just discussed. So
5 this is not, on the surface, us setting out to build
6 facilities. Obviously, the first cut here is to find
7 the facilities that already exist to, as much as
8 possible, leverage opportunities with folks like DOE.
9 This came up in the subcommittee.
10 We are interacting with DOE on this issue
11 on a number of fronts but the most recently in terms
12 of the PIRTs that we are doing right now. And like I
13 said, to separately identify the needs that we have
14 and try to mesh those.
15 DR. BANERJEE: Don, but don't you have a
16 pretty good idea of what already exists so you don't
17 have to task this? I would have thought you would
18 have a pretty good idea of what exists, what
19 facilities there are.
20 MR. HELTON: Well, we certainly have some
21 level of understanding of that. We're certainly
22 developing that as we go now with our advanced reactor
23 research. That's part of the reason that the word
24 "scoping" appears here. And like I said, the second
25 or the other aspect of this is not only knowing what's

1 out there but knowing what our needs are and if I can
2 over -- possibly over-step my bounds a little further,
3 it's -- you've got to know the facilities that are out
4 there but then you've also got to look at them enough
5 in terms of your needs to understand their limitations
6 and what modifications might be needed to get at an
7 aspect that's slightly different than what they were
8 designed to -- fit what they were originally designed
9 for.
10 DR. BANERJEE: So you're talking of maybe
11 adaption or some joint programs in terms of that.
12 You're trying to develop this. These are long-term
13 items.
14 MR. HELTON: Correct, they are.
15 MEMBER POWERS: I might just interject
16 here that I recently completed an examination of a
17 French nuclear facility for gas reactor testing and
18 you find a facility that looks very good for this
19 purpose. The lead time for the necessary
20 modifications, it won't be on line till some time
21 after 2011. And then you discover that the core life
22 limits the amount of testing you can do. So you can't
23 sit down and plan 100 tests. You have about 10, just
24 because of the core life.
25 DR. BANERJEE: When is this going to

1 appear? When can we see this?

2 MR. HELTON: The results of this?

3 DR. BANERJEE: The scoping and the --

4 MR. RUBIN: Maybe I can help out here a

5 little bit. I'm Stu Rubin, Senior Technical Advisor

6 for Advanced Reactors in the Office of Research. And

7 I would kind of mention that this is one area that

8 we're fortunate in that the agency has an outreach

9 program to industry and others and that's the Advanced

10 Reactor Policy Statement. And the Advanced Reactor

11 Policy Statement encourages designers and developers

12 to come in early on with their ideas for new designs,

13 new technologies and the like and new methods for

14 licensing well in advance of making an application and

15 for that reason we know a lot about what are the

16 specific plans, if you will, for technology use and

17 new kinds of designs. So this may be unique in terms

18 of having -- an agency having an outreach to get that

19 kind of long-lead technology interests identified.

20 As far as the facilities themselves are

21 concerned, I think you're right, in terms of knowing

22 what's out there, DOE has a good handle on that. We

23 have a good handle on that. The industry has a good

24 handle on that and we're all basically looking at

25 those same facilities and the adequacy of those

1 facilities to cover the gamut of technical arenas and
2 disciplines. So if you did your matrix, I think we
3 would pretty much touch on fuels, materials, thermal
4 fluids, fission product transport and things like the
5 sub-disciplines for all of those.
6 So we're looking at the availability of
7 facilities to things like develop and benchmark our
8 codes. One area that jumps out for example, is
9 fission product transport modeling and the
10 availability of separate effects and integral
11 facilities for that. I'm not sure that there's much
12 out there right now in that area and there's going to
13 be a need, I think, on the part of the applicants and
14 DOE to come up with some separate effects and integral
15 facilities to get a handle on that because it is vital
16 in terms of the licensing approach that the gas
17 reactors are using which is to have a mechanistic
18 source term and release calculation so they're going
19 to have to get their handle on that, and there will be
20 needs for facilities and we're going to help DOE and
21 the applicants figure that out.
22 Now, as Brian pointed out, the primary
23 responsibility is the applicant to provide the
24 technical basis for the modeling.
25 DR. BANERJEE: The first applicant will be

1 DOE, right, in the sense that they'll build the first
2 one.
3 MR. RUBIN: Well, I think we are looking
4 at DOE and saying, "Hey, you know, if you want to come
5 in for an application or support another applicant for
6 the NGNP very high temperature reactor, we expect that
7 you're going to come in with a sufficient technical
8 R&D basis for the models, the data to support the
9 models for your safety analysis. Now, we may want to
10 -- well, we will want to develop our own independent
11 models and take advantage of that data and may
12 question the adequacy of some of that data and may
13 choose to use those same facilities for some other
14 kinds of testing to either validate or invalidate our
15 concerns.
16 But in answer to your question, I think we
17 know what those facilities are. I think we can
18 anticipate we're going to use some of those facilities
19 or at least expect the applicant will and we may, in
20 fact, when we look at the gap analysis of what is
21 needed versus what's available, insure that those
22 facilities are available, because if they're not
23 available, then I think we may have --
24 DR. BANERJEE: I think this is a good item
25 because there's a very long lead time.

1 MR. RUBIN: Absolutely. Yeah, a lot of
2 these tests take five and six year to run.
3 DR. BANERJEE: Right, so if you can
4 anticipate something that's --
5 MR. RUBIN: Sure. And by the way, the
6 Advanced Reactor Research Plan starts that process of
7 thinking about that, what those kinds of gaps are and
8 what facilities may be needed, maybe not by name but
9 identifying where we think those gaps are.
10 DR. BANERJEE: In parallel probably, you
11 also need to take a look at what instrumentation and
12 measurement systems, because often when we've gone in
13 with the big facility, we've had to develop
14 instrumentation for it in parallel, not that we can
15 actually instrument it -- especially in reactors.
16 MR. RUBIN: Yeah, and I think in some of
17 these plants, we expect the first of a kind to be
18 instrumented even more than the commercial version of
19 the plant and I --
20 DR. BANERJEE: Yeah, that's in a pebble
21 bed, how do you find the temperature within the --
22 MR. RUBIN: Absolutely, if you look at the
23 HGTRs there's no in-core instrumentation to speak of.
24 But yet, we want to have some sort of bench marking of
25 what temperatures may be within the core and there are

1 techniques available to do that. And I do believe
2 that the designers are looking at those kinds of
3 special instruments to help collect that they really
4 need to get a good handle on the parameters to do the
5 bench marking of the codes, et cetera.
6 Now, what's needed for the commercial
7 plants, there will be that as well.
8 MEMBER ARMIJO: The big problem I have
9 with this activity is that it's limited to non-LWRs.
10 I think the test facility is available to support the
11 huge light water reactor fleet plus the new light
12 water reactors that the US has, that infrastructure
13 has atrophied dramatically. Hot cells are in pitiful
14 state, certainly not a test reactor in the United
15 States that for advanced fuel cell. If this task
16 could be expanded working with DOE, I think NRC would
17 do the nation a service by identifying how poor a
18 state we have to support the main fleet.
19 MEMBER POWERS: I wonder how many times it
20 has to be identified. I mean --
21 MEMBER ARMIJO: Well, somebody's got to
22 come up with some money and somebody take the lead.
23 MEMBER POWERS: They have -- I mean, CSNI
24 conducted a major effort, went out and published
25 reports, said, "Oh, my God, these things are decaying.

1 We don't have any hot cells. We don't have any test
2 reactors and whatnot?
3 MEMBER POWERS: When was that?
4 MEMBER ARMIJO: It was about three years
5 ago, four years ago. Maybe you know better than I do.
6 MS. LUI: No, actually there is a report
7 that just came out recently. There is a new study
8 that came out that has highlighted all the facilities
9 and their capabilities and they estimate how much it
10 would cost to rebuild these type of facilities. So
11 that information is pretty recent. We have --
12 MEMBER ARMIJO: I'd like to get a copy of
13 that.
14 MEMBER POWERS: Just to show you how
15 effective the capitalistic system is, the former
16 Soviet Union came out almost immediately with, "We've
17 got something for every one of these needs".
18 (Laughter)
19 DR. BANERJEE: Yes, and the rental was at
20 international rates.
21 MEMBER ARMIJO: Right, and the time scale
22 for getting problems solved is longer and, you know,
23 there's a lot of things.
24 MS. LUI: Right, the next topic area
25 starts on page 16.

1 MR. HELTON: I'll be covering this one as
2 well. This is a topic on multi-phased computational
3 fluid dynamics. This agency currently has an in-house
4 capability in the area of single-phase --
5 DR. BANERJEE: I would dispute that.
6 MR. HELTON: As one of its practitioners,
7 I'll take a little offense at that but not much. We
8 have apparently debatable in-house capabilities.
9 DR. BANERJEE: Let me put it this way,
10 Don, when you can do the calculations for the
11 vibrations and acoustic waves with the steam dryers,
12 I'll buy that.
13 MR. HELTON: That is one application that
14 certainly challenges pretty much anyone trying to
15 practice CFD. As you know, trying to run LES and that
16 type of geometry to get out acoustic functions is not
17 an easy task and our in-house capability would
18 currently not support that.
19 MEMBER KRESS: Just the fact that he knows
20 that is a good sign.
21 MR. HELTON: So it's that single-phase
22 capability that we would like to extend to multi-
23 phase. We are starting to see applications
24 internationally as well as domestically in the nuclear
25 industry building off of the use of multi-phase CFD in

1 other industries. I list a couple of examples here of
2 where we would use it and I would also extend this to
3 operating reactors as well. There are certainly
4 issues related to operating reactors and new reactors
5 that have two-phase issues and as we talked a little
6 bit about in the sub-committee yesterday, there are
7 also applications in advanced reactors for two-phased
8 or quite often --
9 DR. BANERJEE: Again, I want to ask you
10 something about this. Now, if you're talking about an
11 average multi-dimensional, multi-phase capability that
12 maybe already has that. Are you able to access that
13 or not? Not, maybe -- it's a smeared approach but
14 there's been a lot of work done at Capital for this.
15 MR. HELTON: When you say average, you're
16 just referring RANs, the Reynolds Average --
17 DR. BANERJEE: No, I'm talking about the
18 average multi-fluid model for multi-phase flows. But
19 of course, it doesn't give you anything of interest
20 but nonetheless, it's there.
21 (All talking at once.)
22 MR. HELTON: I'd like to thank you for
23 providing us with that one. I'd like to thank you for
24 providing not only the question but the appropriate
25 answer. Since that capability wouldn't really buy you

1 anything, I'm not sure that we --

2 MEMBER POWERS: I understand life in a

3 university is a bit different.

4 DR. BANERJEE: This is a long-term view,

5 come on.

6 MR. HELTON: Certainly, looking at that

7 and other techniques, other capabilities, it's

8 something we would do here. At this point, we're not

9 confining ourselves to a commercial code versus a

10 research code. We're not confining ourselves to a

11 particular approach to the multi-phase modeling. What

12 we'd like to do is look at what's out there,

13 investigate, see what seems to fit our applications

14 the best, build on some recent work that's been done

15 by CSNI working group on two-phase flows at the NRC

16 and others participated in and decide which of these

17 tools is best going to fit our applications.

18 You mentioned the Navy. We are certainly

19 not going to be in the business of developing multi-

20 phase CFD. There are lots of people already doing

21 that. It will be our intent to take the work that

22 somebody else is doing and apply it to our specific

23 areas of interest. A lot of the development is even

24 in other industries where they're just not worried

25 about the pressures or temperatures that we're

1 concerned about. So it's --

2 DR. BANERJEE: But NRC used to lead this

3 field. Why can't you lead it again?

4 MR. HELTON: Used to lead the multi-phase

5 or the CFD in general?

6 DR. BANERJEE: No, CFD, not multi-phase.

7 Why do you have to follow what the Europeans are

8 doing?

9 MR. HELTON: We're not necessarily

10 following what the Europeans are doing. I'm --

11 DR. BANERJEE: The Chairman is giving you

12 an open slate, saying "What is it interesting to do,"

13 right?

14 MR. HELTON: Yeah, not insinuating that

15 we're going to follow what the Europeans are doing, we

16 certainly want to see what they're doing and if it

17 makes sense for us to do that, then that would be a

18 logical path for us to go down, but we'd also like to

19 see what other entities, domestically are doing, what

20 other international groups are doing. And I mean, I

21 don't want to --

22 DR. BANERJEE: Anyway, I'm saying, think

23 out of the box on this.

24 MEMBER WALLIS: Isn't RPI doing --

25 MR. HELTON: I'm sorry, go ahead.

1 MEMBER WALLIS: Isn't RPI doing something
2 like this already?
3 MR. HELTON: What's that?
4 MEMBER WALLIS: Isn't RPI doing something
5 like this already?
6 DR. BANERJEE: That's the Navy stuff.
7 MEMBER WALLIS: RPI doing something like
8 this already and aren't you funding some of that?
9 DR. BANERJEE: No, but they're doing
10 average.
11 MEMBER WALLIS: Yeah, that's right.
12 MR. HELTON: We have had a small --
13 MEMBER WALLIS: It's still CFT, isn't it,
14 it's not the whole channel?
15 MEMBER POWERS: I'm sure that RPI is not
16 looking at the computational vehicles for doing
17 reactor accident regulatory analysis.
18 MEMBER WALLIS: They're not?
19 MR. HELTON: We are -- we have been in the
20 past, involved in a very low level effort in
21 supporting RPI and the Applied Research Lab at Penn
22 State in specific developments for a code called In-
23 Phase that they developed for other users as well, but
24 that has been a fairly low level effort in the past.
25 In-Phase is certainly one of the tools that's out

1 there that we would look at, but --

2 MEMBER POWERS: Don, just to make sure

3 that you get lots of mixed signals from the committee,

4 I am quite certain that somewhere at some time there

5 was a body like this with people like you sitting in

6 front of them saying, "We've got to look at advanced

7 computational devices or the future in France, in

8 Germany, in Japan, and in Korea. And why wouldn't it

9 be reasonable to do that in concert rather than

10 separately?

11 MR. HELTON: If I'm not misunderstanding

12 your question, then I think the CS&I working group

13 that met over the past year which was specifically

14 looking at potential problems that the nuclear

15 industry is trying to solve that could benefit from

16 two-phase CFD problems. That's something that we were

17 engaged in and it's a good starting point for at least

18 identifying which are the -- of the wealth of problems

19 that are out there, which could we actually get some

20 immediate benefit from by using this type of --

21 MEMBER POWERS: It's not the problem that

22 I'm interested so much as suppose I said, yeah, I

23 believe that I do need -- I will in 20 years need some

24 advanced CFD capability and that enlightenment came

25 from me -- say Bland just came in and told me that,

1 why wouldn't I go to my counterpart in France and
2 Japan and South Korea and said, "Let us work together
3 on this," because it's likely to be expensive and you
4 certainly are seeing an internationalizing of the
5 nuclear industry that I don't think is going to get
6 reversed very soon, and so you don't want to get into
7 a situation where you're arguing with your Japanese
8 colleague over whose code is better.
9 MR. HELTON: We do that in every other
10 discipline. Why would we not do it in --
11 (All speaking together)
12 MEMBER POWERS: Well, I'm not sure that
13 that's been a productive expenditure -- it's certainly
14 not been a productive expenditure of ACRS subcommittee
15 meeting time.
16 MEMBER WALLIS: People in the multi-phase
17 area always argue about things.
18 MEMBER POWERS: I have noticed that and
19 I'm trying to put an end to that.
20 MEMBER CORRADINI: It's a religious thing.
21 MR. HELTON: We certainly want to pay
22 attention to that. Certainly the Neptune project that
23 IRSN is entering into which includes multi-phase CFDs
24 is another example of something that we would like to
25 stay abreast of. At this point, we're not limiting

1 ourselves from doing that.

2 MEMBER POWERS: I mean, to me the most

3 encouraging you've said is that you're thinking very

4 broadly on this issue and I'm glad to see that, so

5 press forward. Don't let me or anybody else deter you

6 because --

7 MR. HELTON: I'm not sure I have that

8 luxury.

9 (All talking together.)

10 MEMBER POWERS: Appeal to the Chair and

11 we'll get you through this.

12 MS. LUI: Advanced fabrication techniques

13 starts on slide number 20.

14 MR. TREGONING: Okay, this one is mine,

15 advanced fabrication techniques on slide 20. I'm

16 debating whether I want to begin at this point. The

17 objective of this one is to evaluate the performance

18 of new construction, fabrication and manufacturing

19 techniques that have been used in other agencies --

20 other agencies, other industries and then also used

21 abroad for commercial nuclear construction since we've

22 built our last wave of plants 20 years or more ago now

23 and determine which of these new techniques,

24 procedures may be useful for our next wave of nuclear

25 applications and evaluate and assess any technical

1 and/or regulatory issues associated with those.

2 The other related aspect is we've seen a

3 move away in the industry from prescriptive based

4 specifications both for materials and for construction

5 and fabrication and we want to assess the use and any

6 particular issues related to using performance based

7 specifications.

8 Now this has been an area that's been of

9 interest to DOE for a long time. Back at the early

10 part, 2001, 2002, they formed at the time was a group,

11 a near-term deployment group they called it, to

12 evaluate issues related to new plant construction and

13 evolving from that was their NP 2010 program which the

14 goal of that was essentially to have a viable nuclear

15 option available by 2010. So as part of that effort,

16 they've commissioned several studies in this area

17 related to advanced fabrication techniques.

18 One of them which was completed in 2004 by

19 MPR is actually a pretty good starting point for what

20 this work would try to build on but what that work

21 essentially did was it went out and surveyed the

22 industry, and by the industry I mean that broadly in

23 terms of looking at large construction projects,

24 looking at overseas nuclear applications and trying to

25 identify which new technologies are out there which

1 may be applicable for the next wave of nuclear plant
2 construction in our country.
3 They also talked to the vendors and
4 specifically they queries, you know, ABWR, ESBWR, AP-
5 1000 and then the ACR-700 folks to bounce some ideas
6 or get some ideas from them on what techniques they
7 were considering. And they look at 13 advanced
8 construction techniques and evaluated their maturity
9 and they identified that nine of 12 of those
10 techniques, at least in their opinion, were
11 sufficiently matured to pursue without additional
12 technical issues and then they identified three that
13 there are still technical issues remaining.
14 So now they're in the point at DOE working
15 with the industry to determine which one of these new
16 techniques are actually going to be in use. If I
17 could quickly go down the list, some of the items that
18 they identified as being mature enough to press
19 forward with, a lot of the things that you might
20 expect, steel plate reinforced concrete structures,
21 which is, of course, prominent in AP1000 and some of
22 the other advanced containment designs, concrete
23 composition technologies, high deposition rate
24 welding, robotic welding, 3D modeling and simulation,
25 GPS applications, open top installations. So these

1 are all very large scale construction related things,
2 pipe bends and then precision blasting.
3 Now, the three areas that they identified
4 as having technical issues remaining, those come in on
5 a little bit smaller level in some cases and the three
6 areas that they talk about are prefabrication,
7 modularization of pre-assembly issues. Cable splicing
8 was something that raised a lot of -- or is a
9 potential area of interest because, again, that's an
10 area that they think they can get some performance and
11 acceleration impacts. And then the other one was
12 talked about was advanced information management and
13 control.
14 The other thing with respect to
15 background, much of these techniques are geared toward
16 increasing efficiency, decreasing construction
17 schedules. Some of them offer -- at least advertise
18 performance gains as well. So one of the things we'll
19 be looking at is making sure if those increased
20 efficiencies, if the performance or the safety is
21 still acceptable and adequate and we'll also be
22 evaluating if there's any unique challenges related to
23 nuclear applications. Next slide, please.
24 The uses of this, of course, this will
25 support our staff review for new nuclear applications.

1 FY09 activities, we actually plan on initiating some
2 work prior to FY09. The first thing we're going to be
3 doing is picking up and meeting with DOE to see where
4 they're at in their consultation with industry and to
5 identify what techniques industry is looking at
6 promulgating or possibly coming into us with. Some of
7 them we know about as a result of design certification
8 but we don't get all of the details related to
9 construction when we go through design certification,
10 so there are still issues that potentially haven't
11 been identified yet. And then 2007/2008 will be
12 trying to identify technical and regulatory issues.
13 And then in '09, based on what we've learned in '07
14 and '08, we'll be doing the scoping study to identify
15 what technical issues remain, what may have adverse
16 safety ramifications and from that we'll be able to
17 develop a research plan for addressing and then
18 dispositioning those issues.
19 MEMBER POWERS: It strikes me as
20 incredibly important to pursue this because these
21 kinds of techniques could dramatically effect how you
22 do the monitoring of construction of these facilities.
23 I mean, it's just going to make -- it's just going to
24 be very different from the way we did it when they
25 built the currently existing plants, could be quite

1 different. And also there are the software tools that
2 are guiding this system that could have an enormous
3 impact on just the constructing monitoring activities.
4 MR. TREGONING: The other issue that I
5 neglected to raise yesterday is one that we've been
6 dealing with recently but consideration for
7 decommissioning as well, and that was something that
8 initially was not a consideration but as we move
9 forward, it has become a consideration. So
10 deconstruction in some cases, there may be issues
11 associated with that as much as construction.
12 MEMBER POWERS: I think DOE learned so
13 much in taking apart facilities, particularly -- they
14 said, "We're not going to go through this pain ever
15 again". So when you design a new facility, you have to
16 figure out how to take it apart.
17 MEMBER ARMIJO: If I may just sort of take
18 a -- sort of a far view of all the items in your plan,
19 I would sort of categorize them into three different
20 categories. One is long-term application-oriented
21 research. And that, for example, would include
22 licensing beyond 60 years or fire effects on fiber
23 optic cable, specific application oriented long-term
24 research for which you anticipate a long-term need.
25 The second category amongst the items that

1 you have listed is facility needs with long lead times
2 and there are two facilities or facility-types amongst
3 the group of projects that you have listed and the
4 third group is long-term discipline-oriented research,
5 for example, that two-phased CFD modeling or the
6 advanced manufacturing techniques. It would seem to
7 me that if you are in the process of developing sort
8 of a long-term research plan that you are going to
9 update on a continual basis, it would make more sense
10 to sort of categorize the projects in terms of these
11 three categories rather than essentially trying to
12 link them to a specific application.
13 You have, you know, long-term application
14 oriented, facilities with long lead times and long-
15 term discipline oriented research. This is just an
16 observation that would -- may help you sort of sell
17 this plan and also make it easier to incorporate other
18 projects that will come up in the future.
19 MEMBER CORRADINI: I had a question about
20 this one. So when MRP did their report in 2004, was
21 part of that report how long some of these new
22 advanced fabrication techniques had been in service to
23 assess the effect of the robustness as aging takes
24 place in some of these structures that are built?
25 MR. TREGONING: It didn't look so much at

1 aging.

2 MEMBER CORRADINI: Aging is maybe the
3 wrong word but I'll use the term that -- or the thing
4 that -- in other words, in the nuclear power plants
5 that I've been in and I've been around when they've
6 first been built in the '70s, it was very clear they
7 were over-designed, very clear. On the other hand,
8 there was so much margin that things can last longer -
9 - a lot of these advanced fabrication techniques have
10 cut margin. That's what cut costs. So I'm always
11 wondering, do they know the margin so well they know
12 as time marches on and the structure ages, that they
13 know where they are relative to their fabrication
14 margin. I was curious if the MPR report looked at if
15 there was a technique for making something differently
16 now that was better in terms of its speed or its cost
17 effectiveness, they also looked about how it
18 essentially lasted. Do you see my question?

19 MR. TREGONING: I think I understand your
20 question and I would -- I might take some contention
21 with the fact that these necessarily will decrease
22 margin. The big focus, obviously, is to improve
23 efficiency while retaining margin to make sure that
24 you have sufficient margin. Some of these things,
25 some of these techniques are quite simply just better

1 and faster.

2 MEMBER CORRADINI: Sure, I don't disagree.

3 These are engineers. I trust them implicitly but on

4 the other hand, I just was curious since MPR did it,

5 they might have looked at this as one of the key

6 elements of assessing whether something is mature or

7 is kind of settled that it was doable for this sort of

8 application.

9 MR. TREGONING: When they looked at

10 maturity, they were looking a lot at lessons learned

11 from the construction. Again, they looked at things

12 like construction of the Ted Williams Tunnel,

13 shipbuilding lessons learned, where these fabrication

14 techniques had been applied.

15 MEMBER CORRADINI: First trick is don't

16 build it in Massachusetts, oh, I'm sorry.

17 MR. TREGONING: I won't go there. So, you

18 know, they looked at things like how well it was --

19 how well it was implemented, what problems came up in

20 construction. What sort of -- if they were having

21 defects what sort of things were found. So it was

22 more qualitative than it was a quantitative look at

23 what particular margins were associated with that.

24 MEMBER CORRADINI: That's fine.

25 MR. TREGONING: But they did try to

1 consider, again, those applications and some of the
2 unique nuclear requirements that, you know, that these
3 things would have to demonstrate that they could --
4 CHAIRMAN SHACK: High deposition rate
5 welding for example, sounds a little scary to a
6 materials guy. I mean, I can understand the speed but
7 the --
8 MR. TREGONING: That's one that
9 potentially has issues, certainly.
10 MEMBER ARMIJO: But you know, there's
11 electronic beam welding, laser welding, there's a lot
12 of different things that people can do now and some of
13 it actually would be better.
14 MR. TREGONING: And again, there might be
15 regimes of applicability in terms of what components,
16 what section sizes, things like that, and those are
17 really all the things that we need to be looking at,
18 you know, and making sure that we're, you know, within
19 the realm that's demonstrated to be technically
20 acceptable.
21 MS. LUI: Okay, moving to the last
22 technical topic that we have prepared for this
23 afternoon starts on page number 30.
24 MR. SIU: Are we on negative time?
25 MEMBER POWERS: We'll give you two minutes.

1 MR. SIU: This is a topic and as somebody
2 said, it follows with what we've been pushing on in
3 terms of discipline, in terms of staying up with the
4 state of the art. In fact, the ACRS noted in some
5 specific cases binary decision diagrams that we
6 weren't pursing any activity in that area and asked
7 why. The point of this activity would be to assess
8 some potentially promising quantitative risk
9 assessment methods and determine whether we should be
10 pursing those in greater detail for some of the tools
11 that we have already such as the SAFIRE code.
12 So under this category we are talking
13 about such things as the binary decision diagrams but
14 other things as well that were not mentioned in
15 previous discussions, the Bayesian belief nets, which
16 is a way of providing cause/effect relationships in a
17 probabilistic manner that can be used to address
18 models that are not limited to statements of failure
19 rates but don't necessarily go to full out simulations
20 of the equipment and going even as far as simulation
21 based risk assessment.
22 Yesterday, we talked about a Level 2
23 approach basically hooking MELCOR up to a Monte Carlo
24 driver, very crudely that's the conception. Certainly
25 there are a number of activities we're aware of around

1 the world pursuing the development of dynamic PRA
2 techniques and they seem to have some applicability in
3 Level 2, perhaps even in Level 1 PRA and other places,
4 perhaps even in -- if we start looking at process
5 plants fuel cycle facilities and if we wanted to do a
6 quantitative risk assessment, these might be the kinds
7 of tools that we'd be employing.
8 So the notion here again, just in nutshell
9 is that we'd be -- we recognize the existence of these
10 techniques. We know that they've developed to some
11 extent. They're not in full blown application mode
12 right now. There are definitely problems as well as
13 potential benefits associated with each of them and we
14 have some awareness of these but we want to do some
15 work, assess where we are, keep track of where things
16 are and maybe at some point decide to go pursue them
17 in greater detail. So that's it in a nutshell.
18 MEMBER APOSTOLAKIS: Where would you put
19 the need to calculate or to evaluate the unreliability
20 of a passive cooling system? Is it under this
21 quantitative risk assessment method?
22 MR. SIU: We actually -- I think if there
23 was a quantification aspect, for example, if somebody
24 was saying that they wanted to use a Bayesian belief
25 net approach to that, or a simulation based approach,

1 it would be there. If not, we had another task which
2 we didn't highlight in this presentation talking about
3 empirical data supporting such things as passive
4 system reliability and --
5 MEMBER APOSTOLAKIS: This would require,
6 I think, some kind of a model.
7 MR. SIU: Yeah, the other scape, George,
8 is that the Advanced Reactor Research Plan has a PRA
9 element in it and it certainly has been recognized for
10 awhile that we need to deal with passive system
11 reliability. We've made some starts at it. I guess
12 we're not crazy about where we are right now, so work
13 is needed but it wasn't put into this plan partly
14 because of that aspect. I guess part of the point
15 being, if it completely drops off because it doesn't
16 fit in some category, we need to make sure that we
17 have it.
18 MEMBER APOSTOLAKIS: Oh, yeah, I mean,
19 that's a need.
20 MR. SIU: Now, the committee is going to
21 be briefed on the Advance Reactor Research Plan at
22 some point, yes?
23 MS. LUI: Yes, within the next couple of
24 months. We're working on a schedule on that one right
25 now.

1 MEMBER POWERS: Okay, that completes?

2 MS. LUI: Yeah, just slide number 32, the
3 last slide, I mean just reiterate what Brian has
4 statement that we have a commitment that we're going
5 to provide the Commission the proposed final FY 09
6 long term research plan in July so we'd really
7 appreciate your input and your recommendations and I
8 do want to indicate that because we are attempting to
9 develop and agency-wide plan, so to a certain extent
10 we are -- we may not have the full latitude about
11 doing whatever the Office of Nuclear Regulatory
12 Research feels is the right thing to do, because we
13 want to get input from the rest of the agency and
14 Brian's goal is to get at least a no objection from
15 the other program offices. So we certainly welcome
16 your input and recommendation and we welcome that in
17 the process that we are following to develop this
18 agency-wide plan. And we also thank you for you input
19 on how to organize the information to better
20 communicate with the audience that we are targeting
21 at. So thanks.

22 MEMBER POWERS: They -- what she's saying
23 is that we have to generate a letter and we will and
24 we'll do our level-headed best to get it out to you at
25 this meeting. And other than that we thank you and

1 congratulate you for an awful lot of work starting, I
2 mean, probably ruined your Christmas, New Years and
3 Easter all at once and we'll look forward to hearing
4 more about it as you continue to update. Mr.
5 Chairman, I'll turn it back to you.
6 CHAIRMAN SHACK: Thank you. We'll take
7 a break up until 3:10 and then come back to discuss
8 our favorite topic, the technology-neutral framework.
9 (A brief recess was taken.)
10 CHAIRMAN SHACK: If we could start on.
11 The purpose of today's meeting is to come to some sort
12 of committee position on the technology-neutral
13 framework. We've had a lot of discussion over this.
14 We've had extensive comments from Tom and from Graham.
15 We need to decide where we're going to go. The Staff
16 is preparing a NUREG that they're ready to publish in
17 August. My position sort of is and I've tried to bin
18 these issues that we've all raised into a couple of
19 bins and I put them into what I call technical,
20 policy, and philosophical questions.
21 The technical questions are those that I
22 think arise whatever choice of top level requirements
23 and risk metrics we choose. Do we want to have LBEs?
24 Do we need a complementary function or can we go on
25 the sequence by sequence that they had? Those seem to

1 me issues that we can decide whether we go -- the
2 Staff has basically used the current regulations and
3 the QHOs to set the safety, the top level requirements
4 for this. Tom has some very different suggestions for
5 how to go.
6 But whatever set of top level requirements
7 we would pick, we have to decide whether we like the
8 LBE approach, whether we want to add a complementary
9 cumulative function to this and so I think the
10 technical questions we can address without addressing
11 the policy questions.
12 MEMBER KRESS: I don't agree that your
13 policy issues are policy issues.
14 CHAIRMAN SHACK: Well, okay, that's a
15 distinction. I guess if only to get through these
16 things in some order, I'd start with the technical
17 questions.
18 MEMBER KRESS: I don't care what you call
19 them as long as we get to them.
20 CHAIRMAN SHACK: Again, I think it's
21 probably unreasonable to expect the present NUREG to
22 address policy questions. I think we can expect them
23 to address technical questions.
24 MEMBER KRESS: The real overlap --
25 CHAIRMAN SHACK: What's a technical and

1 what's a policy.

2 MEMBER KRESS: Real overlap in those

3 issues.

4 MEMBER WALLIS: I object to some things

5 called philosophical issues. I thought these were

6 basic principles of how you went about doing a job.

7 CHAIRMAN SHACK: Okay, we can call them

8 basic principles.

9 MEMBER WALLIS: What is it they're trying

10 to do? Until you say what you're trying to do --

11 MEMBER APOSTOLAKIS: Could that be first?

12 MEMBER WALLIS: You don't design anything.

13 MEMBER APOSTOLAKIS: Can we discuss that

14 first?

15 CHAIRMAN SHACK: Yes. I thought, I

16 understood what the Staff was trying to do. The first

17 couple of bullets on the first page is sort of my

18 three-sentence description of what the NUREG is trying

19 to do.

20 MEMBER APOSTOLAKIS: So which one are we

21 looking at?

22 CHAIRMAN SHACK: Maybe that's the thing.

23 Maybe we should go to these basic issues.

24 MEMBER APOSTOLAKIS: I think so, too.

25 MEMBER MAYNARD: Just for clarification,

is this primarily to try to figure out what our approach is relative to the response on the NUREG --

CHAIRMAN SHACK: Yes.

MEMBER MAYNARD: Is that the primary purpose?

CHAIRMAN SHACK: I think that's the first order thing because we're running out of time. That's coming out in August. If we're going to have any input to that, we need to get to a committee position so that we can have input to that.

MEMBER MAYNARD: And realistically, what impact can we have on that? I kind of got the impression you're saying it's done and they're going to issue it.

MEMBER KRESS: But beyond that I think we need to decide on what we think a reasonable coherent technology framework is.

CHAIRMAN SHACK: That's a longer-term question.

MEMBER KRESS: As long as we're developing positions, we should keep that in mind.

CHAIRMAN SHACK: We're certainly going to do that, but as I say, I wanted to look at what we needed for the short term.

MEMBER KRESS: Now the NUREG is not

1 necessarily the rule.

2 CHAIRMAN SHACK: It's certainly not the

3 rule.

4 MEMBER KRESS: And it's not necessarily

5 the end product of what they'll end up with.

6 CHAIRMAN SHACK: Maybe we don't have to

7 discuss the NUREG. Maybe we just go ahead to where we

8 think they should be in the longer term.

9 I thought there were important technical

10 issues that we wanted to press for the NUREG,

11 particularly the notion of a cumulative function.

12 MEMBER KRESS: I think there are a couple

13 of real technical issues and that would be one of

14 them.

15 CHAIRMAN SHACK: To me, the NUREG ought to

16 be modified to include that. That would be sort of my

17 position.

18 MEMBER KRESS: I think, in my mind,

19 there's three primary technical issues that I want to

20 see discussed with respect to just the NUREG itself.

21 One of them is the --

22 MEMBER APOSTOLAKIS: So what are we

23 discussing now, philosophical issues or something

24 bigger?

25 CHAIRMAN SHACK: No, we're down to

1 technical issues on the NUREG. I'm not sure exactly
2 how to proceed here.
3 MEMBER APOSTOLAKIS: Let's start with
4 philosophical and go down.
5 MEMBER KRESS: Okay, suits me.
6 CHAIRMAN SHACK: I'm afraid with the
7 philosophical we can be there forever. I was sort of
8 hoping the technical issues we could come to some
9 agreement.
10 MEMBER APOSTOLAKIS: Doesn't the technical
11 depend on the philosophical?
12 Graham wants to see metrics for every
13 single thing they propose, right, that's what you're
14 saying or something to that effect.
15 MEMBER WALLIS: No. I just say that an
16 awful lot of it --
17 MEMBER APOSTOLAKIS: Choices are made with
18 little justification or exploration of their impact.
19 So there is no analysis and evaluation of various ways
20 of describing the impact on public safety of nuclear
21 reactor operation.
22 Criteria are not articulated and so on.
23 I mean --
24 MEMBER WALLIS: But this is so global, I
25 don't think it's going to have any effect on the

1 NUREG.

2 MEMBER APOSTOLAKIS: Does everyone agree

3 that this is true?

4 CHAIRMAN SHACK: We can start taking soft

5 votes on that.

6 MEMBER APOSTOLAKIS: Soft votes or maybe

7 some discussion first.

8 CHAIRMAN SHACK: Well, discussion if there

9 is some. I mean I'm not sure how I can discuss this.

10 MEMBER APOSTOLAKIS: May Graham can

11 elaborate just a little bit? Give us an example.

12 MEMBER WALLIS: I had a great deal of

13 trouble with this because I'm used to a design process

14 where you start with some very clear top-level

15 objectives and you say what you're trying to do and

16 you try to express these in some kind of performance-

17 based way. Whereas, what I see in the NUREG is apart

18 from sort of talking about the QHOs at the beginning,

19 there's a launching into a description of a framework

20 without saying what performance-based objectives are

21 being satisfied by the features of the framework.

22 For instance, I see these DBAs or whatever

23 they are being inserted there simply by description

24 without saying what they're for, what sort of

25 performance you're aiming to achieve by inserting them

1 and so on.

2 So I had trouble with the whole structure

3 that's proposed. I had trouble with --

4 MEMBER KRESS: Did you have trouble with -

5 -

6 MEMBER WALLIS: I had trouble with Figure

7 6-2 appearing out of the blue without explaining what

8 it's for.

9 MEMBER KRESS: Do you have trouble with

10 them as concepts or the way they're presented?

11 MEMBER WALLIS: Well, first of all, I'd

12 like an exposition on what kind of public safety

13 you're trying to achieve by having this framework.

14 MEMBER ARMIJO: Can I help? The way I

15 look at it, there are two types of figures. One is

16 this step ladder thing, F versus C, and that to me

17 serves two functions. And one of them addresses the

18 concern that Graham has raised is that we will not

19 accept any design in which there is -- there is a

20 scenario that would violate that constraint.

21 The second type of graph is this

22 complementary cumulative distribution function which

23 says we will not accept any design in which the

24 totality of scenarios that can be identified will

25 violate this graph.

1 MEMBER WALLIS: The second one is more
2 important than the first to me. And then the first
3 one, the problem with that is that the way they do it,
4 you can always get around it by reconstructing the PRA
5 so that you have a sequence which doesn't violate your
6 --
7 MEMBER APOSTOLAKIS: No.
8 MEMBER WALLIS: Why can't you do that?
9 You can subdivide your sequences as much as you like
10 until the frequency becomes the small --
11 MEMBER APOSTOLAKIS: They have put
12 restriction son that. The discussion -- see, that was
13 my first reaction too. But the discussion within each
14 step of how you select the LBE precludes that because
15 it says you start with an initiating event, right, and
16 you find the frequency of all the things that can
17 emanate from it, as I recall. I don't remember the
18 exact detail.
19 MEMBER WALLIS: What's an initiating
20 event? When there's an initiating event in the LWR,
21 how do you define an initiating event? It's a pipe
22 break. How are you going to subdivide your pipe
23 breaks? You start subdividing it. You can always
24 make the frequency of any one of them as small as you
25 like.

1 MEMBER CORRADINI: Because you're making
2 them into an infinite number of smaller events, is
3 that your point?
4 MEMBER APOSTOLAKIS: Yes, you can break up
5 a sequence --
6 MEMBER WALLIS: You have to because the
7 scenarios are different for different --
8 MEMBER APOSTOLAKIS: But I think there are
9 restrictions in the way you select the LBE that
10 precludes that. That was my first reaction. I don't
11 remember the details, but there is a restriction. So
12 to me, it's equivalent to what they're doing. If I
13 had the continuous curve, I decided to take pieces of
14 intervals of frequency here and develop discrete,
15 let's say the PDL, they will be equivalent because
16 they're not saying any sequence that goes in here.
17 They have some conditions.
18 MEMBER WALLIS: They have some mysterious
19 thing about grouping sequences or classes of
20 sequences.
21 MEMBER APOSTOLAKIS: But that addresses
22 another issue that has to be --
23 MEMBER WALLIS: I think that we're sort of
24 at the primary level though here, aren't we? We're
25 setting down the top level criteria which I think is

1 what you're trying to do. And then have things follow
2 from that.
3 CHAIRMAN SHACK: But I think they've done
4 that. When I look at it, I sort of tried to set it
5 out here. They assume that the current regulations,
6 the QHOs, the dose limits we have provide a suitable
7 statement of the required level of safety.
8 Nobody disagrees with that.
9 MEMBER WALLIS: Not where the QHO was
10 issued to that --
11 MEMBER KRESS: I don't disagree with that
12 in a sense.
13 CHAIRMAN SHACK: I think that's where they
14 start. There's an expectation of enhanced safety
15 because they're going to apply the QHOs on an
16 individual basis to the reactor and a group of plants.
17 MEMBER KRESS: And Dana made a very astute
18 comment that QHOs are not individual plant
19 characteristics.
20 CHAIRMAN SHACK: You can apply them to a
21 plant and on a site.
22 MEMBER KRESS: But why would you do
23 something that's wrong?
24 CHAIRMAN SHACK: Let me just -- let's just
25 go there. That is the top level requirement. From

1 there you get a framework for a neutral development,
2 based on a full-scope PRA which we agree. They get
3 LBEs from that PRA to represent the entire spectrum of
4 events. They deal with integrated risk in terms of
5 QHOs.
6 I think that's -- to me, there's a logical
7 thing here.
8 MEMBER KRESS: Let me adjust that logic
9 just a little. As I said many times QHOs are a site
10 characteristic. I think they are the overriding risk
11 metric, the safety goals and we need to strive to in
12 our requirement, but they are a site characteristic.
13 I'm saying that you don't design a plant to them
14 because let's say you make the rules such that each
15 plant just meets the QHOs. Then you can only put one
16 plant on the site. And after QHOs, you can't do
17 anything more.
18 My comment --
19 CHAIRMAN SHACK: That's a very poor choice
20 on the designer's part.
21 MEMBER KRESS: Okay, but it's not either.
22 I say the designer --
23 MEMBER WALLIS: But Fleming says that they
24 apply to the group of plants on the site. Fleming
25 says that.

1 MEMBER KRESS: Right, everybody knows
2 that. I mean that's clear.
3 But what I'm saying is a designer who
4 wants to have a design such that at least several of
5 his plants can go on almost any site, but not all
6 sites, almost any site and still meet the QHOs. That
7 would be his objectives. And I'm saying the objective
8 of a design safety set of criteria ought to be
9 consistent with that consideration.
10 And I'm saying that if you give an
11 equivalent of a CDF of 10^{-5}, and a LERF of 10^{-6}, if
12 you're consistent with those, then that's consistent
13 with the statement that any number of plants on any
14 particular site will meet the QHOs. So that's where
15 I disagree with their philosophy. They shouldn't --
16 QHOs should be implicit and it should be implicit with
17 the concept that the designer needs criteria that if
18 he meets those, that his design will be rendered to
19 such that several such plants will fit on just about
20 any site. That's a coherent concept. And that's
21 where I think they've gone wrong. I don't think you
22 want the QHOs to be the --
23 MEMBER APOSTOLAKIS: The staircase curve
24 though really comes from existing regulations.
25 MEMBER KRESS: That's right.

1 MEMBER APOSTOLAKIS: I don't think it
2 comes from the QHO.
3 MEMBER WALLIS: It doesn't come from the
4 QHO.
5 CHAIRMAN SHACK: You also have to meet the
6 QHOs.
7 MEMBER APOSTOLAKIS: It's a separate
8 thing.
9 CHAIRMAN SHACK: Those are two. Tom is
10 arguing that even the QHOs aren't enough.
11 MEMBER KRESS: I am saying that if you
12 have the right CCDF, complementary cumulative
13 distribution function, that's the overriding design
14 requirement that can meet a CDF of 10^{-5} and 10^{-6}.
15 The QHOs are something that you want to
16 have later on, but you do at the site. Is this site
17 suitable? Have you met the risk goals for the site?
18 That's also a requirement.
19 MEMBER APOSTOLAKIS: So the curve would be
20 frequency of release, right, that's what you're
21 saying?
22 MEMBER KRESS: Yes.
23 MEMBER APOSTOLAKIS: Not dose.
24 MEMBER KRESS: That's right. And that's
25 because that I can make equivalent to a CDF and a

1 LERF.

2 MEMBER APOSTOLAKIS: Right, so that would

3 be like a Farmer Curve.

4 MEMBER KRESS: Yes and then you wouldn't

5 have to worry about the site.

6 MEMBER WALLIS: But the problem --

7 MEMBER KRESS: Except implicitly.

8 MEMBER APOSTOLAKIS: The problem --

9 MEMBER WALLIS: There's nothing in the

10 regulations that says you will have this sort of a

11 curve. QHOs are something already you can appeal to,

12 something the Commission said.

13 MEMBER KRESS: I'm saying that those are

14 a criteria also.

15 MEMBER WALLIS: I would like to have a

16 cumulative distribution curve, but it's not in the

17 regulations.

18 MEMBER KRESS: That's all right. We're

19 re-doing the regulations.

20 CHAIRMAN SHACK: This is a new regulation.

21 MEMBER KRESS: I don't care what's in the

22 regulations.

23 CHAIRMAN SHACK: This is consistent with

24 current policy. Now it's a change in the regulations,

25 but we're making a new rule. We can change the rule.

1 The question is whether we want to change policy also.

2 MEMBER APOSTOLAKIS: The practical problem

3 that I see, maybe it's not. Many years ago when I

4 proposed something like that, Dana objected on the

5 basis of what -- you can have 84 curves like that I

6 think he said, because you don't have a common unit,

7 what would you have?

8 MEMBER KRESS: Yes, curies, equivalent

9 curies on a TEDI --

10 MEMBER APOSTOLAKIS: For everything?

11 MEMBER KRESS: The TEDI basis is

12 equivalent curies.

13 MEMBER CORRADINI: Equivalent curies on

14 what basis?

15 MEMBER KRESS: TEDI.

16 CHAIRMAN SHACK: Total effective dose

17 equivalent.

18 MEMBER WALLIS: Like Roentgen-equivalent

19 man.

20 MEMBER CORRADINI: So it's a curie times

21 some sort of RBE?

22 MEMBER APOSTOLAKIS: And that curve would

23 be used for design purposes.

24 MEMBER KRESS: No, it would be an

25 acceptance criteria for design. You would use, and

1 actually you would have F-C curve like they have with
2 design basis accidents as the design. But what I'm
3 saying is that has to be constructed in such a way as
4 to meet the CCDF curve that I'm talking about. If
5 it's not, you have to put more restrictive -- figure
6 of merit. I'm calling this a C curve. A figure of
7 merit curve. It's the same thing as design basis
8 accident and figures of merit. I don't really care,
9 as long as you select your design basis accidents to
10 be representative of all types so that you cover the
11 whole range. I don't really care what you get for
12 these F-C curves, as long as when they meet it, that
13 they -- that it renders a plant to decide it meets the
14 real CCDF curve.
15 MEMBER CORRADINI: So here's what I guess
16 -- I think I understand what you're saying. I don't
17 necessarily disagree with it, except for the fact are
18 you going to totally a risk-based model for what's
19 safe and what's not? Then I get somewhat twitchy
20 because the technology-neutral document at least, and
21 this I guess I was going to go back to Graham's
22 question. I don't really, whether it's stair-stepped
23 or a straight line or a line that kind of comes down
24 or whatever, doesn't really bother me except for the
25 fact that I would want to make them use that curve to

1 elucidate the key accidents that it would have to
2 worry about. Because eventually, it's going to be a
3 series of a class of 5, 10 accidents that they're
4 going to worry about, whether they're at power, not at
5 power, changing fuel, whatever.
6 Once I see that grouping, then I'd scratch
7 my head and say gee, something is missing from that.
8 What did they do in the details? Did they fraction it
9 at too much whatever? But it seems to me the L-C
10 curve gets me an ensemble of accidents that I have to
11 deterministically analyze. I have to
12 deterministically analyze very carefully.
13 MEMBER KRESS: Very carefully, and
14 probably it's hard to go into great detail on
15 analyzing the frequency, but you could --
16 CHAIRMAN SHACK: So we're in violent
17 agreement on the framework document on this point.
18 MEMBER CORRADINI: So let me just go on --
19 so let's say they do the ensemble. They do the
20 calculation, blah, blah, blah, blah. What I'm trying
21 to understand with your final point with the
22 essentially frequency versus something curve, is that
23 going to be a measure of acceptance? Then you become
24 risk based for the license end of the plant.
25 MEMBER WALLIS: What other basis do you

1 have unless you have an acceptance criteria of some
2 sort.
3 MEMBER APOSTOLAKIS: You have the
4 excellent deterministic calculations with the limits.
5 MEMBER CORRADINI: Yes, that's what I was
6 going to say.
7 CHAIRMAN SHACK: But you have to meet them
8 both.
9 MEMBER KRESS: You have to meet them both.
10 CHAIRMAN SHACK: You have to meet them
11 both.
12 Let me just come back to Tom's thing -- this site
13 versus plant design I think is a critical point.
14 MEMBER KRESS: I think it is too.
15 CHAIRMAN SHACK: I have a problem with
16 that because we're going to do a full-scope PRA with
17 internal and external events. I don't know how to
18 come up with an external event without a site
19 characteristic.
20 I'm going to do every generic, every
21 design cert comes in here with a generic site where he
22 does a reasonably robust serious earthquake, a
23 reasonably robust serious meteorological problem. He
24 does a sort of enveloping site. It may not be a worse
25 case, but it takes it pretty -- that forces him to

1 look in his design at both internal events and
2 external events.
3 MEMBER KRESS: I accept. With the HBO,
4 you've got to include things like that and transport
5 and weather, the population distribution -- you don't
6 have to do that with the seismic. Seismic you can
7 choose a seismic curve and put it in your PRA.
8 I can say it's easy to do that.
9 CHAIRMAN SHACK: I can do 2 CFR 20.100.
10 I can do dose at the boundary.
11 MEMBER KRESS: You need a wind rose.
12 MEMBER APOSTOLAKIS: How do --
13 CHAIRMAN SHACK: I can do a generic one
14 and I don't see -- I don't particularly see what I get
15 by not doing what every other design certification is
16 done which is come in with a kind of a generic. Then
17 when I'm done with that, if I can show my site fits
18 that envelope I'm done. In your case, you would have
19 to do a full level three at every site.
20 MEMBER KRESS: No, no, no, no, no. All I
21 want -- I'm asking for a full level two for the
22 design. And then for each site I want a level three.
23 That's at a different state. That's a different
24 requirement.
25 MEMBER APOSTOLAKIS: How do we demonstrate

1 now that we meet the Part 100 criteria? Do we
2 consider the site or each plant that is built on the
3 site?
4 MEMBER KRESS: You do it on a plant by
5 plant basis.
6 MEMBER APOSTOLAKIS: On a plant basis.
7 MEMBER KRESS: Don't constrict your
8 thinking to what we do now.
9 MEMBER APOSTOLAKIS: No, but what I mean
10 what they tried to do was to develop a framework that
11 reflects that and your objecting to that?
12 MEMBER KRESS: Yes.
13 MEMBER APOSTOLAKIS: You are saying that
14 should be really based on all the plants of the units
15 that are on the site.
16 MEMBER KRESS: Yes.
17 MEMBER APOSTOLAKIS: And if you go to an
18 earlier curve.
19 MEMBER KRESS: All we did for you was to
20 tell you something about leakage rate data which was
21 not risk related anyway.
22 CHAIRMAN SHACK: That's another thing,
23 Tom. If we're going to go risk, do we even -- you're
24 the one that always says we regulate lots of things
25 beyond risk.

1 MEMBER KRESS: And I still say that.

2 CHAIRMAN SHACK: They've gone that.

3 MEMBER KRESS: That's why I want the OBEs

4 to be every type of accident and I want there be

5 consistent figures of merit on those that would

6 regulate accidents that are beyond design basis or not

7 beyond design. Lesser releases that don't involve

8 full-core melt. That's the way you control those and

9 I think you also use the LBEs as a way to invoke some

10 defense-in-depth and some margins.

11 CHAIRMAN SHACK: Dana?

12 MEMBER POWERS: Just a question for Tom.

13 How do you see Part 100? Part 100 says don't care

14 about your accident frequencies. Hypothesize a

15 substantial radionuclide release to containment. Tell

16 me what happens at the site now?

17 How would you see that handled in the

18 future?

19 MEMBER KRESS: I'll have to think about

20 that one a second, but I don't that that has gained

21 you very much in the current regulations other than

22 say I have a containment that failed the modes imposed

23 on it and I have a leak rate that's so small that I

24 can meet that.

25 I don't think either of those are very

1 substantial elements of design safety, but I think you
2 can have a design basis accident that talks -- you
3 have the design basis accidents that deal with LOCAs,
4 that deal with the other accidents and I think you
5 have figures of merit which involve release -- not a
6 dose, but a curies of release. I think you meet
7 those, the designer would have to do something.
8 MEMBER POWERS: The Part 100 requirement
9 says don't care about design basis accidents.
10 MEMBER KRESS: I know, that's a defense-
11 in-depth concept and I think you have to think about
12 how to build defense-in-depth and do the design-basis
13 concepts.
14 MEMBER POWERS: I mean --
15 MEMBER KRESS: And you may ask for meeting
16 the figures of merit with some margin or --
17 MEMBER POWERS: Well, they do that.
18 MEMBER KRESS: Or some level of confidence
19 and that may -- I think you deal with it in that sort
20 of way, but --
21 MEMBER POWERS: They meet it in this
22 requirement by -- they don't have it frequency
23 independent, but they will put it at such a frequency
24 that you have to deal with it. You have to deal with
25 it in a conservative way looking at sort of the

highest frequency, the highest dose sequence and meeting it so that it's reasonably equivalent to the current requirement, not quite.

MEMBER ARMIJO: I'm going to put on my designer hat, okay and somebody is going to tell me what the high level requirements are. High level requirements is that the risk associated with all the accidents that can potentially occur from this, in this particular design shall not exceed a certain limit dictated by this -- whatever, the complementary cumulative distribution function.

Second requirement --

MEMBER KRESS: Now keep in mind that that's not a risk of latent cancers. It's a risk of a certain release.

MEMBER ARMIJO: Right.

MEMBER KRESS: It's like a core damage frequency. It's not a risk of --

MEMBER APOSTOLAKIS: Right now, risk is in terms of dose, isn't it?

MEMBER KRESS: Well, in the --

MEMBER APOSTOLAKIS: What they propose?

MEMBER KRESS: Yes.

CHAIRMAN SHACK: It's a dose large enough to cause serious problems.

1 MEMBER APOSTOLAKIS: It can go all the
2 way.
3 MEMBER ARMIJO: So this is higher level
4 requirement number one. There's another high level
5 requirement which is the consequences of any single
6 accident that I can dream of shall not be in excess of
7 a given limit dictated by a curve, whether it is that
8 --
9 MEMBER WALLIS: That's consequence.
10 MEMBER KRESS: Keep in mind that that
11 second level could show up on this CCDF curve because
12 it's dominant -- what it is is accumulated frequency
13 of the ceiling. If you drop above that line in one
14 little area, that's going to be do to these meeting,
15 not meeting those other requirements in that
16 particular set of frequencies.
17 It could be in that too.
18 MEMBER ARMIJO: Let's say we have these
19 two requirements. A constraint on the harm that can
20 come from all the accidents that I can dream of and
21 the constraint on the consequences of a single
22 scenario and I have two constraints. If I do the PRA
23 and I plot each scenario on the first curve that
24 limits the consequences of an individual accident and
25 I'm going to be careful like George said, I'm going to

1 put arrow bars, horizontal arrow bars on the
2 consequences, horizontal, vertical arrow bars on the
3 probability and I will show that each and every event
4 that I can dream of is below that limit.
5 MEMBER KRESS: That's right.
6 MEMBER ARMIJO: Now the next thing I'm
7 going to do, I'm going to look at, group these various
8 events and look at the ones that give me the highest
9 consequences in each category and then add all those
10 up and show that I'm going to satisfy the constraint
11 on the total.
12 MEMBER APOSTOLAKIS: No, I disagree with
13 that.
14 That's not right. You can't do that.
15 MEMBER KRESS: You're going to do the PRA.
16 MEMBER ARMIJO: Right.
17 MEMBER APOSTOLAKIS: Wait a minute. What
18 Sam is saying is that I will be risk informed now and
19 then a few minutes later I will cease being risk
20 informed and I look at the worst possible consequence.
21 MEMBER ARMIJO: No, no, no. I'm going to
22 add all the potential --
23 MEMBER APOSTOLAKIS: On what basis? I
24 mean they have different frequencies.
25 MEMBER KRESS: You're going to do a PRA.

1 MEMBER APOSTOLAKIS: On what expected
2 consequence?
3 CHAIRMAN SHACK: You do the PRA to get --
4 your PRA end state is a dose release and you add all
5 those.
6 MEMBER APOSTOLAKIS: You add what?
7 CHAIRMAN SHACK: A release of some sort.
8 You get all those sequences --
9 MEMBER KRESS: Just do the normal PRA.
10 CHAIRMAN SHACK: He limits to make sure
11 that every sequence is below the one curve, and the
12 total sum of all the others is below the second curve.
13 MEMBER APOSTOLAKIS: Of all the others?
14 CHAIRMAN SHACK: Of all the sequences.
15 MEMBER KRESS: Just the PRA.
16 MEMBER APOSTOLAKIS: Why? On what basis?
17 MEMBER KRESS: Because that's your --
18 MEMBER APOSTOLAKIS: You have one sequence
19 at least to this consequences with frequencies -- how
20 do you know it went with another frequency?
21 MEMBER WALLIS: No, I think he's saying
22 you add up all the frequency times consequence.
23 MEMBER APOSTOLAKIS: What about the
24 expected consequence. You guys are saying no.
25 MEMBER WALLIS: I think that's what he's

1 doing.

2 CHAIRMAN SHACK: The expected consequence.

3 MEMBER APOSTOLAKIS: The expected

4 consequence.

5 CHAIRMAN SHACK: You have to have greater

6 than 95 percent confidence with that.

7 MEMBER KRESS: I would use the 95 percent

8 confidence --

9 MEMBER APOSTOLAKIS: If you expect the

10 consequence, yes, it's fine.

11 MEMBER KRESS: You got the right idea.

12 Now the question is --

13 MEMBER APOSTOLAKIS: Wait a minute --

14 MEMBER KRESS: -- how do you select this

15 figure of merit curve.

16 MEMBER APOSTOLAKIS: Wait, wait. That's

17 what the Staff is saying though.

18 CHAIRMAN SHACK: What the Staff doesn't do

19 is sum all the sequences.

20 MEMBER KRESS: They left that out.

21 CHAIRMAN SHACK: What they do is they sum

22 the big accident sequences.

23 MEMBER APOSTOLAKIS: The other ones drop

24 out.

25 CHAIRMAN SHACK: Well, they drop out if

1 you don't have a CCDF curve and you haven't limited
2 the total risk profile.
3 MEMBER KRESS: That's what the EIA PRA
4 does already. Why not do that?
5 MEMBER APOSTOLAKIS: They are asking you
6 after you satisfy the curve, the staircase, to also
7 meet the QHOs.
8 MEMBER KRESS: No, no, that's different.
9 MEMBER APOSTOLAKIS: That's what they're
10 saying.
11 MEMBER KRESS: I know but that's what --
12 MEMBER APOSTOLAKIS: No, no. Forget about
13 the site versus the other thing. The thing is that
14 they are putting a condition like the one Said
15 mentioned on the total.
16 MEMBER WALLIS: That's right.
17 MEMBER APOSTOLAKIS: Now you may disagree
18 and say I don't like how they're putting at the QHO
19 level. I want it at the lower level like the release,
20 but the philosophy is there.
21 CHAIRMAN SHACK: Tom wants it at a wider
22 range of consequence levels, not just --
23 MEMBER CORRADINI: I think what he's
24 saying, what I heard him say is that he wants --
25 MEMBER KRESS: Or one point.

1 MEMBER CORRADINI: He wants to look at the
2 shape of it. I mean what you guys are saying is this
3 and you're saying if you do whatever you said,
4 expected consequence, you're looking at essentially
5 the product of all of these has got to be less than an
6 X.
7 What he wants to look at is the shape of
8 this and go hm, that's a weird shape out there.
9 What's causing that? I might worry about that.
10 That's what I -- it's the shape, how this develops.
11 MEMBER KRESS: I don't care what shape it
12 is as long as it's under that.
13 MEMBER CORRADINI: Right. But if
14 something is popping up, getting close, I would look
15 at it.
16 MEMBER KRESS: That's exactly right. And
17 I'm saying that if that is a curies of release
18 equivalent that I can make it very completely
19 consistent with the CDF and a LERF which have both
20 been shown to be really neat design attributes.
21 MEMBER APOSTOLAKIS: How can that be
22 consistent with LERF when LERF ignores the amount
23 released?
24 MEMBER KRESS: Because my -- I would have
25 the access to see the ratio of the curies released to

1 the curies that are now released that would bound the
2 LERF from an LWR that we now have. That brings it in
3 there. Now it's a little tricky. You have to either
4 bound it or have a representative value and that's why
5 I say it's consistent with the LERF. It's the
6 integral under that curve.
7 MEMBER WALLIS: What you guys are doing is
8 what I wanted to see in Chapter 1 which was a
9 description of the ways of representing risk, the ways
10 of making a decision about what we're going to do and
11 the a decision about which ones we're going to choose.
12 MEMBER APOSTOLAKIS: But Graham, it seems
13 to me a lot of what you want is there. It's just not
14 in the first chapter.
15 MEMBER WALLIS: It's not clarified.
16 MEMBER APOSTOLAKIS: And you use the
17 staircase curve in Chapter 6 and that bothers you.
18 MEMBER WALLIS: It comes out of the blue.
19 I don't understand why it's there and --
20 MEMBER APOSTOLAKIS: But it's a matter of
21 presentation.
22 MEMBER WALLIS: I disagree with the
23 staircase too because I don't understand this trying
24 to -- to regulate an individual PRA sequence. I think
25 that's a fundamental flaw. You've got to integrate on

1 the basis of some total thing.

2 MEMBER APOSTOLAKIS: The moment you look

3 at this interval and then they say identify the

4 sequence with a larger consequence --

5 MEMBER WALLIS: I understand that. Then

6 you look at it more carefully.

7 MEMBER KRESS: Yes, you use a very good

8 curve, you use a good tool to calculate those

9 consequences.

10 MEMBER APOSTOLAKIS: These eliminate this

11 trick of subdividing because they're saying forget now

12 about frequencies.

13 MEMBER WALLIS: You can always subdivide.

14 MEMBER KRESS: It eventually does or it

15 can.

16 MEMBER APOSTOLAKIS: And you may need to

17 put a few extra words, but the idea is there. They

18 thought about it that you cannot subdivide. And I

19 thought it was pretty good.

20 MEMBER WALLIS: I thought it was

21 incredibly confusing.

22 MEMBER APOSTOLAKIS: It's difficult

23 because they're not the end, they pick one frequency

24 from some -- here and the consequence from there and

25 create a stylized sequence that will be analyzed. But

1 again this is too detailed. This letter will not
2 approve everything they say, right? Will it?
3 MEMBER KRESS: I don't think so.
4 MEMBER APOSTOLAKIS: Then we're in
5 trouble.
6 MEMBER CORRADINI: So can I ask another
7 question? Are we off this or do you want to --
8 CHAIRMAN SHACK: I'd like to start getting
9 into some issues that we can maybe agree on.
10 MEMBER APOSTOLAKIS: I think the way Said
11 put it would satisfy Graham and my contention is that
12 a lot of this stuff is already there.
13 MEMBER KRESS: Right.
14 MEMBER APOSTOLAKIS: With a disagreement
15 as to where you put the curve, which curve is it.
16 CHAIRMAN SHACK: I look at that as Issue
17 8 under technical issues. I think we want both the
18 sequence curve and the cumulative curve.
19 MEMBER KRESS: I agree.
20 CHAIRMAN SHACK: That's where we'd like to
21 come to some sort of consensus.
22 MEMBER WALLIS: Why is there no societal
23 risk in here? Why is there no environmental --
24 MEMBER CORRADINI: You are adding more
25 QHOs.

1 MEMBER WALLIS: That's policy.

2 MEMBER KRESS: I think you have to have

3 that too.

4 MEMBER WALLIS: You have to have that in

5 Chapter 1.

6 CHAIRMAN SHACK: No, that sort of says

7 what does my frequency consequence curve include? I

8 would argue that you want eight, whether we have

9 societal risk or we don't have societal risk.

10 MEMBER WALLIS: Well, explain that at the

11 beginning.

12 MEMBER KRESS: I agree with you.

13 MEMBER WALLIS: Explain that.

14 CHAIRMAN SHACK: I think from the top

15 level, that's a different question, what the top level

16 requirements -- but for any top level requirement, we

17 should look at individuals and we should look at

18 cumulative.

19 MEMBER KRESS: Absolutely.

20 CHAIRMAN SHACK: We can avoid the policy

21 decision on number eight and say we have a consensus

22 on number eight.

23 MEMBER APOSTOLAKIS: I want to understand

24 this first. When you say cumulative, I mean is it the

25 cumulative curve or the number that Said mentioned,

1 the expected value of the consequence?

2 CHAIRMAN SHACK: Expected value,

3 cumulative.

4 MEMBER APOSTOLAKIS: That's not what Tom

5 wants I think.

6 MEMBER KRESS: I want you to take this set

7 of licensing basis events with the figure of merit

8 curve and design your plan to it. But then you have

9 a plant design. Then I want you to go back to your PRA

10 and calculate a cumulative complementary distribution

11 function with the PRA.

12 MEMBER APOSTOLAKIS: Right.

13 MEMBER KRESS: And meet my new curve there

14 which is a design acceptance curve.

15 MEMBER APOSTOLAKIS: So that's not a

16 single number.

17 MEMBER KRESS: It's a curve.

18 MEMBER APOSTOLAKIS: It's a curve that

19 satisfies --

20 MEMBER KRESS: Right. That's exactly what

21 I want.

22 MEMBER APOSTOLAKIS: That's different than

23 what Said said.

24 CHAIRMAN SHACK: No, that's what Said

25 said.

1 MEMBER KRESS: I think basically it is.

2 MEMBER WALLIS: How would draw the curve,

3 Tom? Infinite number of curves which you can draw.

4 MEMBER KRESS: There's only one curve that

5 will fit a CDF and a LERF.

6 MEMBER WALLIS: No, there's two points.

7 A curve is the whole continuous frequency consequence.

8 MEMBER KRESS: Yes, but the LERF is an

9 integral under that curve.

10 MEMBER WALLIS: Yes, but they're all kinds

11 of curves that have the same integral --

12 MEMBER KRESS: But I add a condition to

13 that and my curve -- you're right. My curve -- I

14 impose a condition of a non-risk averse.

15 MEMBER WALLIS: Okay. So you --

16 MEMBER KRESS: You're absolutely right.

17 If you impose that condition, then my curve is

18 correct. But you can also make it risk averse if you

19 want a different curve. That's a policy issue.

20 MEMBER APOSTOLAKIS: So you want an

21 integral part on eight, but I don't think the wording

22 of eight is correct, that these sequences can be

23 arbitrarily changed.

24 MEMBER CORRADINI: Which eight? Eight

25 comma under technical issues, not Graham eight.

1 MEMBER WALLIS: Where is eight?

2 MEMBER CORRADINI: Eight parentheses,

3 technical issue number one.

4 MEMBER WALLIS: I think I would agree with

5 that.

6 CHAIRMAN SHACK: Okay, we agree on

7 something.

8 MEMBER CORRADINI: Can we circle it just

9 to make sure we don't go back on ourselves?>

10 (Laughter.)

11 So on page one, number eight, I can circle

12 it?

13 CHAIRMAN SHACK: We can circle it.

14 MEMBER WALLIS: Isn't that what's in the

15 QHOs? The QHOs are the summation of overall risk.

16 Isn't that what the first QHO is, it's the total risk

17 -- isn't that the same thing.

18 CHAIRMAN SHACK: Only if your PRA is

19 calculating essentially CDF and LERF.

20 MEMBER WALLIS: No, no, no.

21 CHAIRMAN SHACK: You're calculating more

22 consequences and this is an extended PRA.

23 MEMBER KRESS: This covers the whole range

24 of frequencies and consequences.

25 MEMBER APOSTOLAKIS: But you have to make

1 it clear that you're talking about the complementary
2 cumulative distribution function, not just summary.
3 CHAIRMAN SHACK: The Staff knows what
4 we're talking about.
5 MEMBER WALLIS: This is something else.
6 The additional acceptance criteria and the sums over
7 a risk, that's simply the excepted dose. That's one
8 thing. It's not a curve.
9 MEMBER KRESS: No, this is a release.
10 MEMBER WALLIS: We're not talking about a
11 curve here.
12 MEMBER KRESS: This is a frequency of
13 release. Frequency of exceeding that a certain
14 release value.
15 MEMBER CORRADINI: We haven't left this,
16 so can I ask my question at this point? Maybe it's --
17 you can rule me out of order. If right now by
18 regulation the licensee has to do these sorts of
19 calculations, but everything, back to my cartoon,
20 everything that the licensee has to deal with in terms
21 of design space or DBAs over on this side, they do the
22 calculation. They find out what their site here is,
23 but there's nothing to compare to over here. There's
24 just kind of a like this sort of thing with a CDF and
25 a LERF and if it's less than 10^{-5} or 10^{1-6}, they get the

1 thumbs up. Right? That's the current method.

2 By what you're saying here is more than

3 that. You're not only saying develop a curve and do

4 that sort of approach. You're saying regulate out in

5 this space.

6 CHAIRMAN SHACK: Again, in their enhanced

7 safety, they've already agreed that they want the new

8 reactors to meet the QHOs which essentially is

9 regulating out in that space, given Tom's objections

10 over whether we're really a QHO or someplace else, but

11 we're basically doing that.

12 MEMBER CORRADINI: So my question is and

13 I guess it kind of goes back to -- Dana said something

14 the last time we were going through all this, the only

15 place -- the only way I can imagine with the new

16 designs that you would violate out here and yet

17 satisfy in here is some sort of large common mode

18 failure which is external. I can't think of any of

19 the new designs that they are going to have a problem

20 out here and not a problem in here that's an internal.

21 So my question is why would I regulate a

22 design certification out here since we're now back to

23 site dependency.

24 MEMBER KRESS: The design curve.

25 MEMBER CORRADINI: No, but do you

1 understand my point? My point is you agreed with me
2 that the advanced designs, if they violate, they'll
3 have a violation here and here, right? It's hard for
4 them to be violating out here because they're driven
5 by external events. External events is a site issue.
6 MEMBER WALLIS: No, they're not. They're
7 driven by major accidents of any kind.
8 MEMBER CORRADINI: I don't see any of the
9 new designs, practically speaking.
10 CHAIRMAN SHACK: With internal events,
11 your CDFs are very low. Under seismic, you're still
12 somewhere in the order of 10^{-5}.
13 MEMBER WALLIS: That's where we want them
14 to be.
15 MEMBER CORRADINI: Okay, so my practical
16 question is, my practical question is you just told me
17 that we've invented a scheme that's irrelevant out
18 here because it's site dependent more than design
19 dependent.
20 MEMBER WALLIS: We've made them so safe
21 that something else matters, is that what you're
22 saying?
23 MEMBER CORRADINI: Yes.
24 MEMBER WALLIS: So safe against internal
25 events that something else is going to govern design?

1 MEMBER CORRADINI: Yes. So I'm back to my
2 question which is is the right-hand branch out of here
3 essentially dominated by site events and so it's a
4 whole different ball game? That's what I --
5 MEMBER APOSTOLAKIS: The law of
6 probability --
7 MEMBER CORRADINI: Yes.
8 MEMBER APOSTOLAKIS: Here, it is dominated
9 by those, I think.
10 MEMBER CORRADINI: So we can argue about
11 all this stuff, but we're kind of --
12 MEMBER APOSTOLAKIS: Guys, when you say we
13 agree on 8, what exactly are we agreeing?
14 MEMBER WALLIS: What are we agreeing on,
15 yes. I want to know what we're agreeing on.
16 MEMBER APOSTOLAKIS: Are we agreeing in
17 principle? Are we going to write a letter that
18 reflects this?
19 CHAIRMAN SHACK: I think we want to write
20 a letter that reflects that the NUREG should include
21 the complementary cumulative --
22 MEMBER APOSTOLAKIS: Okay, now can we
23 reserve judgment?
24 CHAIRMAN SHACK: The question is what is
25 that curve that they're supposed to meet? I would

1 argue that the staff would get it by looking at the
2 current regulations, the current reactors, finding out
3 what that looks like for the current thing and you've
4 said it's okay.
5 MEMBER APOSTOLAKIS: But what would they
6 put on the horizontal axis? What would you put on the
7 horizontal axis? That's a serious disagreement here,
8 isn't it?
9 MEMBER CORRADINI: Detail, detail.
10 MEMBER APOSTOLAKIS: Detail?
11 CHAIRMAN SHACK: I would put dose because
12 that's the way the current regulations --
13 MEMBER CORRADINI: Just so I'm clear, if
14 you put dose, then I'm back to my point about the
15 site.
16 CHAIRMAN SHACK: My problem with Tom is
17 Tom's change is a policy change.
18 MEMBER KRESS: It's not a policy change.
19 CHAIRMAN SHACK: Well, you have to turn
20 all these dose limits into -- maybe it isn't a policy
21 change. Maybe you could do it in terms of releases.
22 MEMBER KRESS: It's a very --
23 CHAIRMAN SHACK: It's a minor extension of
24 the current.
25 MEMBER KRESS: It's a very rational thing

1 to do because a designer doesn't have any idea what
2 society is going to have to --
3 CHAIRMAN SHACK: I claim the generic site
4 is good enough.
5 MEMBER APOSTOLAKIS: If you have iodine
6 curies and you have cesium curies, then you go through
7 this intermediate thing as you say, the cesium curies
8 are equivalent to so many curies? Is that --
9 CHAIRMAN SHACK: Dose conversation, right.
10 MEMBER KRESS: It's dose conversion.
11 MEMBER APOSTOLAKIS: How is that different
12 from what the staff is doing?
13 MEMBER KRESS: Because they have to talk
14 about some generic site characteristics where they
15 have a wind rose and they have a distance to the site
16 boundary.
17 MEMBER APOSTOLAKIS: Okay, okay. You have
18 eliminated some of that requirement.
19 MEMBER KRESS: Yes, I'm taking that out.
20 MEMBER POWERS: George, the rem-rad
21 conversation is pretty easy for gamma data, some of
22 these modern -- some of these advanced reactors that
23 are focusing on actonite systems, things like that,
24 the conversion is not so obvious. To me, it's more
25 complicated to do.

1 MEMBER APOSTOLAKIS: But it can be done.
2 MEMBER POWERS: Yes, the 10 CFR Part 20
3 tells you exactly how to do it.
4 MEMBER APOSTOLAKIS: Okay.
5 MEMBER CORRADINI: For every isotope.
6 MEMBER POWERS: There may be a few that
7 are not in there, but nearly everyone is in there.
8 MEMBER KRESS: I think you can pretty well
9 --
10 MEMBER APOSTOLAKIS: So we still don't
11 know whether we all agree as to what the horizontal
12 axis should be.
13 CHAIRMAN SHACK: Right.
14 MEMBER APOSTOLAKIS: But we agree that in
15 addition to the staircase that the Staff is proposing,
16 there should be some integral evaluation which is
17 sufficiently different from what they're proposing
18 already which is to check with the QHOs.
19 I'm not happy with that.
20 CHAIRMAN SHACK: I'm not sure it's all
21 that different.
22 MEMBER APOSTOLAKIS: And then what on
23 earth is the disagreement?
24 CHAIRMAN SHACK: My interpretation --
25 MEMBER APOSTOLAKIS: I think a major

1 disagreement is what Tom is raising. He wants to see
2 curies. The Staff says no.
3 CHAIRMAN SHACK: I think the major
4 disagreement is he wants to propose a whole lot more
5 conservatism on the acceptance criteria.
6 MEMBER WALLIS: I think you're crazy to
7 try to design this in a meeting of a couple of hours.
8 MEMBER KRESS: You know, all the utility
9 requirements documents, all the things we talk about
10 in new plants say our goal is to have a CDF of 10^{-5}
11 and a LERF at 10^{-6}. My curve would just make it the
12 policy. That would put --
13 CHAIRMAN SHACK: But they're thinking
14 internal events when they make those statements.
15 MEMBER KRESS: I don't care what the
16 events are.
17 MEMBER APOSTOLAKIS: Do you know what
18 would help a lot here, to do what Graham wants. Why
19 don't we try or maybe the Staff can do it or we can do
20 it or somebody, have a slide with the actual
21 requirements up front.
22 MEMBER WALLIS: You're going to ask us to
23 redesign the framework in one meeting here?
24 MEMBER APOSTOLAKIS: No, I'm trying to
25 support you and you turn around and hit me.

(Laughter.)

MEMBER WALLIS: No, no, no, no. I agree to.

MEMBER APOSTOLAKIS: That will teach me in the future. This is a great lesson.

(Laughter.)

MEMBER WALLIS: I agree. I just think, George, to do it properly is not something you're going to do in a meeting.

MEMBER APOSTOLAKIS: I understand that, but what I'm saying is because of this -- I must say I'm still not very clear regarding what Tom is advancing. I'm not saying I disagree. If we had a list that says here are the actual performance requirements that the Staff has imposed. Regarding number three, Kress disagrees and wants this. Regarding number five, somebody else disagrees. That would make it much clearer and then we can put it in --

MEMBER KRESS: Let me clarify things with the simple analysis. If we were to be designing a current LWR, we would have a set of design basis accidents. We would have figures of merit and they would be required to meet those, but we would also ask nowadays once you see the F in your LERF, and we'd

1 like for you to have 10^{-4} and 10^{-5}, okay. Now let's
2 say we -- that turned out to be a good idea.
3 Now let's say we wanted to do that with
4 the new framework. We'd have design basis accidents.
5 We'd have a figure of merit curve and we'd also ask
6 what's your CDF and LERF? Oh, I don't know what that
7 is because our plant doesn't have CDF and LERF. Well,
8 we can ask them what is their CCDFC curve is because
9 it's the same thing as a CDF and a LERF, not exactly,
10 but it's consistent with it and we know what level to
11 put it at because we're asking now for 10^{-5} and 10^{-6} to
12 be consistent with the international thinking, the
13 utility requirements document, the desire for a higher
14 level of safety for new plants, for lots of reasons.
15 So it's a direct analogy to what we do
16 now. It gives them a really fine set of criteria to
17 design to and a way to do it and a way to impose
18 defense-in-depth through the design basis.
19 MEMBER WALLIS: What you're saying
20 essentially, Tom, is that CDF and LERF have been very,
21 very useful.
22 MEMBER KRESS: Absolutely.
23 MEMBER WALLIS: For many years and this
24 usefulness should not be discarded by using something
25 completely different.

1 MEMBER KRESS: Wonderful. That's exactly
2 what I'm saying and I'm saying you could do it --
3 MEMBER APOSTOLAKIS: We are using too
4 strong a word, because what the Staff is proposing may
5 have it already been --
6 MEMBER WALLIS: It's not clear that it's
7 there.
8 MEMBER APOSTOLAKIS: It should be more
9 evident. I think that's more appropriate.
10 MEMBER KRESS: It's not already built in.
11 If you go straight to the QHOs, you bypass it, the CDF
12 --
13 MEMBER WALLIS: You need the Chapter 1
14 which says how we got these useful things we want to
15 see in the framework such as an equivalent to CDF and
16 an equivalent -- I just think if the Staff doesn't
17 listen, then nothing is going to happen.
18 MEMBER KRESS: Oh, they're listening.
19 Marty listens.
20 MEMBER APOSTOLAKIS: The issue here is
21 what to put in the letter, not what the Staff does.
22 Because if we open it up --
23 CHAIRMAN SHACK: I'm not sure that we're
24 getting any closer as an ACRS to agreement.
25 MEMBER APOSTOLAKIS: I want advice for my

letter.

CHAIRMAN SHACK: We have another hour to go yet, George.

MEMBER APOSTOLAKIS: No, 55 minutes.

MEMBER ARMIJO: The thing is not ready to go. It's not ready to go.

CHAIRMAN SHACK: It's ready to go. We're not ready to agree on anything.

MEMBER ARMIJO: We could write a letter and say it's not ready to go.

MEMBER WALLIS: That's right.

MEMBER ARMIJO: This is not ready to go and we're not ready to give them decent advice. That's all there is to it.

MEMBER APOSTOLAKIS: I think if we do what I suggested in terms of two slides, putting down the requirements specifically the way Graham wants them, the way Said wants them, and then ask Tom to tell us which one he would change. That will go a long towards reaching consensus.

MEMBER WALLIS: But then you're establishing --

MEMBER ARMIJO: Right now, what is -- what determines the maximum acceptable consequences of a single event of a given frequency in the framework?

1 It is the stepladder.

2 MEMBER APOSTOLAKIS: The stepladder.

3 MEMBER ARMIJO: Okay. Second question.

4 What determines the total cumulative consequences of

5 all possible scenarios in a given plant?

6 MEMBER KRESS: There, there's two things.

7 One of them is this CCDF curve with --

8 MEMBER ARMIJO: No, no, currently.

9 MEMBER KRESS: That's what I meant.

10 MEMBER APOSTOLAKIS: They ask you to meet

11 the QHOs. That's an integral quantity.

12 MEMBER KRESS: Yes, but --

13 MEMBER APOSTOLAKIS: Don't dismiss that.

14 MEMBER WALLIS: It's an expected dose and

15 should have a measure of expected dose consistent with

16 the QHOs.

17 MEMBER APOSTOLAKIS: You need more than

18 just a dose to -- because the QHO is in terms of

19 individual risk.

20 MS. DROUIN: I don't know what to say

21 because I don't understand the question to be quite

22 frankly.

23 MEMBER ARMIJO: We are trying to impose

24 two constraints, one on the maximum acceptable risk or

25 maximum acceptable consequences of a single event.

1 This is sort of a decision that you know we will not
2 accept a plant that has a single event with
3 consequences that exceed a certain limit in each
4 frequency range.
5 MEMBER WALLIS: In each frequency range,
6 that's different -- but why do you have dispersion in
7 the frequency range?
8 MEMBER MAYNARD: That's consistent with
9 the current requirements, the current regulations and
10 it's easy to, I think, to explain that and to show
11 that. That's where the existing requirements come
12 from.
13 MEMBER ARMIJO: And the next constraint
14 that we would like to impose is what is the total risk
15 associated with all potential accidents that we can
16 identify for that particular design?
17 MEMBER KRESS: And where risk here is
18 defined as release of fission products. I think
19 there's a third constraint and that is you also must
20 have a site that meets the QHOs and that depends on
21 the site characteristics, the number of plants there
22 are, their power, the type of plant. So you need the
23 three constraints. That's what I'm saying.
24 MEMBER ABDEL-KHALIK: Mary is going to ask
25 about the second constraint. Is there one?

1 MS. DROUIN: I don't understand. Are you
2 asking me if I agree with you.
3 MEMBER ARMIJO: Where in the current
4 framework do you have those constraints or do you have
5 those constraints in the current framework? Because
6 I guess somebody saying yeah, they exist and somebody
7 is saying no, they don't exist.
8 MS. DROUIN: Chapter 6 --
9 MEMBER ARMIJO: Gives the constraints on
10 the first one.
11 MEMBER APOSTOLAKIS: You have the
12 staircase --
13 MS. DROUIN: Right, all of that is in
14 Chapter 6.
15 MEMBER APOSTOLAKIS: You have the
16 requirement of the QHO.
17 MS. DROUIN: And it's probably also in
18 Chapter 3. I didn't bring a copy of the former
19 document with me, but --
20 MEMBER WALLIS: Three has the step curve
21 too. It doesn't explain it.
22 MEMBER APOSTOLAKIS: What's missing is
23 this CDF and LERF --
24 MS. DROUIN: And it will also be discussed
25 in Chapter 8. Chapter 8 is the chapter that says how

1 this stuff is imposed from a regulatory perspective.
2 MEMBER WALLIS: But why did you want that
3 frequency? Why did you want that F-C curve in the
4 first place?
5 MEMBER KRESS: It's just a figure of merit
6 --
7 MEMBER WALLIS: Why that? Why not
8 something else like the cumulative.
9 MEMBER APOSTOLAKIS: Because they want to
10 define the accidents that will replace the design
11 basis.
12 MEMBER WALLIS: But why? Why do you need
13 to replace the design basis?
14 MEMBER APOSTOLAKIS: Because the whole
15 idea is to be risk informed. The design basis
16 accidents are --
17 MEMBER WALLIS: No explanation in this
18 report about why you have to have a DBA --
19 MEMBER APOSTOLAKIS: They are replacing
20 the traditional deterministic DBAs.
21 MEMBER WALLIS: Why?
22 MEMBER APOSTOLAKIS: By something that is
23 risk informed.
24 You have to go to the intervals of --
25 MEMBER KRESS: The reason is you can't

1 rely on the calculations of the PRA because they don't
2 have enough thermal hydraulics. So you use the design
3 basis accident.
4 MEMBER WALLIS: And that needs to be
5 explained. That's not in there.
6 MEMBER KRESS: I know, but you're
7 complaining about what they talk about and not what
8 they're doing.
9 MEMBER WALLIS: I'm talking about the
10 whole thing.
11 MEMBER POWERS: Please continue with your
12 explanation because I personally think that design
13 basis accidents is not only an anachronistic concept,
14 it's a flawed and useless concept.
15 MEMBER APOSTOLAKIS: It's what?
16 MEMBER POWERS: Flawed and useless.
17 MEMBER WALLIS: Thank you. That's a very
18 good statement. Now that has to be rebutted somehow.
19 MEMBER KRESS: I personally think you have
20 an option. Let's say you have completely risk-based
21 regulations where you use the PRA and say you must
22 meet the PRA risk things that could be CDF and LRF
23 equivalents and it could also be the QHOs.
24 Now I don't think in my mind that -- you
25 could also have uncertainties and say they have to

1 meet these certain confidence level, but I personally
2 believe that the design basis accident concept gives
3 you two things beyond that or three. One of them is
4 the PRA normally doesn't deal with releases that are
5 not core melt releases, they're small releases,
6 releases from the --
7 MEMBER WALLIS: Well, the new one will.
8 The new one will because it's dose overall whole
9 range.
10 MEMBER KRESS: Maybe, but not -- I haven't
11 seen it yet. But anyway, the design basis accident
12 gives you a way to look at all the range of accidents
13 whether they contribute to risk or not, but they're
14 things that happen that in a regulatory sense you
15 don't want to happen. They could be small releases.
16 They may just be things that occur and don't even give
17 you a release hardly. That's number one.
18 The design basis accident gives you the
19 ability to have a very detailed consequence analysis
20 that I don't think for a specific set of
21 representative-type accidents, I don't think there's
22 such an ability in the PRA to do. It gives you the
23 concept of a regulator looking at what you do and
24 improving your calculation of two and actually seeing
25 that it's appropriate and has appropriate detail in

1 it. It also gives you what I would call the concept
2 of a design licensing basis which has lots of things
3 associated with it and that is ways to get margin,
4 ways to get defense-in-depth, ways to invoke some form
5 of defense-in-depth and margins. It gives you all the
6 good things about the design basis concept we have
7 now, but then you say well, design basis concept is a
8 bit of a construct and its purpose is to have you look
9 at all these things, but it's primary purpose is to
10 render a plant to a design that's acceptable risk.
11 But it doesn't give you that.
12 MEMBER WALLIS: Can you justify that with
13 LOCA? I mean how does the design basis LOCA help you
14 to do anything about submitting risk from LOCAs?
15 MEMBER KRESS: It doesn't.
16 MEMBER WALLIS: It doesn't. It has
17 nothing to do with it.
18 MEMBER KRESS: I was just getting ready to
19 say that it doesn't tell you the risk. It gives you
20 an implied good feeling that you design this system
21 that may have risk, but then you say oh well, what do
22 we do? We go back to the PRA. We go back to the PRA.
23 MEMBER WALLIS: Focus on the things that
24 are risky, not some artificial thing that's not --
25 MEMBER APOSTOLAKIS: That's what they do.

1 MEMBER KRESS: And if your PRA tells you
2 that you haven't met your goals within a certain
3 confidence level, then you go back and change the DBAs
4 or change their figures of merit. You do something
5 that causes the design to get better so it can meet
6 your risk objective. You've got to do both. And that
7 preserves --
8 MEMBER APOSTOLAKIS: The PRAs --
9 MEMBER POWERS: For one, you the designer,
10 can hypothesize all the DBAs you want to and do your
11 design any way you want to. All I'm going to do is
12 look at your risk assessment and one other thing and
13 the iteration you did to get that risk assessment, I
14 really don't care how you got there. I only care that
15 you got there. Why wouldn't that be fair, Tom?
16 MEMBER KRESS: Well, then the PRA becomes
17 the last thing basis.
18 MEMBER CORRADINI: That's where I have a
19 problem, Dana. I just want to jump in and say if I
20 believe the simulation tool from the point that I
21 could run 10,000 simulations and generate the curve in
22 the uncertainty, I'd buy it. But I don't believe the
23 simulation tool is that good.
24 MEMBER POWERS: So improve it. As I said,
25 there's one other thing.

1 MEMBER CORRADINI: What's that?

2 MEMBER POWERS: And the other thing I do
3 is I say okay, I'm pretty sure that there is probably
4 a flaw in your simulation to where you caused it. It
5 was written by Theodophonos, so I know it's flawless,
6 but there might be a flaw in it. And so I say now
7 despite all your evidence to the contrary, hypothesis
8 is you release a substantial amount of radioactivity
9 in the containment. Tell me what happens to the site
10 boundary?

11 Do a Part 100 analysis for me. And tell
12 me what happens.

13 MEMBER KRESS: I think somewhere along the
14 line we decided that that concept of releasing an
15 artificial fission product source term in the
16 containment and calculated doses at site boundary,
17 didn't really do anything to reduce the risk.

18 MEMBER CORRADINI: I want to play along.
19 Tell me the design basis accident for the containment
20 that keeps it below an acceptable thing at the site
21 boundary and I'll play the game. Because if you look
22 at 10 CFR 100, the DBA with the maximum credible
23 accident is actually a LOCA.

24 MEMBER POWERS: No.

25 MEMBER CORRADINI: Yes, it is. If you

1 look at the temperature pressure --

2 MEMBER POWERS: It is not. It is not.

3 MEMBER CORRADINI: What is it then?

4 MEMBER POWERS: It is a core melt

5 accident.

6 MEMBER CORRADINI: That's the source term,

7 but the load that is put on the containment to meet

8 the .1 percent per day is a LOCA. So you've got this

9 screwed up situation where you've designed a barrier

10 based on a loss of coolant accident, but you've

11 designed a release based on a source term which can

12 never happen from a LOCA.

13 MEMBER KRESS: It's a design basis

14 concept.

15 MEMBER POWERS: I simply don't care. I

16 don't care because I'm saying your calculational tool,

17 your calculational tool, I'm sure again it was written

18 by the esteemed professor from the University of

19 California at Santa Barbara, I'm sure it's flawless,

20 but on the off chance that maybe one of your graduate

21 students who snuck in from Dartmouth and wrote a

22 section of software in there and screwed it up, made

23 a mistake, show me that you have this defense-in-depth

24 capability.

25 I'm also going to ask you about your

1 review emergency evacuation, but that's kind of
2 methodic.
3 MEMBER CORRADINI: How are you going to
4 identify, just so I'm -- I don't disagree with the
5 approach, but somewhere in there you're assuming a
6 barrier at the containment which is the containment
7 system and somebody designed that and they need a
8 series of design specifications for that which means
9 you're back to a design basis accident.
10 MEMBER POWERS: And I say yes, you have a
11 design for this containment. I'm sure you did a good
12 job on this. You have a design basis -- I'm sure you
13 did a good job on this, please tell me what happens to
14 the boundary because it's a defense-in-depth measure.
15 And other than that, I don't care.
16 MEMBER CORRADINI: But I guess, in some
17 sense, the only thing that still gets me and this is
18 just -- I might not be getting it. I've seen other
19 things that were potentially, eventually if they ever
20 get built regulated on risk base versus risk informed
21 and the first attack on the reasonableness of it is
22 the fact that I'm doing simulations and at the very
23 low probability high consequence, I can't be sure of
24 the uncertainty in the simulation.
25 MEMBER POWERS: And it will come in in

1 spades in the gas-cooled reactors, for instance.

2 MEMBER CORRADINI: I actually agree with

3 you there.

4 MEMBER POWERS: All the source-term models

5 are all screwed up.

6 MEMBER WALLIS: So what you guys are doing

7 now is what should be in Chapter 2. You look at your

8 objectives and you look at alternative ways to meet

9 them, one of which is Dana's, one of which is Tom's,

10 one of which is -- you know -- and you decide why you

11 --

12 MEMBER CORRADINI: The only reason I spoke

13 up at this point is Tom gave all the attributes of why

14 you need some sort of set of accidents to work through

15 the design because eventually, when you get to the

16 designer, unless we get much more sophisticated and

17 I'll be dead and a couple of grand kids will be dead,

18 I'm not sure you're going to be able to get past some

19 deterministic method of an engineering system and what

20 that engineering system has got to essentially

21 withstand.

22 MEMBER POWERS: Let me explain why I would

23 take what Tom told me about his design basis accident

24 and I would turn it right around and say yes, you're

25 absolutely correct, Tom. Everything you said was

1 absolutely correct. What you are doing is
2 proliferating a huge number of requirements, most of
3 which are not of any use because they focus on
4 accidents that don't occur.
5 MEMBER WALLIS: That's another question is
6 why you have all these requirements. There's nothing
7 in this framework about what's really necessary and
8 why this is efficient and all that. There's not
9 criterion at all. It's simply describing a whole lot
10 of requirements.
11 MEMBER POWERS: And frequently the
12 requirements are for accidents that never occur.
13 CHAIRMAN SHACK: That's not true. The way
14 they're picked here though because they do come out of
15 the PRA. They are --
16 MEMBER APOSTOLAKIS: But you look at the
17 beginning, I think that's Graham's problem. You don't
18 see a list of what will be required. You don't see
19 that. I mean you go to Chapter 6 and you see some
20 requirements and maybe later on you have other
21 requirements. That's why I think we will never agree
22 to anything unless we see a summary of what is
23 required.
24 MEMBER KRESS: And there's a chicken and
25 egg question. In order to determine the licensing

1 basis events which involve frequencies and
2 consequences of classes of accidents, you have to have
3 a PRA first. In order to have a PRA first, you have
4 to have a design. But the purpose of the licensing
5 basis event is for the designer to have something to
6 design to.
7 MEMBER WALLIS: They already go together,
8 you develop --
9 MEMBER CORRADINI: I think the purpose of
10 the licensing basis event is to have the regulator
11 have something to regulate.
12 MEMBER WALLIS: That's it, give him
13 something to do.
14 MEMBER KRESS: So the designer will sit
15 there and --
16 MEMBER APOSTOLAKIS: It's also something
17 else. In order to do the PRA --
18 MEMBER KRESS: The concept would be that
19 the designer comes forth with say, here's my licensing
20 basis events. Here's my F-C curve that I want to use.
21 MEMBER APOSTOLAKIS: It's a back and forth
22 thing.
23 MEMBER KRESS: It's a submission. So I
24 don't see what the Staff is doing telling them what
25 the F-C curve is.

1 CHAIRMAN SHACK: His F-C curve wont' look
2 like their F-C curve. His F-C curve just has to be
3 inside that F-C curve.
4 MEMBER ARMIJO: The Staff's F-C curve
5 should be universal, both for the single events and
6 for the --
7 MEMBER KRESS: But if it's the maximum
8 frequency and the maximum consequence or some
9 combination of those, coming out of the PRA sequences,
10 how could it be universal? Those are all different
11 for every reactor --
12 CHAIRMAN SHACK: They have to be inside.
13 MEMBER APOSTOLAKIS: Below the curve.
14 MEMBER CORRADINI: I guess the only thing
15 that -- the thing that I guess I didn't think about
16 that Dana has brought in is that we still have 10 CFR
17 100 or the equivalent of it. It's essentially the
18 site criteria. So if you were to default to a totally
19 risk-based system, you still would have --
20 CHAIRMAN SHACK: No, no, no, this is a new
21 regulatory system.
22 MEMBER APOSTOLAKIS: This is a new rule.
23 CHAIRMAN SHACK: You have it in their
24 system because they have their staircase that
25 essentially puts --

1 MEMBER CORRADINI: There would be no site
2 criteria?
3 CHAIRMAN SHACK: No, they have essentially
4 the Part 100 thing built into that F-C curve. Instead
5 of postulating it -- they put it in as a frequency
6 kind of a thing.
7 MEMBER APOSTOLAKIS: The designer, if this
8 ever becomes a rule, will take a different approach
9 from the regulator. The designer will go back and
10 forth because to determine the success criteria for
11 the PRA, you need the thermal hydraulic analysis.
12 After you determine the success criteria,
13 you are really very crude. You are saying if you
14 don't have these two trains, you have failed. Well,
15 hell, there is a whole range of things in there, but
16 the PRA says that. So if it goes with the PRA, finds
17 the sequences, then the Staff says we don't care how
18 you got there. We will confirm at the end. So for
19 this frequency range, we will pick the one with the
20 highest consequence, determine some -- I don't
21 remember the details, some sequence, and do a detailed
22 calculation with best estimate codes on certainness,
23 and so on, to confirm that you are below this --
24 MEMBER WALLIS: But it still has to be
25 integrated with that particular PRA sequence.

1 MEMBER APOSTOLAKIS: Yes, yes, absolutely.
2 The frequency.
3 MEMBER WALLIS: All you're doing is doing
4 a better analysis of that particular sequence.
5 MEMBER APOSTOLAKIS: Yes, but the designer
6 knows that so when they develop the design they go
7 back and forth and --
8 MEMBER WALLIS: They do that already.
9 MEMBER APOSTOLAKIS: -- but the Staff
10 doesn't have to do that. The Staff will look at the
11 end and say we cannot review three million sequences
12 that the PRA produces. We will review 6, 7, 10,
13 whatever.
14 MEMBER KRESS: And we'll review your
15 calculational tool you used to determine this.
16 MEMBER APOSTOLAKIS: Yes.
17 MEMBER KRESS: Absolutely.
18 MEMBER APOSTOLAKIS: And you have to meet
19 the temperature limits. You have to meet all that and
20 the designer knows that. He has already done it.
21 MEMBER POWERS: George, the problem I have
22 is the designer knows that.
23 MEMBER APOSTOLAKIS: Yes.
24 MEMBER POWERS: So we optimize a whole lot
25 of things for the ones he knows you're going to

1 investigate. He can say yes, I'm going to investigate
2 in depth four or five of your accidents, but I'm not
3 going to tell you which ones they are. I'm going to
4 look at your PRA and decide. Then he has to do the
5 job on all of them.
6 MEMBER APOSTOLAKIS: But he well -- well,
7 he may very well have to do that.
8 MEMBER POWERS: The problem that we've had
9 with design basis accidents, every context where I've
10 encountered them is that we optimize the systems to
11 confront that accident and forget about everything
12 else.
13 MEMBER APOSTOLAKIS: Your argument is that
14 we should tell the designer for this frequency range,
15 we'll pick an accident we want and we will do the
16 mechanistic calculations, is that what you're saying?
17 Instead of picking the licensing basis accident?
18 MEMBER CORRADINI: He's just saying he
19 won't say what he's going to audit, but he's going to
20 audit something.
21 MEMBER APOSTOLAKIS: That's what I'm
22 saying too. In this range, I will reserve the right
23 to pick what I like.
24 CHAIRMAN SHACK: If you came in with a
25 design and suddenly, you know, after you pick that one

1 and he goes back and he finds that one, you only get
2 four choices to pick an accident and that he meets all
3 four of those, you're okay?
4 MEMBER APOSTOLAKIS: But the guy still
5 knows.
6 MEMBER KRESS: They are going to agree at
7 some point on what the licenses basis events are.
8 MEMBER APOSTOLAKIS: But after we do it
9 five times, we'll say to heck with it, we'll look at
10 the highest --
11 CHAIRMAN SHACK: It seems to me, the
12 current approach obviates a lot of what Dana wants
13 because you're picking the design basis event after
14 you do the PRA. It's not imposed a priori.
15 MEMBER APOSTOLAKIS: That's what the Staff
16 wants.
17 CHAIRMAN SHACK: That's right. That's
18 what I say. I think it avoids a great deal of
19 problems that Dana sees in the design basis accident
20 approach. Yes, if you just pick the accident sort of
21 ahead of time, you distort the design. If you --
22 MEMBER APOSTOLAKIS: There are rules that
23 will lead you to the accident.
24 MEMBER ABDEL-KHALIK: If you have this
25 freedom, imagine you start with LWR right at the

1 beginning here, like we might with PBMR or whatever.
2 Then you would say well, I have many ways to handle
3 this as a designer, so instead of putting an ECC in,
4 I'll just make an intelligence core catcher. And I'll
5 make whatever I can to my contains. I'm sure I can
6 cope with the core melt.
7 Now is that an acceptable --
8 MEMBER CORRADINI: Sure. According to the
9 logic --
10 MEMBER ABDEL-KHALIK: According to the
11 logic, it is. It's perfectly logical.
12 I think when you say that you take away
13 all the stylized stuff you've done, I can beat finals
14 and go to G and say I'm going to do whatever the hell
15 to save you from --
16 MEMBER KRESS: You include in your
17 framework some concept of GDCs which takes care of
18 that.
19 MEMBER ABDEL-KHALIK: But that's defense-
20 in-depth. Your core catcher is another defense.
21 MEMBER KRESS: The GDCs --
22 MEMBER APOSTOLAKIS: The deviation will
23 still be there, but that's a good point though because
24 --
25 MEMBER KRESS: You talk about the

1 redundant ways to shut off the core. You would still
2 maintain these kind of concepts and classes and
3 framework.
4 MEMBER WALLIS: You have to have a concept
5 that you don't want to have a core melt.
6 MEMBER ABDEL-KHALIK: Yes.
7 MEMBER WALLIS: You have to have that in
8 there.
9 MEMBER ABDEL-KHALIK: Yes, but then you'd
10 have to put that in.
11 MEMBER WALLIS: You have to put that in.
12 MEMBER KRESS: And that would be a general
13 design criteria.
14 MEMBER WALLIS: I think it should be
15 there.
16 MEMBER ABDEL-KHALIK: The whole thing is
17 no longer a pure risk-based system.
18 MEMBER WALLIS: That's why you've got to
19 go and say what is it you're trying to achieve. One
20 of the things you're trying to achieve is you don't
21 want --
22 MEMBER APOSTOLAKIS: It can still be risk
23 informed --
24 MEMBER WALLIS: You don't want major core
25 damage accidents.

1 MEMBER APOSTOLAKIS: Exactly.

2 MEMBER WALLIS: And that's in there.

3 MEMBER APOSTOLAKIS: That was part of an

4 earlier version.

5 MEMBER WALLIS: Right.

6 MEMBER MAYNARD: There's something else I

7 think we need to make sure that we maintain is also

8 the ability, the stability of the regulator and also

9 the licensee and what the requirements are.

10 We touched on it a little bit earlier.

11 One of the advantages right, design basis accidents,

12 LBEs, is that it provides clear guidance on what

13 becomes the requirement, what comes in the tech specs,

14 what's regulated and what's not. And I'd be all for

15 eliminating design basis accidents if we came up with

16 a good way to really make clear what the requirements

17 are and maintain. I think it is wrong to have a

18 system where hey, as long as you stay under the curve,

19 you're okay. Because I tell you every day I can

20 change and take systems out and do all kinds of

21 things. And we're all going to get confused as to

22 whether I'm in compliance or not.

23 And I think that's something, a lot of

24 attention needs to be paid to before we eliminate it.

25 MEMBER WALLIS: That's not really

1 considered. If you're designing a regulatory system,
2 you've got to do this top down thing and you've got to
3 say then what are -- how are we going to from day to
4 day administer this? How are we going to make it
5 happen?
6 That really isn't in there either.
7 MEMBER ABDEL-KHALIK: You know, the thing
8 that I was saying is not that far out because that's
9 exactly what the Canadians do. What they do is they
10 take different consequences being allowed for
11 different frequencies. So they allow a system to have
12 let's say a sudden consequence if you have the
13 emergency cooling operational and a different
14 consequence if the emergency cooling doesn't operate.
15 And they designed the system so that if the emergency
16 cooling doesn't operate, it still keeps -- melts
17 locally, but keeps a coolable geometry.
18 So you know, once you start to go down
19 this route, it's not clear to me how you patch in all
20 these things to make sure the core is coolable in this
21 frequency range. It is going to not melt in that
22 frequency range. It's not going to do this in that
23 frequency range. Steam explosions in that frequency.
24 I think it's all sorts of stuff, you know. It's
25 frightening in some way, unless you say that all the

1 GDCs actually are there.

2 MEMBER KRESS: Not all of them.

3 MEMBER ABDEL-KHALIK: So your core remains

4 coolable and all this sort of stuff.

5 MEMBER APOSTOLAKIS: We are focusing on

6 the curve too much, it seems to me. If you look at

7 the diagram they have up front they show the QHOs and

8 then you go down, they have defense-in-depth, they

9 have tactics, they have all sorts of things.

10 MEMBER WALLIS: It's a means to an end.

11 That's the performance criteria.

12 MEMBER APOSTOLAKIS: No, but that doesn't

13 end with that staircase. I mean there is all this

14 other stuff you're supposed to meet. A lot of the

15 GDCs probably will be transferred over.

16 MEMBER ABDEL-KHALIK: So when you do a new

17 design, let's say of a PBMR or a HTGR or whatever,

18 which GDC do you transfer and which you do not?

19 MEMBER WALLIS: The first thing you do is

20 you look at 1250 in the GDCs and you say which things

21 are we going to transfer over? And you list those.

22 That's never been done.

23 MEMBER KRESS: They've been doing that.

24 MEMBER WALLIS: That should be done.

25 MEMBER KRESS: They've been doing that

1 with respect to the PBMR.

2 MEMBER ABDEL-KHALIK: That's an essential

3 part to have, right?

4 MEMBER CORRADINI: So just to use the

5 example of your point, I think what Sam and Dana have

6 crafted for the letter we're eventually going to see,

7 relative to fuel performance is performance based. If

8 that was in force, you would have your concern

9 alleviated because it just says thou shall keep it --

10 I don't know what the words you used -- I'll use the

11 word "coolable" so that regardless of whether I have

12 a water-based system that can melt or a gas-based

13 system that can burn, neither is allowable to get past

14 that in terms of fuel performance.

15 MEMBER KRESS: Not allowable at some level

16 of probability.

17 MEMBER CORRADINI: At some level of

18 probability.

19 MEMBER APOSTOLAKIS: Is prevention versus

20 mitigation discussed in the framework, I don't

21 remember.

22 MS. DROUIN: I can't remember where it is.

23 I think it's in Chapter 6.

24 MEMBER APOSTOLAKIS: Because in an earlier

25 version in 2003, you had a table that clearly had core

1 damage frequency and condition probability of
2 containment and the ratio was about 4 over something,
3 so there was -- the requirement that Sam just talked
4 about was there. Now that does not appear in the
5 current version, but I'm wondering -- it does not
6 appear as a table, but I'm wondering whether in the
7 text there is some discussion of that and I don't
8 remember now.
9 MEMBER WALLIS: There is. George, can I
10 tell you where I think we are. It's clear that
11 there's all kinds of opinions here and we're not going
12 to write a letter which says you've got to do these
13 things because we can't make up our minds.
14 What we can say is we think that this
15 framework needs some improvement, needs some
16 modification, something needs to happen to it and
17 we'll work with the staff and it's going to take a
18 year or something to do it. It's not going to happen
19 now. It's not going to happen by one letter. It's
20 going to happen by some serious thought over a period
21 of time.
22 MEMBER POWERS: So that's why we can't
23 rush a NUREG that's not ready to go.
24 MEMBER CORRADINI: So Sam got to the point
25 that in the last half an hour --

1 MEMBER APOSTOLAKIS: Say that again, what
2 is the point?
3 MEMBER CORRADINI: I thought the point
4 that we're having this discussion is to give them
5 informal feedback as they modify a report that's going
6 to emerge.
7 CHAIRMAN SHACK: And also to develop our
8 own position on what the technology neutral framework
9 is.
10 MEMBER CORRADINI: Let's just talk about
11 the first thing which is to give them informal
12 feedback so when the report emerges it has a bit more
13 clarity in certain places.
14 MEMBER APOSTOLAKIS: The only thing I can
15 see now us recommending is don't publish the NUREG in
16 August.
17 MS. DROUIN: May I give some informal
18 feedback to the informal feedback I've heard for the
19 last two hours?
20 MEMBER APOSTOLAKIS: Yes, you can.
21 MEMBER KRESS: Yes.
22 MS. DROUIN: Can I go off the record?
23 MEMBER KRESS: Yes. No, I don't know.
24 Can she? Sorry.
25 MEMBER CORRADINI: Leave it on the record,

1 don't worry about it.

2 MS. DROUIN: I'm not even sure where to

3 start to be honest.

4 CHAIRMAN SHACK: Count to 10.

5 MS. DROUIN: I'm already up to 100. There

6 is a gross misunderstanding what this framework

7 document is and what it's supposed to be and what it

8 is not. You all are looking for everything for this

9 whole regulatory licensing structure with all of the

10 answers in this document. It was never meant to do

11 that.

12 This was a first phase of a program to get

13 to what a regulatory structure for licensing future

14 reactors. This was not meant to have everything. You

15 all are looking for everything to be here. So I'm not

16 surprised you aren't finding these things because they

17 aren't supposed to be in it yet.

18 This was a document that was to provide

19 the initial thinking, the conceptual approach, to see

20 whether it was going to be feasible to move forward.

21 You all are trying to get everything resolved and all

22 of the bells and whistles into this document that was

23 never meant to be. So that's my -- I want to put that

24 out there.

25 MEMBER ARMIJO: What use is it if it's

1 just an interim step, for purposes of review, which
2 we're doing now, you now and maybe that's all it
3 should be. Why publish something that really isn't
4 going to do anything?
5 What are you going to do with it?
6 MS. DROUIN: That's a matter of debate
7 whether it's going to do anything. That's the first
8 step in any program.
9 MEMBER CORRADINI: Can I ask you a
10 question, Mary? So just to go with that, since I
11 don't have it, I looked for it. I only have a
12 synopsis of it. In the preamble or executive summary,
13 does it say literally those things you just said which
14 is be careful, this is an initial step? This is a
15 starting point. This has some key things on a path
16 that will be longer than just this document?
17 If it says that in the preamble or
18 executive summary, I'm on board. If it doesn't --
19 MS. DROUIN: The foreword has not been
20 written yet and the foreword would say that. The
21 initial -- I believe the forward that was drafted did
22 say that.
23 I mean there are a lot of policy issues
24 that need to be made before we can really go to things
25 because it's fraught with policy issues that we need

1 answers on before we can resolve a lot of this stuff.

2 MEMBER WALLIS: Mary, that's not the

3 impression the document gives. The impression the

4 document gives is that this is what you want to see

5 happen and it's final. I mean there's no, there

6 aren't all these cautionary statements in there.

7 MS. DROUIN: Well, I think they're in

8 there. You might not have found them and they may not

9 be clear enough, but they are in there.

10 You talk about that you want to see the

11 requirements up front. We haven't written the

12 requirements. That's not done yet.

13 MEMBER WALLIS: If you don't know what the

14 requirements are, how can you design a framework?

15 MS. DROUIN: The framework is to help you

16 write the requirements. It's like you want to have

17 the requirements and then come back and say well,

18 here's the framework of how I got there. The

19 framework is supposed to give you the framework, the

20 guidance for how you're going to write these

21 requirements.

22 MEMBER APOSTOLAKIS: But some of the

23 comments here are not at that level, Mary. If this

24 document completely ignores a core damage frequency,

25 and some people say no, that's an extremely important

1 part, that's not just a requirement. That's a
2 philosophical basic approach.
3 MS. DROUIN: I'm not arguing that point.
4 I'm back up here with the overall general discussion
5 that I've heard for the last two hours.
6 MEMBER APOSTOLAKIS: So the focus should
7 be at that level. What is it that should be there?
8 And if it's not, maybe we should --
9 MEMBER ABDEL-KHALIK: I am looking at it
10 from a pragmatic point of view.
11 MEMBER APOSTOLAKIS: Everybody is trying
12 to do that.
13 MEMBER ABDEL-KHALIK: I'm trying to apply
14 this to a PBMR or whatever.
15 I want to know what is the minimal set of
16 GDCs and some sort of risk-informed thingies that I
17 can put together and actually do something with it.
18 I'm a designer. Let's say --
19 MEMBER APOSTOLAKIS: We did recommend --
20 MEMBER ABDEL-KHALIK: I go to the South
21 Africans and I say look, guys, we're going to try and
22 get this through the NRC and I want to --
23 MEMBER APOSTOLAKIS: Do we recommend that
24 they do that?
25 MEMBER ABDEL-KHALIK: I think that is the

1 minimum one should have in this document.

2 MEMBER APOSTOLAKIS: In the document

3 itself.

4 MS. DROUIN: We have said on numerous --

5 I know we have said it at every meeting we have come

6 to the ACRS. We've said it at every public meeting,

7 this document is not meant for licensees. This is a

8 document meant for staff to help the staff write the

9 requirements. This is not a document for licensees to

10 go out and use to design their plans with.

11 MEMBER WALLIS: I don't understand this.

12 They use the framework to write the requirements. I

13 thought the framework derived from some more basic

14 requirements which you were trying to enforce in some

15 way by having a framework. I don't understand this

16 idea that requirements somehow come out of the

17 framework. It's backwards.

18 MS. DROUIN: No. We were asked to come up

19 with --

20 MEMBER WALLIS: We want the plant be safe

21 and you measure the safety in various scales. That's

22 your requirement.

23 MS. DROUIN: We were asked to write and

24 develop a comparable Part 50. Well, you know, you

25 aren't just going to go in your office and sit down at

1 the desk and start writing it. You need some
2 guidelines. You need some criteria to help you decide
3 what those requirements are going to be. And this
4 framework, we called it a framework, people can debate
5 whether that's the use of the proper word. That's the
6 word that we coined and we have used to say we're
7 trying to lay out the guidance, what we would use and
8 when you use that, that is what's going to help us
9 provide the technical basis and the justification for
10 developing requirements if the Commission decides yes,
11 we do want this Part 53, whether it will be called
12 Part 53, I don't know -- if they chose to go that
13 route.
14 MEMBER POWERS: Well, I am becoming very
15 sympathetic with Graham. I'm always sympathetic with
16 Graham.
17 It seems to me that what he struggles to
18 find is the trait study you used to arrive at the
19 framework you defined.
20 MS. DROUIN: The trait study?
21 MEMBER POWERS: Yes. I mean you said I
22 could go this way or I could go this way, so here are
23 two options, presumably there are more than two. And
24 you did something to decide ah, this is the way I'm
25 going to go.

1 And he's missing that part and I think I'm
2 missing that part too.
3 MS. DROUIN: I don't know how to answer
4 that. I really honestly don't. We think it's clear.
5 Do we think it could be improved, of course it could
6 be improved.
7 We've offered to come back and meet with
8 this Committee and --
9 MEMBER POWERS: The document is -- we can
10 talk offline at some length about the document itself.
11 It is the path that was pursued in order to arrive at
12 the conclusion. Why didn't you adopt wholeheartedly
13 what Tom says or adopt wholeheartedly what George
14 says? I know why you didn't adopt wholeheartedly what
15 I said.
16 (Laughter.)
17 MS. DROUIN: Right, and if you're looking
18 for those answers in that document, you aren't going
19 to find them.
20 MEMBER POWERS: The question is why not?
21 MEMBER WALLIS: It's more important than
22 the framework itself. It's the basis for why you did
23 what you did. That's the most important thing you can
24 speak and describe.
25 MS. DROUIN: We can debate whether or not

1 that should go into that document. I personally don't
2 think it should go into that document. Were there
3 discussions and a lot of thinking on that? Yes. And
4 to be quite frank, we've had a lot of them with this
5 Committee.
6 There's a lot of frustration coming out on
7 my part because we've had a -- I hear the discussion,
8 for example --
9 MEMBER WALLIS: Mary, you send it to a
10 reviewer like me, I read this thing. I say why do
11 they do that? I have no idea why you did that.
12 You've got to tell me. You can't just say it was in
13 some discussion somewhere. It's got to be clear in
14 the document itself, otherwise, it's not convincing me
15 of anything. It's just saying you're just describing
16 something that you came up with. Here's a building I
17 built. Well, it's a pyramid. Well, why isn't it an
18 oblong or a sphere or something? You're just
19 describing something.
20 MS. DROUIN: I don't know what to say,
21 Graham.
22 MEMBER MAYNARD: First of all, I think
23 this is an important subject. It's obviously
24 generated a lot of discussion and I think it's
25 something that is totally appropriate for the ACRS.

1 I think we're looking at what do we do with the next
2 generation, with new technology plants. Do we want to
3 continue under the old system or do we want to try
4 something new? I think it's valuable discussion. I
5 don't believe that we're at a point with this NUREG or
6 anything else to say hey, this is what we really
7 should do.
8 Now I do believe a lot of good work has
9 been done. I think the NUREG has got a lot of good
10 stuff in it. I don't think it's ready for use. I
11 think if it was put out with the right foreword and
12 the right caveats and stuff that that may be very
13 appropriate. If it's put out with the context of it's
14 ready to use, then I'd say it's not ready.
15 I kind of hate to see the work killed. I
16 'd hate to see us do something that basically says
17 let's just give up on the new technology framework.
18 And so I'd like personally, I'd like to see us find a
19 way to keep this moving forward.
20 MEMBER WALLIS: We wrote a letter last
21 month which said the framework should be pursued. We
22 wrote a rather fairly strong letter, clear letter,
23 without details.
24 MEMBER MAYNARD: But I don't think it's
25 ready to issue for use. Again, with the right caveats

1 on it, and maybe that's what's needed.

2 MEMBER POWERS: But Otto, do you think

3 that somewhere, I don't know where, but somewhere,

4 the route of which we arrive, judgments laid down, has

5 to be delineated someplace?

6 MEMBER MAYNARD: I'm not sure -- I think

7 I understand your question. I think the answer to

8 that is yes. You're saying that we need to identify -

9 - these are the things we reviewed. These are the

10 options. This is why we went that way. I think it

11 would be very beneficial.

12 MEMBER APOSTOLAKIS: I think though

13 experience says that if the document is published, if

14 they put in the foreword their caveats, do you think

15 that the next phase, let's say they apply to the PBMR

16 or so or whatever, are they going to go and change

17 some of the fundamental premises and say now we're

18 going to consider the cumulative curve that Kress

19 wanted?

20 MEMBER KRESS: They probably will do that.

21 MEMBER APOSTOLAKIS: No, they wouldn't.

22 MEMBER KRESS: But they won't change the -

23 -

24 MEMBER APOSTOLAKIS: The NUREG is out.

25 The NUREG is out. That is the question, Otto, the

1 fact as I see it is no, nobody wants to kill the
2 effort, but is there really any urgency to publish the
3 study in August? I mean do we have a PBMR that works
4 to be built next January?
5 MEMBER ABDEL-KHALIK: Or needs to be
6 reviewed.
7 MEMBER MAYNARD: I don't know if by
8 delaying it -- the reason to publish it is to put it
9 out for more comment.
10 MEMBER APOSTOLAKIS: The public has seen
11 it. The draft NUREG is available. It's on the web.
12 There's no need to finalize it.
13 MEMBER MAYNARD: By the way, I did want to
14 support something that Mary said. My short term in
15 dealing with this, it's been obvious to me that the
16 intent of this NUREG was as a tool for developing the
17 requirements for new reactors as opposed to being the
18 definitive set of requirements for a new technology.
19 CHAIRMAN SHACK: It makes a big difference
20 whether we start with the QHOs or Tom's proposal.
21 We're still at the level where we are setting basic
22 requirements and we haven't come --
23 MEMBER WALLIS: You said they're going to
24 be LBEs like DBAs and all that -- you're already
25 saying those are going to happen.

1 MEMBER ARMIJO: Or go even a step higher
2 than that and say we're going to impose constraints on
3 the maximum consequences of an individual accident and
4 we're going to impose constraints on the total risk
5 from all accidents.
6 That seems to be --
7 MEMBER WALLIS: We're going to --
8 MEMBER ARMIJO: The highest level --
9 MEMBER WALLIS: Right, the limiting
10 frequency on major core damage events or something
11 like that.
12 CHAIRMAN SHACK: Those are release event.
13 MEMBER WALLIS: No, it's not necessarily--
14 CHAIRMAN SHACK: Here, it's release. In
15 the 2004, there was this core damage accident and that
16 disappeared from the -- presumably because of the PBMR
17 people who argued they didn't have such a beast.
18 MS. DROUIN: PBMR had no -- we did not
19 agree with them.
20 CHAIRMAN SHACK: It disappeared. In 2004,
21 you had essentially the criteria for those things and
22 in this version it disappeared. I have both versions
23 here.
24 MEMBER WALLIS: Mary, Would TMI --
25 CHAIRMAN SHACK: And why?

1 MEMBER WALLIS: Would TMI meet your
2 framework? There's no major release.
3 MS. DROUIN: I am not going to get into
4 those kind of debates here.
5 MEMBER WALLIS: It's important. This is
6 a traumatic event for the industry.
7 MS. DROUIN: I'm not trying to be quip
8 here, but these are questions that you know, I'm not
9 going to give a sound byte answer to it. We have
10 offered to come back to this Committee for another
11 subcommittee detailed discussion. We're willing to do
12 it. But I think trying to answer some of this in 30
13 seconds, I'm sorry, I don't think is right or fair.
14 MEMBER APOSTOLAKIS: I think there is
15 another issue here in all honesty. It's not just the
16 stuff. I mean first of all, the amount of material
17 that's in the report is overwhelming. To have a
18 meeting here a day and read it before you come still
19 it takes time to digest.
20 On top of that, we have to digest what
21 Kress is saying and then what Graham is saying.
22 MEMBER KRESS: It's a hard thing to stop.
23 MEMBER APOSTOLAKIS: And it's a natural
24 evolution. It's not necessarily anybody's fault. It
25 seems to me these are very important issues. You need

1 time to digest them. And if there is no urgency,
2 let's give ourselves -- I don't think, in other words,
3 that meeting with the stuff again in a month will help
4 us very much. We're trying to understand each other
5 here.
6 So what we need to do is maybe take a
7 couple of the Saturdays that are coming up and spend
8 the whole morning just on these issues. Until we
9 settle it among ourselves, because it's unfair to them
10 too.
11 MEMBER KRESS: And just because I'm going
12 off the Committee, putting it off -- I'm coming back
13 as a consultant on this.
14 MEMBER WALLIS: I'll tell you what you do,
15 George -- since Tom and I are going off the Committee,
16 you can hire us at the appropriate fee to --
17 (Laughter.)
18 MEMBER ABDEL-KHALIK: Now that is a
19 sensible idea.
20 MEMBER APOSTOLAKIS: But then we will be
21 able to tell you to keep silent.
22 MEMBER MAYNARD: I think we can decide on
23 an appropriate fee.
24 MEMBER APOSTOLAKIS: No, really. I don't
25 think the issue in front of us will be absorbed by a

1 meeting with the Staff.

2 MEMBER MAYNARD: Right.

3 MEMBER KRESS: We have to agree among

4 ourselves first. Argue these things out.

5 MEMBER ABDEL-KHALIK: I think there's a

6 wide divergence even in our philosophies.

7 MEMBER APOSTOLAKIS: I think it's more

8 than that. I don't think we really understand each

9 other.

10 MEMBER ABDEL-KHALIK: Maybe if we do, we

11 are divergent in the say we look at things.

12 MEMBER APOSTOLAKIS: Yes.

13 MEMBER ABDEL-KHALIK: And we have to come

14 to some meeting of minds.

15 CHAIRMAN SHACK: We didn't make much

16 progress today.

17 (Laughter.)

18 MEMBER CORRADINI: You got one circle

19 here.

20 Let's not fall back on that.

21 MEMBER KRESS: And, of course, Said made

22 a couple of really good points, I thought, to clarify.

23 MEMBER APOSTOLAKIS: So is there a

24 Saturday in the future that would be free of anything

25 else?

1 MEMBER WALLIS: How long on a Saturday
2 would you want, the whole day?
3 MEMBER APOSTOLAKIS: The morning, the
4 morning. The standard thing. But --
5 CHAIRMAN SHACK: This Saturday might be
6 free.
7 MEMBER APOSTOLAKIS: Okay, so let's finish
8 all the letters tomorrow, don't raise any questions
9 about my letter.
10 (Laughter.)
11 MEMBER ABDEL-KHALIK: That's a quick way
12 to get this letter through.
13 MEMBER APOSTOLAKIS: And then on Saturday
14 we will come together. I really would like --
15 MEMBER WALLIS: I think, George, you need
16 to digest some of this stuff too, and think about it.
17 Not just you, everybody. The spontaneous discussion
18 needs -- we need to come with some thoughts that are
19 written down and really worked out.
20 MEMBER APOSTOLAKIS: That's right. That's
21 right. That's what's happening.
22 MEMBER WALLIS: I'm not sure that
23 something we have on Saturday like we have today is
24 going to help anything.
25 MEMBER APOSTOLAKIS: Maybe we can start by

1 having Dr. Kress give a more formal presentation.

2 MEMBER KRESS: I would love to do that.

3 MEMBER APOSTOLAKIS: I'm willing to

4 listen.

5 MEMBER POWERS: I would like to understand

6 if you, Dr. Kress, consider Graham's argument, the

7 trait study character appropriate or not.

8 MEMBER KRESS: I think it's generally

9 appropriate to decide on what your trait study options

10 are going to be, pros and cons of them. I think they

11 did that internally without really calling it that and

12 decided that this is an appropriate way to go and has

13 attributes in it they like.

14 I think it was implicit in their thinking.

15 I don't think they actually went down and said we

16 could do this, this, this and what are the pros and

17 cons of that.

18 I don't think you can always do that

19 because there aren't many options for the way they

20 could go here. If you're going to have a risk-

21 informed system as opposed to completely risk based.

22 I don't think -- I can only think about three options

23 on how to go about doing that and I don't know -- what

24 I'm trying to say is I think it should be implicit in

25 your thinking, but as far as putting it down as pros

1 and cons, I don't think it's necessary here. I do
2 think it would be a good idea to say why it is, what
3 it is about this, this, this and this concept, why we
4 chose those. The one part of the trait study, why we
5 picked these particular concepts. And they tended to
6 do that. It was scattered out through the report.
7 MEMBER POWERS: The report itself is
8 incredibly wordy and repetitive.
9 MEMBER KRESS: Yes.
10 MEMBER POWERS: And it's very difficult to
11 read.
12 MEMBER KRESS: I agree with that. I don't
13 tell them how to write their report. I'm just
14 interested in concepts.
15 MEMBER POWERS: It's helps to understand
16 it though. The problem you get into --
17 MEMBER KRESS: It's appropriate to help
18 them out on that, but as far as I'm concerned, I want
19 to get the concepts right first.
20 MEMBER WALLIS: Let me say, they start
21 saying off the -- the only thing that they say is the
22 real criterion is the QHOs. Now the rest is all
23 discursive and strategy and stuff.
24 If you only need to meet the QHOs, then
25 you need to say each future reactor has to meet the

1 QHOs, period. Then what do we need to do to ensure
2 that they do that and you base everything on that.
3 That's not what they've done at all.
4 Is that what they intend to do? Is that
5 the only criterion, really?
6 MEMBER KRESS: No, because --
7 MEMBER WALLIS: It isn't because they
8 start losing their way.
9 MEMBER KRESS: L-C curve also.
10 MEMBER APOSTOLAKIS: I think you are a bit
11 unfair. They have a whole chapter with a diagram that
12 goes down and tells you you have to worry about
13 defense-in-depth. There are strategies that are --
14 MEMBER WALLIS: That's all discursive.
15 MEMBER APOSTOLAKIS: Don't dismiss that.
16 MEMBER WALLIS: That's all discursive
17 stuff.
18 Strategies are means to an end. They're not an end to
19 themselves.
20 MEMBER APOSTOLAKIS: Yes, but they explain
21 to you why they want defense-in-depth. What else do
22 you want them to do? Be more explicit or what/
23 MEMBER ABDEL-KHALIK: It meets certain
24 safety goals, right? I mean whatever strategy you
25 employ.

1 MEMBER APOSTOLAKIS: It cannot just be
2 quantitative.
3 MEMBER CORRADINI: I think there's more
4 there than the QHO.
5 MEMBER APOSTOLAKIS: It's also the
6 qualitative part which is extremely important.
7 MEMBER CORRADINI: So I'm back to what are
8 we going to do on Saturday?
9 MEMBER APOSTOLAKIS: Let's finish the
10 letters first.
11 CHAIRMAN SHACK: Let's finish the letters,
12 then we'll figure out.
13 MEMBER WALLIS: Yes, let's do George's
14 letter.
15 CHAIRMAN SHACK: I think the next thing
16 would be, perhaps to have Tom, since he has a
17 position.
18 MEMBER KRESS: I would like to give a much
19 better exposition on what my position is.
20 MEMBER APOSTOLAKIS: Tell us what is being
21 done now that you object to and --
22 MEMBER KRESS: And why.
23 MEMBER APOSTOLAKIS: I would like to see
24 that.
25 MEMBER KRESS: I can certainly do that.

1 I don't know if I can do it on Saturday.

2 MEMBER APOSTOLAKIS: Oh, Tom, you can do

3 it in two minutes.

4 MEMBER KRESS: Okay, I'll do it Saturday,

5 without slides. Okay.

6 MEMBER APOSTOLAKIS: Or you can draw what

7 you like.

8 MEMBER ABDEL-KHALIK: Tom, can you treat

9 the philosophical phases for this because somehow I

10 think that's very important.

11 MEMBER KRESS: I sent you guys an email on

12 the philosophical basis for my thinking and it's

13 pretty much still my philosophical basis. You read

14 that. It's pretty much complete in terms of why I

15 think --

16 MEMBER APOSTOLAKIS: It's nice to hear you

17 speak. It's very nice.

18 MEMBER ABDEL-KHALIK: For the last month

19 I haven't read anything.

20 MEMBER WALLIS: It was very nice in that

21 he put the basic high-level requirements first. He

22 said you've got to be clear about those.

23 MEMBER KRESS: Yes, and I was very clear

24 about what they are and why and some rationale behind

25 it. But I'll be glad to go over it on Saturday.

1 CHAIRMAN SHACK: One of my problems is I
2 think you're dead with the Commission at your first
3 level. I mean they have consistently said that the
4 QHOs are good enough.
5 MEMBER KRESS: I'm still saying the QHOs
6 are good enough. They haven't said they were good
7 enough for a specific incident at a plant.
8 MEMBER APOSTOLAKIS: They didn't --
9 MEMBER KRESS: I don't think they've ever
10 said that. They said that's good enough for a design
11 -- for our safety goals. And I'm saying sure they're
12 good enough, even though they don't address societal
13 risks. You've got to address societal risks some way
14 and right now it's done with some population. But I'm
15 not disagreeing with the QHOs. I'm saying that's the
16 overall risk objective.
17 CHAIRMAN SHACK: No, but then you impose
18 on an individual design far more stringent limits.
19 MEMBER KRESS: That's right, because you
20 don't impose QHOs on a design . That's where I think
21 you're wrong.
22 MEMBER POWERS: I personally cannot
23 understand how you would apply the QHOs to a design
24 and second of all, how you even evaluate how a plant
25 on a site meets the QHOs.

1 MEMBER KRESS: I'm at a loss to explain
2 that because I don't understand it either.
3 MEMBER ABDEL-KHALIK: That's Tom's point.
4 MEMBER KRESS: What the concept there is
5 the QHOs are to apply to an individual plant's risk on
6 a site and they use some sort of representative site
7 and say all right, calculate the doses due to this
8 design and if it meets the QHOs, fine. That's a
9 concept. What that fails to do is say that the site
10 itself is going to meet the QHOs which is really what
11 I think the safety goals were intended for. So it
12 goes against the current safety goal and the safety
13 goal guidance in my mind.
14 Even though the safety goals were never
15 meant to be applied other than as a gauge for how good
16 we're doing in regulations, but we're in a different
17 venue now and a different level.
18 MEMBER CORRADINI: Just so I understand
19 Dana's comments because I thought I was going to agree
20 with him except the way you interpret them. What I
21 thought he just said was is that if I had the QHO, and
22 I then had a plant at a site, the comparison of the
23 two would be difficult unless I did some sort of
24 connecting calculation that says what is the societal
25 risk, what is the risk on early fatalities and all of

1 that in that region. You're going to need something
2 in between or a calculation in between to do the
3 comparison.
4 MEMBER KRESS: You have to have a site
5 description. And what you do is you use some sort of
6 representative site.
7 MEMBER CORRADINI: With a representative
8 population.
9 MEMBER KRESS: Absolutely. And maybe you
10 bound a little bit, but that's the way you do it. Or
11 you --
12 MEMBER POWERS: Suppose I'm going to put
13 a reactor on the Clinton site in the great State of
14 Illinois, wind blowing presumably toward Chicago some
15 place and you sit down and calculate the QHO, you
16 calculate the risk in comparison to QHOs. How would
17 I do it?
18 MEMBER CORRADINI: That's what I was
19 trying to say.
20 MEMBER KRESS: You do a full -- do you
21 have a plant there?
22 You have a plant and a PRA there? You
23 calculate it out to 50 miles, the cancers?
24 MEMBER POWERS: There's an internal events
25 PRA.

1 You might have a seismic hazard analysis.

2 MEMBER KRESS: I completely agree with you

3 on this, Dana, that the PRA and the calculation of the

4 QHOs have to include all the risk including seismic

5 and external events and internal events and shut down.

6 I agree with you completely and I think you're right

7 in saying we don't really know how to do that and we

8 don't it properly -- and in my mind, you ought to have

9 uncertainty in that also. Because QHOs are talking

10 about means and in order to get a mean I think you

11 have to have uncertainty distribution.

12 I agree with you, I don't know how to do

13 it, but I'm looking at conceptual things and I'm

14 hoping that once we get the concept down and say oh,

15 in order to meet these conceptual regulations, we have

16 to have a PRA that's this quality that includes

17 seismic and shut down and --

18 MEMBER APOSTOLAKIS: I think the

19 Commission has already decided it will be Level 1 and

20 Level 2, haven't they?

21 MEMBER KRESS: I think --

22 MEMBER APOSTOLAKIS: Part 52 says Level 1

23 and Level 2, I believe.

24 CHAIRMAN SHACK: Yes, and you get your

25 curie release by going to the QHOs, going to some

1 representative site, figuring out what the curie
2 release and then dividing by 10. It's as artificial
3 as any other --
4 MEMBER KRESS: And I agree you can do
5 that. I'm just saying --
6 CHAIRMAN SHACK: I'm not sure it's any
7 better or any more design oriented than picking a
8 generic site and sticking with the current
9 requirements. I mean you end up with an artificial
10 sort of thing anyway, aside from the fact that you
11 stuck an extra order of magnitude on it.
12 MEMBER KRESS: I think it's just the wrong
13 way to design a reactor. In principle, you should not
14 apply site characteristics to individual plants, you
15 just should not do that. That's basically a bad
16 approach to design in my mind. And that's what I'm
17 saying. Don't do something that's bad and requires
18 you to do all these things that are somewhat
19 artificial.
20 CHAIRMAN SHACK: As I said before, it
21 forces you to think about all the things that are
22 associated with the site, even if you're dealing with
23 a generic site.
24 MEMBER KRESS: What I'm saying is you
25 already thought about that when you impose a CDF and

a LERF. You've already thought about that. That was the basis of my philosophy. You have already thought about that and that's where I come up with the numbers of 10^{-5} and 10^{-6}, because that's exactly where I got them from. I thought about this.

MEMBER CORRADINI: But they arrived at it, Tom, in the reverse direction, at least I would have thought that. They derived the CDF from the fact that nobody argued with WASH-1400 that it should be 10^{-4} and they just added an order of magnitude and nobody argued the fact that they could potentially show containment performance of an order of magnitude, so they divided it by 10 again. So they worked in the foreword direction and all of these things are working in the backward direction and all of them involve more and more calculation.

MEMBER KRESS: It doesn't matter which direction you go in.

MEMBER CORRADINI: In my mind, the foreword direction I have more certainty on what the numbers might be. The backward direction is a lot of -- so what you're saying --

MEMBER KRESS: What I'm saying is the level of design safety as described by a CDF and a LERF or the equivalent FCCCDF is a policy issue.

1 MEMBER CORRADINI: See, where I'm agreeing
2 with you --
3 MEMBER KRESS: It's strictly a policy
4 issue. Now I'm saying I think the policy ought to be
5 10^{-5} and 10^{-6}. Somebody else may have a different
6 policy. The Commission may want a different policy.
7 MEMBER CORRADINI: Not to drag this out,
8 but just from the standpoint of clarification, I guess
9 what I'm saying is I'm with you where you're taking a
10 core damage frequency and a large release and saying
11 okay, I'm going to take that and get a stylized curve
12 that represents that on a shape. I'm okay there.
13 Right? I'm not sure if I'm with you about site versus
14 design certification, but leaving that aside, once I
15 have that stylized curve, I'm with you there.
16 Where I think though --
17 MEMBER KRESS: Single plant.
18 MEMBER CORRADINI: For a single plant.
19 Where I think --
20 MEMBER KRESS: It doesn't have anything to
21 do with the site except complicit.
22 MEMBER CORRADINI: Right, where I think
23 Dana was bringing something up which makes what you're
24 saying to drive it to a curve relatively conservative
25 although maybe that's where I want to go when I have

1 a lot of plants on the site is if I include everything
2 beyond internal events, the wiggle room out here on
3 this part of the curve is very big because there's a
4 lot of things I don't know how to calculate. And so
5 you're saying too bad, that's it and you've got to
6 show it all fits inside the boundary and if you can't
7 figure out or calculate it, go do more work and figure
8 it out --
9 MEMBER KRESS: Will you tell me what else
10 you would do? What would you do instead? The
11 criteria is a site risk.
12 MEMBER CORRADINI: Okay, again, I'm not
13 disagreeing yet, I'm just -- I'm walking through in my
14 mind all the things that that implies. And if I did
15 a 10 CFR 50 approach right now, it leaves all that
16 wiggle room to judgment. It doesn't put it in the
17 regulation.
18 That's where I understand --
19 MEMBER KRESS: Unless you have a CDF and
20 a LERF in your rules which we kind of implicitly have.
21 They're not --
22 MEMBER CORRADINI: Yes, we do, but for the
23 --
24 MEMBER KRESS: Well, in Part 50 we do.
25 MEMBER CORRADINI: Right.

1 MEMBER KRESS: We say you have to look at
2 it.
3 MEMBER CORRADINI: Right.
4 MEMBER KRESS: They don't say what it has
5 to be.
6 MEMBER CORRADINI: But I guess what I'm
7 saying is if I work out from the standpoint of what
8 we're doing now and create a curve for it, a
9 cumulative curve, I'm with you. I represent I'm with
10 you. But now as I get and I start including all these
11 external events to what I understood Dana's point was
12 is that now you're going to have a real problem in
13 getting a lot of these estimates and if I put it in
14 the regulation base, then I'm going to have --
15 MEMBER KRESS: I'm not saying it's not a
16 problem to calculate it, but if it's the right thing
17 to do, I mean are we going to have -- are we going to
18 protect the health and safety of the public by having
19 a risk criteria? We've already got QHOs and they're -
20 - they have the same issue with QHOs. It doesn't
21 matter whether it's my curve or QHOs.
22 MEMBER CORRADINI: That's where I have the
23 problem with the QHOs. I actually understand yours by
24 working out from the numbers that people are using now
25 as a practical way to provide safety.

MEMBER KRESS: Well, they calculate the F-C curve for all the current reactors. Every time they do a PRA, it's kicked right out. It's calculated. And the only trouble with it there, except I agree with Dana that this is almost always for internal events and they use some other way to screen out seismic and fires usually and say they're not contributing much to this is the way to deal with the amount. I don't think they can always do that. If you get down to the magnitude I'm talking about, then you can no longer screen out seismic because it's problem may be the dominant one. You end up with a different issue there, but I'm saying you have to deal with it. If that's the dominant risk, then you've got to deal with it.

CHAIRMAN SHACK: We better stop here. We need to get on with the letters. Let's take a 10-minute break for everybody to recharge here.

(Off the record.)

CERTIFICATE

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

Name of Proceeding: Advisory Committee on Reactor Safeguards 542nd Meeting

Docket Number: n/a

Location: 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.

Charles Morrison
Official Reporter
Neal R. Gross & Co., Inc.

Advisory Committee on Reactor Safeguards
Digital Instrumentation and Control Systems Matters
May 3-5, 2007
Rockville, MD

- Proposed Schedule -

Cognizant Staff Engineer: Charles G. Hammer, cgh@nrc.gov 301-415-7363

Topics	Presenters	Time
Opening Remarks	G. Apostolakis, ACRS	8:35 - 8:40 am
Industry perspective on digital instrumentation and control (I&C) systems issues	A. Marion, NEI K. Keithline, NEI T. Harris, NEI	8:40 - 8:55 am
Staff research, review, and guidance activities regarding digital I&C systems issues	J. Grobe, NRR P. Loeser, NRR M. Waterman, RES S. Arndt, RES	8:55 - 10:15 am
Committee Discussion	G. Apostolakis, ACRS	10:15 - 10:30 am

Note

- Presentation time should not exceed 50 percent of the total time allocated for specific items. The remaining 50 percent of the time is reserved for discussion.

- 35 copies of the presentation materials to be provided to the Committee.

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Protecting People and the Environment

Agency Long-Term Research Plan Development

Christiana Lui, Don Helton, Nathan Siu, Rob Tregoning
Office of Nuclear Regulatory Research

May 3, 2007

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Objectives

- Agency-wide long-term regulatory research plan focusing on
  - possible new program areas
  - emerging technologies that may have future nuclear applications
- Planning and communication tool
  - High-level description of research activities
- Living document that will be updated periodically

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Scope

- Focus is on anticipated future needs which are not currently identified in other NRC planning document
- Does not address currently planned activities some of which may be long-running
- Does not duplicate research activities described in other stand alone research plans (e.g., Advanced Reactor Research Plan)

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Plan Development Considerations

- Plan development timeline supports FY 2009 budget formulation
- Mapping out a process while developing the initial version
- Living document => topic areas and focus within areas can be revised as new information emerges
- Success of the current effort will likely stimulate further participation

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Summary of Proposed Activities*

- DOE Global Nuclear Energy Partnership
- **Reactor License Renewal Beyond 60 Years**
- Test Facilities
  - Integrated Digital I&C and Human Machine Interface Research Facility
  - **Integral Effects Test Facilities for Advanced non-LWRs**
- Cross-Cutting and Emergent Technologies
  - Advanced Analytical Capabilities
    - Advanced Computational Methods
    - **Multiphase Computational Fluid Dynamics Capability**
    - Advanced Modeling Techniques for Level 2/3 PRA
    - Advanced Offsite Consequence Code

*Bold text indicates topics to be discussed in more detail

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Summary of Proposed Activities (Cont.)

- Cross-Cutting & Emergent Technologies (cont.)
  - **Advanced Fabrication Techniques**
  - Extended In-Situ and Real-Time Inspection & Monitoring Techniques
  - Offsite Mitigation Strategies
  - Nanotechnology for Nuclear Power Applications
  - Fire Effects on Fiber-Optic Cables
  - Risk Assessment for Adv. Reactor/Fuel Cycle Facilities
    - Empirical Data for Risk Assessment
    - HRA Methods for Advanced Facilities
    - **Advanced Quantitative Risk Assessment Methods**
  - Formal Decision Analysis Methods

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Candidate Activity Descriptions

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GNEP

- Objective
  - Develop regulatory infrastructure needs associated with DOE's GNEP program
- Technical Background
  - NRC already interacting with DOE on this issue
  - Staff is evaluating licensing options, including any necessary rulemakings
  - Depending on technology selection, will likely involve technologies such as:
    - Chemical separation for reprocessing
      - fission products, transuranics, Uranium
    - Fast reactor (LMR) transuranic transmutation

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GNEP

- Uses
  - Technical bases development for licensing a
    - consolidated fuel treatment center and
    - an advanced burner reactor
  - Associated risk strategies and acceptance criteria
- FY09 Activities
  - Specific activities depend on DOE's selection of technologies (June 2008)

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Reactor License Renewal Beyond 60 Years

- Objective
  - Evaluate and update, as necessary, the technical basis for supporting evaluation of possible requests for license renewal beyond 60 years
- Technical Background
  - Modifications of safety-related systems, structures, and components may increase impetus for license renewal.
  - No regulatory limit which precludes additional life renewal beyond 60 years.
  - Informal DOE inquiry about possibility of renewal beyond 60 years, but no formal letter of intent received.
  - Earliest renewal application is assumed between 2014 – 2019.
  - Current technical bases are the GALL and GEIS reports.

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Reactor License Renewal Beyond 60 Years

- Uses
  - Support GALL and GEIS modifications, as necessary, to extend technical bases beyond 60 years.
  - Technical information for updating related SRPs (NUREG-1800 & NUREG-1555, Supplement 1) and Regulatory Guides (1.188 and 4.2)
- FY-09 Activities
  - Identify possible supporting extended in-situ and real time instrumentation and monitoring techniques
  - Conduct scoping study to assess and prioritize technical issues
    - Aging of critical passive structures, systems, and components
    - Aging of electrical and instrumentation systems
  - Develop research plan

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Integrated Digital I&C and Human Machine Interfaces Research Facility

- Objectives
  - Develop facility for digital I&C systems which is integrated with a full-scale, reconfigurable simulator to improve the realism, applicability, and efficiency of planned research
- Technical Background
  - Research is currently performed at several different national laboratories, universities and international research facilities.
  - NRC is acquiring several digital safety systems that are being used (or proposed for use) in the industry for evaluation at these different facilities.
  - Use of multiple facilities is inefficient and does not allow for realistic simulation of the various representative digital I&C and human machine interfaces

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Integrated Digital I&C and Human Machine Interfaces Research Facility

- Uses
  - Single, integrated test facility would provide capability to independently confirm analyses of proposed I&C systems.
  - Facility would also provide data to validate digital system risk and reliability models currently being developed.
  - Modular, reconfigurable human factors simulator would permit evaluation of all expected plant control room and HMI designs.
- FY-09 Activities
  - Prepare detailed options paper (early FY 2008)
  - Pending Commission approval of paper
    - NRC and industry will jointly establish facility requirements and initiate development.
    - Staff will complete detailed facility development and operations plan.

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Integral Effects Test Facilities for Advanced non-LWRs

- Objective
  - Availability of facilities for regulatory activities associated with advanced non-LWRs
- Technical Background
  - Early LWR experience demonstrates the need for these facilities (technical bases to support licensing decisions)
- Uses
  - Ensuring adequacy of safety criteria
  - Ensuring adequacy of licensees' analytical tools
  - Development and validation of the agency's tools
- FY09 Activities
  - Scoping and prioritizing regulatory research needs for a wide range of technical disciplines

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Advanced Computational Methods

- Objective
  - Identify / evaluate external developments:
    - problems relevant to a broad range of applications
    - improved integrated cross-disciplinary analysis capabilities
- Technical Background
  - Prompted by improvements in the internal and external computational environment
  - Increased importance due to "best estimate + uncertainty"
- Uses
  - Sensitivity analysis for multi-parameter problems
  - Quantitative uncertainty analysis
  - Direct system simulation
- FY09 Activities
  - Scoping level assessment to identify, evaluate and recommend needed research activities (generic and/or application-specific)

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Multiphase Computational Fluid Dynamics

- Objective
  - Extend NRC's single-phase CFD capability to multi-phase
- Technical Background
  - Used in other industries
  - More applications being seen in the nuclear industry (especially in other countries)
- Uses
  - Two-phase issues in current and new reactors (e.g., DNB)
  - Two-phase / two-fluid issues in advanced reactors
- FY09 Activities
  - Evaluate domestic/international collaboration opportunities
  - Examine existing commercial/research tools
  - Benchmark versus simple, well-characterized experiments

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Advanced Modeling Techniques for Level 2/3 PRA

- Objective
  - Provide integral, quantitative, predictive capability to directly support Level 2/3 PRA (alternative to the APET approach)
- Technical Background
  - Important phenomena-based insights incorporated in to the agency's severe accident computer code
  - Current Level 2 treatment relies on a simplified logic-based approach and static approximations of behavior

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Advanced Modeling Techniques for Level 2/3 PRA

- Uses
  - Eliminate reliance on simplified LERF in favor of quantified Level 3 or discrete release categories
  - Capability of considering alternate risk metrics
- FY09 Activities
  - MELCOR developments specific to this application
  - Investigation of fast-running MELCOR incorporation into Level 2 PRA framework

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Advanced Offsite Consequence Code

- Objective
  - Development of a next-generation offsite consequence code
- Technical Background
  - Current codes (MACCS2, RASCAL) utilize simplified transport models (Gaussian plume/puff)
  - Code architecture limits the ability to evolve
- Uses
  - Offsite consequence calculations for postulated fission product releases
- FY09 Activities
  - Evaluate currently available models
  - Investigate implementation issues and potential benefits in effectiveness/realism
  - Develop a code development plan (if justified)

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Advanced Fabrication Techniques

- Objectives
  - Evaluate the performance of new construction, fabrication, and manufacturing techniques for nuclear applications
  - Assess use of performance-based specifications
- Technical Background
  - New techniques are being considered for new and next generation nuclear systems, structures, and components.
  - Many techniques may greatly decrease the construction schedule and relative cost of new plants, while simultaneously improving quality.
  - Industries are moving from prescriptive to performance-based specifications.
  - It's unknown if nuclear applications present unique performance challenges.

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Advanced Fabrication Techniques

- Uses
  - Support staff review and development of updated guidance for new nuclear power plants construction
- FY-09 Activities
  - Coordinate with DOE and industry to identify viable construction and component manufacturing techniques (FY 2007- 2008)
  - Identify preliminary technical and regulatory issues (FY 2007 – 2008)
  - Conduct systematic scoping study to fully identify and prioritize technical issues that may have adverse nuclear safety ramifications
  - Evaluate existing laboratory and service performance of techniques and assess the use of performance-based specifications
  - Develop detailed research plan

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Extended In-Situ and Real-time Inspection & Monitoring Capabilities

- Objectives
  - Expand monitoring capabilities
  - Improve evaluation of critical nuclear systems and components both during normal and accident conditions
- Technical Background
  - Development of miniaturized, cost-effective, and advanced sensors capable of performing real-time monitoring
  - Wide-spread use in automotive, chemical processing, aerospace, and other commercial industries
  - Commercial nuclear and material facilities often use older technologies.
  - DOE's Nuclear Energy Research Initiative has investigated a number of these new sensors and techniques.

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Extended In-Situ and Real-time Inspection & Monitoring Capabilities

- Uses
  - Monitor real-time material degradation
  - Characterize residual stress
  - Assess radionuclides/chemical species in ground water and soil
  - Characterize fuel properties
  - Monitor severe accident conditions
- FY-09 Activities
  - Select promising sensor candidates for industry use
  - Evaluate regulatory and safety considerations to verify reliability, accuracy, and acceptability for nuclear service.
  - Develop research plan, culminating in regulatory approval, for viable candidates

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Offsite Mitigation Strategies

- Objective
  - Monitor developments in the area of capture and cleanup of radioactive materials
- Technical Background
  - Other entities are performing research for airborne scavenging technologies
- Uses
  - Identification of potentially beneficial mitigation technologies
- FY09 Activities
  - Monitor external activities in this area, including:
    - Airborne mitigation systems
    - Non-airborne on-site delivery systems

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Nanotechnology for Nuclear Power Applications

- Objectives
  - Identify candidate nuclear applications of nanotechnology
  - Develop plans to support regulatory use of identified technologies
- Technical Background
  - NRC is partner in National Nanotechnology Initiative (NNI), a nanotechnology research and development program among 25 Federal agencies.
  - One NNI objective is to identify the applied research and development needed to transition scientific discoveries into commercial applications.

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Nanotechnology for Nuclear Power Applications

- Uses
  - Condition-based sensing for early potential fault detection
  - Security of information technology systems
  - Nonvolatile, radiation-hard, low-power, high-density, random access memory
  - Enhancement of containment or reactor coolant system heat transfer during accident conditions
- FY-09 Activities
  - Continue participation in NNI to monitor scientific developments
  - Identify, with industry, viable nuclear applications
  - Develop research plans to assess the potential regulatory applications of these technologies and develop acceptance criteria for their use

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Fire Effects on Fiber Optic Cables

- Objective
  - Develop and validate fire models for fiber optic cables
- Background
  - Substantial work on conventional cables (e.g., CAROLFIRE)
  - Potential questions with introduction of fiber optics cables
    - Fragility (cables as targets)
    - Combustibility (cables as intermediate fire sources)
- Potential Uses
  - Assessments of acceptability
  - Risk-informed applications (e.g., fire protection)
- FY09 Activities
  - Initiate development (including literature search, model framework development, identification of empirical data needs and sources)

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Empirical Data for Risk Assessment (Advanced Reactors and Fuel Cycle Facilities)

- Objective
  - Improve empirical basis for PRA models in key areas (e.g., HRA, passive systems)
- Background
  - Failure event data: sparse, of limited relevance, or non-existent
  - Non-nuclear sources may be relevant, but need to address quality, applicability, and availability
- FY 09 Activities
  - Initiate pilot project
    - Identify, collect, and analyze non-nuclear data relevant to human performance during accidents
    - Derive qualitative failure mechanism information and associated risk assessment implications
    - Assess ability of data to support quantitative risk assessment

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HRA Methods for Advanced Facilities

- Objective
  - Extend current HRA capabilities to advanced reactor and fuel cycle facilities
- Background
  - Current frameworks are general
  - Application work to date focuses on operating facilities
  - Ongoing benchmarking study may provide information relevant to extensions
- FY09 Activities
  - Perform scoping study
    - Identify key HRA issues for advanced facilities
    - Evaluate ability of current HRA methods and data to support risk assessments for these facilities

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Advanced Quantitative Risk Assessment Methods (Advanced Reactors and Fuel Cycle Facilities)

- Objective
  - Evaluate potentially promising advanced quantitative methods
- Background
  - Improved methods have been developed
    - Numerical solution of logic-based models
    - Explicit representation of deterministic and probabilistic relationships
  - Some applications to current systems
  - Potential value in addressing advanced systems
- FY09 Activities
  - Scoping studies to assess the state, costs, and benefits of selected methods:
    - Binary Decision Diagrams
    - Bayesian Belief Nets
    - Simulation-based risk assessment approaches

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Formal Decision Analysis Methods

- Objective
  - Identify and evaluate barriers preventing more widespread use of formal methods
- Background
  - Successfully used in other fields
  - Limited use within agency
- FY09 Activities
  - Pilot study
    - Identify key implementation issues
    - Develop recommendations for follow-on work

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Summary

- Staff has developed an initial Long-Term Research Plan for FY 2009
  - Discussed a sample of proposed activities in the initial plan
- The final proposed FY 2009 Long-Term Research Plan to the Commission by July 2007
- ACRS recommendations will be addressed as the staff move forward in finalizing the FY 2009 plan and future updates

Stakeholder Comments

Policy issues

- Level of safety (LOS) and Integrated risk (IR) and the ACRS views
  - Stakeholders agreed that the quantitative health objectives (QHOs) established in the Commission's Safety Goal Policy should be used to establish the minimum level of safety for new plants.
  - Stakeholders felt that both preventive and mitigative measures should be taken into account when evaluating a plant's ability to meet the QHOs. There was no consensus concerning the consideration of integrated risk.
  - In general, the stakeholders believed the ACRS had raised important and relevant points about these issues addressed in the Framework.

Staff Recommendation For Reactor Requirements for Future Plant Licensing

Presented to

Advisory Committee on Reactor Safeguards

Joe Birmingham, (301) 415-2829, NRR
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May 3, 2007

Purpose of Today's Briefing

- Provide ACRS information on the staff's recommendation on reactor requirements for advance reactors and stakeholder comment on:
  - Plan to risk-inform Part 50 reactor requirements
  - Policy issues included in the ANPR
  - Technology-Neutral Framework

History

- January 2003: RES Advanced Reactor Research Plan recognized the need for a licensing framework for advanced reactors
- Current reactor regulatory structure
  - Focuses on LWRs with limited application to non-LWRs
    - Advanced reactors will have design and operational issues different from LWRs
    - Contains requirements not applicable to advanced reactor designs
  - Evolved with limited insights from PRAs and severe accident research
    - PRA and PRA insights will be an integral part of licensing advanced reactors
- Program begun to develop a risk-informed, performance-based regulatory structure that could be technology-neutral to support future licensing

ANPR Background

- January 2006, Commission directed the staff to:
  - Issue an Advance Notice of Proposed Rulemaking (ANPR)
  - Provide its recommendation on whether and, if so, how to proceed with rulemaking
- Commission requested the staff to seek stakeholder input for:
  - The Technology Neutral Framework
  - Certain advanced reactor policy issues
  - The Plan to revise requirements for advanced reactors
- Commission directed that the staff should facilitate stakeholder participation, hold public meetings and workshops starting soon after the ANPR is issued

Staff Followup Actions

- January 2007, staff met with the Advanced Reactor Steering Committee on a proposed recommendation for reactor requirements for future reactors
- Staff discussed options in light of:
  - Stakeholder comment to "test" draft requirements
  - Near-term impact on design certifications and COLs
  - Impact on NGNP schedule
  - Impact on far-term projects such as GNEP
- March 2007, staff completed preliminary review of stakeholder comment and drafted Commission paper

Stakeholder Comments

- Stakeholder comments were from:
  - AREVA
  - ASME (two sets)
  - Strategic Teaming and Resource Sharing (STARS)
  - Nuclear Energy Institute (two sets)
  - American Nuclear Society (two sets)
  - Pebble Bed Modular Reactor (Pty) Ltd. (two sets)
  - Westinghouse
  - IEEE Power Engineering Society
  - GE Energy Nuclear
  - Nuclear Equipment Quorum

ANPR Comment Areas

The ANPR asked for stakeholder comment on 3 areas:

- Plan to risk-inform 10 CFR Part 50
- Policy issues
  - Level of safety (LOS) and integrated risk (IR)
    - Feedback requested on ACRS letter views
  - Defense-in-depth
  - Single failure criterion
  - Containment performance standards
  - Integration of safety, security, and emergency preparedness
- The Framework

Stakeholder Comments

- Plan to risk-inform 10 CFR Part 50
  - Stakeholders generally supported development of risk-informed requirements but suggested that:
    - Do not disrupt near-term plans for LWR DC and COL applications
    - Continue current efforts to risk-inform Part 50 (e.g., LOCA-LOOP)
    - Develop preliminary draft requirements
    - Publish the draft requirements for information, and
  - Upon receipt of non-LWR application
    - Review and approve non-LWR application using Part 50/52
    - Evaluate draft requirements against the non-LWR design
    - Refine draft requirements and initiate rulemaking

Stakeholder Comments

Policy issues

- Level of safety (LOS) and Integrated risk (IR) and the ACRS views
  - Stakeholders agreed that the quantitative health objectives (QHOs) established in the Commission's Safety Goal Policy should be used to establish the minimum level of safety for new plants.

Stakeholder Comments

Policy issues

- Defense-in-depth
  - The comments generally supported the definition of defense-in-depth in the Framework.
  - The comments supported development of a separate policy statement on defense-in-depth rather than a revision of the PRA policy statement. Some comments asked to have further interaction with NRC prior to finalization of the DID statement.
  - Some comments recommended that the definition be "tested."

Stakeholder Comments

Policy issues

- Single failure criterion
  - The stakeholder comments supported replacing the single failure criterion by an approach in which the frequency and consequences of each licensing basis event are taken into account and there are no arbitrary redundancy requirements.
  - This approach would be undertaken as part of the plan to risk-inform 10 CFR Part 50 and would be supported by the Framework.

Stakeholder Comments

Policy issues

- Containment performance standards
  - Stakeholders generally did not agree with the containment performance standards as proposed in the Framework
  - The staff's approach addressed containment as part of defense-in-depth and required the plant to have a containment functional capability to prevent an unacceptable release of radioactive material to the public

Stakeholder Comments

Policy issues

- Integration of safety, security, and emergency preparedness
  - Stakeholders expressed concerns for integrating safety, security and emergency preparedness
  - A general concern was that integration of security would limit public participation, other stakeholders believed it was premature, not beneficial, or not practical to integrate these areas using risk

Stakeholder Comments

The Framework

- In general, the comments agreed with the top down approach used in developing the framework and agreed that the next step should involve testing the framework on a specific reactor design. Specific comments were provided on the various criteria.

- The comments on the Framework were discussed with the ACRS in a meeting Mar 8-9, 2007.

Status May 2007

- Framework, to be published summer 2007 as NUREG-1860
- Staff to provide the Commission recommendation on "whether and, if so, how to proceed with rulemaking" in May 2007
  - Staff recommends that rulemaking be deferred until experience is gained with NGNP or PBMR
  - Experience with NGNP will help inform the staff on the need for technology neutral requirements and the best approach for meeting that need

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Protecting People and the Environment

NRC Digital Instrumentation and Control System Program

Presentation to the
Advisory Committee on Reactor Safeguards

May 3, 2007

John A. Grobe, NRR
Paul J. Loeser, NRR
Michael E. Waterman, RES
Steven A. Arndt, RES

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BRIEFING OVERVIEW

- **Digital I&C Steering Committee**
- **Diversity and Defense-in-Depth**
- **Risk - Informing Digital Systems**

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Overview of Digital Instrumentation and Control Steering Committee Activities

John A. Grobe
Associate Director for Engineering and Safety Systems
Office of Nuclear Reactor Regulation

COMMISSION MEETING

- ***November 8, 2006*: Commission briefing on Digital I&C issues by industry and NRC staff**
- **Staff Requirements Memorandum, *M061108*, requires that senior NRC management:**
  - **Engage industry to establish a project plan with specific milestones, deliverables and priorities**
  - **Address critical-path actions and long-term objectives**
  - **Address Diversity and Defense-in-Depth, Risk-Informed Digital I&C, Operator Training, Cyber Security, and Lessons Learned from experience of other industries and agencies**

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THE DIGITAL I&C STEERING COMMITTEE

January 12, 2007 memorandum from the Executive Director for Operations established the Digital I&C Steering Committee to:

- **Interface with industry primary representatives on plans for resolution of digital I&C issues**
- **Ensure effective interoffice coordination on digital I&C issues**
- **Oversee and facilitate resolution of technical and regulatory issues related to the deployment of digital I&C**
- **Monitor NRC line organizations' progress on Digital I&C Project Plan implementation**

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COMMITTEE MEMBERS

- **Jack Grobe, Associate Director for Engineering, NRR, Committee Chairman**
- **Mike Mayfield, Director, Division of Engineering, NRO**
- **Mark Cunningham, Director, Division of Fuel, Engineering and Radiological Research, RES**
- **Joe Giitter, Deputy Director, Division of Fuel Cycle Safety and Safeguards, NMSS**
- **Scott Morris, Deputy Director, Division of Security Policy, NSIR**

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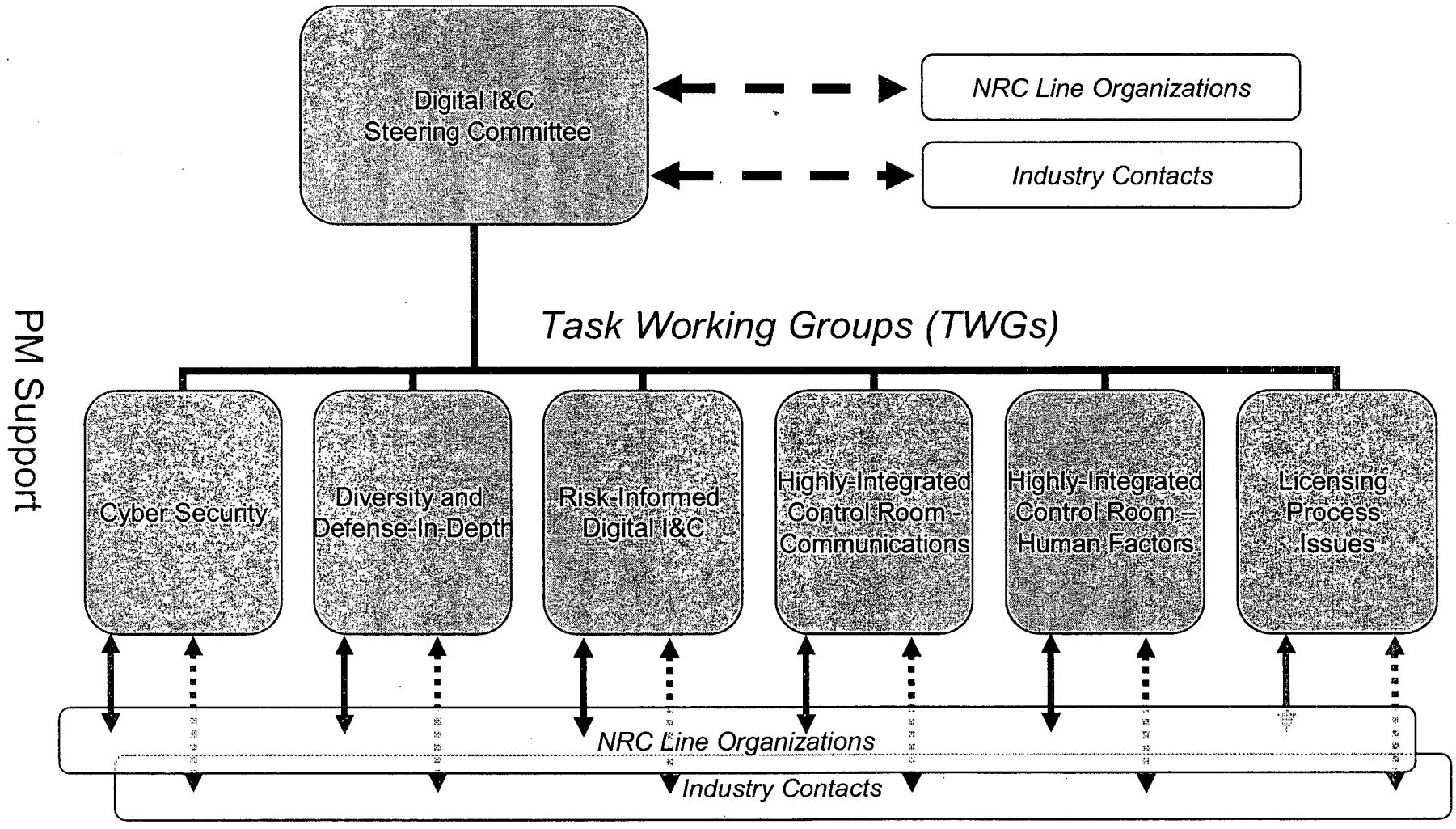
ORGANIZATION



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TASK WORKING GROUPS

- **Cyber Security**
  - Provide regulatory guidance and acceptance criteria including resolution of inconsistencies within existing NRC and industry cyber security documents
- **Highly Integrated Control Room – Communications**
  - Provide regulatory guidance and acceptance criteria that defines at a sufficient level of detail the expectation for inter-divisional and safety and non-safety communications independence
- **Highly Integrated Control Room – Human Factors**
  - Provide human factors engineering regulatory guidance and acceptance criteria to address new aspects of digital control room displays and controls

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TASK WORKING GROUPS

- **Diversity and Defense-In-Depth**
- **Risk-informed Digital I&C**
- **Licensing Process Issues**
  - **Identify licensing process protocols for submittal and review of new digital technology applications**

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Digital System Diversity and Defense-in-Depth for Digital

Paul J. Loeser
Division of Engineering
Office of Nuclear Reactor Regulation

Michael E. Waterman
Division of Fuel, Engineering, and Radiological Research
Office of Nuclear Regulatory Research

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SAFETY CONCERN

- November 8, 2006 SRM requested that ACRS provide its views on the staff's effort related to digital instrumentation and controls and consider potential means for providing reasonable backup, if appropriate.

- The concern is that an error in common software could cause all channels of all protection systems where this software is used to malfunction. Consolidation of many safety functions into a single four channel system has increased the concern.

- High-quality design is still considered the most important method to defend against potential common-cause failures. High-quality software and hardware reduce the failure probability, however software errors may still defeat safety functions in redundant, safety-related channels.

- This was confirmed by the 1997 National Academy of Science report "Digital Instrumentation And Control Systems In Nuclear Power Plants: Safety And Reliability Issues." The NAS study concluded that: "The USNRC position of assuming that common-mode software failure could occur is credible, conforms to engineering practice, and should be retained."

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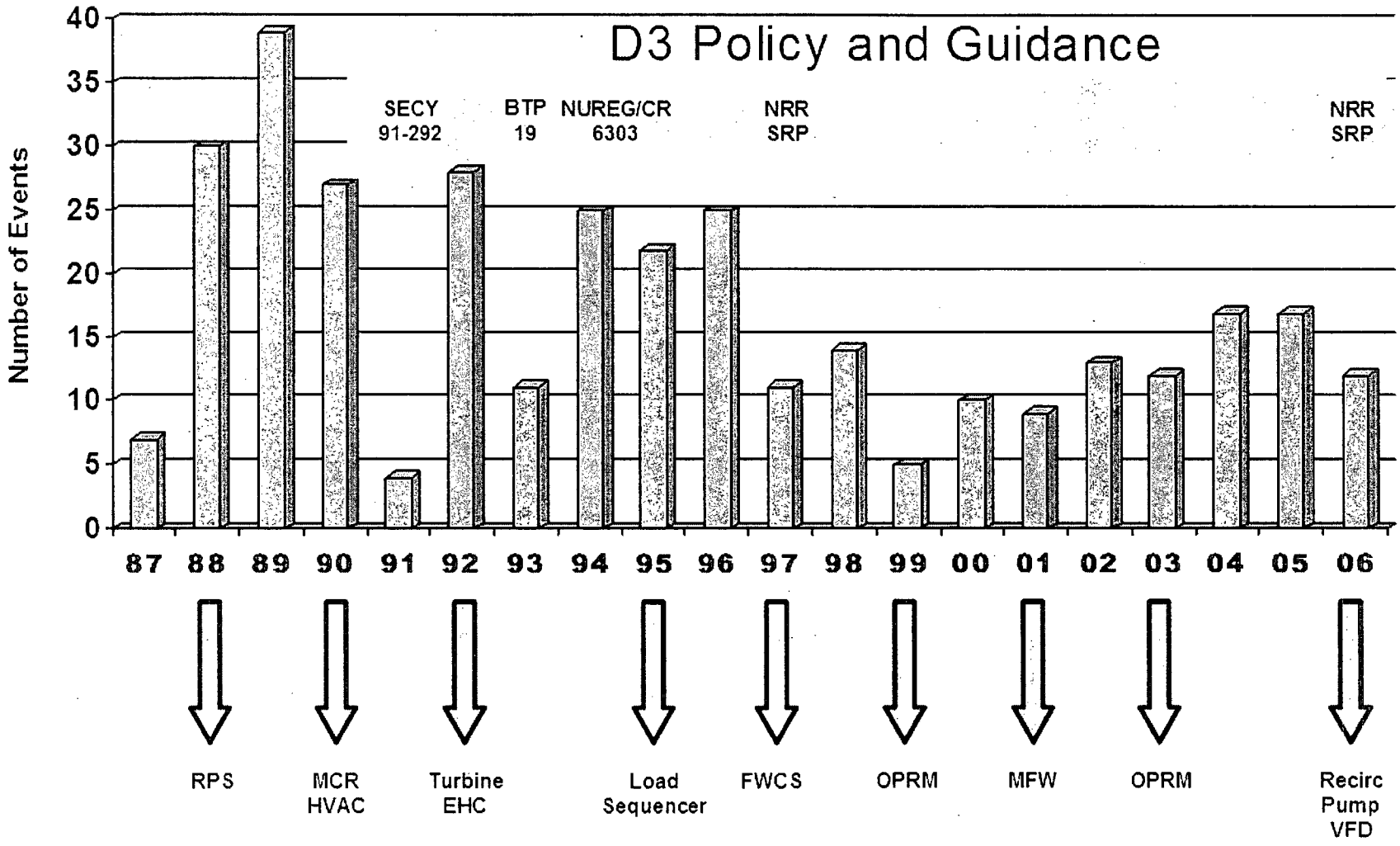
OPERATING EXPERIENCE



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CURRENT POLICY

- NRC has established the following four-point position for common mode failures in digital I&C systems. This was originally in SECY 93-087 dated April 2, 1993 and was modified by the SRM dated July 21, 1993:

  1. Assess the defense-in-depth and diversity to demonstrate that vulnerabilities to common-mode failures have adequately been addressed.

  2. Analyze each postulated common-mode failure for each safety analysis event to demonstrate adequate diversity within the design for each of these events.

  3. If a common-mode failure could disable a safety function, then a diverse means shall be required to perform either the same function or a different function. Since common mode failures are beyond design-basis events, this may be a non-safety system if the system is of sufficient quality.

  4. A set of independent and diverse displays and controls in the main control room shall be provided for manual, system-level actuation of critical safety functions and monitoring of parameters that support the safety functions.

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TASK WORKING GROUP

- **NRC guidance does not explicitly identify what constitutes acceptable diversity and defense-in-depth.**
- **Industry desires clearer and more detailed guidance**
- **Diversity and Defense-in-Depth Task Working Group to address specific issues:**
  - **Define adequate diversity**
  - **Determine criteria for manual actions in lieu of automatic actions**
  - **Clarify guidance on system-level and component-level manual actuation requirements**
  - **Provide guidance on CCF effects that should be considered (e.g., fails to actuate; spurious actuation)**
  - **Identify design attributes that eliminate CCF mitigation**
  - **Define how defense-in-depth factors into CCF**
  - **Address digital CCF in the single-failure criterion**

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TASK WORKING GROUP SCOPE

Goals:

- Describe existing requirements
- Identify acceptable D3 strategies
- Determine criteria for manual actions in lieu of automatic actions
- Identify consensus standards that could be endorsed as regulatory guidance
- Develop regulatory guidance on acceptance criteria
- Revise SRPs, industry guidance, regulations as appropriate

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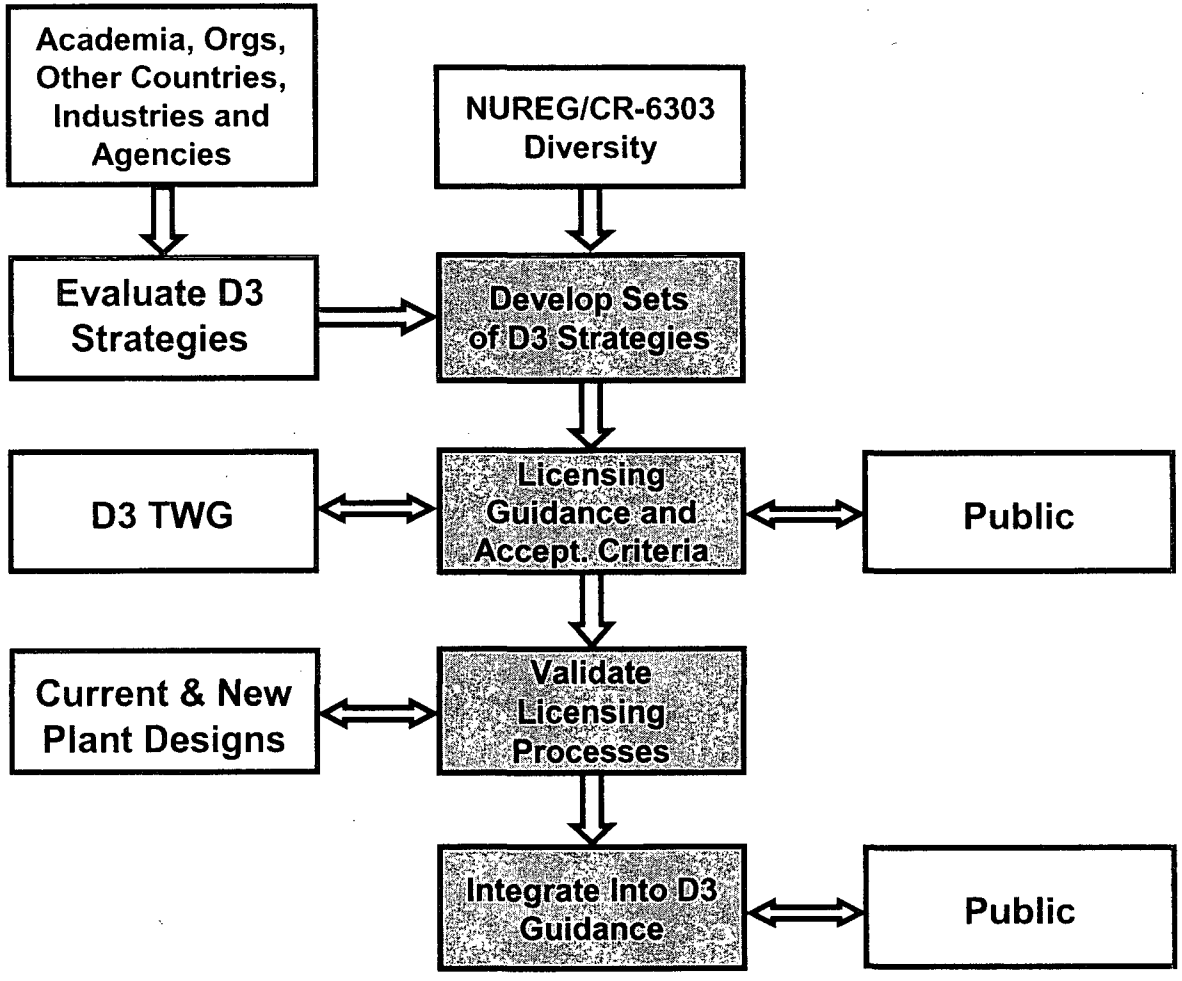
APPROACH FOR DEVELOPING DIVERSITY GUIDANCE



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SUMMARY OF DIVERSITY STRATEGIES

	Space Shuttle	Space Station	Mission Control JSC	FAA Flight Control System	Airbus A320	Boeing 777	DoD Battlefield	Electrical Grids	Chemical Industry
Design									
Equipment									
Function									
L.C. Process									
Signal									
Software									

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SUMMARY OF DIVERSITY STRATEGIES

	Sizewell B UK	Temelin Czech	Dukovany Czech	Ringhals Sweden	Beznau Switz.	Chooz-b France	Darlington Canada	Paks Hungary	Lungmen Taiwan
Design									
Equipment									
Function									
L. C. Process									
Signal									
Software									

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POSSIBLE APPROACH TO ADDRESSING D3

- **Diversity and defense-in-depth requirements should be the same for new (future) reactors and current operating plants**
- **Include sufficient diversity to mitigate adverse effects in protection system functions (RTS and ESFAS) in the presence of**
  - **a single failure (non-CCF)**
  - **all non-detectable common cause software failures**
- **For safety system functions that do not incorporate sufficient diversity, provide diverse automated backup safety system functions**
- **Provide displays and controls in the main control room for manual actuation and control of safety equipment to manage plant critical safety functions**

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Risk-Informing Digital Instrumentation and Control System Licensing Reviews

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BACKGROUND

- **The NRC and industry currently use a deterministic approach for licensing digital system that relies on:**
  - **Specific digital I&C system development, design, testing, maintenance, and staff review processes**
  - **Process is intended to ensure adequate quality, reliability, and diversity and defense-in-depth when implementing a digital I&C system.**
- **The NRC Policy Statement on PRA directs the staff to use risk information to the extent supported by the state-of-the-art.**
- **Currently, there is no comprehensive risk-informed method, endorsed by the NRC, for digital systems reviews.**

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CURRENT SITUATION

- **To date in operating reactors reviews, risk-insights have not been incorporated into digital I&C system licensing submittals by either staff or industry**

- **For new reactors design certification reviews, some PRAs have included digital systems (software CCF) and/or performed uncertainty, importance, and sensitivity studies of digital systems including software**
  - Standard fault tree/event tree methods
  - Level of detail as low as circuit board level
  - Hardware failure data derived from proprietary or generic databases
  - Common cause failures (CCF) of hardware considered circuit boards and circuit boards across systems, software CCF considered for individual modules and across multiple modules
  - NRC uncertainty, sensitivity and importance studies show importance of diversity (diverse actuation functions) in reducing the impact of uncertainties associated with digital systems

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CHALLENGES

- **Modeling digital systems**
  - Software Reliability
  - Common Cause Failures (including software)
  - Hardware/Software Interactions
  - Failure Data
  - Interfacing a Digital System Models into a PRA
  - Time Dependencies
  - Diagnostics/Fault Tolerance/Coverage
  - Failure Modes – Including unknown or unforeseen failure modes

- **Development of a review process that is consistent with current regulations/guidance**
  - Acceptance Guidelines
  - PRA Quality - Attributes for digital system modeling
  - Open Issues - Use of PRA with a Deterministic Defense-in-Depth Philosophy/Methodology

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STRATEGY

- **The NRC Task Working Group, identified three issues**
  - Clarification on the use of current methods for modeling digital systems in Part 52 PRAs
  - The use of risk-insights in operating reactor digital system reviews
  - A comprehensive risk-informed decision making framework for licensing digital systems needs to be developed
- **For the short term tasks develop interim guidance**
  - Industry white papers outlining proposed current methods and lessons learned
  - NRC review of current guidance and methods
  - Input from research to date
  - Interim guidance to resolve short term problems
- **In the longer term evaluate and develop modeling methods needed to support risk-informed regulation of digital systems**
  - NRC research is looking at both the capabilities and limitations of current methods (FT/ET) and the advantages of advanced methods
  - Both research projects are reviewing best practices
  - Development of attributes of acceptable methods
  - Testing capabilities and limitations of possible methods using two benchmark systems
  - Develop long term regulatory guidance

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RESEARCH STATUS

- **Traditional Methods Research**
  - **Developed criteria for evaluating reliability models of digital systems.**
  - **Review applications using traditional risk methods, such as fault tree/event tree, against the criteria to determine the capabilities and limitations of the state-of-the-art.**
  - **Identified the most promising traditional methods for modeling and quantitatively assessing the reliability of digital systems.**
    - Fault Tree / Event Tree, SINTEF, Reliability Prediction Methods, NASA (software reliability approach) as well as a simplified analytical method used for an ABWR in Japan
    - Applications reviewed included:
      - AP1000 reactor vendor PRA
      - ESBWR reactor vendor PRA
      - ESFAS of Korean National Standard Plant (Westinghouse 80+ design)
  - **Future work will include:**
    - External peer review of the criteria for evaluating reliability models of digital systems and of the selection of traditional methods.
    - The application of traditional methods to two digital systems using the insights from this review and the best features from the current state-of-the-art.

RESEARCH STATUS

- **Dynamic Methods Research**
  - Review of current best practices review complete (NUREG/CR-6901)
  - First proof-of-concept of application of dynamic methods complete, draft NUREG/CR titled "*Dynamic Reliability Modeling of Digital Instrumentation and Control Systems for Nuclear Reactor Probabilistic Risk Assessments*" has been revised per reviewer comments and is in the final approval process.
  - A discrete state model has been developed based on FMEA and expected data availability
  - A methodology has been developed to incorporate Markov/ Cell to Cell Mapping Technique (CCMT) and Dynamic Flowgraph Methology (DFM) results into an existing plant PRA
  - Future work will include:
    - A standalone reliability modeling of the benchmark system using the DFM and Markov/CCMT methodology
    - Qualitative comparison of the event combinations that lead to the benchmark system failure as obtained by the DFM and the Markov/CCMT methodology
    - Quantitative evaluation of the models using data obtained through the fault injection procedure, as well as other means (e.g. field data, data libraries)
    - Incorporation of models into an existing PRA for selected initiating events (e.g. turbine trip, station blackout, loss of main feedwater)
    - Performing analyses using second benchmark problem

RESEARCH RESULTS

- **Challenges observed with traditional methods:**
  - **Lack of Systematic Evaluation of Possible Failure Modes and Effects**
    - PRA level of detail
    - Potential failures e.g., inter-channel communication
    - Propagation of failures
    - Fault tolerance features, e.g., self-diagnostics, watchdog timers, surveillance tests, etc.
  - **Lack of Applicable Digital Failure Parameter Data**
    - Raw failure data is generally not publicly available
    - Data analysis is not publicly documented, e.g., in advanced reactor PRAs and reliability prediction methods.
    - Data has large variability, therefore estimated failure rates have large error factors.
    - In some cases, the applications derived some parameters using judgment without any additional documentation.
  - **Inadequate Quantitative Software Reliability Methods**

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CONCLUSIONS

- **For the short term tasks the staff will develop interim guidance that will**
  - Clarify guidance on digital system modeling for Part 52 PRAs
  - Provide interim guidance, if possible, on use of risk-insights in digital system reviews
- **In the longer term, the staff will continue to work to develop a comprehensive risk-informed decision making framework for licensing digital systems. Current research indicates:**
  - It may be possible using traditional modeling methods (FT/ET) to develop reasonable digital system reliability models if the current limitations are addressed.
  - Dynamic methods (Markov or DFM) are capable of modeling the unique aspects of digital systems explicitly and it has been shown that, at least in principle, they can be used with current generation PRA's.
  - As part of developing long term regulatory guidance a required set of needed modeling capabilities will developed.
  - As part of the on-going research, a method of categorizing digital systems needs to be developed to help determine the level of modeling detail needed.