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BY THE
UNITED STATES NUCLEAR REGULATORY COMMISSION'S
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS**

FEBRUARY 6, 1996

The contents of this transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards on February 6, 1996, 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

3 + + + + +

4 438TH MEETING

5 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

6 + + + + +

7 THURSDAY

8 FEBRUARY 6, 1997

9 + + + + +

10 ROCKVILLE, MARYLAND

11 + + + + +

12 The Advisory Committee met at the Nuclear
13 Regulatory Commission, Two White Flint North, Room T2B3,
14 11545 Rockville Pike, at 8:30 a.m., Robert L. Seale,
15 Chairman, presiding.

16 COMMITTEE MEMBERS:

17 ROBERT L. SEALE, Chairman

18 DANA A. POWERS, Vice Chairman

19 GEORGE E. APOSTOLAKIS

20 JOHN J. BARTON

21 IVAN CATTON

22 MARIO H. FONTANA

23 THOMAS S. KRESS

24 DON W. MILLER

25 WILLIAM J. SHACK

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1 ACRS STAFF PRESENT:

2 JOHN T. LARKINS, Executive Director
3 ROXANNE SUMMERS, Technical Secretary
4 SAM DURAISWAMY
5 CAROL A. HARRIS
6 RICHARD P. SAVIO
7 PAUL BOEHNERT
8 NOEL DUDLEY
9 MADHAT M. EL-ZEFTAWY
10 MICHAEL MARKLEY
11 AMARJIT SINGH
12

13 ALSO PRESENT:

14 FRANK COFFMAN
15 MARK A. CUNNINGHAM
16 MARTIN J. VIRGILIO
17 WAYNE HODGES
18 HAROLD VANDER MOLEN
19 TIM COLLINS
20 WARREN LYONS
21
22
23
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P-R-O-C-E-E-D-I-N-G-S

(8:34 a.m.)

1) OPENING REMARKS BY THE ACRS CHAIRMAN

1.1) OPENING STATEMENT

CHAIRMAN SEALE: Good morning. The meeting will now come to order. This is the first day of the 438th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will consider the following: ACRS subcommittee activities, future ACRS activities, shutdown operations risk, reconciliation of ACRS comments and recommendations; and proposed ACRS reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act.

Sam Duraiswamy is the designated federal official for the initial portion of this meeting.

We have received no written statements or requests for time to make oral statements from members of the public regarding today's sessions. A transcript of portions of the meeting is being kept, and it is requested that the speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

First of all, I'd like to apologize to start with for any problems that we might have because of my

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1 working my way into this slot, but we'll get there. And I
2 know that I'll have the good humor of everyone to help me
3 as we go along.

4 1.2) ITEMS OF CURRENT INTEREST

5 CHAIRMAN SEALE: Among the items of current
6 interest, we have four candidates for consideration as
7 possible members of the Committee. These gentlemen
8 generally have capabilities in the thermal hydraulics
9 area.

10 Two sets of interviews with members of the
11 Committee are scheduled for today and two tomorrow. That
12 will require some of the members to be out of the meeting
13 for short periods of time during the day today. I hope
14 that we can take care of that transition without too much
15 difficulty. I do urge everyone to be sure that you do
16 take the opportunity to take to the candidates.

17 There is a packet of bio information that you
18 have available to you. Also somewhere else there was a
19 set of questions that were made available to us that are
20 the questions that are being covered by the screening
21 group which has been set up by the Commission. And so we
22 don't need to worry about those. I would urge you to take
23 a look at that list. Do we have it? Well, they'll pass
24 it out to you. And those are things you don't need to
25 worry about in that process.

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1 Today it's Virgil Schrock and Jose Reyes from
2 Oregon State that are going to be in the group.

3 This evening at 6:30, we will all reconvene at
4 Positano's for a last chance to take a shot at Ivan as a
5 member of the Committee. And we need to plan to do that.
6 So we will also plan to adjourn for the evening from here
7 at 5:30. So you might keep that in mind among your plans.

8 1.3) PRIORITIES FOR PREPARATION OF ACRS REPORTS

9 CHAIRMAN SEALE: We've got a fairly full plate
10 this week. There are already three draft letters
11 available to you. And I want to compliment the authors of
12 those letters for having those ready in such a prompt way.
13 Hopefully we will be able to do this sort of thing a
14 little bit more regularly. And, as a matter of fact, I
15 want to have some more comments to make about the process
16 of doing letters when we get to that.

17 We also have a couple of reconciliation items
18 from Congress that we will get to later.

19 Oh, by the way, among our letters, so far
20 everything has got an A on it except one. And that's an
21 A++, the letter to Congress, which we have to get out in
22 February.

23 MR. DURAISWAMY: Yes.

24 CHAIRMAN SEALE: So that's the reason for that
25 status.

1 Are there any other comments that anyone would
2 like to make before we get started? John, we're about to
3 get started. Were there any comments you wanted to make
4 before we got started?

5 EXECUTIVE DIRECTOR LARKINS: No.

6 MEMBER KRESS: We're not going to overlook any
7 problems that we may have due to your transition here.

8 CHAIRMAN SEALE: Not at all, I'm sure.

9 MEMBER KRESS: We're going to look for them.

10 CHAIRMAN SEALE: I understand. I understand.
11 That's fair.

12 Okay. Well, Dr. Catton wanted plenty of time
13 this morning. So I've tried to make it available for him.
14 The first item is a report by the Chairman of the Thermal
15 Hydraulics Subcommittee having to do with the review of
16 the Westinghouse AP600 test program.

17 MEMBER CATTON: Thank you.

18 2) SUBCOMMITTEE REPORT -

19 THERMAL HYDRAULIC PHENOMENA SUBCOMMITTEE

20 MEMBER CATTON: In that I'll be leaving the
21 Committee, I'd like to take the opportunity to give you a
22 broader picture in just the subcommittee meeting I'm
23 reporting on.

24 The AP600 thermal hydraulics differ in some
25 respects from existing plants. These differences are

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1 primarily in the passive thermal hydraulic features they
2 employ to deal with various loss of coolant events that
3 could occur.

4 The ACRS became involved very early in the
5 review process because of these new issues and some
6 concern about the computational tools that were to be used
7 both by the staff and by Westinghouse.

8 In particular, what drove us was that both
9 Westinghouse and the staff through their INEL contractors
10 -- and I'm not referring to NRR here -- argued that there
11 were little differences. And if you look at some of the
12 early reports that were put out of Idaho, they saw no need
13 to do anything to any code. This sort of rapidly changed.

14 NRR was unconvinced and made a case for
15 high-pressure, full-height testing. Westinghouse offered
16 SPES, and Research offered ROSA. We reluctantly agreed
17 about SPES but disagreed about ROSA. And I think our
18 views have been confirmed, but that's another story.

19 Westinghouse argued from the outset that they
20 only needed information about long-term behavior because
21 all breaks were turned into large breaks and their
22 computational tools were adequate for the task.

23 The need for data for this phase led to design
24 and construction of the OSU facility. I think it's called
25 APEX. The OSU facility is probably the best designed and

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1 instrumented facility in the U.S. And in my view, its
2 only close competitor might be the BETHSY facility in
3 France, in Grenoble.

4 Some of the results from the OSU facility
5 clearly deonstrated how sensitive the thermal hydraulic
6 behavior is to small design differences. It was clear, at
7 least to some, before any data became available and
8 confirmed when it was in hand that condensation, thermal
9 stratification, small differences in buoyancy and drag
10 forces lead to difficulties in simulation.

11 Both NRR and NRC have the wrong types of codes
12 for the job. This doesn't mean that they can't get it
13 done. It just means it's going to be far more difficult
14 and computationally expensive than it needs to be.

15 The actual design has been a moving target. A
16 series of small changes, ranging from addition of a sparer
17 to the CMT to removal of the balance line between the
18 pressurizer and the CMT and timed opening of Stages 2 and
19 3 of the controlled opening of the primary system, the
20 process has evolved to something that I believe can be
21 approved. This doesn't mean that it has been shown to be
22 approvable. Unfortunately, the bringing together of all
23 the information has not been well-done.

24 According to Part 52, a case must be made for
25 the fidelity of the predictions of AP600 behavior. In a

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1 meeting with Westinghouse about six months ago, maybe a
2 little longer, -- Paul would know the date -- we told
3 Westinghouse that they needed to address the issue of the
4 completeness of the data set in a meaningful way.

5 Our meeting on 17-18 December was to address
6 this issue. To address completeness, one needs to bring
7 to bear analysis, experience, and common sense in some
8 kind of a scrutable way.

9 I believe the following steps are needed:
10 first, a clear statement of what is though to be
11 important and what is not with documentation of the basis;
12 -- this is often called a PIRT -- second, scaling studies
13 to demonstrate that the various facilities, both SET and
14 IET, will yield the data needed to verify the ability of a
15 code to predict the phenomena highlighted by the PIRT.
16 The scaling needs to be bottom up for SET -- that's
17 separate effects tests -- and top down for the integral
18 tests.

19 The effort by Westinghouse to date is
20 incomplete. Westinghouse touched on all of the needed
21 elements but feel short in bringing it together in a
22 scrutable way.

23 Of the many questions that we raised during
24 the meeting, only a few require further technical work in
25 my view. Unfortunately, many answers to the questions and

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1 concerns raised by the subcommittee were by reference to
2 as yet unwritten reports or unavailable, unreferencable
3 documents.

4 The large-break LOCA is treated in a best
5 estimate manner. And early work by Westinghouse is
6 referenced. Unfortunately, the documentation referenced
7 was never finished, and commitments to do so have not been
8 met either by the staff or by Westinghouse. The
9 commitments to make the documentation scrutable and
10 complete appear to have been forgotten. And I think you
11 probably recall some of the efforts that we had to go
12 through to get them to even agree that it was needed.
13 I'll come back to this.

14 Many questions were addressed by referring to
15 unreferenced RAIs. And, Paul, I got it right that time.
16 I wrote it down so I would.

17 These RAIs are sometimes a series of questions
18 and answers that create a convoluted and difficult path to
19 follow given that the reader knows of their existence.
20 Once the NRR reviewers are happy, they move on. Little
21 attempt is made to correct the original documents or
22 cross-reference the RAIs to the submitted documents.

23 We told Westinghouse that we were unwilling to
24 move to the next step, which I'll describe in a moment,
25 until the process was complete. We relented but noted

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1 that if something turns up, which I doubt, it's a
2 Westinghouse problem.

3 Once the integral and separate effects data
4 sets are found to be complete enough, the process is
5 finished. The steps that follow this are to: first,
6 obtain a description of the code that's detailed enough to
7 assure that all important phenomena are modeled.

8 Now, they use several codes. And the only one
9 that we really know about is COBRA/TRAC. The
10 documentation that we had in hand for the NOTRUMP code, at
11 least what I had, was almost 20 years old.

12 It turns out at the outset they had planned to
13 use COBRA/TRAC, which is a best estimate tool, for the
14 whole process. But it got too damned expensive for the
15 small breaks. So what they did is they said: Okay. We
16 will use COBRA/TRAC for the large-break LOCA, and we'll
17 use NOTRUMP for the small-break. Now when you get out to
18 the long-term cooling, they went back to COBRA/TRAC, which
19 in my view is a mistake.

20 The second step in this process is to make
21 appropriate comparisons of the code in the separate
22 effects test data to show that the predictions have
23 sufficient fidelity.

24 The final step is to make appropriate
25 comparisons of code predictions in integral test data to

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1 show that the predictions will have sufficient fidelity
2 for AP600 evaluation. In my view, a suite of codes is
3 needed to carry out such a process and that the use of one
4 code to do it all is an expensive way to do business.
5 But, again, it's Westinghouse's choice.

6 Again, I'd like to emphasize the need for
7 scrutable documentation by referring to the lessons
8 learned from the recent Maine Yankee problems. The
9 document of most interest is a memo from Dorman, Cubbage
10 and Cotta to Holahan dated 5 December 1996. And if you
11 look about midway through it, you'll find there are some
12 recommendations made.

13 It's recommended that a guide for
14 documentation of ECCS methodologies be developed; --
15 that's first -- two, RAIs and responses be included in
16 approved versions of vendor topical reports; and, three,
17 sample applications of codes and methodology should be
18 submitted for approval. There were others but not
19 relevant I believe to the AP600 review.

20 These recommendations have been made by the
21 ACRS in the past. And if you look through letters and
22 minutes of meetings for the past 10 or 15 years, the ACRS
23 has been pushing very hard to get the staff to create some
24 sort of a structure for these kinds of reviews. And it
25 never happened.

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1 I believe the ACRS should continue to be
2 proactive in this area. And, further, I think the
3 Westinghouse effort should be required to meet these
4 recommendations. It is probably more important that they
5 do so for plant certification than for a Yankee-type
6 problem.

7 I'd be delighted to answer any questions about
8 our subcommittee meeting. I only took ten minutes.

9 CHAIRMAN SEALE: Yes. Mario, do you have a
10 question?

11 MEMBER FONTANA: What do you think it would
12 take to get all of these things, how much time?

13 MEMBER CATTON: I don't know. I find it
14 really strange that some of these things that appear to me
15 to be relatively simple seem to be impossible for an
16 organization like Westinghouse. But I don't know.

17 I think that if you put two or three people in
18 a room and locked them up for a couple of weeks, they
19 could get it done. It's mainly a matter of organization.

20 I would say 95 percent of the issues that were
21 raised during the subcommittee meeting were answered by
22 reference to something, but nobody quite knew where it
23 was. In some cases, it hadn't been written yet. And
24 there was no referencing anywhere. So what you had was
25 words, a transcript, and an incomplete document.

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1 I don't think how long it would take is really
2 important. I think they should do it when you're about to
3 put on the table a certification for a plant.

4 MEMBER FONTANA: Your key thing that you said
5 was that you don't think much more technical work is
6 necessary, it's a case of putting it together. Is that
7 correct?

8 MEMBER CATTON: That's right. I don't think
9 they need to go out and run more experiments.

10 MEMBER FONTANA: Yes.

11 MEMBER CATTON: Now, there were a few
12 technical issues. One had to do with the passive heat
13 removal system and whether or not there was sufficient
14 area and whether or not boiling in the pool would impact
15 it. I think these questions can be addressed.

16 MEMBER KRESS: Ivan, you said that you thought
17 a suite of codes was needed.

18 MEMBER CATTON: Yes.

19 MEMBER KRESS: If you look at any thermal
20 hydraulic code, that really is a suite of subroutines. If
21 you have enough of those subroutines or the right kind,
22 why couldn't that be viewed as a suite of codes?

23 MEMBER CATTON: Well, it certainly could
24 except that when you do that, you build something that's
25 so complicated you can never figure it out.

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1 MEMBER KRESS: It becomes inscrutable and --

2 MEMBER CATTON: Yes and becomes very difficult
3 to follow. There's no reason you can't. The problem is
4 the way codes like TRAC are put together is they have a
5 particular time-stepping algorithm. And they have a
6 certain way of doing business with the nodalization.
7 That's what has to change, and that's the heart of the
8 code.

9 If you backed up and started over, you
10 probably could put together a code that could have complex
11 representation when needed and simple when needed, but
12 that ain't the way it was done. And that's the problem.

13 MEMBER KRESS: Okay.

14 CHAIRMAN SEALE: Any other comments or
15 questions?

16 VICE CHAIRMAN POWERS: Ivan, you've talked
17 primarily about thermal hydraulics in the reactor coolant
18 system. What can you tell us about thermal hydraulics
19 within the containment?

20 MEMBER CATTON: That is a little more bleak.
21 At the outset, Westinghouse -- well, for reasons that are
22 unknown to me, it seems that the standard operating
23 procedure is to run tests, then see if they are any good.
24 And that's exactly what was done with the containment.

25 They ran some scale tests, and they got some

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1 data. Then they tried to do calculations. The
2 computational tool is GOTHIC.

3 MR. BOEHNERT: Right.

4 MEMBER CATTON: GOTHIC runs so slowly when
5 they run it in the mode that's needed to represent the
6 environment within the containment that they really
7 couldn't do the calculations.

8 VICE CHAIRMAN POWERS: When you say "the mode
9 that's needed," what is that mode?

10 MEMBER CATTON: A finite difference of some
11 sort, lumped parameter, something. See, the difficulty in
12 the containment is stratification. And stratification
13 impacts the heat and mass transfer to the boundaries of
14 the containment volume. And unless you properly represent
15 that environment, you can't predict the behavior of
16 stratified flow.

17 MEMBER KRESS: Is this thermal stratification
18 or --

19 MEMBER CATTON: Thermal stratification. And
20 you have also steam stratification. And if you have any
21 inert gases, they're going to stratify as well because you
22 have a convective process that carries this stuff up. And
23 the steam condenses out on the wall.

24 The measurements that they did were
25 inappropriate to measure these kinds of things. So they

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1 really don't know what they had inside. There were
2 scaling difficulties with the experiments that they ran,
3 simple things like: How much flow should I have in order
4 to represent what I would actually see in a full-scale
5 system? They just flooded it, and there was no
6 relationship between their flooding and what you might
7 expect.

8 MR. BOEHNERT: There were also some
9 atypicalities in the test facility as well.

10 MEMBER CATTON: Yes. That's right. Some
11 atypicalities you can live with, and others you can't. If
12 the film evaporation on the external surface is important,
13 then somehow you ought to be scaling that film evaporation
14 process properly. Either that or you have to have a
15 damned good model that represents the whole thing. Well,
16 they have neither.

17 That's my understanding that they're going to
18 -- I guess Jack Kudrick is the NRR person who is
19 responsible for this.

20 MR. BOEHNERT: That's correct. It's in his
21 branch.

22 MEMBER CATTON: Sandia, by the way, through --
23 I forget the person's name -- did a really good job of
24 evaluating the data. I think they're coming to the
25 conclusion that they'd better put sprays or something.

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1 I don't recall where they have really come
2 down on that. We haven't heard in quite a while. As a
3 matter of fact, Dana, it's probably time to ask them. I
4 guess you have responsibility for containment.

5 VICE CHAIRMAN POWERS: Not in this area. I
6 have to recuse myself.

7 MEMBER CATTON: Somebody ought to ask about
8 what they're doing.

9 CHAIRMAN SEALE: Okay.

10 MEMBER KRESS: We'll ask.

11 CHAIRMAN SEALE: Thank you.

12 MEMBER CATTON: It's been quite a while.

13 CHAIRMAN SEALE: Any other questions?

14 (No response.)

15 CHAIRMAN SEALE: Well, what's our next step
16 now?

17 MEMBER CATTON: What's your next step?

18 CHAIRMAN SEALE: Yes.

19 MEMBER CATTON: I think the next thing is
20 Westinghouse is going to come back with -- and I think
21 they have. We received a new table of contents for the
22 report that addresses Step 1 of the process.

23 And I've taken a brief look at it. And I
24 notice no mention of the RAIs. So I told Paul to let them
25 know that there needs to be an appendix. And in the

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1 appendix, there should be all the RAIs. And they need to
2 be properly cross-referenced to the text. And when
3 they're ready, we go forward.

4 Now, in parallel, what they want to do is they
5 want to start looking at the code validation process,
6 which means you need to take a look at the codes to make
7 sure it properly represents all the important phenomena.
8 That's one of the next steps.

9 I think that's a fairly simple task.

10 MR. BOEHNERT: Well, the next meeting,
11 actually, they want to meet with us on long-term cooling.

12 MEMBER CATTON: Long-term cooling is a major
13 headache.

14 MR. BOEHNERT: That's why they want to meet
15 with us.

16 MEMBER CATTON: The problem is they're using
17 COBRA/TRAC. COBRA/TRAC was a code that was written to
18 evaluate large-break LOCA, deals with very fast
19 transients.

20 And I don't know. If any of you have done
21 numerical work, you know that you have to use different
22 kinds of algorithms for slow transients than for fast.
23 Well, they're using a code that has the algorithms for
24 fast transients for a slow transient problem. And they're
25 having major headaches, and they're coming up with all

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1 kinds of convoluted ways to deal with it.

2 The problem you have, or at least that I have,
3 is that you can't tell them what to do. It's their
4 business and their money. And you have to listen to all
5 of this nonsense and hope they get to an answer that makes
6 sense. They probably can if they spend enough money and
7 time.

8 MEMBER KRESS: The only problem is for running
9 time; right?

10 MR. BOEHNERT: They're going to something
11 called a windows approach, where they take --

12 MEMBER CATTON: There's more to it, Tom, than
13 that. If you take the codes with these kinds of
14 algorithms and you start doing some -- you can't do proper
15 convergence testing.

16 So it's not like when I take a nice problem
17 and solve it with a CFD. It's not the same.

18 MEMBER KRESS: But usually you don't have a
19 convergence problem with these slow transients long term.

20 MEMBER CATTON: You shouldn't.

21 MEMBER KRESS: You could, though, you're
22 saying?

23 MEMBER CATTON: You could because the
24 time-step is for a different kind of problem. And so you
25 have a tendency to build up errors and all sorts of things

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1 as you move forward. You don't know if you're going to
2 get true convergence unless you test it. And how are you
3 going to test it?

4 They have a problem. And I guess that's why
5 they want to talk to us.

6 MEMBER KRESS: It's not really a convergence
7 problem. It's converting to the right value.

8 MEMBER CATTON: Now, they're arguing that they
9 will and that it's really none of our business if they
10 choose a poor way to do it.

11 MEMBER KRESS: They might have a point there.

12 MEMBER CATTON: I agree. I agree. But when
13 you choose the wrong method to address a problem, it just
14 makes it a major headache to try to figure out if it's
15 being done right. So in a way, it is our problem.

16 MEMBER KRESS: So what are we going to look at
17 out at L.A. in the --

18 MEMBER CATTON: Oh, when we go to Los Angeles?

19 MEMBER KRESS: Yes.

20 MR. BOEHNERT: That's another issue.

21 MEMBER CATTON: Next week.

22 MEMBER KRESS: That's a different issue?

23 MEMBER CATTON: That's the research effort in
24 the same arena.

25 MR. BOEHNERT: What you're going to look at in

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1 L.A. is the RELAP5 code applicability work, where they're
2 taking RELAP --

3 MEMBER KRESS: Oh, that's the RELAP stuff?

4 MR. BOEHNERT: Yes, RELAP.

5 MEMBER CATTON: Westinghouse is trying to get
6 a subcommittee meeting scheduled for sometime in March.

7 MR. BOEHNERT: Right. I need to talk to you
8 gentlemen to see if I can --

9 CHAIRMAN SEALE: Okay. Fine, Paul.

10 All right. Is there anything else that we
11 need to bring up at this time?

12 (No response.)

13 CHAIRMAN SEALE: Okey-dokey. The next thing
14 we have is a report by the Subcommittee on I&C Systems and
15 Computers. This involves the National Academy of Sciences
16 Phase 2 report and also our review of the -- also some of
17 the things on the review plan.

18 I understand you're going to be assigning
19 members' or confirming members' responsibilities for the
20 review of pieces of this thing, Don.

21 MEMBER MILLER: Well, with the support of the
22 Chairman, yes, we will --

23 CHAIRMAN SEALE: Okay. Well, we look forward
24 to hearing what you have to say.

25 And I'll remind some of you that you have a

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1 date at 9:15 to begin the discussions with one of the
2 candidates.

3 MEMBER MILLER: And I have an appointment with
4 one of the commissioners at 9:30. So I'm not going to be
5 able to make one of these assignments.

6 CHAIRMAN SEALE: Well, we'll move you around,
7 then. Okay?

8 MEMBER MILLER: Okay.

9 CHAIRMAN SEALE: All right. Do you want to go
10 ahead and get started?

11 MEMBER MILLER: Yes.

12 3) SUBCOMMITTEE REPORT - SUBCOMMITTEE ON
13 INSTRUMENTATION AND CONTROL SYSTEMS AND COMPUTERS

14 MEMBER MILLER: As a bit of background,
15 between the meeting in December and the meeting in
16 February, I felt that it would be an opportunity to kind
17 of sit down and reflect upon some of the I&C issues that
18 have come about as we have discussed it in various
19 subcommittees.

20 So I pulled together the memos and the reports
21 and so forth and started a memo which kind of grew like a
22 camel built by a committee and kept evolving. Finally I
23 had all of the issues written down, which evolved into
24 that memo you all received dated January 23rd.

25 We also had a PRA Subcommittee meeting, which

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1 was shortened from two days to one. So I took the
2 opportunity of initiating an informal meeting with some
3 staff members in the I&C area, both from Research and from
4 NRR. And that did occur on January 29. Dana was in town.
5 He joined me, which I appreciated his input and
6 collaboration on that meeting.

7 Now, the issues are as I documented in the
8 memo on January 23rd. And they involved, as I said, a
9 number of things that various members of this Committee
10 have brought up during our discussions, including items
11 brought up in our meeting with the commissioners in
12 December.

13 I'm not planning to review that memo here
14 unless you have questions. I'd certainly be glad to
15 respond to them. As you can see, it's just a potpourri of
16 issues that were brought up.

17 In addition to that, I added an issue, or at
18 least an item, that came out of a report that I had the
19 opportunity to review over the December time period.

20 So, with that, we had a meeting on January
21 29th, which I thought was from my perspective productive.
22 And I'm certain Dana would be happy to comment also.

23 In the meantime, as we came to the January
24 29th meeting, the National Academy study or report became
25 available on January 22nd. And I received it I guess

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1 about that time period as well as the rest of the
2 committee members. And, of course, being the chairman, I
3 dived in it right away and made some sort of review before
4 the January 29 meeting.

5 It turned out a number of the issues that I
6 put together in my memo kind of naturally moved into the
7 issues that were raised in the National Academy study. At
8 least some of them did.

9 So, with that, the meeting of January 29th
10 became one of discussing the memo I put together as well
11 as my comments and my view of the National Academy report
12 as well as the staff's view of the report, which many of
13 them also had had the opportunity to at least have a
14 first-cut review.

15 So, with that, we went into the meeting and
16 went through a number of issues and came out of the
17 meeting with some commitments by the staff. And I'm going
18 to review those commitments as we approach the National
19 Academy review, which will be presented to us at the March
20 meeting.

21 And also, as heads up, we're going to deal
22 with the final standard review plan update for Chapter 7
23 at the May meeting. And between that, there will be a
24 subcommittee meeting to deal with a number of these
25 issues, including folding the National Academy study into

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1 any additions or changes or recommendations for the
2 standard review plan.

3 That kind of gives you a background, a kind of
4 an overview of where I believe we are with the I&C. And
5 I'd be glad to stop now for a moment if there are any
6 questions. Otherwise, I'll go on and discuss some of the
7 commitments that have come up that came up out of the
8 January 29th meeting. And I'd also stop and see if Dana
9 has anything to add to this.

10 VICE CHAIRMAN POWERS: Well, I think, like
11 you, that I got a great deal out of our meeting with the
12 staff, understanding how they were responding to the
13 National Academy report and what they thought were issues
14 they could handle.

15 I think it's important to understand that the
16 Academy report is not a carved stone tablet from the
17 mount. It has its own sets of strengths and weaknesses and
18 difficulties or impossibilities in some cases to guide the
19 staff. And so it can only be treated as a set of
20 suggestions.

21 MEMBER MILLER: Dana gave me and the staff
22 some insight on National Academy-type I guess efforts.
23 You've served on a couple of those, I assume?

24 VICE CHAIRMAN POWERS: I have.

25 MEMBER MILLER: I served as a subcommittee

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1 member on one, but I'd never been on a final review, where
2 you kind of pull everything together.

3 And, as such, Dana also gave us, then, some
4 insight on, as he just pointed out, the strengths and
5 weaknesses of a National Academy report. And, as I said,
6 they're not cast in concrete. So we're not obligated to
7 do anything with them. Certainly they're recommendations
8 and suggestions.

9 With that, we went through that. And so I've
10 got a memo I'm putting together, and we'll send it out.
11 Mike and I will send that out sometime in the next day or
12 two. And I'll just summarize the memo, which summarizes
13 the meeting of January 29th.

14 The first thing we did do is we have at least
15 tentatively scheduled a subcommittee meeting for April 17
16 to 18, which would deal with the National Academy study
17 report as well as the standard review plan.

18 CHAIRMAN SEALE: When is that subcommittee
19 meeting?

20 MEMBER MILLER: That would be April 17 through
21 18.

22 CHAIRMAN SEALE: Okay.

23 MEMBER MILLER: And here I'm just -- there's a
24 list of I say comments or commitments as this meeting took
25 place on January 29th. Dana noted that formal methods,

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1 which were discussed in the report, are out there but are
2 not being used. But he did request the staff to provide a
3 discussion regarding this matter and why they are not
4 being used. And they agreed to do that.

5 The staff agreed to provide a discussion on
6 the use of software development tools and how the proposed
7 guidance would assess the various tools used in licensee
8 submittals. That issue was one I had raised in my memo.
9 And it's also embedded within the National Academy report.

10 The staff agreed to provide a discussion
11 regarding diversity between their view on what it is and
12 what it is not as in regards to I&C systems. And, again,
13 that issue was brought up in the National Academy report
14 as well as comments that I brought up in my memo.

15 The staff agreed to provide a copy of the EPRI
16 topical report on commercial off-the-shelf software. We
17 discussed the staff safety evaluation report when it's
18 available.

19 I have available in my library the report as
20 of July of '96. The report is being updated. And
21 apparently we do have an updated version.

22 MR. MARKLEY: It's coming.

23 MEMBER MILLER: We will have one coming which
24 will be probably pretty close to the final version that
25 the staff agrees to and in a sense endorses through an

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2 Again, that issue of COTS was a major or was
3 one of the technical issues that the National Academy
4 study addressed. And they also referred to the EPRI
5 effort in collaboration with the staff.

6 The staff agreed to provide a walk-through
7 presentation to demonstrate acceptance criteria and how
8 they apply throughout the process as in guidance, which is
9 provided with the SRP. Dana and I both emphasized that
10 the staff should lead us through I guess as best they can
11 in a tutorial or instructional type perspective, that we
12 all need to be educated, so to speak.

13 I had taken the opportunity of opening up the
14 SRP again and saying: Okay. If I were a user of this and
15 trying to follow it through, could I indeed see where the
16 acceptance criteria are provided and how we test the
17 product as well as do the process because that's been an
18 issue this Committee has raised on a number of occasions?

19 And in doing that, I prepared more for myself
20 than anybody else kind of a guideline of what I would do.
21 And that guideline document we provided to the staff. And
22 I'm certain they're going to shoot holes in it and give me
23 some feedback.

24 And I believe that guideline has been provided
25 to the Committee. Right, Mike?

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1 MR. MARKLEY: Yes.

2 MEMBER MILLER: They have that?

3 Again, you have to take that as notes that I
4 made as I went through the process of saying: If I were a
5 user of the SRP, how would I look at it? And where would
6 I see process versus product and testing of the product?

7 So if it's a little bit sketchy, the staff is
8 going to fill in the gaps and hopefully make it readable
9 for all of us on the Committee.

10 CHAIRMAN SEALE: Did you also examine it as a
11 victim of the SRP?

12 MEMBER MILLER: Victim.

13 CHAIRMAN SEALE: That is, an applicant that is
14 presumably making a proposal they hope will meet the
15 requirements of the SRP.

16 MEMBER MILLER: I tried to look at it as a
17 potential user, yes.

18 CHAIRMAN SEALE: Well, the user is the
19 reviewer.

20 MEMBER MILLER: Okay. Oh, I see, from that
21 perspective. I suppose I was looking at it from both
22 perspectives, yes.

23 CHAIRMAN SEALE: Okay. I thought you probably
24 were, but there is that distinction.

25 MEMBER MILLER: Again, I didn't spend as much

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1 time as a reviewer would nor as a potential user would,
2 but I tried to trace it through from beginning to end.

3 And it turns out that by looking at a couple
4 of the documents that we have been provided, Chapter 7,
5 OAA, and the BTP-14, really are the key documents. And
6 when I came out, I felt the acceptance criteria were
7 pretty well laid out, although it's a little more
8 complicated than maybe it could be. Other than that, I
9 felt it was fairly well laid out.

10 VICE CHAIRMAN POWERS: I thought one of the
11 most interesting features of our discussions was the
12 central role that the branch technical position plays.
13 And when you first approach this document, you say, "Well,
14 what's important is the SRP elements." And you don't
15 realize how central this branch technical position, it
16 seems, a second tier document really is.

17 MEMBER MILLER: Yes. The BTP-14, as I went
18 through this exercise, I gained more appreciation for it.
19 I think the staff did a good job with the BTP-14, but they
20 probably should have done a better job in emphasizing the
21 importance of that document to us as a member of this
22 Committee. So we emphasize they should walk us through
23 how they would use this as guidance and emphasize the
24 importance of that document and some of the key issues
25 brought up in that document.

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1 It is a matter of I had to go through it a
2 second time to begin to appreciate where that document fit
3 into the entire scheme. As Dana points out, it's almost
4 the primary document to look at. And the SRP is in a
5 sense supportive.

6 We discussed for those who might worry about
7 consensus standards the fact that OMB Circular A-19
8 basically requires or -- how did we put that, Mike? --
9 almost requires us to use standards when they're
10 available.

11 MR. MARKLEY: It's a government document that
12 tells agencies to go out and do these things, but it was
13 later promulgated into law. So it is a requirement.

14 VICE CHAIRMAN POWERS: Well, what you don't
15 want to do is overestimate the impact of Public Law
16 104-113. It says, "Use consensus standards when they're
17 available and suitable." It is not a straitjacket. It
18 says, "Don't develop a standard simply because you want
19 one in an area when one already exists in the consensus
20 process." If you have a situation that's unique and
21 different and whatnot, you're not constrained to avoid the
22 standard, the sub-generation of regulations.

23 MEMBER MILLER: Yes.

24 MR. MARKLEY: I think the primary purpose of
25 it is really just so that government agencies and offices

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1 don't recreate things that already exist and waste
2 government money. It's more an efficiency in government
3 document than anything else.

4 VICE CHAIRMAN POWERS: You also have to look
5 at the title on the act. And it is a technologic transfer
6 and advancement act. It is simply reiterating a truism we
7 all know, that a certain amount of standardization across
8 and between industries facilitates technology transfer and
9 the advancement of technology.

10 Looked upon that way, I think it gives a lot
11 of understanding of what the legislature was trying to
12 accomplish.

13 MEMBER MILLER: The next item, Dana requested
14 the staff provide a briefing on the Halden reactor project
15 at a future meeting. And this should be added to the
16 future activities list for this Committee.

17 VICE CHAIRMAN POWERS: I'll just interject
18 here that I've had the benefit of looking at a trip report
19 from some of the NRC staff who attended the Halden
20 meeting. And I found -- a very good trip report, by the
21 way -- that there are an awful lot of things going on at
22 the Halden project that addressed topics of interest to
23 this Committee. And what I asked if the staff could brief
24 us on in this particular area, what was going on at Halden
25 for our information and that we may want to pay closer

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1 attention to this Halden effort.

2 NRC has increased its involvement in that
3 whole Halden effort recently. And it is an international
4 consortium of researchers that are producing information
5 at least that's pertinent to a lot of the topics that we
6 address, both in the digital I&C and in the fuels area and
7 in the human performance area.

8 In addition, it seems like the gatherings that
9 they have annually seem to attract a lot of allied topics
10 to be addressed at various workshops. So it looks like as
11 we move toward a more international research effort in
12 reactor safety, that maybe the Halden is an area that we
13 should keep our finger on the pulse a little closer.

14 CHAIRMAN SEALE: You'll remember several
15 months ago we had a presentation on human factors that
16 included a fairly large component from some work that had
17 been done in control room behavior from Halden. We'll
18 have to put that on the future projects list and see what
19 we can get that will --

20 VICE CHAIRMAN POWERS: Apparently at this last
21 meeting there were also some discussions of risk
22 assessments during low-power and shutdown operations.

23 CHAIRMAN SEALE: It would be useful.

24 VICE CHAIRMAN POWERS: So it looks like
25 there's an awful lot of information being brought together

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1 both as part of the research program again but also being
2 brought to the table by the participants in that research
3 program.

4 It's clear that a lot of our research is
5 becoming international, rather than self-directed. We
6 need to take advantage of this evolution.

7 MEMBER MILLER: It would sound to me like we
8 need almost a routine periodic report of the Halden
9 program.

10 VICE CHAIRMAN POWERS: Well, I think it's my
11 impression that this program goes out of its way each year
12 to reveal to its participants all that's been discovered,
13 that they have a periodic recording effort and maybe we
14 want a little more active participation.

15 CHAIRMAN SEALE: Yes.

16 VICE CHAIRMAN POWERS: And maybe we want a
17 little more active participation.

18 CHAIRMAN SEALE: Get on the circuit.

19 MEMBER MILLER: How long do those meetings
20 last?

21 VICE CHAIRMAN POWERS: They're several days
22 long.

23 MEMBER MILLER: It might be prudent that one
24 of us go and attend one of them.

25 In direct regard to the National Academy Phase

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1 2 study, we proposed the following actions. And the staff
2 has agreed to do that. First of all, the staff and we,
3 Dana and I, agree that many of the points raised in the
4 National Academy study are, in fact, addressed, either
5 directly or indirectly, in the Branch Technical Position
6 14, again raising our appreciation for that document. And
7 it was not clear whether -- it was our assumption the
8 National Academy study did not have the branch technical
9 position available when they did their report.

10 An issue that might be controversial coming
11 out of the National Academy study is the use of PRA and
12 quantitative reliability numbers for software in digital
13 I&C systems, which we as a policy, as NRC policy, are not
14 going to do it this time.

15 The staff agreed to look at that issue and
16 felt they could handle that issue. And that will be part
17 of their report to us in the April subcommittee meeting.

18 VICE CHAIRMAN POWERS: And I felt that the
19 Academy report did an incomplete job of defending that
20 position. I think when we hear about that Academy report,
21 that really ought to be a topic that we try to understand
22 better how they came to that conclusion.

23 MEMBER MILLER: I would assume you and I and
24 other members of the Committee and George will spend some
25 time when they give that report on that issue.

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1 VICE CHAIRMAN POWERS: I think it's just
2 important for us to understand because this is a step that
3 cuts the Gordian knot if we can take it. I mean, this is
4 the issue from what a lot of us -- the pressure to have
5 the Academy report was borne. Our concern that applying
6 probablistic failure criteria were penalizing digital
7 methods unfairly.

8 And they're coming along and saying, "No. You
9 can do that." In a practical sense they're saying you can
10 do that. And I'd like to understand very well why that is
11 because it does, as I say, sever the Gordian knot that we
12 found ourselves in.

13 CHAIRMAN SEALE: I should comment that at the
14 request of the subcommittee chairman, we have invited
15 former member Hal Lewis to be here at the presentation in
16 March on the National Academy study. And he has accepted.

17 I think that we can expect that Dr. Lewis will
18 also be interested in that particular aspect of their
19 findings.

20 MEMBER MILLER: The March subcommittee meeting
21 should be interesting, to say the least.

22 CHAIRMAN SEALE: Yes.

23 MEMBER MILLER: That probably from my
24 perspective of a first-cut review of the entire report is
25 probably potentially the most controversial issue or

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1 uncertain issue, recommendation, so to speak, made in the
2 report.

3 The next item, the staff agreed that for the
4 proposed final SRP Chapter 7 review to forward a document
5 identifying their points of agreement and disagreement
6 with the conclusions and recommendations that were made in
7 the National Academy Phase 2 study as well as their
8 proposed resolution and recommended actions.

9 During their meeting, we went through the
10 National Academy report kind of issue by issue and looking
11 at each of the recommendations. And I formed some
12 opinions of my own at that point as well as staff members.

13 We kind of compared notes. We tentatively had
14 I would say a reasonable correlation on the points we felt
15 needed to be further addressed and further studied to be
16 taken place on those issues.

17 There were a number of points raised or
18 recommendations that we felt were more or less validating
19 what we were already doing, a number of recommendations
20 that were made that in a sense confirmed that the
21 positions that we're moving into are probably the right
22 way to go, a number that really just were ones that we
23 didn't think we had to deal with, so to speak. So the
24 National Academy recommendation kind of fell under three
25 categories: potentially controversial; validating; or in

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1 a sense stating, "Here's the position of the industry, and
2 you don't need to do anything with it," or a position of
3 software engineering.

4 And following the lead of the Chairman in
5 trying to facilitate more efficient letter writing, I have
6 made assignments of members of this committee to look at
7 the National Academy study report and look at the
8 particular sections and then provide me some feedback. So
9 those assignments are made.

10 You're going to pass out that list; right,
11 Mike?

12 CHAIRMAN SEALE: It has been.

13 MEMBER MILLER: It's already been passed out?
14 So if there is any debate on that list, I would appreciate
15 feedback or comment.

16 CHAIRMAN SEALE: Yes. There's a sheet here
17 you've been given. And it has 2 sets of lists on it: one
18 from the PRA Subcommittee, 5 items; and then Dr. Miller's
19 assignment of 11.

20 I believe everyone is committed to do
21 something here.

22 MEMBER MILLER: Yes. This is not limited to
23 the subcommittee. This is the entire committee.

24 MEMBER KRESS: These all are the March
25 meeting?

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1 MEMBER MILLER: Yes.

2 CHAIRMAN SEALE: Okay.

3 MR. DURAISWAMY: The members can take a look
4 at the whole report, but this is especially assigned. You
5 are encouraged to look at the whole report.

6 MEMBER MILLER: Yes, everybody is encouraged
7 to look at it. You know, this is our report. This report
8 or this study was initiated by this Committee. So in a
9 sense it's our report. Certainly the staff is going to
10 provide a lot of support in dealing with the entire
11 report. But we, the ACRS, initiated it. We I suppose are
12 obligated to make certain we do a pretty thorough study of
13 it.

14 And as the chairman of the subcommittee, I'm
15 going to certainly be. And I have already take a fairly
16 serious look at this report and have drawn a number of
17 conclusions. And they're still evolving. By the March
18 meeting we'll have a more thorough study from my
19 perspective.

20 So, even though I'm assigned to only one or
21 two parts, I'll take responsibility in a sense for all of
22 it. But I certainly am hoping the rest of the Committee
23 members will support us on various sections here.

24 CHAIRMAN SEALE: Well, I think that we owe
25 ourselves, in one way or another, a serious consideration

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1 of these assignments. We can't expect to approach these
2 problems in a unified and task effort way unless we do our
3 share of the task. And so I would urge everyone to be
4 sure to come prepared to meet your obligations here.

5 MEMBER MILLER: One thing further. As far as
6 looking at the March meeting -- and I think Frank Coffman
7 here is in the audience. He might want to make a comment
8 on who is going to attend the meeting in addition to the
9 chairman of the committee.

10 Frank, do you have any idea on that yet?

11 CHAIRMAN SEALE: Yes, Frank. Thank you.
12 Thank you.

13 MEMBER MILLER: Thanks for coming.

14 MR. COFFMAN: Yes, sir. Right now the entire
15 panel has been invited, but we only know that Larry Damon
16 will be attending and that Nancy Leveson will not, will be
17 unable to attend, in addition to the chairman. Are there
18 others, Leo, that --

19 CHAIRMAN SEALE: And that date is again when?

20 MR. COFFMAN: March 7th.

21 MR. DURAISWAMY: Well, it's a full Committee
22 meeting.

23 CHAIRMAN SEALE: Yes, that's during the full
24 Committee.

25 MR. DURAISWAMY: Right.

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1 MEMBER MILLER: And we're going to have what,
2 two or three hours on that?

3 MR. DURAISWAMY: Yes.

4 CHAIRMAN SEALE: Okay. And then are there
5 subcommittee meetings subsequent to that?

6 MEMBER MILLER: The subcommittee meeting for
7 I&C will be in April, April 17th.

8 MR. DURAISWAMY: That is a look at the
9 proposed and final SRP and the reg guides and the BTPs,
10 those kinds of things.

11 CHAIRMAN SEALE: Okay.

12 MEMBER MILLER: Right.

13 MR. DURAISWAMY: Bob, I think the members'
14 assignments, individual members, it will come at the
15 future activities, but I think I put a specific date, I
16 think February 21st, for the members to give you feedback.
17 So if you want to put together something. It will come in
18 the future activities.

19 MEMBER MILLER: Okay. So not only have we
20 made assignments. We have made a deadline, drop-dead
21 dates, on these.

22 CHAIRMAN SEALE: Okay.

23 MEMBER MILLER: February 21st, of course,
24 we're also scheduled to have a subcommittee meeting on
25 PRA. So many of the members will be here.

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1 MR. DURAISWAMY: That's why I picked the date.

2 MEMBER MILLER: I figured you picked that
3 date. This way I can go around and collar people who are
4 here. So those attending that meeting may certainly bring
5 your reports.

6 CHAIRMAN SEALE: Anything else?

7 MEMBER MILLER: I believe that's all unless we
8 have comments or questions.

9 CHAIRMAN SEALE: Well, I had one question.

10 MEMBER MILLER: Okay.

11 CHAIRMAN SEALE: You said that this Committee
12 was the originator of the National Academy report. I
13 certainly would agree that the Committee had a lot to do
14 --

15 MEMBER MILLER: Stimulator.

16 CHAIRMAN SEALE: -- with the stimulation of
17 the report. On the other hand, of course, it's Research
18 that is the official --

19 MEMBER MILLER: Yes.

20 CHAIRMAN SEALE: - custodian of this. One of
21 the characteristics of these National Academy reports
22 occasionally is that they seem to attract extreme measures
23 to keep them alive once they've been put together. And
24 they don't die very easy.

25 Do you think this report is going to have a

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1 clean, crisp end of life?

2 MEMBER MILLER: I'll answer that by saying I
3 don't believe and I think the staff -- one conclusion out
4 of the January 29th meeting was we don't believe there are
5 any of what I call showstoppers.

6 CHAIRMAN SEALE: Okay.

7 MEMBER MILLER: And I think that answers your
8 question. However, I think the report is a document which
9 can be valuable. For example, in the human factors area,
10 I felt that section was quite interesting just from the
11 viewpoint of it gave me a lot of education, put together a
12 lot of things that I had not understood.

13 I thought that section, for example, I would
14 go back and read a couple of times. Other sections were
15 not quite as tutorial, so to speak, but they were
16 interesting reading. I think it's a way to put together a
17 lot of issues in an area.

18 But, as I say, there are no recommendations
19 except the one we already discussed that I think is going
20 to have a life beyond the report.

21 CHAIRMAN SEALE: But the National Academy
22 activity itself will end at that time?

23 MEMBER MILLER: Oh, I think so, yes. I don't
24 see any reason why it won't. I thought you were saying:
25 Are there issues --

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1 CHAIRMAN SEALE: No, no. I realize there will
2 be follow-up internal in Research and other places likely.

3 MEMBER MILLER: I guess I can't fully comment
4 on that because, as you point out, Research is really the
5 caretaker or the administrator of that issue. But I think
6 Frank and others would assume it's going to be over as of
7 the March meeting.

8 CHAIRMAN SEALE: Staff, want to make any other
9 comments about the status of the report?

10 MR. COFFMAN: Just to clarify.

11 CHAIRMAN SEALE: Yes.

12 MR. COFFMAN: The contract will close the
13 National Academy activity.

14 CHAIRMAN SEALE: I understand that. I
15 understand that.

16 MR. COFFMAN: The staff will be providing the
17 response to the recommendations.

18 CHAIRMAN SEALE: Yes.

19 MR. COFFMAN: Perhaps the ACRS may want to
20 consider responding to the NAS.

21 CHAIRMAN SEALE: We'll certainly have some
22 comments for you. And likely you may wish to pass those
23 along.

24 MEMBER MILLER: Would we not write a letter on
25 this report?

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1 CHAIRMAN SEALE: Yes, I think we should.

2 MEMBER MILLER: We'll write a letter. We'll
3 write a report on this report, yes. That's really the
4 reason for everybody's input.

5 CHAIRMAN SEALE: Well, it's been mentioned
6 there may be a problem with the 17th date.

7 MEMBER MILLER: Yes. We can discuss that.

8 CHAIRMAN SEALE: We'll discuss that later in
9 scheduling.

10 Any other comments or observations?

11 (No response.)

12 MEMBER MILLER: Okay. Thank you.

13 CHAIRMAN SEALE: Well, it looks like we're
14 back to -- we've taken care of that one. The next thing
15 on the agenda is future ACRS activities. Okay.

16 (Whereupon, the foregoing matter went off the
17 record at 9:32 a.m. and went back on the
18 record at 10:34 a.m.)

19 CHAIRMAN SEALE: The next item, then, is a
20 discussion of shutdown operations risk. Dr. Powers is
21 taking the lead on that. And I'll ask him to take over.

22 5) SHUTDOWN OPERATIONS RISK

23 5.1) REMARKS BY THE SUBCOMMITTEE CHAIRMAN

24 VICE CHAIRMAN POWERS: Well, members are aware
25 that the area of risk during shutdown and low-power

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1 operations has been a concern to this Committee for
2 certainly the last year. At our subcommittee meeting in
3 Boston, it occupied a substantial amount of our attention.

4 It arises when we think about the entire risk
5 profile posed by nuclear power plants, not only during
6 power operations, but in these low-power and shutdown
7 operations.

8 Historically several years ago, there was an
9 interest in what contribution these low-power and shutdown
10 operations posed to the total risk in the United States
11 that interest was provoked or certainly accentuated by an
12 incident at Vogtle. It was also provoked by a risk
13 assessment that was done in France. As a result, NRC has
14 sponsored some examinations of risk at the Surry and Grand
15 Gulf plants.

16 We have discussed this issue among ourselves
17 at some length. And at our December meeting, it was
18 proposed that we prepare a draft letter to the effect that
19 a careful assessment of risk during low-power and shutdown
20 operations be undertaken. I think members have available
21 to them a draft of that letter.

22 In the latter part of January, I had the
23 benefit of meeting with the staff on the areas of
24 low-power and shutdown operations. Staff is very
25 concerned about the risks these operations pose and has

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1 undertaken to develop regulations, standard review plans,
2 reg guides in that area.

3 And what they came forward with was an
4 argument that this was a very critical area to address
5 immediately. It is certainly occupying lots of the NRC
6 attention. They felt they were in a position to develop
7 risk-informed, performance-based regulations in this area
8 based on the exploratory studies that they have done up
9 until now.

10 And they have a fear that our letter as now
11 constituted might well derail that effort. What they have
12 wanted to do is make a presentation to us on what their
13 effort is and how it might interface with our letter.

14 I think we need to listen very carefully to
15 this presentation to decide how our thinking may be
16 changed and how we might want to change our comments in
17 this particular area. And I have set before the members a
18 listing of what I think our options are, which range all
19 the way from abandoning our effort to abandoning their
20 effort and everything in between. So I think we have a
21 lot of discussion ahead of us.

22 I think the presentations to be made by Dr.
23 Cunningham and Marty -- who is making the presentation?
24 I'm not sure.

25 MR. CUNNINGHAM: Both of us.

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1 VICE CHAIRMAN POWERS: Both of you are making
2 the presentation?

3 We need to pay a great deal of attention to
4 this because it's going to affect our debate and
5 discussion substantially.

6 With that, I guess I'll turn it over to you
7 gentlemen. And you're starting off, Mark?

8 MR. CUNNINGHAM: Yes.

9 (Slide)

10 5.2) BRIEFING BY AND DISCUSSIONS WITH REPRESENTATIVES OF
11 THE NRC STAFF REGARDING ISSUES ASSOCIATED WITH
12 SHUTDOWN OPERATIONS RISK

13 MR. CUNNINGHAM: Good morning. I'm Mark
14 Cunningham from the Office of Research. Marty Virgilio
15 from NRR and I are here to talk a little bit more about
16 the subject of --

17 CHAIRMAN SEALE: I almost didn't recognize
18 Marty because of his recent reemergence.

19 MR. CUNNINGHAM: Yes. He fools many of us.

20 MR. VIRILIO: I've been hiding up in the
21 Northeast for the last year, and I'm back to join you.

22 MR. CUNNINGHAM: At any rate, we're here to
23 talk a bit this morning about the risk analysis of
24 low-power and shutdown accidents, some of the history, an
25 update, and some of the possible ways to how we could

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1 proceed in terms of research in the future in this area.

2 (Slide)

3 MR. CUNNINGHAM: Dr. Powers has already
4 commented on several of the items here. In terms of the
5 low-power and shutdown PRAs that were sponsored by the
6 Office of Research over the last four or five years, the
7 original interest came from a number of low-power and
8 shutdown events that were occurring in the U.S. plus some
9 French events and studies. This was back in the mid '80s,
10 if you will.

11 As we started into the program, we were a
12 small fraction into the program, the Vogtle event occurred
13 down in Georgia. That was March of 1990. That led us to
14 rethink how we might do the PRAs and how we can support
15 the regulatory actions that were believed necessary at the
16 time with the PRA work.

17 (Slide)

18 MR. CUNNINGHAM: We ended up having a
19 two phase risk analysis program. The Phase 1 was what we
20 called a coarse analysis or coarse screening analysis of
21 all of the operational modes, non-full-power operational
22 modes, for two plants: Surry and Grand Gulf.

23 They did a coarse screening on both the
24 frequency of accidents and the potential consequence of
25 accidents, measuring consequences, for example, more by

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1 "Is the containment open or closed? Is the timing for
2 evacuation short or long?" and those types of questions,
3 rather than getting into any kind of details.

4 That work was completed. And we proceeded,
5 then, to follow up with a Phase 2, which went into more
6 detail on two of the aspects or two of the operational
7 states within the broad category of low-power and shutdown
8 operations that seemed to be of more significance.

9 For the PWR at Surry, it was actions being
10 taken during mid-loop operations. For the Grand Gulf
11 study, it was cold shutdown conditions.

12 VICE CHAIRMAN POWERS: Mark, I have to ask.
13 The Phase 1 of the study proves to be far more important
14 than you might have thought when you undertook it. It's
15 fairly rational to break this problem down a little bit.
16 But you made some judgments there on what was
17 risk-significant and what was not risk-significant.

18 Can you delineate for us the kind of peer
19 review and examination of those and validation of that
20 screening result? Why should we have any confidence that
21 he gave you a useful answer?

22 MR. CUNNINGHAM: Okay. I'm trying to think in
23 terms of peer review. In that time frame, I can't recall
24 if we specifically had a peer review of the results. We
25 had a number of interactions with the ACRS back then

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1 talking about the different results.

2 Harold, do you recall? Did we?

3 MR. VANDER MOLEN: I don't recall any. I'm
4 Harold Vander Molen of the methods development group in
5 Mark's branch.

6 As I recall, there was no specific peer review
7 on Phase 1. The results, of course, were included in
8 Phase 2, when it later went out for more thorough review.
9 But the purpose of the Phase 1 was to get as rapid a look
10 as we could because NRR was anxious to get on with their
11 work and wanted to know if there were any surprises that
12 were coming from the PRA. So at that point, there was no
13 formal peer review.

14 MR. CUNNINGHAM: One of the things that
15 perhaps gave us a little more comfort, more so for the PWR
16 than the BWR, is that when you looked at the relative
17 significance of the different operational states, one of
18 them jumped out for Surry. And that was mid-loop
19 operation. So, even by relative analysis, there was one
20 that seemed to be the big concern. And others seemed to
21 drop off into the noise.

22 For the BWR, it wasn't so clear-cut that there
23 were two or three that were of more significance. And
24 then we had to kind of go through and say, "Well, how do
25 we deal with that?" We ended up choosing one of them.

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1 So there was some sort of a comfort level
2 there, but that's --

3 VICE CHAIRMAN POWERS: Well, I think it was at
4 our last meeting that a speaker from AEOD pointed out to
5 us that at Operational Mode 4, an incident had occurred
6 which set new standards as far as its conditional core
7 meltdown probability was. And, yet, Operational Mode 4 by
8 your screening analysis came out to be a relatively
9 low-risk mode.

10 Now, with deference to Dr. Kress and his
11 accurate comments about stochastic processes, this causes
12 a great deal of discomfort to me.

13 MR. CUNNINGHAM: I assume you're talking about
14 Wolf Creek.

15 VICE CHAIRMAN POWERS: Yes.

16 MR. CUNNINGHAM: Yes. Okay. At any rate, we
17 went through this study. And we ended up a couple of
18 years ago finishing that part of the work and publishing
19 NUREGs. This is actually part of what was published in
20 terms of the PRAs in NUREG/CR-6143 and 6144. Those were
21 the very last pieces that came out in July and October of
22 '95.

23 What I have done is sort of set the stage for
24 what I'll call the initial work in terms of low-power and
25 shutdown. I'm going to switch over, and Marty is going to

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1 talk a little bit about the rule development that has
2 occurred since then. And I'm going to come back after
3 that and talk a little bit more about research that has
4 occurred and may be worthwhile in the future.

5 (Slide)

6 MR. VIRGILIO: Okay. I joked a little bit
7 about being up in the Northeast. The last time the staff
8 met with the ACRS I was leading an inspection team up at
9 Millstone Nuclear Power Plant.

10 That was in May of this past year. And at
11 that point in time, we briefed the staff on the rule that
12 we were developing. And, in response, we got a letter
13 dated June 4th. And I've summarized in the bullets here
14 some of the points that were included in the letter, where
15 the ACRS agreed with the staff that: shutdown risk is
16 important and we need to focus on it, that the proposed
17 rule would likely lessen risk, that the rule you
18 recognized was based, in part, on engineering judgment.
19 And I will not minimize that as a significant part based
20 on engineering judgment. And the ACRS at that time
21 suggested that we would get together again after we
22 reconciled public comments.

23 The approach that we're on is to develop a
24 revised rule based on comments that we received the last
25 time we published the rule, go back out for comments, and

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1 then come back to the ACRS.

2 (Slide)

3 MEMBER BARTON: What's your timing on that?

4 MR. VIRGILIO: I'll get to the schedule in
5 just a second.

6 We responded to the ACRS letter. We agreed,
7 as I said, that engineering judgment was a significant
8 piece in the development of the rule. We acknowledged
9 some limitations in the Surry and Grand Gulf studies and
10 offered that the regulatory analysis that was being
11 completed to support the backfit would provide additional
12 insights. We also recognized that a Level 3 PRA would be
13 helpful but not necessary to support the rulemaking.

14 (Slide)

15 MR. VIRGILIO: Specifically to answer your
16 question, we're on a schedule now that I've outlined here
17 to have a completed package developed for rulemaking at
18 the end of March.

19 This is a slip in the schedule that we
20 presented to you back in the May time frame. One of the
21 things that we recognized back as we were about ready to
22 publish the rule and reg guide was that there were some
23 areas that needed additional work. And so we dropped back
24 and re-scoped what our efforts were staffed up with about
25 a dozen people who were working on the rule pretty much

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1 full-time at this point, and at this point myself
2 included, and put forward a new schedule. And this is
3 currently the schedule that we're working on.

4 So following EDO concurrence, we would submit
5 the rule to the Commission. We're currently on their
6 schedule for a Commission meeting sometime in the August
7 time frame. I don't think we've pinned down the exact
8 date yet. And following that Commission meeting, we would
9 go out for public comment on the rule.

10 Then, of course, you go through the process of
11 reconciling comments. One of the milestones at that point
12 would be to come back to the ACRS and discuss with them
13 how we've reconciled the public comments and then go
14 forward and issue the rule if we had full support of the
15 Commission and the ACRS.

16 (Slide)

17 MR. CUNNINGHAM: Let's turn back now, then, to
18 the research element of this. I wanted to mention --

19 VICE CHAIRMAN POWERS: Before we advance to
20 the research activities, Marty, can you give me some
21 understanding of: Is it the regulatory analysis that
22 you're going to use to convince yourself that you're not
23 just inflicting a large number of requirements on an
24 already heavily regulated industry with hope that you
25 actually address risk-significant items and not just

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1 correcting the deficiencies and vulnerabilities that have
2 been observed in the past?

3 MR. VIRGILIO: That's -- sorry. A little
4 distracted here.

5 VICE CHAIRMAN POWERS: Sorry about that.

6 MR. VIRGILIO: An invitation of the Chairman's
7 office. A pleasant distraction.

8 Let me just -- Mark, can I borrow the
9 projector a second?

10 MR. CUNNINGHAM: Sure.

11 MR. VIRGILIO: I think maybe we back up and
12 try to answer the question. I had a couple of backup
13 slides.

14 (Slide)

15 MR. VIRGILIO: What we're looking at is the
16 cost-beneficial safety enhancement. Clearly the burdens
17 that we imposed have to be justified in a trade-off
18 evaluating the risk and evaluating the cost.

19 There are burdens to be imposed, but I think
20 when we look at the regulatory assessment, it is telling
21 us that some burdens are justified. Burdens in terms of
22 extending outages? I don't think so. And I say I don't
23 think so because the regulatory analysis isn't complete,
24 but we recognize the significant impact. If you add a day
25 or add two days or add a week to an outage, you have to

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1 have significant risk benefits.

2 It is a cost-justified safety enhancement.

3 We're not talking about adequate protection here. We're
4 talking about justified costs. And, in addition to the
5 regulatory analysis, we fall back on engineering judgment.
6 And engineering judgment is coming from, in part, the
7 offense that we're seeing.

8 We recognize we just put together a short
9 list, but it's significant when you step back and think of
10 the events that have occurred over the last several years
11 that have gotten -- they have been recognized for their
12 risk significance, Haddam Neck most recently.

13 I think you all were briefed on that event,
14 where we were really surprised and a little bit
15 disappointed, but, again, it renewed our emphasis on the
16 need for this rule. And that's --

17 VICE CHAIRMAN POWERS: I'd just comment that
18 it also renewed my understanding of how complicated it
19 must be to formulate a rule in this area.

20 MR. VIRGILIO: In part, it is. And, in part,
21 it is because what we're trying to do is formulate a
22 risk-informed, performance-based rule. And what we're
23 doing is we're looking at both preventing and mitigating
24 events that occur.

25 From our risk insights, both from the Surry

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1 and Grand Gulf studies and from the regulatory assessment
2 we have done, we recognize that there were loss of RHR
3 events, there are events that cause loss of level control,
4 there are draindown events, and there are loss of power
5 events that lead to loss of decay heat removal or some of
6 the secondary systems that support that.

7 These are key risk insights that help us focus
8 on where we want to have the additional measures of
9 prevention and protection. Why we are saying this is and
10 why I fully believe it's a performance-based approach is
11 because what we want to do is outline very objective
12 performance measures for licensees, operators actually in
13 the power plant to focus on to ensure that they have
14 adequate decay heat removal, to ensure they have inventory
15 control, that they control pressure and reactivity. So it
16 is performance-based in that regard. We'll lay out clear
17 objectives, and we'll expect licensees to measure those
18 objectives and to adhere to them.

19 We will also ensure that they have reliable
20 means of mitigating events should they occur. And, again,
21 here's where these risk insights come into play. We focus
22 on those events that all of our risk studies are telling
23 us are important. And we'll have reporting requirements.

24 What I want to do is make sure it's clear to
25 everybody what the relationship between this rule and the

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1 maintenance rule and also the industry guidelines that are
2 now out there, NUMARC-9106. So we're not trying to
3 duplicate what's out there.

4 In a sense, a lot of what's out there today is
5 what's needed. In one sense, we're codifying a lot of
6 what's currently being done by the good plants.

7 VICE CHAIRMAN POWERS: Let me ask you a couple
8 of questions here. You brought up 9106. Is that factored
9 in into the risk assessments that you have done?

10 MR. VIRGILIO: The way we're doing the
11 regulatory assessment, there is what we call the base
12 case, which is without voluntary actions. Then we look at
13 industry voluntary actions. And then we look at the rule
14 case. So we cut it three ways.

15 VICE CHAIRMAN POWERS: What I'm interested in
16 is: Your insights, your risk insights, the quantitative
17 risk insights that you gained, were those obtained with
18 these voluntary actions in mind or not?

19 MR. VIRGILIO: Yes and no. Let me --

20 VICE CHAIRMAN POWERS: That covers the range
21 of possibilities.

22 MR. VIRGILIO: It's a complicated question and
23 a complicated answer. If I look at what we got from
24 research in terms of the insights from Grand Gulf and
25 Surry, we recognize that some of those voluntary actions

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1 have, in fact, been incorporated into the procedures and
2 programs that the licensees have had.

3 And so, even with them incorporated, there
4 were still insights, but we also recognize that in some
5 cases; for example, in Surry, why we get different numbers
6 when we run our risk assessments and look at what Mark
7 provides from the Surry study and then pick apart and say,
8 "Well, why are these different numbers? What are the
9 insights that are coming out of this?"

10 You recognize that in some cases, what Surry
11 has done is they have implemented the voluntary actions.
12 And in some areas, they have been able to suppress the
13 risk.

14 But we have to back out or step away and
15 realize that not all plants have done this. Most of the
16 good plants have. Most plants have done something like
17 this, but not all plants have taken it to that level that
18 Surry has in that regard.

19 So yes, in that regard, we recognize that the
20 risk insights are telling us the importance of these
21 procedures and programs that prevent events that shutdown.
22 They are telling us the importance of having the
23 mitigative features available.

24 VICE CHAIRMAN POWERS: And on these risk
25 insights that you have, the ones that you have in detail

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1 come from shutdown operations. Do you feel like they
2 translate to low-power operations or do you have to
3 extrapolate or interpolate between power operations and
4 shutdown to get these insights or just how do you go about
5 getting it for low-power operations?

6 MR. VIRGILIO: It's not easy to extrapolate.
7 And where I'm having a little bit of difficulty, quite
8 truthfully, is in understanding how Wolf Creek happened
9 because that was an event that was sort of outside of
10 where we're studying now.

11 And I think that we have regulatory, good,
12 sound, regulatory, requirements that cover those modes of
13 operation. And I think the licensee failed to comply with
14 those requirements.

15 MEMBER BARTON: I would agree.

16 MR. VIRGILIO: So in a sense we're not really
17 going back and looking at power operations. We have drawn
18 the line. We're looking at cases where the plant is shut
19 down, where they're in cold shutdown and refueling as
20 prescribed by the tech specs. And that's where we're
21 focusing our attention.

22 MEMBER BARTON: Dana, what I think makes this
23 even more complicated is if you look at plants that have
24 used the NUMARC guidance and have signed up for EPRI, the
25 ORAM program and stuff, and have pretty well done a risk

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1 assessment of their shutdown and refueling activities.

2 I think you find that, still following that,
3 the human error factor factored in, a lot of these events
4 happened because people did something that they shouldn't
5 have done. Even though there was in place a risk
6 assessment with some backup and defense-in-depth and all
7 that was there, somebody still did something they
8 shouldn't have done which caused an event.

9 So that has to complicate the process you're
10 going through with the rule.

11 MR. VIRGILIO: It makes a purely
12 performance-based approach a little bit more difficult
13 because we firmly believe at this point in time that you
14 have to have features to prevent events from occurring.

15 I don't think it's enough just to monitor and
16 control parameters. What we have to do is increase the
17 operators' awareness, the licensees' sensitivity, and
18 prevent events from occurring.

19 And I agree with you. A lot of them are
20 driven by operator error. There are some equipment
21 failures that lead us into the events, but I personally
22 believe that operator errors are a real significant
23 contributor.

24 MEMBER BARTON: I agree.

25 MR. VIRGILIO: That's about all I had. I'm,

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1 unfortunately, going to have to leave.

2 VICE CHAIRMAN POWERS: A higher authority.

3 MR. VIRGILIO: I leave you in good hands. Tim
4 Collins is at the table. Warren Lyons is in the audience.
5 There's a lot of good people here. They could answer any
6 questions that you might have with regard to what we're
7 doing. Please excuse me.

8 CHAIRMAN SEALE: And we trust that they will
9 be able to answer the questions that are going to be
10 addressed to you.

11 VICE CHAIRMAN POWERS: And let me just say
12 that I have appreciated you being here and I've
13 appreciated you taking time out in January to come talk
14 with me.

15 MR. VIRGILIO: Thanks a lot.

16 (Slide)

17 MR. CUNNINGHAM: The discussion we were just
18 having about operator errors and things is a good lead-in
19 to what we have been doing in terms of follow-up research
20 items. This is in a sense follow-up to these studies.

21 One of the things that we saw fairly early on
22 as we started to do these PRAs was that we looked at
23 operational events that were occurring in the plants. And
24 one of the concerns we raised was that the types of human
25 errors that were occurring in these low-power and shutdown

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1 events were different than the types of human errors that
2 we were seeing in operations.

3 And what we did then was to say, "Well, we're
4 going to proceed with the PRAs as best we can, but we're
5 going to follow up with an additional program that's going
6 to try to expand the boundaries of PRA human reliability
7 analysis."

8 VICE CHAIRMAN POWERS: Mark, you just a set of
9 words that's just intensely interesting to me. And so I
10 look to you as a well-respected expert in the PRA
11 community to educate me a little bit.

12 MR. CUNNINGHAM: Okay.

13 VICE CHAIRMAN POWERS: Is it, in fact, true,
14 which I believe it to be true, that we are better off to
15 do a PRA as best we can than not to do a PRA?

16 MR. CUNNINGHAM: It's an interesting question.

17 MEMBER BARTON: Where's George?

18 VICE CHAIRMAN POWERS: The answer had better
19 be yes.

20 MR. CUNNINGHAM: I'm just trying to think
21 across the cases. In a general sense, I would say yes,
22 we're better off. I'm just trying to think. Now I'm
23 going to pick an extreme example and try to decide as --

24 VICE CHAIRMAN POWERS: I'm not asking you for
25 an absolute judgment.

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1 MR. CUNNINGHAM: Yes.

2 VICE CHAIRMAN POWERS: Your feeling is that
3 we're better off, that you gain so much from the
4 discipline of thinking that, even if you can't do things
5 very precisely, the methodology has built within it a
6 forgiving nature for your ignorance or an accommodation
7 for your ignorance?

8 MR. CUNNINGHAM: It has an accommodation for
9 ignorance.

10 VICE CHAIRMAN POWERS: So that you gain
11 insight, --

12 MR. CUNNINGHAM: Yes.

13 VICE CHAIRMAN POWERS: -- even if it's not
14 perfect?

15 MR. CUNNINGHAM: Yes. And, all other things
16 being equal, people have the money to do things and all
17 that stuff, yes, I think in general.

18 CHAIRMAN SEALE: There's an interesting
19 orthogonal cut in that. And that is that the IPEs
20 themselves represent, among all of the people that
21 conducted them, a highly variable set of quality control
22 standards for the PRAs that were done for all of the
23 different plants. And, yet, I think you can generally say
24 that everybody who did one learned something that made
25 that exercise worthwhile.

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1 It's a very different look at it, but I think
2 it certainly supports that position.

3 MR. CUNNINGHAM: Yes. I think that's right.
4 I was thinking more of trying to think of an extreme
5 example --

6 CHAIRMAN SEALE: Sure.

7 MR. CUNNINGHAM: -- and asked the question for
8 --

9 VICE CHAIRMAN POWERS: I'm not interested in
10 mathematical proof.

11 MR. CUNNINGHAM: No.

12 VICE CHAIRMAN POWERS: I'm interested in an
13 in-general kind of answer.

14 MR. CUNNINGHAM: In general. I was thinking
15 of sabotage, and I was trying to say: Would it be better
16 if you tried to do a PRA on something like sabotage than
17 not to? That's perhaps a little more --

18 VICE CHAIRMAN POWERS: Arguable and has been
19 argued.

20 MR. CUNNINGHAM: Yes. It's been argued with
21 this Committee and others, yes.

22 At any rate, so we have started a program,
23 started a program a number of years ago to try to broaden
24 the scope of the types of human errors that we build into
25 PRAs.

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1 VICE CHAIRMAN POWERS: That may be in the most
2 unfortunate wording, "human errors that" you "build into
3 PRAs." I would hope you don't build any human errors in
4 --

5 MR. CUNNINGHAM: Okay. Poor choice of words.
6 That we explicitly reflect in the PRAs or something like
7 that.

8 That work isn't finished yet. We're going
9 through in the spring an initial demonstration of it with
10 the Grand Gulf plant and try to understand how best to
11 build the model, how to construct the model so that it can
12 be practically applied in a PRA. Then we're going to go
13 back and see how the results differ from expanding the
14 scope of the human reliability analysis.

15 A couple of other things underway were to look
16 at the methods that you could use for analyzing the impact
17 of performing preventive maintenance at power versus at
18 shutdown.

19 Obviously there are risk trade-offs that occur
20 if you decide to maintain a piece of equipment while
21 you're at power versus shutdowns. And what equipment you
22 maintain during shutdown may be different depending on
23 your risk insights from that. This work will basically be
24 done about the end of this fiscal year.

25 The third thing is a feasibility study of

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1 looking at developing more simple models of low-power and
2 shutdown operation that could be used in events
3 assessment.

4 We talked about the Wolf Creek event and the
5 AEOD studies of that a little bit ago. One of the things
6 that made their study more difficult is they did not have
7 a routine, if you will, or have something in their office
8 at the time, a model of the risk model of the low-power
9 and shutdown operations.

10 So we're looking at the practicality of being
11 able to do that; in addition, to extend in a sense the
12 traditional accident sequence precursor models that they
13 have for normal operations.

14 CHAIRMAN SEALE: Are you going to include in
15 those models or that approach an attempt to look at
16 various stages of shutdown: hot shutdown, cold shutdown,
17 transitions, and --

18 MR. CUNNINGHAM: Part of the feasibility study
19 is to look at that, yes.

20 CHAIRMAN SEALE: Okay. I know that there's
21 considerable interest in exactly what the implications of
22 those different levels are.

23 MR. CUNNINGHAM: Yes.

24 CHAIRMAN SEALE: And that would be incomplete
25 I think unless you did it.

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1 MR. CUNNINGHAM: Yes. That's right. The same
2 issue applies for analyzing the impact of maintenance.

3 CHAIRMAN SEALE: Sure.

4 MR. CUNNINGHAM: And you don't maintenance
5 equipment during mid-loop operation. There are better
6 times during shutdown to do it and that type of thing.

7 So these are three of the examples of the
8 things that have been going on since the Grand Gulf and
9 Surry studies were finished.

10 (Slide)

11 MR. CUNNINGHAM: Then, to look a little more
12 in the future, then, the Committee has raised the issue
13 some times before about the need to proceed and do
14 something like an 1150 for a larger number of plants for
15 looking at the full breadth of operations, of shutdown
16 operations and things like that. It's taking this and
17 going on closer to the scope of the 1150 study, which is
18 five plants, internal events, external events, that type
19 of thing.

20 When we thought about that and were trying to
21 deal with the Committee's concern about this, we had a
22 number of considerations we had talked about as
23 alternatives for dealing with the issue of risks from
24 shutdown operations.

25 One was to pursue specific method

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1 applications, development applications or development
2 activities in areas that we saw were particularly crucial
3 to shutdown operations.

4 The human reliability analysis is one I've
5 already talked about a little bit. Another question
6 that's come up is the need for having fire methods for use
7 in PRA. And that came up more in the general sense of not
8 just shutdown operations but PRAs in general. And this
9 Committee has talked about that issue before that we may
10 not be doing as good a job in fire methods as could be.

11 The human reliability work is a good bit
12 underway now. We are just getting started in the area of
13 trying to look at how we could better do fire PRA work, if
14 you will.

15 Another alternative is in a sense the
16 alternative that was suggested by the Committee at one
17 time, which is: Do we go on and do additional
18 demonstration PRAs? And filling out the 1150 box or
19 matrix, if you will, is one way to do that.

20 A third alternative --

21 VICE CHAIRMAN POWERS: Not necessarily the
22 only way.

23 MR. CUNNINGHAM: Yes, not necessarily the only
24 way.

25 VICE CHAIRMAN POWERS: It has some advantages

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1 in that you would give yourself a better description of
2 the spectrum for a subset of plants.

3 MR. CUNNINGHAM: Yes.

4 VICE CHAIRMAN POWERS: On the other hand, it
5 is by no means obvious that the criteria that were used to
6 select the 1150 plants for power operations is the correct
7 criteria to use for the equivalent work in low-power and
8 shutdown operations.

9 MR. CUNNINGHAM: That's right. That's right.
10 It's one way to do it, but it's not necessarily the best
11 way.

12 Another option, of course, would be to say,
13 "Well, we feel comfortable enough on how to do shutdown
14 PRAs that we could develop a guidance document to say:
15 This is the way to do low-power/shutdown PRAs." I don't
16 think we're at that point right now based on our
17 experience and what we have seen with other PRAs.

18 Another alternative, of course, is to say the
19 industry can go out and do -- somebody has raised the
20 question more than once: Well, is the outgrowth of all of
21 this IPEs for shutdown operations? I'm not sure we're at
22 that point either.

23 VICE CHAIRMAN POWERS: It has always struck me
24 that the technology is in a very primitive state
25 relatively. And the ability to receive an industry IPE at

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1 NRC and then review it and do more than just weigh it is a
2 little low right now. I mean, your own understanding is
3 limited.

4 MR. CUNNINGHAM: That's right. In both cases,
5 I think with the industry and with the staff, that our
6 understanding is not something where we think we should go
7 out. And we don't think it's the right way to do it, just
8 go out and do a set of IPEs for these. It's just --

9 CHAIRMAN SEALE: Don't ask for something
10 unless you're prepared to receive it.

11 MR. CUNNINGHAM: Yes, that's one way to look
12 at it. Yes, sir.

13 VICE CHAIRMAN POWERS: On the other hand, if
14 our colleague from MIT were here, he would pound the
15 table, I suspect, and say, "But the industries are doing
16 shutdown PRAs."

17 MR. CUNNINGHAM: Yes. Well, that was my next
18 point here, is that there are a number of things going on
19 in the industry. As I understand it, there are shutdown
20 PRAs that have been performed for some of the plants.

21 More broadly, someone mentioned earlier there
22 was work going on, for example, with, I believe it is, the
23 EPRI-sponsored work on ORAM, which is a risk management
24 approach. I wouldn't necessarily call it a PRA, but it's
25 a way to manage the outages and things like that. And

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1 that figures into the -- that's a factor that comes into
2 our discussions of what research needs to be done.

3 The last point on this slide is that there's
4 been a number -- or there's a fair amount of work being
5 done via CSNI to look at internationally what is going on
6 in low-power and shutdown safety studies, if you will.
7 It's looking at what improvements are being made to plants
8 internationally, what types of methods are they using to
9 drive them to make safety improvements.

10 There are PRAs that have been done
11 internationally for shutdown operations, so we're told,
12 and things like that. There is a --

13 MEMBER KRESS: Do we have a delegate that
14 takes part in that study; NRC, I mean?

15 MR. CUNNINGHAM: Yes, we do. Joe Murphy has
16 been the traditional -- this is being done under Principal
17 Working Group 5 of CSNI, which is the PRA group. Joe has
18 been the delegate for that committee for a number of
19 years. He's now the Chairman of PWG-5. And I guess that
20 makes -- I've become sort of the delegate, if you will.

21 There have been a couple of studies that CSNI
22 has published in the '93-'94 time frame in this area.
23 They're updating this work now. And they're supposed to
24 -- we were in a meeting of CSNI in September, I guess it
25 was, of last year. And they were about finished with a

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1 draft report on whatever, their update from the 1993-1994
2 time frame.

3 I haven't seen that. We're supposed to be
4 back meeting with them again in another month or two. And
5 I think that's on the agenda to discuss.

6 VICE CHAIRMAN POWERS: When you encounter this
7 situation where you have technical alternatives, you can
8 do this or you can do this, you can spend your money this
9 way, do you do something like a formalized trade study?

10 MR. CUNNINGHAM: We do a trade study, but I
11 wouldn't even come close to calling it formalized, if you
12 will. It's more of an informal discussion of the pros and
13 cons of things and that sort of thing.

14 VICE CHAIRMAN POWERS: So there's not an
15 attempt to do something like a multi-attribute utility
16 analysis?

17 MR. CUNNINGHAM: No, no. There's not, not in
18 the traditional sense of those definitions, no. It's all
19 very informal, if you will.

20 VICE CHAIRMAN POWERS: The Department of
21 Defense has certainly found that to be fairly valuable in
22 its decision-making on the acquisition of systems in
23 making decisions that it is codified within the rules of
24 the Department of Energy that thou shalt do that. It may
25 be honored more in the breach than in fact.

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1 Certainly other agencies have found that on
2 these substantive issues a more formalized decision-making
3 process has been valuable because it allows you to put in
4 perspective biases that otherwise get accounted as truth.

5 Do you have an opinion?

6 MR. CUNNINGHAM: Personally I would like to
7 see a process of deciding what research needs to be done
8 made more formally, if you will. I think it would help us
9 focus the research and give us a lot more credibility in
10 the outside world as to how we decide to do one thing or
11 another.

12 We have studied some of these things over the
13 years. And one of the concerns that seems to be a nagging
14 concern is that they are not practical. I wasn't aware of
15 what DOD has been doing in this area. Maybe they have
16 come up with a better way to do this than we have seen or
17 I have seen anyway.

18 VICE CHAIRMAN POWERS: The Department of
19 Defense has an extremely formalized process of identifying
20 mission needs and then having a fairly independent
21 assessment of alternatives for meeting that mission need
22 on fairly rigorous kind of trade studies between various
23 alternatives before they go to the development stages --

24 MR. CUNNINGHAM: Yes.

25 VICE CHAIRMAN POWERS: -- of a preferred

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1 alternative.

2 MR. HODGES: This is Wayne Hodges with the
3 Office of Research.

4 I will say it's not totally just sitting
5 around and having some informal discussions. I mean,
6 clearly in what Mark will propose to management needs to
7 be done, he has some trade-offs that he does there. But
8 there is an office-level discussion.

9 We go through some criteria. There are
10 relatively few and fairly general things, like: Should
11 this work be done in the Office of Research versus
12 somewhere else? Try to rank its importance from a
13 regulatory standpoint and from a safety standpoint, those
14 types of things.

15 So there are criteria of that type that are
16 applied to it across the office, where it's competing for
17 funds against projects in other divisions or whatever. So
18 there is some of that that goes on, but I'm not sure it's
19 as formalized as you are trying to refer to.

20 VICE CHAIRMAN POWERS: And, of course, highly
21 formal systems are useful only on big decisions, not
22 myriads of decisions. That would just tie you up, and
23 you'd never get anything done.

24 MR. CUNNINGHAM: Yes. That's right. Clearly
25 the Defense Department's scale of decisions is much

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1 different than the ones I deal with on a normal basis.

2 VICE CHAIRMAN POWERS: You'd be surprised.

3 MR. CUNNINGHAM: I'd like to think that.

4 (Slide)

5 MR. CUNNINGHAM: At any rate, in a sense that
6 kind of gets us into my last slide here. Some of the
7 considerations we've brought into play as to looking at
8 the alternative of expanding the 1150 matrix, if you will,
9 to go out into a number of plants and do the full
10 low-power and shutdown operations, internal and external,
11 for all of those plants.

12 I guess there was -- obviously the cost of
13 that is considerable. These PRAs were quite expensive.
14 They were expensive by the budgets I had five years ago,
15 and they would be --

16 CHAIRMAN SEALE: Humongous.

17 MR. CUNNINGHAM: They would be humongous or
18 overwhelming by the budget that I have today probably.

19 VICE CHAIRMAN POWERS: I'm not going to pin
20 you down on budget. I'm going to ask you to nod. I was
21 asked to estimate what I thought it would cost. My guess
22 would be to do your completion of the 1150 PRA matrixes
23 about \$13 million. Am I wildly high, low, or about right?

24 MR. CUNNINGHAM: You're about right, yes.

25 Part of 1150 was that we did it in a sense 2 or 3 times

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1 because of the considerable external review. And that's
2 an element in what 1150 cost, but you're about right in
3 the --

4 CHAIRMAN SEALE: There was a steep learning
5 ramp on 1150.

6 MR. CUNNINGHAM: Yes, there was. Yes.

7 VICE CHAIRMAN POWERS: And I think there would
8 be a steep learning ramp in the expanding to --

9 MR. CUNNINGHAM: Yes, that's right. That's
10 right.

11 VICE CHAIRMAN POWERS: I would not want to
12 underestimate the learning curve here.

13 MR. CUNNINGHAM: Yes, that's right. So \$13
14 million in terms of my budget today, that's basically
15 about 2 years worth of my budget. So it's a strong factor
16 in the consideration.

17 VICE CHAIRMAN POWERS: In that regard, time
18 and money, there's a trade-off.

19 MR. CUNNINGHAM: Yes.

20 VICE CHAIRMAN POWERS: Is there in thinking
21 about this -- NUREG-1150, there was a great deal of
22 pressure to get it done in a finite period of time. When
23 you think about an expansion of the matrix, were you
24 thinking of a similarly intense activity or is it equally
25 valuable to do a more drawn-out activity?

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1 MR. CUNNINGHAM: I suppose I had in mind when
2 we're thinking about more of a drawn out activity where
3 you could probably save some money and things, but it
4 would be a three or four-year process or something like
5 that.

6 It's probably what was sitting in the back of
7 my mind when I was thinking about this.

8 MR. HODGES: When Mark says that's two years
9 of his budget, I mean, that's all of his budget.

10 VICE CHAIRMAN POWERS: I understand what he
11 was saying.

12 MR. HODGES: There's nothing else but that if
13 he does that.

14 VICE CHAIRMAN POWERS: I understand what he
15 was saying, yes.

16 MR. CUNNINGHAM: That's right.

17 MEMBER APOSTOLAKIS: Now, in 1150, a
18 significant item, expensive item, was the expert opinion
19 elicitation process, wasn't it, and figuring out what to
20 do?

21 MR. CUNNINGHAM: That was a significant
22 contributor to it, yes. It wasn't by far the biggest item
23 or anything like that.

24 MEMBER APOSTOLAKIS: No. But would you have
25 to repeat that here, you think?

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1 VICE CHAIRMAN POWERS: No question in my mind.
2 Now, could they do it more efficiently, and did they learn
3 something from how to do that? Absolutely.

4 MR. CUNNINGHAM: Yes.

5 VICE CHAIRMAN POWERS: I am certain they would
6 do it more efficiently. But I'm willing to bet that
7 enough substantive technical issues would come up that you
8 wouldn't have to get an expert elicitation. And, in fact,
9 I think that's one of the great values of 1150 that it
10 gives it an imprimatur that's hard to ignore.

11 MR. CUNNINGHAM: Yes. In terms of the cost of
12 expert elicitation in 1150, I would probably say the
13 biggest cost associated with that was the fact that we did
14 it two different ways.

15 We did it one way and had a lot of costs
16 associated with building up that information base. And
17 then we basically said in peer review that it wasn't
18 adequate. And so we had to go back and start anew.

19 That part of it we could avoid now. I think
20 we have a much better feel for how to do quality expert
21 elicitations now. Still, it's not cheap. But I tend to
22 agree with Dr. Powers that there are some of these issues
23 that are going to almost drive you to have to deal with
24 expert elicitation because of the complexity, among other
25 things, and the lack of information in a number of areas.

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1 MEMBER APOSTOLAKIS: But would the number of
2 issues be the same? I mean, at that time you had to
3 formulate issues, decide what to do and all of that. Now,
4 with all of that experience, it shouldn't really be that
5 much.

6 MR. CUNNINGHAM: It's hard for me to say
7 whether it would be dramatically different or not.

8 VICE CHAIRMAN POWERS: I think that if I
9 follow my analogy for the DOD system, that any attempts to
10 shave costs in planning effort along that direction would
11 be rejected soundly.

12 Your historical database is this. You just
13 have to use that as your planning basis in thinking about:
14 What does it take for time and costs on this study?

15 MR. CUNNINGHAM: I was going to say one of the
16 other concerns that I guess plays into it in terms of the
17 cost of it is that the way we performed the PRAs for these
18 PRAs was a very detailed, extensive study going down into
19 a great deal of detail in the plant operations and design.
20 Whether that was necessary now in hindsight is in my mind
21 a fair question.

22 Clearly PRAs are being done on low-power and
23 shutdown operations by a number of utilities
24 internationally. And I'm quite sure they're not at the
25 level that we're talking about here.

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1 Where the right level is I'm not quite sure.

2 VICE CHAIRMAN POWERS: And I think that's a
3 very difficult question because I worry that too high of a
4 level, you start missing these things that are all of our
5 problems in shutdown.

6 MR. CUNNINGHAM: Yes, that's right.

7 VICE CHAIRMAN POWERS: And those are very
8 detailed sorts of things.

9 MR. CUNNINGHAM: That's right. That's right.
10 So that's a tough one.

11 MEMBER KRESS: You were pretty strong about
12 saying you would need the expert elicitation judgment
13 process. I understand that's needed to get uncertainties
14 and you need uncertainties to have a distribution and
15 actually get a mean value. But do you think a pure PRA
16 that does the Level 2 only with just using the codes to
17 calculate the core damage frequency and the containment
18 failure probability would not serve a very useful purpose
19 in this case? And wouldn't it be much, much less
20 expensive than going through the full uncertainty
21 analysis?

22 VICE CHAIRMAN POWERS: Earlier I asked Dr.
23 Cunningham if a PRA done as well as you could with
24 existing technology wasn't better than no PRA at all. And
25 he said that with certain limitations on the extremes,

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1 that yes, that would be the case and that you would gain
2 insights from there.

3 And since he's far more expert in the area of
4 PRA than I, I'm going to defer to his judgment in that
5 area and say that, indeed, a crudely done PRA is better
6 than no PRA at all.

7 And that's what you're saying here, I think,
8 is that you do as well as you can with the tools you have.
9 Doesn't that give you insights that you probably don't
10 have right now?

11 MEMBER KRESS: Or can't I get enough
12 information to make risk-informed decisions with that?

13 VICE CHAIRMAN POWERS: And I think the answer
14 is probably. I also think that in this area, that during
15 shutdown operations, that you've got to be relatively
16 careful about what you declare as success criteria and
17 that they're different than what you have used in power
18 operations.

19 And then when you go to the Level 2 analysis,
20 it's different than what we have. Now, can you use what
21 we have now and still derive something useful,
22 understanding that there are probably the physics and
23 chemistry you're not modeling?

24 I guess that's a decision that you have to
25 make out of this. I welcome Mark's judgment on these

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1 things.

2 MR. CUNNINGHAM: As I said, if I were going to
3 go off today and -- well, this is another way of saying
4 it. If I were going to go off today and start some PRAs
5 on low-power and shutdown operations, what I have in my
6 mind is that the way we did it for Grand Gulf and Surry
7 was probably too detailed. How much we can back off from
8 that, it's difficult.

9 As I say, the industry has PRAs. We have the
10 events assessment work that I talked about. That's
11 another end of the spectrum. The question for us there
12 is: How much is good enough to be able to be done in
13 events assessment? That's an issue we're still wrestling
14 with.

15 VICE CHAIRMAN POWERS: Before you undertook
16 1150, you had sponsored a lot of PRAs.

17 MR. CUNNINGHAM: Yes.

18 VICE CHAIRMAN POWERS: And those PRAs in their
19 earliest days got lots of scrutiny on the Level 1 aspects
20 of it so that you had a good idea of how detailed to do it
21 for power operations. By the time you got to 1150, --

22 MR. CUNNINGHAM: Yes, that's right.

23 VICE CHAIRMAN POWERS: -- you knew how far to
24 go. You don't really have that, I think, for shutdown.
25 So if you were going to this mythical undertaking that you

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1 imagine, is the situation where you'd have to walk the
2 learning curve on the Level 1 and you said, "I'd do it
3 less detailed"? Would you go through and peer review that
4 proposal and kind of take baby steps through this
5 mirroring what you had to do from about 1974 until 1150s
6 in the late '80s or something like that?

7 MR. CUNNINGHAM: That's right. It seems just
8 like yesterday, but I think that's right. And that's one
9 of the things that --

10 VICE CHAIRMAN POWERS: Longest 100 years of
11 your life.

12 MR. CUNNINGHAM: That's right.

13 CHAIRMAN SEALE: Time flies fast when you're
14 having fun.

15 MR. CUNNINGHAM: Yes, that's right.

16 MEMBER KRESS: Mark, on this question of costs
17 and what needs to be done, if you were to only do Level 1
18 PRA to get a core damage frequency and with uncertainties
19 in that; whereas, the uncertainties were only propagated
20 through the model and from distributions on the input so
21 that you might use some sort of expert opinion to get
22 those but you might already have those, would that
23 substantially change your estimate of how much this would
24 cost? It seems to me like they would be much cheaper.

25 MR. CUNNINGHAM: It would be -- I don't know

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1 -- a good bit cheaper, yes.

2 MEMBER KRESS: And if one could say something
3 like, instead of a core damage frequency of 10^{-4} , we're
4 really worried under these circumstances about core damage
5 frequencies of 10^{-5} . Then you'd have something very
6 useful, it seems to me.

7 MR. CUNNINGHAM: Okay. Yes, I guess so. The
8 right level of detail, or even the Level 1 part of it,
9 it's -- I'm uncomfortable with the level of detail that we
10 did here. It's just I think it was overkill.

11 One of the things that's clear is that we
12 haven't thought much about that issue of: Well, what is
13 the right level of detail since the completion of these
14 studies? We have been focusing on other aspects of the
15 technical issue, notwithstanding that we have a rule going
16 forward separately.

17 The technical issues that we tended to focus
18 on were more -- human reliability assessment was clearly
19 the big item, if you will, because that was something we
20 -- I can't remember if you were in the room or not. We
21 talked about that. We saw it early in the low-power and
22 shutdown studies, where we were just leaving out important
23 human errors.

24 MEMBER KRESS: I wasn't here for that.

25 MR. CUNNINGHAM: Okay. And that was --

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1 VICE CHAIRMAN POWERS: Mark, let me ask you a
2 question. When you think about "Let's just do Level 1 on
3 this problem" and then we think about the insights that
4 you've got out of what you've done so far, isn't one of
5 those insights that the risk relative to risk at power
6 operations is not well-reflected to the core damage
7 frequency?

8 MR. CUNNINGHAM: I think that's correct. I
9 think one of the important insights coming out of the
10 studies was the very different containment performance in
11 shutdown operations relative to full-power operations.

12 VICE CHAIRMAN POWERS: And, in fact --

13 MEMBER KRESS: That's why I suggested backing
14 off on the acceptable CDF that you deal with to a lower
15 level because of that insight.

16 VICE CHAIRMAN POWERS: You're coming to a
17 conclusion because if you just look at CDF, it reflects
18 poorly the actual risk when you compare it relative to
19 power operations.

20 MR. CUNNINGHAM: That's right. Even in the
21 Phase 1 studies, one of the criteria we had for deciding
22 what were the important operating states was containment
23 performance right from the beginning.

24 It was not just core damage frequency. Core
25 damage frequency and containment performance was the key

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1 issue because in some parts of shutdown operations, you
2 have basically an intact containment.

3 In other aspects, you have containment that
4 can be open. You can have the suppression pool drained in
5 boilers and things like that. And that plays a key role
6 in the decision.

7 VICE CHAIRMAN POWERS: I think what you're
8 telling me is that if I have an IPE on power operations
9 that gives me a core damage frequency and I lack anything
10 for the low-power and shutdown operations, that there is
11 not a facile way to multiply my CDF by some number and add
12 it to that CDF to give me a total of core damage
13 frequency.

14 MR. CUNNINGHAM: I think in the context of the
15 regulatory guides that we have been here talking to you
16 about, we certainly have kicked that idea around. As I
17 said, it would be nice if we could do that because it
18 would give us a much clearer definition of acceptance
19 guidelines and things like that. It's not a
20 straightforward ratio, if you will, or something like
21 that.

22 MEMBER KRESS: I think it is on core damage
23 frequency. The problem is if you're trying to talk about
24 an acceptable core damage frequency along with an
25 acceptable containment failure probability, there's where

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1 you have the difficulty. I mean, you can --

2 VICE CHAIRMAN POWERS: I left out a sentence.

3 MEMBER KRESS: Yes. Okay.

4 VICE CHAIRMAN POWERS: It's that acceptable
5 core damage frequency.

6 Let me formulate one. Simply by multiplying
7 here, I've got to have red and black CDFs here, two
8 different colors.

9 MR. CUNNINGHAM: Again, I might be more
10 comfortable with the PWR and some sort of a ratio because
11 of the prominence of mid-loop operations as a sore thumb,
12 if you will, in the shutdown operations. With boilers,
13 it's a little more difficult to see something like that.

14 VICE CHAIRMAN POWERS: One always worries that
15 it may be that it's these two particular plants. In the
16 broader spectrum, you might not be this concerned.

17 MR. CUNNINGHAM: That's correct. That was one
18 of the concerns from the beginning, I guess more so with
19 Grand Gulf. Grand Gulf was a BWR-6. It had some
20 additional features beyond the normal, if you will, BWR
21 and things. That was always a concern of how that was
22 going to -- that might buy us the results that we had.

23 MEMBER KRESS: See, the reason I'm arguing the
24 way I'm going, Dana, is that I see this slide up here,
25 which to me almost rules out doing really good Level 3

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1 elicitation process of the NUREG-1150 type. But maybe we
2 should think a little more about acceptance criteria on
3 core damage frequency and back off to a Level 1 on this
4 issue of shutdown risk and --

5 VICE CHAIRMAN POWERS: We haven't allowed the
6 speaker yet to advance from the first or the second line
7 of his slide to his conclusion.

8 MEMBER KRESS: Okay. That's true. I've
9 already read it.

10 VICE CHAIRMAN POWERS: I'm dying to hear how
11 he reached this conclusion.

12 MEMBER APOSTOLAKIS: I have a question,
13 though, on the first. We hear that the industry, both
14 here and abroad, has done detailed low-power and shutdown
15 risk assessments. Do you know how much of this matrix,
16 how many entries of this matrix, can be filled by the
17 results of these PRAs so you don't have to reproduce them?

18 MR. CUNNINGHAM: Let's back up a second. The
19 matrix that we're talking about here was one way to
20 address the question of shutdown risk. That was an issue
21 that was raised by the Committee at one time, which was in
22 a sense to stylize the answer expand 1150 to cover the --

23 MEMBER APOSTOLAKIS: Right.

24 MR. CUNNINGHAM: Okay. That's one way to deal
25 with that. My point in the slide was that I'm not

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1 comfortable with that for a couple of reasons. With that
2 specific definition of how to consider low-power and
3 shutdown risks, on that redo, if you take it in the
4 context of redoing 1150 or expanding 1150 is very costly
5 keeping with the ground rules, if you will, of 1150.

6 A technical justification aspect of it is I'm
7 uncomfortable with that today because of the work that we
8 have going on in human reliability analysis that I think
9 is an important element of any detailed PRA that you would
10 want to do in shutdown operations. So that's the middle
11 part of this.

12 I'm trying to work through this slide without
13 --

14 MEMBER APOSTOLAKIS: No. But what I'm saying
15 is that you did limited-scope studies.

16 MR. CUNNINGHAM: Yes.

17 MEMBER APOSTOLAKIS: Others probably have gone
18 beyond that.

19 MR. CUNNINGHAM: Yes.

20 MEMBER APOSTOLAKIS: Have you collected all
21 this information that others have generated to see how
22 much more we know now?

23 MR. CUNNINGHAM: That's really I get to my
24 bottom line here.

25 MEMBER APOSTOLAKIS: Okay.

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1 MR. CUNNINGHAM: Something we have talked
2 about is in a general sense of going back and looking at
3 the other PRAs that have been done. The specific answer
4 to your question is no, we haven't. We haven't not gone
5 back to do that.

6 The last bullet was intended to be something
7 to say maybe that's a good idea to do, that it's to go
8 back and look at the PRAs that have been done, to look at
9 the international experience, the CSNI work that I had
10 mentioned, to look at how risk is being factored into
11 outage management by the utilities, to look at the
12 operational events that have occurred since these were
13 done and kind of come back and do a reassessment and say:
14 Is there specific research that now is merited in the area
15 of low-power and shutdown risk assessment?

16 In a more general sense, what I was going to
17 suggest is that we take the task on of doing that, of
18 trying to compile this information, either via collecting
19 reports or workshops or a subcommittee meeting or
20 something like that, and come back and lay it out on the
21 table as to what's out there and have the industry -- you
22 know, EPRI has been very involved in this -- and have them
23 come in and talk about it and use that as a basis to say:
24 Is there something else that's missing? Is there a piece
25 of this risk puzzle for shutdown operations that's missing

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1 that merits research by the Office of Research?

2 MEMBER APOSTOLAKIS: I think that's a
3 worthwhile approach.

4 MEMBER BARTON: Good approach.

5 CHAIRMAN SEALE: Yes.

6 MEMBER SHACK: It sort of boggles my mind,
7 though, that you're ready to have a rule on this at the
8 end of March when you haven't done this yet.

9 MR. CUNNINGHAM: Well, the rule is trying to
10 deal with some specific concerns that have been raised and
11 that deal with containment performance, that deal with
12 mid-loop operations and things like that.

13 The question is: Does the staff feel like it
14 has to wait for this type of information before it
15 proceeds with that rule? And I think the staff does not
16 want to wait.

17 I think the safety issues out there for
18 mid-loop operations, for example, and things are
19 considered to be serious issues and we want to proceed
20 with it. I think we have enough information to proceed
21 with the elements of the rule as they are.

22 CHAIRMAN SEALE: Could I ask a question about
23 some of the characteristics of that rule? I'm very
24 intrigued. We've seen initiatives on the part of the
25 utilities to apply risk assessment methodologies in a wide

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1 variety of areas.

2 And we have here a situation where we say:

3 Well, part of our difficulty is that we can't afford the
4 time line that would allow us to apply that risk
5 assessment to these problems but that clearly risk
6 assessment could be very helpful in resolving or in
7 prioritizing these issues and putting them in their proper
8 perspective.

9 Do you have in the rule any accommodation for
10 or acceptance of a risk assessment initiative by a utility
11 to address these issues, as opposed to the prescriptive
12 rule that you're talking about?

13 MR. CUNNINGHAM: I'm going to defer that to
14 Mr. Collins. Since Mr. Virgilio had to leave, Tim will --

15 MR. COLLINS: This is Tim Collins from DSSA.

16 There is nothing in the rules specifically to
17 take into account an industry-initiated risk assessment,
18 if you will.

19 But I would disagree somewhat with your
20 characterization of the rule as being prescriptive. We're
21 deliberately trying to make the rule a
22 performance-oriented rule, which takes us away from the
23 prescriptive aspects.

24 I think what we're going to come up with is a
25 little bit of a hybrid: a little bit of prescription and

1 a little bit of performance elements. But I believe that
2 we're really trying to minimize the prescriptive aspects
3 of the rule.

4 CHAIRMAN SEALE: But the idea of an
5 alternative approach by one or two or whatever number of
6 people who might want to come in and do a risk assessment
7 to prioritize the way in which they attack these things,
8 there's no accommodation for that.

9 MR. COLLINS: Well, no. I think the rule
10 would accommodate that, in fact. Like I say, there may be
11 some elements which are prescriptive. Now, that would not
12 accommodate somebody's risk assessment as we see it now.
13 But in general the performance aspects of the rule would
14 accommodate that the way we have it written. I mean,
15 we're trying to hit it that way, at any rate.

16 CHAIRMAN SEALE: We have this whole problem
17 of: How do you bring risk into the game as a substitute
18 for what is already there, as opposed to an add-on to
19 what's there? And this is kind of a case where you maybe
20 can address that question up front, rather than trying to
21 figure out what the Band-Aid looks like on the back end to
22 modify it.

23 MR. COLLINS: See, one other thing is as far
24 as what's already there in regulatory space, there's not a
25 whole lot that's --

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1 CHAIRMAN SEALE: But in other areas, there are
2 things that are there.

3 MR. COLLINS: Well, I don't know what you mean
4 by "in other areas."

5 CHAIRMAN SEALE: I'm saying at the present
6 time when we look at other technical problems, we ask
7 ourselves: How do we bring the risk assessment to bear on
8 that problem?

9 It seems we always wind up adding additional
10 things, rather than substituting for what's in the present
11 regulatory requirement.

12 MR. COLLINS: I guess I'm not really following
13 what you're saying.

14 MEMBER APOSTOLAKIS: Does the PRA add
15 requirements or not? Is that really what it comes down
16 to?

17 CHAIRMAN SEALE: Yes. That's right, the idea
18 that --

19 MEMBER APOSTOLAKIS: Is the PRA used just to
20 add requirements?

21 MR. CUNNINGHAM: No.

22 CHAIRMAN SEALE: That's what I'm saying, see.

23 MR. LYONS: Warren Lyons.

24 In the process of the entire development of
25 the rule, we started back in essentially November of '94

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1 to develop a risk assessment. Of course, in many areas we
2 didn't have the data that we wanted. And in that sense it
3 was not as quantitative as we would have liked.

4 And, as Marty mentioned earlier, we are
5 continuing to modify the regulatory analysis, the PRA that
6 we have done, to come up with better insights and perform
7 additional sensitivity studies.

8 With this little bit of an introduction, we
9 have found the PRA work that we have done to be highly
10 valuable as we went ahead and developed what we believed
11 was necessary.

12 There have been several instances in which we
13 have seen insights that, in hindsight, if you will, were
14 obvious. But without the PRA in my judgment, we would
15 have missed them.

16 For example, when we looked at the results of
17 our PRA and our release calculations, we found the PWR
18 containments were not as effective as from an engineering
19 standpoint we thought they would be. So we went back and
20 we asked why. Both we and the industry were basing
21 containment closure operations on loss of RHR.

22 Well, the contributor that this clearly
23 flagged for us was loss of inventory would be taking
24 people by surprise and resulting in an inability to get
25 the containment closed.

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1 We consequently modified our approach in the
2 rulemaking activity to take this into account and doubled
3 the -- I'm sorry -- cut in half the failure to get the
4 containment closed.

5 So we are using the PRA techniques. We are
6 finding they are valuable in combination with our
7 engineering judgments as we have gone forward in putting
8 this together, both the rulemaking itself and the guidance
9 in the implementation.

10 CHAIRMAN SEALE: Well, in a sense I guess
11 that's fine, but I'll bet you there are some insights that
12 a utility might be able to bring to the table, too, if
13 they sat down and looked at the problem.

14 And what do you do with those insights? Is
15 there a way in which they can be brought to that utility's
16 approach to satisfying the requirements?

17 MR. LYONS: I would agree that utility
18 insights are also very valuable. And as those of you have
19 been associated with us in the long term know, we have
20 gone out to the industry on a number of occasions. We
21 have, in effect, crawled through the plants during
22 shutdowns and observed the way they were doing things. We
23 have shared information. We have obtained a number of
24 highly valuable feedbacks.

25 We do have some awareness of the procedures

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1 that they use and how they apply PRA in the conduct of
2 their outages and, in effect, how those provide the kinds
3 of feedback that are very similar to the example that I
4 just provided during our rulemaking activity.

5 So we're not doing this in a vacuum, if you
6 will.

7 VICE CHAIRMAN POWERS: Mark, you've skipped
8 this wonderfully provocative conclusion that says
9 "Completing the matrix is not technically justified." If
10 it's not technically justified, it surely is not
11 cost-effective.

12 Can you summarize again the thinking?

13 MR. CUNNINGHAM: The aspect of it, the
14 technical justification of proceeding with, again,
15 defining a fairly stylized approach to this, which is
16 redoing 1150 or expanding 1150, the technical
17 justification concern I have is that we shouldn't proceed
18 with that while we're trying to better model the human
19 performance in these accidents.

20 VICE CHAIRMAN POWERS: What you're saying is
21 that you have to do a lot of the homework that was done
22 for operational PRAs over 10 or 15 years. It just hasn't
23 been done yet. You're just not --

24 MR. CUNNINGHAM: Yes.

25 VICE CHAIRMAN POWERS: -- in a technical

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1 position to do the job.

2 MR. CUNNINGHAM: Yes. That's what I mean
3 here.

4 VICE CHAIRMAN POWERS: So that a plant which
5 said, "My ultimate goal is to, for instance, do
6 NUREG-1150" -- I don't want to make that too precise
7 because it doesn't have to be a carbon copy of 1150 --
8 would be preceded by a variety of steps that still need to
9 be carried out.

10 MR. CUNNINGHAM: Exactly, exactly.

11 VICE CHAIRMAN POWERS: Have you formulated a
12 plan to get to the state of nirvana like that formally or
13 is this, "Gee, I have a hard enough time getting the first
14 step done. Now we're" --

15 MR. CUNNINGHAM: No. We have talked about
16 this not so much in the context of shutdown operations but
17 in the broader context of methods development in PRA that
18 said we've had an item in the budget, at one time anyway,
19 that basically said -- I forget if it was 5 years or so or
20 7 years or something after we finished 1150 or after we
21 finished these key methods development activities, we
22 would go back and apply them in an integral sense in a
23 reevaluation of one or more of the NUREG-1150 plants to
24 say: What is the overall impact of the methods
25 development over the last 5 years or so? In a sense, 1150

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1 was that in relation to the reactor safety study in a
2 sense.

3 When WASH-1400 was done, they recommended that
4 it be redone in about the 1980 time frame. We were kind
5 of slow in actually doing it, but --

6 VICE CHAIRMAN POWERS: Well, I think that's
7 not fair. I think the proper statement is they didn't
8 realize the magnitude of the problem.

9 MR. CUNNINGHAM: That could be, too. That
10 could be. And there were some other things that came
11 along in the interim that kind of distracted us.

12 VICE CHAIRMAN POWERS: Got your attention.

13 MR. CUNNINGHAM: Yes, got our attention.

14 So this has been in the budget. I will admit
15 that when we look at the long-term resources in the office
16 and others, it's always a big question. Is that
17 necessary? When is the right time for it?

18 It's an expensive proposition. And is that
19 the right place to put the money? That's a constant or an
20 annual discussion, I guess it is, in terms of the budget,
21 our long-term budget projections for the PRA research.

22 Should that be an element that says we're
23 going to go redo this X years down the pike, if you will?
24 Usually I don't fare very well with the budget people or
25 the decision-making process in that that --

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1 VICE CHAIRMAN POWERS: Well, it provokes me,
2 then, to ask a question. Would it be of use to you and
3 the entire office, not you in particular, --

4 MR. CUNNINGHAM: No.

5 VICE CHAIRMAN POWERS: -- to acquaint the
6 commissions with the needs in this area?

7 MR. CUNNINGHAM: If the Committee would like
8 to do that, I'm sure the Commission and I would be happy
9 to hear about it. Yes, sir.

10 VICE CHAIRMAN POWERS: You've completed your
11 presentation?

12 MR. CUNNINGHAM: Yes. Maybe I'll reinforce
13 the end of it. I think we have some learning to do as to
14 where we are, where the industry in general is in terms of
15 low-power and shutdown PRAs. I think that would be
16 worthwhile to have some sort of forum where we could
17 discuss that and see perhaps where that could lead us in
18 terms of what we do in terms of other research activities
19 and things like that.

20 MEMBER APOSTOLAKIS: So you plan to do this or
21 at this point you're just saying it's a good idea?

22 MR. CUNNINGHAM: If the Committee thinks it's
23 a good idea, I think we would go ahead and try to do this
24 over the next -- I don't know -- sometime between now and
25 the end of the fiscal year or something like that. If the

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1 Committee is not terribly interested in it, then maybe the

2 --

3 VICE CHAIRMAN POWERS: Perhaps it's useful to
4 tell you the Committee is acutely aware that there are
5 needs for research in this area and that their methods
6 development would have to precede any full-blown
7 NUREG-1150-style effort and did not in any sense think
8 that this was an easy chore.

9 MR. CUNNINGHAM: Yes. And on the technics
10 side, I think there is -- we need to go back and look and
11 see what's there. That's a legitimate question. And it's
12 more of a matter of the timing of when we would do that
13 relative to some other things probably. There's probably
14 a better way to characterize how we would proceed with
15 this.

16 VICE CHAIRMAN POWERS: The Committee
17 definitely does not attempt to set the management
18 priorities and doesn't try to dictate the time scales for
19 doing things.

20 MR. CUNNINGHAM: Yes.

21 VICE CHAIRMAN POWERS: We're not very skilled
22 at that, to begin with. And we're much better at saying
23 what the needs are than how you get there.

24 MR. CUNNINGHAM: Yes. Okay.

25 CHAIRMAN SEALE: We cause more trouble than --

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1 VICE CHAIRMAN POWERS: Than we're worth, yes.

2 Well, thank you, Mark. That's --

3 CHAIRMAN SEALE: Are there any industry

4 comments?

5 VICE CHAIRMAN POWERS: I guess we have no

6 additional --

7 CHAIRMAN SEALE: There was no industry

8 comment? Was there anything anyone else on the staff

9 would like to --

10 (No response.)

11 CHAIRMAN SEALE: Well, I guess we're through

12 with that, then. And we --

13 VICE CHAIRMAN POWERS: We are far from

14 through.

15 (Laughter.)

16 CHAIRMAN SEALE: We have just begun to fight.

17 VICE CHAIRMAN POWERS: We have enjoyed you so

18 much it looks like we're going to get to have your company

19 many, many times here.

20 MR. CUNNINGHAM: Thank you very much.

21 MEMBER APOSTOLAKIS: It was very, very useful,

22 though. It was really very useful.

23 CHAIRMAN SEALE: Yes, it was. We appreciate

24 your response on relatively short notice.

25 MR. CUNNINGHAM: Certainly.

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1 CHAIRMAN SEALE: Would you like to discuss the
2 letter a little bit since we have about ten minutes here?

3 VICE CHAIRMAN POWERS: As I said, I think in
4 our new procedures, that we're not going to try to --

5 (Whereupon, the foregoing matter was concluded
6 at 11:52 a.m.)

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C E R T I F I C A T E

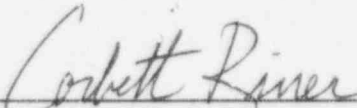
This is to certify that the attached
proceedings before the United States Nuclear
Regulatory Commission in the matter of:

Name of Proceeding: 428TH ACRS

Docket Number: N/A

Place of Proceeding: ROCKVILLE, MARYLAND

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.



CORBETT RINER

Official Reporter

Neal R. Gross and Co., Inc.

2
INTRODUCTORY STATEMENT BY THE ACRS CHAIRMAN
438TH ACRS MEETING, FEBRUARY 6-8, 1997

THE MEETING WILL NOW COME TO ORDER. THIS IS THE FIRST DAY OF THE 438TH MEETING OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS. DURING TODAY'S MEETING, THE COMMITTEE WILL CONSIDER THE FOLLOWING:

- (1) ACRS SUBCOMMITTEE ACTIVITIES
- (2) FUTURE ACRS ACTIVITIES
- (3) SHUTDOWN OPERATIONS RISK
- (4) RECONCILIATION OF ACRS COMMENTS AND RECOMMENDATIONS
- (5) PROPOSED ACRS REPORTS

THIS MEETING IS BEING CONDUCTED IN ACCORDANCE WITH THE PROVISIONS OF THE FEDERAL ADVISORY COMMITTEE ACT.

DR. JOHN T. LARKINS IS THE DESIGNATED FEDERAL OFFICIAL FOR THE INITIAL PORTION OF THE MEETING.

WE HAVE RECEIVED NO WRITTEN STATEMENTS OR REQUESTS FOR TIME TO MAKE ORAL STATEMENTS FROM MEMBERS OF THE PUBLIC REGARDING TODAY'S SESSIONS. A TRANSCRIPT OF PORTIONS OF THE MEETING IS BEING KEPT, AND IT IS REQUESTED THAT THE SPEAKERS USE ONE OF THE MICROPHONES, IDENTIFY THEMSELVES AND SPEAK WITH SUFFICIENT CLARITY AND VOLUME SO THAT THEY CAN BE READILY HEARD.

I WILL BEGIN WITH SOME ITEMS OF CURRENT INTEREST.



United States
Nuclear Regulatory Commission

RISK ANALYSIS OF ACCIDENTS INITIATED DURING LOW POWER AND SHUTDOWN CONDITIONS

Presentation to Advisory Committee on Reactor Safeguards

Mark A. Cunningham 415-6189
Division of Systems Technology
Office of Nuclear Regulatory Research

Martin J. Virgilio 415-3226
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

February 6, 1997

Low Power & Shutdown Studies

BACKGROUND

- **ORIGINAL INTEREST IN LOW POWER & SHUTDOWN RISK WAS BASED ON BNL AND FRENCH STUDIES, WHICH INDICATED THAT CORE DAMAGE FREQUENCY DURING SHUTDOWN MODE COULD BE SIGNIFICANT.**
- **PROJECT BECAME PART OF USNRC'S RESEARCH PLAN IN RESPONSE TO THE CHERNOBYL ACCIDENT IN APRIL 1986.**
- **PROJECT WAS JUST BEGINNING WHEN THE VOGTLE PLANT LOST ALL VITAL AC POWER AND RHR SYSTEM WHILE AT MID-LOOP IN MARCH 1990.**
- **PROJECT WAS DIVIDED INTO TWO PHASES IN ORDER TO PROVIDE EARLY SUPPORT TO SEPARATE VOGTLE EVENT RESPONSE BEING CONDUCTED BY THE OFFICE OF NUCLEAR REACTOR REGULATION.**

Low Power & Shutdown Studies

- **PHASE 1 PERFORMED A COARSE SCREENING ANALYSIS OF ALL NON-FULL-POWER OPERATIONAL MODES AT ONE PWR (SURRY) AND ONE BWR (GRAND GULF). RESULTS WERE NOT PUBLISHED AS NUREG/CR REPORTS BUT WERE SUMMARIZED IN PHASE 2 APPENDICES.**
- **PHASE 2 ESTIMATED THE FREQUENCIES OF SEVERE ACCIDENTS INITIATED DURING TWO PLANT OPERATIONAL STATES BY PERFORMING A REALISTIC PRA FOR THE DOMINANT OPERATING STATE OF THE TWO PLANTS STUDIED UNDER PHASE 1. THIS RESULTED IN TWO PRAs:**
 - **SURRY DURING MID-LOOP OPERATION (DONE BY BNL).**
 - **GRAND GULF DURING COLD SHUTDOWN (DONE BY SNL).**
- **RESULTS PUBLISHED IN:**
 - **NUREG/CR-6143 (JULY 1995)**
 - **NUREG/CR-6144 (OCTOBER 1995)**

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SHUTDOWN RULE DEVELOPMENT

LATEST DISCUSSION WITH ACRS MAY 21, 1996

ACRS LETTER JUNE 4, 1996:

- EVIDENCE SUGGESTS SHUTDOWN RISK IS IMPORTANT**
- PROPOSED RULE WOULD LIKELY LESSEN RISK**
- RULE BASED ON ENGINEERING JUDGEMENT**
- ACRS WILL COMMENT AGAIN AFTER PUBLIC COMMENT**
- RECOMMENDED LEVEL 3 PRA FOR SHUTDOWN OPERATIONS LIKE NUREG-1150**

Low Power & Shutdown Studies

SHUTDOWN RULE DEVELOPMENT CONT

STAFF RESPONSE JUNE 28, 1996:

- AGREED THAT ENGINEERING JUDGEMENT SIGNIFICANT**
- ACKNOWLEDGES LIMITATIONS OF SURRY AND GRAND GULF STUDIES**
- REGULATORY ANALYSIS WILL HELP RISK INSIGHTS**
- LEVEL 3 PRA NOT NECESSARY, BUT MAY BE DESIRABLE**

Low Power & Shutdown Studies

SCHEDULE

Item	Date
Complete development of rulemaking package	3/31/97
Office concurrences	5/07/97
Committee To Review Generic Requirements (CRGR) concurrence	6/30/97
EDO concurrence and submittal to Commission	7/31/97

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FOLLOWUP RESEARCH ACTIVITIES

- **HUMAN RELIABILITY ANALYSIS**
- **IMPACT OF MAINTENANCE AT POWER VS. SHUTDOWN**
- **LOW POWER/SHUTDOWN MODELS FOR EVENTS ANALYSIS**

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CONSIDERATIONS IN RESEARCH PRIORITIES

TECHNICAL ALTERNATIVES:

ADDITIONAL METHODS DEVELOPMENT

- **FIRE METHODS DEVELOPMENT**
- **HUMAN RELIABILITY ANALYSIS**

ADDITIONAL DEMONSTRATION PRAs

GUIDANCE DEVELOPMENT

INDUSTRY-SPONSORED PRAs

INDUSTRY ACTIVITIES

RISK MANAGEMENT PRACTICES

INTERNATIONAL ACTIVITIES:

CSNI SURVEY

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CONSIDERATIONS IN RESEARCH PRIORITIES (CONTINUED)

COSTS: COMPLETION OF NUREG-1150 PRA "MATRIX" - VERY HIGH

CONCLUSIONS: COMPLETING MATRIX IS NOT TECHNICALLY-JUSTIFIED NOR COST-EFFECTIVE APPROACH

REASSESSMENT OF NEEDED RESEARCH IN SPECIFIC AREAS WORTHWHILE