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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

NOVEMBER 9, 2001

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1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

5 487TH MEETING

6 + + + + +

7 FRIDAY,

8 NOVEMBER 9, 2001

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10 ROCKVILLE, MARYLAND

11 + + + + +

12
13 The committee met at the Nuclear Regulatory
14 Commission, Two White Flint North, T2B3, 11545
15 Rockville Pike, Rockville, Maryland, at 8:30 a.m.,
16 George E. Apostolakis, Chairman, presiding.

17 COMMITTEE MEMBERS:

18 GEORGE E. APOSTOLAKIS, Chairman

19 MARIO V. BONACA, Vice Chairman

20 NOEL F. DUDLEY, Member

21 F. PETER FORD, Member

22 THOMAS S. KRESS, Member

23 GRAHAM M. LEITCH, Member

24 DANA A. POWERS, Member

25 STEPHEN L. ROSEN, Member

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1 COMMITTEE MEMBERS: (CONT.)

2 WILLIAM J. SHACK, Member

3 JOHN D. SIEBER, Member

4 GRAHAM B. WALLIS, Member

5 ACRS STAFF PRESENT:

6 JOHN D. SIEBER, ACRS

7 SAM DURAISWAMY, ACRS/ACNW

8 HOWARD J. LARSON, ACRS/ACNW

9 SHER BAHADUR, ACRS/ACNW

10 CAROL A. HARRIS, ACRS/ACNW

11 JOHN T. LARKINS, ACRS/ACNW

12 MAGGALEAN W. WESTON

13 MEDHAT M. EL ZEFTAWY

14 MICHAEL T. MARKLEY

15 ALSO PRESENT:

16 LARRY MATHEWS

17 STEVEN MOFFAT

18 WARREN BANFORD

19 ALLEN HISER

20 ED HACKETT

21 KEN BYRD

22 ALEX MERRION

23 JACK STROSNIDER

24 RAJ PATHANIA

25 DAVE GEISEN

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1 ALSO PRESENT: (CONT.)

2 MARK REINHART

3 TOM KING

4 N. PRASAD KADAMBI

5 ERIC J. BENNER

6 JIM LYONS

7 EDWARD MCGAFFIGAN (Commissioner)

8 TONY ULSES

9 STEWART BAILEY

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

(8:31 a.m.)

1
2
3 CHAIRMAN APOSTOLAKIS: The meeting will
4 now come to order.

5 This is the second day of the 487th
6 meeting of the Advisory Committee on Reactor
7 Safeguards. During today's meeting, the committee
8 will consider the following: circumferential cracking
9 of PWR vessel head penetrations; licensing approach
10 for the pebble bed modular reactor design; future ACRW
11 activities/report of the Planning and Procedures
12 Subcommittee; reconciliation of ACRS comments and
13 recommendations; preparation for the meeting with the
14 NRC Commissioners; proposed ACRS reports.

15 In addition, the committee will meet with
16 Commissioner McGaffigan to discuss matters of mutual
17 interest.

18 This meeting is being conducted in
19 accordance with the provisions of the Federal Advisory
20 Committee Act. Mr. Sam Duraiswamy is the designated
21 federal official for the initial portion of this
22 meeting.

23 We have received a request from the
24 Nuclear Energy Institute for time to make oral
25 statements regarding circumferential cracking of PWR

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1 vessel head penetrations.

2 A transcript of portions of the meeting is
3 being kept and it is requested of the speakers use one
4 of the microphones, identify themselves and speak with
5 sufficient clarity and volume so that they can be
6 readily heard.

7 I would also like to remind Members that
8 during lunch time we are scheduled to interview three
9 candidates for potential membership on the ACRS.

10 The first item on our agenda is
11 circumferential cracking of PWR vessel head
12 penetrations. Dr. Ford is the cognizant member and he
13 will lead us through the discussion.

14 MEMBER FORD: Thanks, George. In July, we
15 heard a presentation on the proposed bulletin relating
16 to the vessel head penetration cracking. At that
17 time, we wrote a letter to Chairman Meserve indicating
18 that the bulletin was both appropriate and timely.
19 Bulletin 2001-01 was issued on August 3, 2001.

20 In the response back to us from the staff,
21 it was indicated that the update on the staff
22 assessment will be given early next year. That's
23 2002. Because of the urgency and importance of this
24 issue, the committee decided to request an interim
25 presentation on the status of various issues that came

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1 up in the July meetings. These issues included risk
2 assessment, prioritization algorithms, evaluation of
3 inspection methods, responses to the bulletin and
4 question of cracking initiation and kinetics, both for
5 the axial and circumferential cracks.

6 Therefore, the purpose today is to hear
7 generic discussion of these issues. There's no plan
8 at this stage to issue a letter.

9 As you heard from the Chairman, NEI has
10 requested -- I'm just looking for the Member from NEI
11 -- has requested to make a statement. We'll hear that
12 statement at the end of the industry presentation.

13 We'll begin with Larry Mathews from MRP.

14 MR. MATHEWS: My name is Larry Mathews.
15 I'm with Southern Nuclear Operating Company. I'm the
16 Chairman of the Alloy 600 Issues Task Group of the
17 Materials Reliability Program.

18 I'm just going to provide an update on a
19 few issues of where the industry is on some of these
20 issues with respect to the head penetration cracking.

21 Some of the topics I'm going to address
22 quite briefly is the crack growth rate in the annulus
23 environment, not the details of what we're doing in
24 that regard; the risk assessment, where we stand on
25 that; inspection impacts on susceptibility. We've had

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1 several plants inspected this fall. Does that have
2 any impact on our rankings? Recommendations that we
3 may be making for the spring outages and the ASME code
4 activity that's going on.

5 In the area of crack growth rate, I'm not
6 sure if I told you this last time, but I think, I
7 believe I did. We were convening an expert panel to
8 try and assess what's the appropriate crack growth
9 rate to use when evaluating this phenomena. That
10 panel, which consists of members from all over the
11 world, convened for the first time in August, kind of
12 an introductory, get to know what they're going to do
13 meeting. Then they had a second multi-day meeting in
14 Airlie in October, the first part of October.
15 Numerous phone calls and discussions have taken place
16 amongst those Members since then and they produced the
17 first draft of a report on Alloy 600 on October 22nd.

18 As the industry reviewed that, we had
19 many, many comments on the structure and the content
20 of the report. Those are being incorporated and not
21 just us. Dr. Shack had comments on the thing too, so
22 those are being addressed. The second draft is
23 expected out next week and we're scheduling the report
24 on crack growth rate from the expert panel for
25 publication at the end of this month.

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1 MEMBER FORD: In terms of communication,
2 ease of communication, has any of this information
3 from this expert panel been transferred to the NRC
4 staff?

5 MR. MATHEWS: I don't believe we've sent
6 the draft to them yet. Dr. Shack was on the committee
7 and I believe he's seen the draft of the report, first
8 draft of the report and so that's as far as it goes.
9 We haven't sent anything else yet, but we've gone back
10 and tried to incorporate and I'll get into some of
11 what we've tried to do.

12 MEMBER FORD: The reason for my question
13 is because of the urgency, I just want to make sure
14 there's plenty of backwards and forwards.

15 MR. MATHEWS: Yes. I guess the extent of
16 that is Dr. Shack has been given the draft and
17 commented on it.

18 MEMBER FORD: Sure.

19 MR. MATHEWS: The process they went
20 through was they established some data screening
21 criteria. There's lot of data out there on Alloy 600.
22 Not all of it is of the same quality so the expert
23 panel established some criteria for selecting the data
24 sets and then the data sets that were to be used were
25 selected and initially a best fit curve was put in the

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1 report and that was it. Some of the comments from the
2 industry were we need to put in the kinds of curves we
3 need to address, what the data is going to be used
4 for. So some of the curves that are being
5 investigated at the moment are heat to heat
6 variability, is there some effect there that needs to
7 be accounted for; the widespread in the data, there is
8 a very wide spread in the data; what amount of
9 conservatism needs to be put into the curve if you're
10 using it for deterministic evaluations; is that the
11 right same curve or should you use a different curve
12 if you're doing probabilistic evaluations? And also,
13 the annulus environment.

14 One of the things -- the things the expert
15 panel has determined is that the environment that is
16 possible in the annulus after a leak established is
17 about the same as a primary water as far as the impact
18 on crack growth rate. And it doesn't matter that much
19 where the boiling transition takes place inside the
20 crack, at the exit. The only times there's potential
21 any impact, as I understand it, is when the boiling
22 transition is right at the crack.

23 MEMBER FORD: I recognize you don't have
24 very much time today and obviously we'll be having
25 another meeting with the Materials Subcommittee. We

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1 have a whole day to go through all the ins and outs of
2 this.

3 Can you give us some feeling about where
4 you stand right now in terms of the choice of a
5 disposition curve for both axial and circumferential
6 cracks? Is it going to be a mean? Is that the way
7 you're moving?

8 MR. MATHEWS: I doubt that it will be a
9 mean for a disposition curve or for probabilistic,
10 we're still trying to decide. It may be a mean for a
11 probabilistic evaluation, but even there you have to
12 -- we have to look at what's the effect of heat to
13 heat, how do we really handle those kinds of
14 variations and I don't think it will be a mean curve
15 for disposition. There will be some conservatism in
16 a disposition curve, but then again we're not really
17 talking about dispositioning a circ flaw above the
18 weld. Those will typically be repaired and so we're
19 not going to find one and try and figure out how long
20 we can run with it. We can't run with it. So what we
21 do there will be different than if it's a short axial
22 flaw and we're trying to disposition that then there's
23 also the dispositioning of the hypothetical flaw and
24 we've got to figure out how to handle all of that.

25 MEMBER FORD: I was just looking through

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1 your presentation here. This is the only slide there
2 is because there's no data and there's a lot of
3 technical discussion necessary.

4 When do you think you'll be ready to
5 discuss this?

6 MR. MATHEWS: We're intending to try to
7 publish this by the end of the month and we will have
8 discussions in our meeting that's scheduled with the
9 NRC at the end of the month on the 27th.

10 MEMBER FORD: Thank you.

11 MR. MATHEWS: The second draft is due out
12 next week. Hopefully, we will -- that will be the
13 final one or shortly thereafter we'll be able to
14 publish it.

15 One of the things we found out yesterday
16 or it appears that there may be some differences in
17 the data sets that have been used by the staff and the
18 ones that the expert panel used, so those things have
19 to be addressed very quickly I think.

20 MEMBER FORD: Okay.

21 MR. MATHEWS: Anything else?

22 MEMBER FORD: Well, there's lots and lots
23 of questions.

24 MR. MATHEWS: That is the only slides I
25 have on the crack growth rate and that's a very

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1 important topic because it drives a lot of stuff and
2 we need to reach resolution on that area and we
3 recognize that and we're moving toward that as fast as
4 we can.

5 In the area of risk assessment --

6 MEMBER POWERS: Maybe I don't understand
7 quite. What is it that's so crucially dependent on
8 knowing the crack growth rate?

9 MR. MATHEWS: How long you have -- well,
10 the crack growth rate can have impacts on reinspection
11 intervals. It can have impacts on how long you can
12 run, once you find an acceptable flaw, how long does
13 it remain acceptable and those kinds of things. And
14 it also has an impact on the probabilistic fracture
15 mechanics that you fold into your industry risk
16 assessment. It drives and feeds into a whole bunch of
17 aspects of this issue.

18 MEMBER POWERS: Yes, as long as one is
19 willing to operate the flaws, I see that.

20 MR. MATHEWS: Yes. Well, even if you're
21 trying to assess the probability of core damage or the
22 frequency of core damage on the mere presumption that
23 there may be a flaw.

24 MEMBER POWERS: It will usually come out
25 three times the life of the universe or something like

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1 that.

2 MR. MATHEWS: We hope so.

3 (Laughter.)

4 MEMBER POWERS: Doesn't mean I believe
5 them, but that's the way they always come out, so it
6 doesn't matter what number you put in.

7 MR. MATHEWS: Well, in the area of risk
8 assessment, the preliminary work was performed for the
9 various plant types, some preliminary work. We had a
10 meeting this week to finalize our approach for the
11 industry and how to bring these various approaches
12 that were put together.

13 What we're looking at is using industry
14 statistics for probability of a thru-wall flaw versus
15 time to get -- that gives you then the probability of
16 initiating a thru-wall flaw. Then we're using
17 probabilistic fracture mechanics to determine the
18 probability of crack propagation versus time from the
19 time of the leak to the thru-wall or the rupture.

20 The conditional core damage probabilities
21 for results of LOCA and rod ejection will be assessed
22 from either generic industry numbers or plant specific
23 numbers and those should include any effects of
24 collateral damage that may happen. And then finally,
25 the core damage frequency --

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1 MEMBER POWERS: I don't understand your
2 language here. You have probability fracture
3 mechanics for probability crack propagation versus
4 time from leak to thru-wall or rupture.

5 I mean if it's leaking isn't it through
6 the wall?

7 MR. MATHEWS: There's a couple of ways to
8 get a leak and if you had a leak through the weld, the
9 thru-wall we're talking about here is thru-wall in the
10 direction that could lead ultimately, if it grew far
11 enough to an ejection.

12 You can get water on the outside in the
13 annulus region by a leak through the weld that's an
14 axial leak that does not threaten the ejection of the
15 rod. Then what we're talking about is using from the
16 time you've got that leak to the time that the crack
17 could turn circumferential and grow through the wall
18 and/or grow all the way around until it ejects.

19 MEMBER POWERS: It's really not thru-wall
20 so much as being circumferential.

21 MR. MATHEWS: Yes, thru-wall in the plane,
22 that is a circumferential flaw. You can get a leak
23 from an axial flaw which has no -- does not threaten
24 a LOCA or an ejection. Once you get that, how does it
25 grow back toward the potentially dangerous flaw of the

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1 circumferential flaw all the way around. And the
2 thru-wall component, they're talking about there, how
3 does that crack propagate until it's a thru-wall
4 position. Well, it just goes -- we propagate it
5 probabilistically all the way until it gets to the
6 limit.

7 MEMBER POWERS: I'm trying desperately to
8 remember language of general design criteria, but it
9 seems to me once we have a leak, we are in violation
10 of having a leak type primary piping system.

11 MR. MATHEWS: Yes. We're not arguing
12 that.

13 MEMBER FORD: Larry, at the meeting we had
14 both to the Materials Subcommittee and then to the
15 Full Committee earlier this year on this particular
16 topic, you came under a fair amount of fire, I seem to
17 remember, for the assumption that you made on
18 initiating event frequency. Since that time I know
19 Ocone has given a public meeting here to the staff on
20 that issue.

21 Could you, for the members, give a kind of
22 bottom line conclusion from that meeting?

23 MR. MATHEWS: I'm not sure -- I wasn't
24 there, and I'm not sure I know the specifics of what
25 they presented at that meeting.

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1 MEMBER FORD: Okay.

2 MR. MATHEWS: They were -- I have seen
3 numbers of -- in one of the approaches, one and a half
4 flaws for an assumption, but that's for a given set of
5 plants at a given point in time. Most of the other
6 plants were much, much lower on the susceptibility
7 curve and therefore the probability of having a leak
8 at this point in time.

9 And what we're trying to assess is that
10 probability starting now and into the future for each
11 and every unit and you can use the data that has been
12 gathered on the plants that do have leaks and the
13 plants that don't have leaks at this point in time to
14 come up with some distribution and I believe there's
15 a wide distribution that they're trying to use to come
16 up with a --

17 MEMBER FORD: But there will be a uniform
18 industry argument on this particular risk assessment
19 issue for discussion with the NRC staff?

20 MR. MATHEWS: Yes, there will. That's our
21 intent.

22 MEMBER FORD: And that will be presumably
23 by the end of this month, November?

24 MR. MATHEWS: No, no. That was the crack
25 growth rate. It's going to take a little bit longer

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1 to get all of this pulled together. It's probably
2 going to be in the January time frame.

3 MEMBER FORD: Okay.

4 MR. MATHEWS: Before spring outages for
5 the most part, we should have some results.

6 MEMBER FORD: Okay.

7 MR. MATHEWS: We've seen this curve
8 before, except that I've changed it a little bit and
9 I put up there who has which units have leaks, which
10 units have had cracks, but have not discovered leaks
11 on their head, which units have done visual
12 examinations with no leaks and then the ones that are
13 later. It's hard to see up close, so I got it blown
14 up for the first 30 years. This was our ranking of
15 the units and when we put it together it was a quite
16 simple ranking. We all know time and temperature of
17 the head and if you look at the plants that have had
18 leaks to date --

19 CHAIRMAN APOSTOLAKIS: Could you explain
20 a little bit. Don't assume we know.

21 MR. MATHEWS: Okay, I'm sorry. This
22 bottom axis is the effective full power years that it
23 would take a unit normalize to 600 degrees Fahrenheit
24 head temperature to reach the same effective full
25 power years calculated for Oconee 3 at the time they

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1 shut down and discovered their numerous flaws at
2 Oconee 3. So we use Oconee 3 as the base point and
3 then we normalized all the plants to that same, to an
4 effective full power year number that would be
5 equivalent to an equivalent head temperature of 600
6 degrees.

7 Using that then, we just ranked the plants
8 as far as how far away they were in time until they
9 would reach that same equivalent time at temperature.

10 CHAIRMAN APOSTOLAKIS: So if I go to EFPY
11 10 and I go up and I find 20 on the left --

12 MR. MATHEWS: Okay that means --

13 CHAIRMAN APOSTOLAKIS: What does that
14 mean?

15 MR. MATHEWS: What that means is that the
16 highest ranked 20 units in the country are less than
17 10 years from being equivalent to Oconee 3.

18 CHAIRMAN APOSTOLAKIS: The highest ranked?

19 MR. MATHEWS: Right, or if you go up the
20 left column, 20, the 20th ranked plant, if you rank
21 them sequentially, the 20th ranked plant would be 10
22 years away from Oconee 3.

23 CHAIRMAN APOSTOLAKIS: They would be
24 weighed in what sense?

25 MR. MATHEWS: It would take 10 more years

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1 of operation, effective full power years of operation
2 at their head temperature to reach the same time at
3 temperature equivalent as Oconee 3 normalized to the
4 600 degrees.

5 CHAIRMAN APOSTOLAKIS: I see.

6 MR. MATHEWS: So it's just a way that we
7 could rank plants based on time and temperature, how
8 far away are they from being equivalent to Oconee 3
9 and the number up the side is just the rank order of
10 the units.

11 CHAIRMAN APOSTOLAKIS: Now what I see
12 there at that point is a circle, a green circle and up
13 there it says later.

14 MR. MATHEWS: And that means that that
15 unit has not had an outage done and inspection of
16 their vessel head to date since Oconee 3 and since we
17 put this February 2001 was our normalization point.

18 VICE CHAIRMAN BONACA: Now I see a 6, I
19 see one unit with a triangle there, a red triangle?

20 MR. MATHEWS: Right, and that unit has
21 done an inspection of their head. I believe it was
22 this fall and discovered a leak on their head, at
23 least one.

24 VICE CHAIRMAN BONACA: So although it
25 would take 6 years for it to get to the same

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1 temperature --

2 MR. MATHEWS: Same time.

3 VICE CHAIRMAN BONACA: Oconee still has
4 leaks. Why wouldn't that plant -- I'm trying to
5 understand that the reference is to Oconee.

6 MR. MATHEWS: Well, we can change the
7 reference. If we change the reference all that does
8 is move Oconee to a negative number.

9 VICE CHAIRMAN BONACA: Okay, I see. All
10 right.

11 MR. MATHEWS: We just selected Oconee 3 at
12 that point in time because it was the worse cracking
13 that we had observed to date at the time we put the
14 initial --

15 VICE CHAIRMAN BONACA: It's logical, all
16 right.

17 MEMBER FORD: At the time this was thought
18 about, the temperature time algorithm was a reasonable
19 start.

20 MR. MATHEWS: Yes.

21 MEMBER FORD: As you stand right now, are
22 there any surprises from the algorithm telling you
23 that there's something physically wrong with it? In
24 other words, just glancing at it, it seems that you
25 don't have any red triangles all the way to the right.

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1 Thank goodness.

2 MR. MATHEWS: That's true. There are no
3 red triangles to the right. We do have some blue
4 diamonds to the left, at least one or two and have
5 done visual exams of their head and not discovered
6 leaks.

7 MEMBER FORD: Right.

8 MR. MATHEWS: We have some other green
9 circles over there that haven't looked yet. We have
10 plenty of "haven't looked yet's" right in here. So --
11 and on out. So we don't see anything, I don't see
12 anything here that really surprises me and says the
13 model that we're using is just a totally ineffective
14 way to address the issue. The plants that have
15 discovered leaks are the plants that are high in the
16 susceptibility ranking here at time and temperature.

17 There are plants, we're starting to get
18 into plants that don't have leaks or don't have
19 observed leaks that are intermingled here. It's not
20 a perfect model by any stretch of the imagination, but
21 we are starting to get to the point where we're seeing
22 some that don't have leaks.

23 MEMBER FORD: Is there anything in these
24 observations that intimate that, for instance,
25 different -- they're all hot head plants, but is there

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1 anything that would intimate that plants of a certain
2 design would be more likely to crack than not at a
3 given EFPY?

4 MR. MATHEWS: Well, there are many leaking
5 plants here. Seven plants, I believe, here that have
6 red triangles.

7 MEMBER FORD: Right.

8 MR. MATHEWS: Six of those plants are BNW
9 design plants.

10 MEMBER FORD: Yes.

11 MR. MATHEWS: One of those plants is a
12 Westinghouse-designed plant. There's a wide variety
13 of materials that were used to make the head
14 penetrations throughout the industry, especially on
15 the Westinghouse units. So that's one of the things
16 we're starting to look at, is there some segregation
17 of the population that we could do. One of the plants
18 that did have a leak, their cracks were entirely
19 contained in the weld metal and so we have to say
20 well, do we know enough to talk about the specifics of
21 the weld metal for all the rest of these plants or is
22 time and temperature going to ultimately be the thing
23 we use all along. And we're not sure yet. We're
24 assessing the data continuously as it comes in.

25 VICE CHAIRMAN BONACA: Given that you have

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1 this dependency evidently. I mean most of the red are
2 for one type of plant. Is it reasonable still to put
3 all these kind of different designs, etcetera on the
4 same plot?

5 MEMBER FORD: That's the reason for my
6 question is can you read out from that that there is
7 a --I don't know, a heat to heat or a fabrication
8 style?

9 MR. MATHEWS: Certainly, we hope to
10 ultimately to be able to figure out what those
11 parameters are and characterize them and start to sort
12 this data into bins. And we've already sorted -- not
13 this data, but we're starting to look at well, who has
14 what type of material, what type of tubes and as we
15 get more inspection data, a lot of the types we don't
16 have much inspection data on yet, but as we get more
17 inspection data, we'll be able to say well, this
18 doesn't look quite as susceptible as it should be, you
19 know. We should be seeing some indications here and
20 we don't. So we can maybe sort that out. But at this
21 point in time we don't think we have enough
22 information to start to do those discriminations.

23 MEMBER FORD: But based on the data you
24 have so far, the historical data you have so far, it
25 is real to suppose those three open circles run about

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1 3 EPFY if they were inspected, you would expect to see
2 cracks, based on that data?

3 MR. MATHEWS: I would say it wouldn't
4 surprise me to see cracks there.

5 MEMBER FORD: Okay.

6 MR. MATHEWS: Because they're not --
7 there's material variabilities, etcetera there.

8 MEMBER FORD: Sure.

9 MR. MATHEWS: And it wouldn't surprise me
10 to see some cracks, but it's not going to surprise me
11 to not see some either.

12 MEMBER FORD: Thank you.

13 MR. MATHEWS: When we look around the
14 industry we already have several plants that have
15 decided that it's the right thing for them to do,
16 based on their ranking and their decision making
17 process, etcetera, that they should be doing some
18 under the head NDE inspections and part of that could
19 be tied to the difficulty that they would have doing
20 a visual inspection because of their particular
21 insulation package, but we have several of these
22 plants that have already told us that they probably
23 will be doing inspections this next spring and next
24 fall and we have a draft industry inspection program
25 under review where we're trying to say is this enough,

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1 we're looking at the ones that are volunteering and
2 saying is this enough? If not, what do we need to do
3 as an industry and we're working on that right now and
4 that program is under review and when we get through,
5 if it's a published recommendation we'll be sharing
6 that.

7 MEMBER FORD: On that basis and I'm
8 referring back to the previous one, do you remember we
9 asked whether it was possible to improve this
10 prediction algorithm.

11 MR. MATHEWS: Yes.

12 MEMBER FORD: Are there -- where do you
13 stand on that right now or do you not see any reason
14 to improve it at this time?

15 MR. MATHEWS: We'd love to be able to
16 separate the whole rest of the fleet from the ones
17 with the red triangles, but do we have the data now to
18 do that? We don't. We need some more data to be able
19 to sort out and figure out which plants might be able
20 to be separated and which ones belong in the same
21 population.

22 MEMBER FORD: I recognize it's a complex
23 problem, but from a cost-effectiveness point of view,
24 is there any point in continuing with that effort to
25 try and improve on the --

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1 MR. MATHEWS: Improve on the modeling?

2 MEMBER FORD: Yes.

3 MR. MATHEWS: Well, it's pretty simple to
4 do this model.

5 MEMBER FORD: I'm sure.

6 MR. MATHEWS: And as we get into it, you
7 have to look at the parameters you're looking at. If
8 you've got great lab data on a parameter, but you
9 don't know what it is in the field, there's no point
10 in chasing it and so we're -- that's like the welds.
11 If we knew exactly what properties caused the weld to
12 crack, that may or may not be of any benefit if you
13 don't know what the properties are for all the plants.

14 MEMBER FORD: Sure.

15 MR. MATHEWS: So that's the kinds of
16 things we're having to weigh, but right now we're
17 still going with the time and temperature and trying
18 to gather data. We know what the subsets are as far
19 as materials, etcetera, but right now we're still
20 having them write this way.

21 MEMBER FORD: Okay.

22 MR. MATHEWS: As far as the long range,
23 NRC has indicated that the inspection criteria for
24 head penetration area in the ASME section 11 code is
25 potentially inadequate or has been over the years,

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1 although we haven't really had an action because of
2 that, but they feel that it needs to be modified. So
3 Section 11 has established a working group to look at
4 the Alloy 600 inspection requirements that are in the
5 Section 11 code right now. They met at the last
6 Section 11 meeting and they'll be meeting again at the
7 December meeting and I believe there's at least one
8 draft of something that they'll be discussing at the
9 December meeting.

10 I'm not sure how quickly the code moves,
11 but ultimately, long range down the road, I believe
12 Section 11 will have some requirements that they will
13 put into place that will be a long range inspection
14 program.

15 We need to work with them because some
16 plants are replacing heads and they're using much more
17 resistant material, so we need to figure is that the
18 right -- make sure that whatever gets into the code
19 for inspection doesn't overpenalize people who go into
20 proactive or necessary head replacements.

21 That's all I have. I have used my half
22 hour almost exactly.

23 MEMBER LEITCH: Just one quick question.
24 The visual with no leaks, the blue dots on your
25 histogram?

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1 MR. MATHEWS: Yes.

2 MEMBER LEITCH: Refresh my memory, what
3 does that mean? You looked for boron and found none?
4 That was the extent of the examination?

5 MR. MATHEWS: Yes, that's what it means
6 but it was at least an effective visual which means
7 that you got a good hard look at metal to metal
8 interface where the penetration goes inside the
9 interference gap on the head. And saw no evidence of
10 leakage on all of those plants.

11 Now NRC's requirement was that we
12 absolutely demonstrate for plants less than 5 years if
13 you were doing a visual that it be a qualified visual
14 which means you demonstrate it would leak and for the
15 others out to 30 years they didn't require that
16 demonstration at this point.

17 Some of these plants have done some work
18 to demonstrate that they believe most, if not every
19 single one of their penetrations would leak if they
20 had a crack. Others have not done that to date.

21 MEMBER LEITCH: Okay, thank you.

22 VICE CHAIRMAN BONACA: Just before you
23 take it down, of these plants, how many of them have
24 exhibited this circumferential cracks?

25 MR. MATHEWS: I believe three plants had

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1 circ flaws: Oconee 3, Oconee 2 and Crystal River.

2 VICE CHAIRMAN BONACA: So they are spread.

3 MR. MATHEWS: Two of them are real close
4 and then the other one is out.

5 MEMBER FORD: The uppermost triangle is
6 Crystal River, uppermost red triangle?

7 MR. MATHEWS: I believe.

8 MEMBER ROSEN: You said that the small
9 cluster is down between 0 and 5?

10 MR. MATHEWS: These three.

11 MEMBER ROSEN: If you found the plant in
12 that group that had a leak, that it wouldn't surprise
13 you, am I right?

14 MR. MATHEWS: Right. It would be
15 consistent with the data from the other plants.

16 MEMBER ROSEN: Now what about the next
17 open circle that you see up around 6 or the next one
18 after that, 7th. If they had a leak, would that
19 surprise you?

20 MR. MATHEWS: It becomes more and more of
21 a surprise the further to the right you go.

22 MEMBER ROSEN: That's what I'm trying to
23 figure out. What is your crack definition?

24 MR. MATHEWS: I don't have one. I don't
25 know. The data is out there. We're trying to gather

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1 the data to figure out where it is.

2 We didn't try to use this as a predictive
3 model to say this plant will leak in X number of
4 years. What we were trying to do is say these are the
5 plants that -- on a time and temperature basis any
6 way, the highest in rank and they're the ones we
7 really need to be concerned.

8 MEMBER ROSEN: I know from listening to
9 you that the ones below 5 would surprise you and I
10 think if you saw a crack between 25 and 30 that would
11 surprise you. The ones between 25 and 30 would
12 surprise you. The ones between 0 and 5 would not. So
13 I have two points on the curve.

14 (Laughter.)

15 CHAIRMAN APOSTOLAKIS: Are you plotting
16 being surprised?

17 MEMBER ROSEN: I'm trying to figure out
18 when we should say oops, this isn't working.

19 MR. MATHEWS: I think a leak in the 30-
20 year time frame certainly would warrant, whoa, what's
21 going on, a whole bunch more, no leaks down in the 5
22 to 10 year range doesn't.

23 MEMBER ROSEN: Yeah.

24 MEMBER FORD: You are looking at how a
25 scatter band of depths is impacting over time and so

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1 you expect if all the plants were exactly the same
2 design, manufacture, there should be a clear cut, but
3 they're not. Is there any reason -- the reason I'm
4 asking the question, between cracking and no cracking
5 on that curve. That's why I asked the question can
6 you put a normal cut between, for instance,
7 Westinghouse and Babcock on that?

8 MR. MATHEWS: Part of the unfortunate
9 thing about trying to do something like that is all of
10 the BNW units happen to be very high in the ranking on
11 time and temperature.

12 MEMBER FORD: Because of time primarily.
13 These are 600.

14 MR. MATHEWS: Just from a time and
15 temperature basis, they're very high in the ranking.

16 MEMBER FORD: Right.

17 MR. MATHEWS: They were all built fairly
18 close together in time. They all run with fairly high
19 head temperatures relative to the rest of the industry
20 and so when you couple those, it pushes most of the
21 BNW units --

22 MEMBER FORD: It is primarily time, isn't
23 it, Larry, because most of these are 600 plus or minus
24 2 head temperatures. Is that correct?

25 MR. MATHEWS: Well, some of these units

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1 are probably even on down into the 590, 580 range.

2 MEMBER FORD: Okay.

3 MR. MATHEWS: Well, maybe not these.
4 These may not be down in the 580, but some of the
5 plants on the higher end up here are in the final --

6 MEMBER ROSEN: Some are even lower than
7 that.

8 MR. MATHEWS: Yes. If you look at the
9 curve for the entire fleet it goes all the way out.
10 Most of these plants are designed such that their head
11 temperatures are calculated to be very near the cold
12 lake temperature.

13 MEMBER ROSEN: Right.

14 MR. MATHEWS: And these are either hot
15 head or warm head plants.

16 MEMBER ROSEN: Right.

17 MR. MATHEWS: The Westinghouse design
18 diverts a little of the cold lake flow up there and it
19 varies from design to design. But most of these
20 plants out in here have what we call cold heads.
21 Their heads have enough cold lake flow diverted to the
22 head and they're operating at significant lower head
23 temperatures than most of the other fleet.

24 MEMBER ROSEN: Okay.

25 MR. MATHEWS: Now the BNW designs tend to

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1 be even on the high end of the head temperatures, over
2 600 and most of the Westinghouse plants are a few
3 degrees under 600, NCE plants.

4 MEMBER ROSEN: Okay. Have you got all the
5 inspection results in for the fall outages that's
6 shown on this curve?

7 MR. MATHEWS: I believe North Anna 2.
8 Well, we've got all of them that are complete. And
9 we've got all of them that are -- I believe all of
10 them that have discovered any leaks, even if they're
11 not completely through with their exam is on there.
12 There's a few units that are down now that have not
13 finished their exam and I don't know if they've found
14 anything or not. So --

15 MEMBER ROSEN: I'm going to take your
16 answer to mean there may be some new data yet from
17 this set of fall outages.

18 MR. MATHEWS: Absolutely.

19 MR. BANFORD: There's one more green
20 diamond in the less than 5 year.

21 MR. MATHEWS: Green circle.

22 MR. BANFORD: That we just became aware of
23 about two days ago. Warren Banford from Westinghouse.
24 So one of the three open circles in the 0 to 5 is now
25 a green circle.

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1 MR. MATHEWS: A blue diamond.

2 MR. BANFORD: Or a blue diamond.

3 MR. MATHEWS: Visual with no leaks. I
4 guess that that's within the last two or three days
5 that that came out.

6 Well, it won't change the color. Oconee
7 is down and I don't know how I'm going to plot this
8 when -- if they come down and don't find anything this
9 time, how do I plot that. Successful repair.

10 MEMBER FORD: I'd like to bring this one
11 to a close unless there's any urgent questions. But
12 is it my understanding, Larry, that by December if we
13 had a Materials Subcommittee meeting in December, you
14 would have a full technical data presentation on the -
15 - at least on the cracked assessment?

16 MR. MATHEWS: Crack growth rate?

17 MEMBER FORD: Yes.

18 MR. MATHEWS: I think we can --

19 MEMBER FORD: And the annulus would not be
20 a waste of time, I believe to have a meeting at that
21 time if that's what we decide.

22 Larry, thank you very much. I'd like to
23 call upon now Steven Moffat of Davis-Besse. I think
24 it's 10 minutes.

25 MR. MOFFAT: Thank you. I have a power

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1 point type presentation that starts with Davis-Besse.
2 Again, I'm Steve Moffat from Davis-Besse. I'm the
3 Director of Technical Services.

4 With me is David Geisen and Ken Byrd who
5 are on our staff. We also have several of our subject
6 matter experts who contributed from an industry
7 perspective to our discussion this morning with us in
8 the audience. First off, I'd like to sincerely thank
9 the ACRS for allowing us this opportunity to give what
10 could be characterized as a case study of some of
11 these diamonds we just saw as relates to Davis-Besse.

12 Our objective today is to have ACRS
13 consider additional industry information as it
14 deliberates on the Control Rod Drive Nozzle cracking
15 issue. Obviously, this is an evolving issue. There's
16 information we recently got from the staff on
17 positions relative to this issue and we'd like to
18 include the additional information today in formal
19 correspondence to the NRC that may be related to
20 regulatory action.

21 As we heard Larry talk about consensus
22 documentation at this point in time, what we have done
23 is used the best industry data we could in order to
24 determine what would be appropriate action for us
25 based on the safe operation of our power plant. Our

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1 reason for request is that Davis-Besse is considered
2 a high susceptibility plant as discussed in Bulletin
3 2001-01, specifically the time and temperature model
4 puts us within three years of -- actually, slightly
5 over 3 years of the adjusted Oconee 3 data that we saw
6 a minute ago.

7 MEMBER FORD: So you're one of those open
8 circles?

9 MR. MOFFAT: We are one of the "to be
10 inspected" --

11 MEMBER FORD: To be inspected open
12 circles.

13 MR. MOFFAT: Yes sir, that's right. And
14 as indicated here, we are the only high susceptibility
15 plant that's ranked by the Bulletin that will not
16 perform a visual inspection by December 31 of 2001 and
17 we've used these subject matter experts, as I
18 referred, to assess the impact of the continued safe
19 operation of our plant until our next scheduled
20 refueling outage which is currently scheduled for the
21 end of March of 2002.

22 As far as Dave is essentially a
23 deterministic engineer and Ken is a probabilistic,
24 some of the discussions will go in that area in my
25 brief presentation. As far as the deterministic, we

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1 believe we have what could be characterized as
2 qualified visual inspection that was performed in 1996
3 and additional inspections in 1998 and 2000. My
4 reason for using that terminology is that we had done
5 inspections of the head for other reasons, however,
6 the people that did the inspections are available and
7 we, in fact, videotaped the heads which we have
8 subsequently reviewed in light of the information that
9 evolved as part of Bulletin 2001-01. So this provided
10 us an opportunity to put a new set of eyeballs, if you
11 will, on the historical issue at hand.

12 What we did with the 1998 and 2000 is
13 essentially utilize that data, albeit limited in our
14 probabilistic assessment of the risk associated with
15 this issue.

16 As Larry indicated earlier, the majority
17 of our nozzles through out own plant-specific finite
18 element analyses show that they would open which
19 essentially means the visual efficacy of the
20 inspection was adequate.

21 MEMBER POWERS: I guess, maybe I don't
22 understand that quite. I guess I have a couple of
23 questions about that.

24 MR. MOFFAT: Certainly.

25 MEMBER POWERS: If I go in and I look at

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1 these regions and I don't see anything, what is the
2 likelihood that there is, indeed, a crack there I just
3 didn't see it.

4 MR. MOFFAT: The likelihood due to the
5 fact that we did specific finite element analysis is
6 extremely low because the analysis shows that should
7 there be a crack and pressure --

8 MEMBER POWERS: It has nothing to do with
9 my vision and your finite element analysis. If I go
10 in and look at your head and I don't see anything,
11 what's the probability that I just missed the crack?

12 MR. MOFFAT: That human error probability
13 Ken will discuss momentarily, Mr. Powers. We did
14 include that in our probabilistic safety analysis for
15 essentially the ability of a human to detect that.
16 What this is is more of a mechanistic assessment that
17 says should there be a flaw, would we be able to
18 detect that with on head leakage. That's what I'm
19 referring to by the 56 and 69.

20 MEMBER POWERS: Well, your finite element
21 analysis shows what?

22 MR. MOFFAT: We looked at the 69
23 penetrations and of those, 65 of them would open up
24 enough so that we would have a sense as characterized
25 as qualified that we could detect a flaw through

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1 visible leakage boron deposit.

2 MEMBER POWERS: All right. Thank you.

3 MR. MOFFAT: Additionally, we perform our
4 own plant specific analysis that essentially would
5 look at the end point as it relates to safety factor
6 of 3 using the code we've discussed previously and
7 have a number that's slightly bigger than the industry
8 data to date as it applies to Davis-Besse. That
9 number is 302 degree flaw as safety factor of 3.

10 We also believe --

11 MEMBER FORD: Excuse me, physically, what
12 allows you to make that difference in material
13 properties? I mean what's the --

14 MR. MOFFAT: I'll let you take that, Dave.

15 MR. GEISEN: Well, we had the -- the
16 analysis was done by Structural Integrity Associates
17 and when they did their analysis they were looking at
18 the -- using the fracture mechanics with the nozzles
19 and looking at our worse case nozzle in our particular
20 strengths of materials what does that take us out to.

21 MEMBER FORD: So it's a larger qualifying,
22 larger than you mentioned than who? Industry average?

23 MR. MOFFAT: Nominally 270 plus or minus
24 several over here. Quite a body of information
25 yesterday, but that's the general characterization

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1 between roughly 260 and 272.

2 MEMBER FORD: Okay.

3 MR. MOFFAT: Additionally, in order to
4 look back, as I said previously, with a new set of
5 eyes, assumed an initial flaw size that would have
6 occurred immediately subsequent to our 1996
7 retrospective, if you will, and believe that we would
8 still have a reasonable assessment that we can proceed
9 until our refueling outage based on that initial flaw
10 size.

11 And then finally the last deterministic
12 aspect I'd like to go over briefly is just the fact as
13 Larry was showing, we are over the three adjusted
14 effective full power years plus at Oconee Unit 3.
15 Essentially, we're at roughly 6 EFPY as far as the
16 EFPY, but as adjusted for time and temperature, we're
17 a bit over 3.

18 VICE CHAIRMAN BONACA: A question on the
19 1998 and 2000 inspections, you said that they were
20 limited.

21 MR. MOFFAT: Yes sir.

22 VICE CHAIRMAN BONACA: What was the extent
23 of the inspection?

24 MR. GEISEN: I'll talk to that. What we
25 did is recognize -- this is Dave Geisen. With regard

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1 to these inspections, recognize that they were not
2 done looking for this particular phenomenon. They
3 were looking for other things. The two inspections
4 done in 1998 and 2000 were really looking for the
5 impact of boric acid leakage from leaky flanges that
6 we had subsequently repaired and what was the impact
7 to that. So the view that we got from those was in
8 many cases some of the drives you couldn't even get a
9 good view of.

10 There were many cases, the camera angle
11 was looking upwards because it was looking at the
12 structural material of the service structure on top of
13 the head.

14 When we looked at a 1996 data, you got
15 more of a downward look at these nozzles because we
16 were specifically following around a vacuum and probe
17 that was looking for head wastage as result of the
18 boron being deposited on head. So what really comes
19 down to it, the best video we have on this goes all
20 the way back to 1996.

21 MR. MOFFAT: So essentially those are some
22 of the characteristics specific to our power plant as
23 plant specific information, as we discussed, given
24 that the body of knowledge related to this issue, what
25 we've done is using Framatone and our own engineering

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1 staff, constructed a probabilistic safety assessment
2 to help us gain an understanding of the significance
3 of the issue as it pertains to our specific plant and
4 for that, I would ask Ken Byrd to present.

5 MR. BYRD: Davis-Besse has performed a
6 plant specific risk assessment and we base this on the
7 method developed by Framatone, however, we have worked
8 with Framatone to make some improvements and we've
9 also investigated some of the sensitivities to a
10 greater extent with this method.

11 We acknowledge that there's a number of
12 uncertainties with regard to some of the phenomena
13 we're dealing with and in order to resolve those kind
14 of uncertainties we had to make a number of bounding
15 assumptions. Consequently, the results we see here
16 aren't necessarily consistent with our baseline core
17 damage frequency. These are actually numbers that
18 would have to be looked at as kind of a bounding case
19 for a core damage frequency.

20 I'll talk a little bit about how we did
21 that. Again, as more information is developed, we can
22 hone this more accurately.

23 Our results did come out. Our core damage
24 frequency, which again is a conservative number, came
25 out in the category which would be considered small.

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1 Our large early release frequency came out in the
2 category that we considered very small and we did run
3 this through our level 3 PSA and we came out with a
4 negligible public health risk.

5 I might point out right now because
6 results seem somewhat inconsistent with each other and
7 we have a core damage frequency in one category and a
8 large early release frequency, a public health risk
9 that's much lower. That's consistent with our plant-
10 specific, what we would have expected. We're a large,
11 dry containment. We have a relatively large
12 containment relative to our core power. The
13 consequent that we placed on this was a medium LOCA
14 and we would not expect a medium LOCA to have a
15 significant impact on our containment.

16 For a large dry containment usually that's
17 containment bypass or interfacing system LOCA or it
18 could be kind of an event which affects a support
19 system such as a loss of cooling or a station blackout
20 and obviously this doesn't deal with any of those kind
21 of circumstances. It is not a significant release
22 issue and certainly not a significant public health
23 issue.

24 Going on to my second page, what I did
25 here was just listed a number of what I would consider

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1 the most significant bounding or conservative inputs
2 that we use in order to deal with some of the
3 uncertainty that's currently not been resolved yet.
4 Starting out with a nozzle leak frequency, we did base
5 our nozzle leak frequency on information from the
6 other BNW plants, but we applied this very
7 conservatively so that our model estimates that right
8 now we should have nine leaking nozzles and I think
9 that bounds the rest of the BNW fleet. Or actually
10 that was the number that was found at Oconee 3 which
11 is the maximum. Obviously, that would be a lot of
12 nozzles and we wouldn't expect that.

13 The second thing we did was the
14 probability of the outside dent diameter crack
15 initiation. We assumed that for every axial crack
16 which gives leakage or every leaking CRDM nozzle, we
17 would have an outside diameter crack initiated.
18 Actually, if you look at the data from the BNW plants,
19 we've had 21 leaking nozzles. Five of those have gone
20 to circumferential cracking, so obviously not all of
21 them have initiated circumferential cracking. We're
22 assuming in every case, we will get circumferential
23 cracking.

24 MEMBER FORD: Can I please interrupt for
25 one second? This hasn't been discussed with the staff

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1 yet, I understand.

2 MR. BYRD: We've given them our analysis
3 and presented and will discuss this afternoon.

4 MEMBER FORD: That's just great.

5 CHAIRMAN APOSTOLAKIS: We have this
6 analysis.

7 MEMBER FORD: Could I suggest, this is
8 really good input to the overall general thing which
9 we're discussing today. Maybe if you could just move
10 to the bottom line. You've obviously done a lot of
11 work. It's just fantastic. And it's relevant, but it
12 should be discussed with the staff. Could I ask you
13 to move to the end -- to your end conclusion maybe?

14 MR. BYRD: Certainly.

15 MEMBER FORD: Based on -- we read these
16 inputs.

17 MR. MOFFAT: I appreciate that. I'll take
18 it from here. As Ken said, we've submitted this PSA
19 to the staff and we are going to discuss it. It is on
20 the docket. Looking at this as a topic, realizing
21 that we are one of the ones within the three and where
22 we sit from our understanding it becomes an issue
23 essentially is our power plant safe to operate until
24 March, as far as the basis between December 31st and
25 March, as far as our best understanding of this issue

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1 and the expertise that we've brought to bear as a
2 utility and a nuclear steam supply system, Davis-Besse
3 nuclear power station believes that the plant is, in
4 fact, safe to operate until March. We don't believe
5 that the distinctions between December 31st and March
6 are an issue with regard to reasonable basis of
7 safety. So that's our bottom line that you asked me
8 to get to.

9 MEMBER FORD: I thank you very much
10 indeed, sir, Mr. Moffat.

11 Are there any overall questions from the
12 Members at this time, bearing in mind that it hasn't
13 been discussed in detail with the staff.

14 Any questions?

15 CHAIRMAN APOSTOLAKIS: I wonder what is
16 the actual evidence of the plant regarding this issue?
17 I remember there were circuits there, but have you
18 seen -- maybe I missed it, leaks or --

19 MR. MOFFAT: What we were able to do, Dr.
20 Apostolakis, by going back through the video tape was
21 to do our best retrospective examination, knowing in
22 light of what is known now of the characteristic which
23 we not only call popcorn due to the nature of this
24 leak. You can tell, based on this body of evidence
25 that we've acquired as an industry what it looks like.

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1 So we essentially went back as best we could at those
2 video tapes from 1996, 1998 and 2000 and that is the
3 evidence that we have for the current condition of our
4 plant. We also use the Peter Scott model to then
5 extrapolate what would bound that should something
6 progress in that interim since we've had those visuals
7 and that's some of the detail that we'll be discussing
8 with the staff when Mr. Byrd has the opportunity
9 today.

10 MEMBER ROSEN: I'm going back to your
11 second slide, your objectives.

12 MR. MOFFAT: Yes sir.

13 MEMBER ROSEN: One was to have us consider
14 the information that you presented here today and I
15 think that clearly is being done.

16 Your second one was to include, have us
17 include this additional information in formal
18 correspondence to the Commission.

19 MEMBER FORD: Well, we won't be doing that
20 until the staff has come to us with their --

21 MEMBER ROSEN: Yes, I don't think we're in
22 a position to do that.

23 MEMBER FORD: That is correct. Not at
24 this time.

25 CHAIRMAN APOSTOLAKIS: It can still be an

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1 objective.

2 (Laughter.)

3 What we do with it is a --

4 MEMBER POWERS: As I understand it,
5 they're fighting over four months.

6 MEMBER FORD: Mr. Moffat, I thank you very
7 much indeed. I appreciate it.

8 MR. MOFFAT: Thank you.

9 MEMBER FORD: I'd like at this time to ask
10 the representative from NEI, Alex Merrion to make a
11 statement.

12 MR. MERRION: I'm Alex Merrion. I'm the
13 Director of Engineering at the Nuclear Energy
14 Institute and I just have a couple brief comments. I
15 want to say something about the susceptibility model
16 and my concern with -- and this is just an observation
17 that people may be reading too much into it. As Larry
18 clearly indicated, it's a simple model primarily
19 focused on two parameters, time and temperature, to
20 try to represent an estimate of who may be susceptible
21 to finding some kind of flaw should they do an
22 inspection.

23 It's very simple from the standpoint of
24 the kind of degradation mechanism we're talking about
25 which is very complicated. I think as we go through

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1 this, we need to keep that in mind because I find --
2 I've seen where people in the industry have been
3 looking at that susceptibility model as if it was
4 founded in ground truth and try to make all kinds of
5 conclusions from it. I've also seen people outside
6 the industry reading too much into it, so I felt
7 obligated to make a comment about that.

8 There was a public meeting held yesterday
9 where the NRC staff provided their preliminary
10 technical assessment on crack growth rate and I have
11 to admit I thought it was an excellent meeting and
12 it's not painful for me to make that admission, but it
13 was very useful and I think beneficial from the
14 standpoint of industry understanding what the staff's
15 current thinking is and I think the NRC benefitted
16 from some of the comments and interactions from that
17 meeting.

18 And we will be providing comments to the
19 NRC at a public meeting that's been scheduled for the
20 27th of November on that. We'll probably follow up
21 with some formal communication with the staff and on
22 that meeting on the 27th we'll provide a further
23 update of the industry efforts of the material
24 reliability project and deal with some of these
25 questions that you raised regarding the chemistry and

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1 crack growth rate.

2 MEMBER FORD: Excellent.

3 MR. MERRION: And that's all I wanted to
4 say and I thank you for the opportunity.

5 MEMBER FORD: Any comments? Thank you
6 very much indeed.

7 MEMBER KRESS: I have a question. You
8 mentioned that the susceptibility model is very simple
9 for a very complex phenomena. Am I to interpret that
10 to mean it could go either way?

11 MR. MERRION: Yes. Yes, it can and we're
12 in the process of collecting data. That's why Larry
13 was so cautious in making any kind of firm
14 representation of what we know today because it could
15 very well change with the next couple of inspections
16 and it could go either way.

17 MEMBER FORD: And I think it's also my
18 understanding, however, that this idea of having more
19 than just temperature and time, at temperature, in the
20 algorithm to include weld conditions, heat conditions
21 is very hard to do and many people have tried this
22 over the last 20 years and have failed. And this is
23 the reason behind my question to Mr. Mathews, is it
24 cost effective to try and improve on that? Are you
25 going to materially improve your prediction

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1 capability? That was the reason. You're absolutely
2 correct, it's a question of whether we move forward.

3 I'd like to move on at this time to cover
4 the NRC staff presentation.

5 MR. STROSNIDER: I didn't have a lot to
6 say as an introduction and given the time constraints
7 we have, I just suggest that the staff start on the
8 presentation.

9 I guess I could comment that this is a
10 work in progress. You've heard a little bit already
11 with regard to need for some additional information,
12 but we've been working with the data that are
13 available and trying to pull that into some
14 comprehensive models.

15 I'm Jack Strosnider from the staff and
16 hopefully you'll get some flavor for that based on
17 this presentation.

18 MR. HACKETT: Good morning. I'm Ed
19 Hackett from the Office of Research and joining me at
20 the table are Allen Hiser and Mark Reinhart from NRR.

21 We're going to try, as a team here, to
22 give you a perspective for what the staff has been
23 doing. I guess especially since July as Dr. Ford
24 mentioned. So I was just going to start by
25 summarizing a few items. One was an independent group

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1 of experts, two of whom are here. Your colleague, Dr.
2 Shack, Dr. Gary Wilkauski here who assisted us in
3 performing an independent evaluation of the cracking
4 occurrences, Ocone and ANO. We have also in the
5 Office of Research continued to support NRR
6 specifically in development of the technical
7 assessment that was just mentioned that's in a state
8 of development that's basically deterministic at this
9 time point. What I'm going to focus on briefly in
10 this presentation is aspects of the probabilistic
11 assessment in terms of probabilistic fracture
12 mechanics, but the disciplines that are noted there
13 are the ones that we're providing support on.

14 If I could just mention briefly that the
15 Office of Research has also provided inspection
16 support to NRR, I believe for two inspections at Three
17 Mile Island and also North Anna. The bottom line of
18 this presentation is that we're working towards and we
19 did discuss this in July. We have made some progress.
20 We're working on developing the elements of a
21 probabilistic fracture mechanics assessment, as is the
22 industry. Structural Integral Associates has had the
23 lead for the industry in that regard as far as I'm
24 aware. We had a conference call with Structural
25 Integrity Associates led by Dr. Pete Riccadella on the

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1 27th of September. I think that was very productive
2 for both us and for the industry in terms of trying to
3 get a baseline as to what's going on. And Alex
4 Merrion mentioned yesterday the public meeting we just
5 completed which was also very beneficial.

6 Moving on, what we wanted to do is focus
7 on some of the key considerations. I think Larry
8 Mathews and the representatives from Davis-Besse have
9 covered a lot of this information. In our
10 deterministic assessment which the NRR deterministic
11 assessment which was released yesterday, I believe,
12 these are basically sort of the elements that went
13 into what is Section 6 of that report, but obviously
14 key to these types of assessments are the assumptions
15 you're going to making on crack initiation and crack
16 growth rates in specific. In that particular area,
17 Dr. Shack has had the lead for us in the contract work
18 he's done. There's also a lot of variability in the
19 analysis of the stress state for this particular
20 situation and the maintenance of the structural
21 margins. That's an area where Dr. Wilkauski and Dr.
22 Richard Bass from Oak Ridge have helped us out
23 significantly. And then sort of the bottom line of
24 this whole thing, that a number of the speakers have
25 already mentioned is where does this go to in terms of

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1 inspection methods and maybe specifically timing is
2 sort of the crucial element at this point for several
3 plants.

4 CHAIRMAN APOSTOLAKIS: So what is the
5 ultimate product of this analysis? What is it going
6 to be used for?

7 MR. HACKETT: The ultimate product, at
8 least in my mind, is a probabilistic assessment that
9 would hopefully be able to give us guidance on exactly
10 this bottom line, inspection methods and timing. The
11 actual, I think the representatives from Davis-Besse
12 were heading there in their presentation and sort of
13 where does this end up in risk space ultimately. I
14 don't think -- we're not ready to discuss that in
15 detail today. I don't think we're there yet and
16 that's what I'm going to come to in the presentation,
17 but I think that's where it's going.

18 CHAIRMAN APOSTOLAKIS: So if I wanted to
19 keep the probability of risk initiating event or
20 frequency low, then this analysis will tell me how
21 often I will have to inspect?

22 MR. HACKETT: Yes.

23 CHAIRMAN APOSTOLAKIS: And what to do?

24 MR. HACKETT: Exactly.

25 CHAIRMAN APOSTOLAKIS: And it will include

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1 things about the ability of the inspection method to
2 get an accurate picture --

3 MR. HACKETT: That would be factored in,
4 would have to be.

5 MEMBER KRESS: And what would the risk
6 analysis tell you if you calculated just the
7 conditional core damage frequency and the conditional
8 large early release, given that you had the failure of
9 these particular penetrations?

10 MR. HACKETT: That's a good question and
11 I might turn to my colleague, Mark Reinhart on that
12 one.

13 MR. REINHART: We've presented that just
14 looking at the IPEs and updates of PSAs to date, the
15 conditional core damage probability for the medium
16 LOCA that we're projecting would result from this type
17 of control drive mechanism ejection is in the 10₋₂,
18 10₋₃ range. There's not a lot of debate on that. The
19 issue that Ed's really addressing is the initiating
20 event frequency that we're having the problem with,
21 but if you just assume one on that initiating event
22 frequency, you end up with a CCDP.

23 CHAIRMAN APOSTOLAKIS: So you will be able
24 to say something about the frequency of a medium LOCA
25 in this mechanism? That's the whole purpose?

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1 MR. REINHART: That's where we're trying
2 to go.

3 MEMBER KRESS: But from an overall risk
4 perspective, do your conditional probabilities tell
5 you that it's not that big of a deal?

6 MR. REINHART: I think 10₂, 10₃ is -- you
7 can't just say that's not a big deal, if you have the
8 event. I think we're not comfortable just going along
9 allowing this. I think we want to --

10 CHAIRMAN APOSTOLAKIS: Allowing this for
11 how long?

12 MR. REINHART: Right.

13 CHAIRMAN APOSTOLAKIS: I mean allowing
14 forever is --

15 MR. REINHART: We don't want it to go
16 undetected for --

17 MEMBER KRESS: I was trying to decide
18 whether there was a real urgency to the inspection and
19 timing.

20 MEMBER FORD: I was about to address that
21 specific point. This is really a program management
22 chart. And if you look at Larry's temperature time
23 plot, you can see that this is not a one off problem.
24 It's a generic problem and you're going to continue
25 doing it. So what is your timing on this to deliver

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1 this capability, analytical capability to the staff?

2 MR. HACKETT: That's a good question. I
3 guess that one is mine.

4 CHAIRMAN APOSTOLAKIS: The only ones you
5 get here --

6 MR. HACKETT: I'm looking at Gary
7 Wilkauski at this one because we -- the short answer
8 is we haven't exactly worked that out. I think the
9 sort of on-line answer to it would be I think pretty
10 much we were hoping for around the same kind of time
11 frame that Larry indicated, somewhere maybe after the
12 turn of the year, but in all honesty, recognizing the
13 complexity of this problem and we talked about
14 surprises or not being surprised. It wouldn't
15 surprise me if we're still looking at some of this
16 well into 2002, some of the aspects of it. One of the
17 things I'll come to and Dr. Ford as well, I think to
18 really make some progress on this area Jack
19 Strosnider, when we met last time talked about the
20 dangers of the seductiveness of using a PFM analysis
21 in this case and I think they're readily evident here
22 that we're missing a lot of data is the bottom line
23 and being able to generate all that data in the next
24 six months or year, I don't want to be up here telling
25 you we're going to do that.

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1 MEMBER KRESS: That's one reason I asked
2 the question. One way to prioritize would be the
3 conditional probabilities, the ones that have a high
4 condition probability you do first and you sort of
5 bypass all this difficulty.

6 CHAIRMAN APOSTOLAKIS: Well, there is
7 another issue that, I don't know, maybe it's a
8 non-issue, but it just occurred to me, why should all
9 these decisions be made on the basis of delta CDF and
10 delta LERF?

11 I mean the reactor oversight process tells
12 me that the staff worries about the frequency of
13 initiating events itself.

14 MEMBER KRESS: Yes, but only because
15 that's going to affect delta CDF and delta LERF.

16 CHAIRMAN APOSTOLAKIS: They have declared
17 that they don't want to see higher frequencies
18 independently of what happens.

19 MEMBER KRESS: That's a defense-in-depth.

20 CHAIRMAN APOSTOLAKIS: Yes,
21 defense-in-depth. So why don't we apply that here and
22 say okay, the 10_{-2} or 10_{-3} conditional core damage
23 probability is a useful input, but I really don't want
24 the frequency of the medium LOCA to be too large. So
25 on the basis of that, I will also make a decision. Is

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1 that -- are we just using regulatory guide 1174 here
2 or are there more issues?

3 MR. STROSNIDER: This is Jack Strosnider
4 and I'd like to make two comments with regard to this
5 discussion.

6 First of all, the question on schedule.
7 And I think with the problem this complex, it's clear
8 that we can continue to do research and collect data
9 and try to refine our analysis for a long time.

10 The practicality and reality of the
11 situation is that we need to set some priorities and
12 we're going to be looking at that such that we can
13 have some analyses early next year that will help
14 inform what the appropriate inspection intervals and
15 timing is. And I put that in the context of
16 recognizing that the bulletin that's being discussed
17 is just a one time action, right? And the industry
18 and the NRC still have to develop and come to
19 agreement on what the longer term program is for
20 managing this issue. And that has to happen next --
21 in 2002. All right? Because people will have to be
22 making decisions in 2002, so we have to position
23 ourselves in early next year to have the most
24 important information and the best information we can
25 to inform that decision. And there may be additional

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1 work that continues to refine this and to better
2 refine whatever that decision is, just as this fall,
3 we're making information based on the best information
4 we have available today.

5 And that gets to the second point which is
6 from a regulatory decision making process, how do we
7 deal with this and I would just point out that is it
8 just Reg. Guide 1174 and we have a tendency when we
9 think about 1174 to sort of focus on the quantitative
10 aspects of that framework, but in fact, that's only
11 one piece in there and if you look at the total five
12 elements that need to be considered you need to
13 consider traditional margins, defense-in-depth,
14 monitoring and those other areas and we clearly will
15 be taking those things into consideration with any
16 regulatory decisions we make.

17 But again, getting back to this
18 presentation, we need to get this technical work, we
19 would like to put this into a 11174 quantitative
20 framework as well early next year so that we can help
21 inform the decision, so that's our goal.

22 MR. REINHART: And maybe Ed, we have a
23 suite of regulatory guidance that is guiding us,
24 obviously, but we're certainly open to be thinking out
25 of the box and as we go along we're looking for

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1 different ways to look at the data, look at the
2 information, what's important, what's not important,
3 so we're not tunnel vision, but we do want to work
4 within not just 1174, there's a whole suite of guides
5 that we have, and use that information as a place to
6 start from the probabilistic aspects.

7 MR. HACKETT: I think as a kind of
8 illustration of what Jack and Mark were just talking
9 about, you look at -- kind of two ways you could go
10 about looking at crack initiation. I've got them on
11 the slide. Two sort of processes that have been
12 discussed or postulated for how this would progress in
13 a mechanistic sense are really what those first two
14 bullets are up here. That would be the way you would
15 like to go about doing this in a more purely
16 scientific mechanistic way. I think, in fact, we're
17 probably going to be severely limited in that regard
18 by lack of data and other difficulties, so when you
19 come to the bottom bullet there, what Dr. Shack has
20 done is consider laboratory data, supplemented or form
21 of laboratory data for some of what we're looking at
22 in initiation space, sort of conditioned by
23 consideration of time to initiation from inspection
24 data which is more of an empirical approach for going
25 about this kind of thing. But that's a good example.

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1 I think the first two bullets there are something we
2 could spend many master's theses and Ph.D. theses on
3 exactly how these should be progressing. And as Jack
4 pointed out, that's not what we're about.

5 CHAIRMAN APOSTOLAKIS: By the way, Dr.
6 Shack's name has been mentioned many times this
7 morning. This is Dr. Shack of Argonne National
8 Laboratory, right?

9 MR. HACKETT: That's correct.

10 CHAIRMAN APOSTOLAKIS: Okay.

11 MEMBER FORD: Ed, on just a definition.
12 Your definition of time initiation is the time it
13 takes to get an environment in that annulus, is that
14 correct?

15 MR. HACKETT: I might turn to Bill on
16 this. My own definition -- I don't know that we've
17 really gotten into discussion of that would be the
18 development, that plus the development of I guess what
19 I would call an engineering crack that would be
20 hopefully discernible through the --

21 MEMBER FORD: For circumferential crack.

22 MR. HACKETT: Right.

23 MEMBER FORD: Okay.

24 MR. HISER: I think also what you would
25 need to look at, is going back to the very beginning,

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1 what is the crack that gives you the leak? Is it
2 through the J groove weld? Is it an axial crack that
3 goes through the wall?

4 MEMBER FORD: That's why I'm asking the
5 question.

6 MR. HISER: There are several.

7 MEMBER FORD: What do you mean by --

8 MR. HISER: I think there actually several
9 times that really are important. I'd include all of
10 those.

11 MEMBER FORD: Okay.

12 MR. HACKETT: The other one in this area
13 that's obviously already been discussed this morning,
14 that's been contentious to say the least is the
15 annulus environment. I think to sort of cut to the
16 chase, I think we're in -- largely in agreement with
17 the industry that this is hopefully a primary water
18 environment for the reasons I state here. We don't
19 know that for sure is the bottom line. But I think
20 this is an area that's a tight crevice. It's unlikely
21 to be oxygenated. Depending on where the flash point
22 is when the fluid is exiting the crack that exists, if
23 that's far enough away you're maybe not likely to
24 concentrate as aggressive a species as we might
25 otherwise and then the other thing is once these

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1 cracks go through wall, they now have a communication
2 with the primary water environment that's hopefully
3 causing some flushing. This is key to the next slide
4 because we are going on with the assumption that this
5 would largely be a primary water environment. We
6 don't know that.

7 I'll just move real quick through --

8 MEMBER FORD: Hold on. Before you do
9 that, because this came up for a lot of discussion in
10 the meetings we had in July where it was arbitrarily
11 decided that there was a primary environment without
12 any justification.

13 From what I understand, you can have pH as
14 anything from 4.5 to 8.5 in that annulus.

15 MR. HACKETT: That's correct.

16 MEMBER FORD: And practically speaking,
17 there's really no way that you can look at a specific
18 CRDM housing and say the pH in that annulus is that.
19 There's no way you can do it.

20 You have data, I assume, that shows that
21 it doesn't really matter. Is that correct? On
22 cracking susceptibility, you can go from 4 to 8.5, do
23 you have data that shows, hey, this uncertainly
24 doesn't really matter.

25 MR. HACKETT: Without a large impact for

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1 Canal 600, I'm caveating this, in a primary water
2 environment, that's correct.

3 MEMBER FORD: Okay, fine.

4 MR. HACKETT: But that's why, actually,
5 starting with the next slide I said the first
6 statement that I did there. The bottom line is we
7 don't know exactly what this environment is. To cut
8 to one of these, there is -- I don't know where I
9 guess I had on the previous slide, the -- one of the
10 considerations would obviously be to go find out. We
11 discussed that with the industry that came up at the
12 meeting yesterday to sample one of these environments.

13 MEMBER WALLIS: Can't you make some
14 calculations what happens in that crack in the
15 annulus?

16 MR. HACKETT: That has been done indeed.
17 Dr. Shack has done that.

18 MEMBER WALLIS: I mean in terms of the
19 fluid and chemical environment. Has he done that too?

20 MR. HACKETT: He's saying no.

21 (Laughter.)

22 So maybe not.

23 MEMBER POWERS: Why don't you get yourself
24 a new contractor.

25 MR. STROSNIDER: This is Jack Strosnider.

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1 I think there's some industry calculations that were
2 done that were referenced in some of the work that Dr.
3 Shack provided to us and is documented in the
4 assessment report, but they were industry
5 calculations.

6 MR. HACKETT: This comes down to then the
7 next step is for crack growth. We're making the jump
8 from the first one to the second one as Dr. Ford
9 mentioned that the big jump there is that this is a
10 primary water environment largely.

11 MEMBER WALLIS: Intuition would be that it
12 can't possibly be, boiling off the water, leaving
13 behind whatever else is there.

14 MR. HISER: I think it's described in the
15 preliminary technical assessment, it may not be
16 primary water initially, but as you get cracked
17 opening and get additional leakage, there's enough
18 communication with the bulk primary water. I think a
19 lot of the --

20 MEMBER WALLIS: The water is continually
21 disappearing by flashing.

22 MR. HISER: Initially, yes.

23 MEMBER WALLIS: It always is. You're not
24 squirting out water into the environment. You've got
25 a very dry environment on top of this crack.

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1 MR. HACKETT: I think what Allen was
2 coming to, Dr. Wallis is that once the communication
3 is there through wall --

4 MEMBER WALLIS: I'd like to see -- it
5 would be much more reassuring if someone would draw a
6 picture to show that something else hasn't been done
7 to justify these --

8 MEMBER FORD: I think what's becoming very
9 obvious, Graham, is that we are not going to have the
10 answers to all of these questions.

11 MEMBER WALLIS: It shouldn't be all that
12 difficult to do some simple fluid dynamic diffusion,
13 whatever is necessary, boiling analysis and get maybe
14 some boundary estimates of what's there.

15 MR. STROSNIDER: This is Jack Strosnider.
16 I just would comment that the technical assessment
17 report that we just provided a few days ago actually
18 has several page discussion referencing those sort of
19 analyses, so there's a lot more detail in that report.

20 MEMBER FORD: I think from the point of
21 view of this meeting, all we're trying to get is a
22 feeling that we are moving forward on this whole
23 issue, all the parts of the issue.

24 MEMBER WALLIS: I'm not feeling we're
25 moving forward if we don't have some sort of analyses.

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1 MEMBER FORD: Well, put it this way. I'm
2 at the advantage, I've seen some of this data
3 unofficially, and yeah, they are moving forward.

4 If we have another meeting, then we will
5 be discussing all of these ins and outs.

6 MEMBER POWERS: I think we ought not
7 underestimate the complexity of doing a simple quote
8 diffusion analysis in a crack environment and it's
9 because not only do you have multiple species reaching
10 saturation, but you have an incredibly high
11 electromagnetic field in the vicinity of this crack
12 surfaces, that I'm not sure you would really have the
13 ability to calculate things like diffusion
14 coefficients and things like that in that relatively
15 narrow crack.

16 You could put a diffusion coefficient in
17 there for the ionic species, but I think you'd just be
18 dead wrong.

19 MEMBER FORD: Dana, you could well be
20 right. I'm trying to move this one on forward. Where
21 I stand, anyway, at this point is that all the
22 analyses I've seen you're between 4.5 and 8.5. That's
23 four orders of magnitude of hydrogen ion concentration
24 and you intuitively say that's going to make a big
25 effect on cracking susceptibility. If you have data

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1 and I understand there is data to show that you can go
2 over that range and you're only going to change the
3 crack propagation rate by a factor of two, then forget
4 this problem for the time being. Forget it, and let's
5 move on.

6 That would be my technical view. I think
7 go back and revisit it later on. But if you're going
8 to move forward, scrub that out as a major issue at
9 this point.

10 MEMBER ROSEN: I'm having a great
11 difficulty believing this is a primary water
12 environment. Primary water is under 2000 pounds per
13 square inch pressure. Clearly, that's not what's
14 happening in this annulus. So just from that
15 standpoint alone, it's not a primary water
16 environment.

17 MR. HACKETT: I think that's what Dr. Ford
18 was getting to and I know you guys will want to move
19 on, but we talked about this yesterday for many hours
20 and in fact, we could probably devote an entire
21 meeting to this subject easily.

22 Maybe it's incorrect to be saying primary
23 water, but maybe largely more that way than more
24 concentrated, once the communication is there with the
25 thru-wall crack. I think that's where we're getting

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1 to.

2 To move beyond that, one of the things
3 that's of interest here, if that is a problem, we have
4 no data for that specific environment. What we do
5 have a lot of data for and that's one of the good
6 aspects of this slide is there is a lot of data for
7 Canal 600 in a primary water environment from a lot of
8 sources. There's significant variability in that
9 data, but it's real variability. It's actually data
10 that we have as Dr. Ford has pointed out. It's also
11 appropriate, we think, to consider that variability on
12 a heat basis as opposed to an actual per data point
13 basis. The net effect of that is it expands your
14 uncertainty bounds when -- because you have fewer
15 numbers of heats than you have total data points.

16 The overall problem is complicated by
17 consideration for multiple initiation sites. You
18 could account for this in several ways. At least one
19 way is that you're multiplying your crack growth rate
20 potentially and we certainly have seen the crack
21 growth rates in excess of units per year are possible
22 for this type of phenomenon.

23 In terms of the stress state, I think this
24 is an area where we're still developing some details
25 on some of the inputs. I think the ones that are

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1 fairly straight forward, the first bullet are stresses
2 due to primary pressure and crack face pressure.
3 However, the primary drivers in this particular
4 phenomenon are really residual stresses and I've tried
5 to summarize some of the sources there, the main
6 source being welding. Any time there's a welding
7 process, there's potential for leaving up to yield
8 level residual stresses from that process. This is
9 also a complicated manual weld which is done in a --
10 it's basically a helical sort of situation. The
11 fabrication processes and sequences can change the
12 residual stress state or affect it significantly. The
13 installation procedures for the penetrations
14 themselves can result in residual stresses from
15 straightening or bending that might have occurred when
16 they were put together.

17 Modeling details can be fairly critical in
18 how many passes are being modeled. If you're looking
19 at finite elements to try and figure out what the
20 residual stress state is, how many elements do you
21 need to go through the thickness there to get the
22 refinement that you need. And there's been -- the
23 industry has done some work in pointing out the
24 influence of thru-wall strength gradients that looked
25 to be a factor at Ocone, for instance, with shifting

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1 the primary stresses, the larger stresses to the outer
2 diameter of the penetrations.

3 There's also -- these are the first two
4 bullets are ones that have been considered so far in
5 the analyses that we're aware of that we've done and
6 that the industry has done. Dr. Wilkauski has pointed
7 out the two bottom sources that really haven't been
8 considered thus far, that we're looking at, addressing
9 in the analysis that the NRC is sponsoring. One is
10 differential expansion at the root of the J-groove
11 welds. You know, we've talked about and the industry
12 I think has demonstrated pretty convincingly that
13 there's a separation when the plant is under pressure
14 and heated up between the penetration and the head
15 itself.

16 That's a good thing from the perspective
17 of leakage, but what it does for people who are
18 familiar with fracture mechanics, it induces basically
19 a crack tip opening displacement at the bottom where
20 the bottom of that annulus where it's joined to the
21 J-groove weld. We haven't really assessed the driving
22 forces from that.

23 There's also potential for a contribution
24 from cyclic thermal stresses. That was discussed
25 yesterday at the meeting that we had with the

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1 industry. Dr. Scott made some comments on that in
2 terms of this may not be a principal driver for like
3 fracture mechanics, but it may have the effective
4 breaking of film in terms of the film rupture model or
5 it may have initiation impact on the initiation.
6 Anyway, these are considerations that we still need to
7 address.

8 MEMBER FORD: On the residual stress
9 aspect, I know you can do a whole lot of finite
10 analyses to determine what these could be. Are there
11 any qualifying measurements?

12 MR. HACKETT: Not that I'm aware of. I
13 turn that to --

14 MR. HISER: Maybe somebody on the industry
15 side could speak to that a little more.

16 MR. PATHANIA: I'm Raj Pathania from EPRI.
17 I'm working on MRP project. AS a part of this problem
18 back I think about 7 or 8 years ago, measurements were
19 done on CRDM nozzles in France and then those
20 measurements were checked against the finite element
21 stress residual stress models and there was reasonable
22 agreement. There's a published EPRI report on that
23 and we can provide that report if anyone is interested
24 in that. There was reasonable agreement both with the
25 residual stress measurements and the fact that when

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1 you weld these things, the tube goes over because of
2 distortion and so the ovality measurements themselves
3 are a reasonable way to check out your models.

4 And in addition, I believe Westinghouse
5 has done some measurements also on the CRDM nozzles.

6 MR. BANFORD: Yes, this is Warren Banford
7 from Westinghouse. We made some measurements of the
8 ovality, of the tubes below the head. Because of the
9 weld, being on an angle, what it does it makes the
10 tube go from circular to oval and we used finite
11 element results that we got that we were using to
12 predict residual stresses and we used those results,
13 the predictions of the ovality and check with the
14 actual ovality that had been measured in the field of
15 tubes in that particular position and we found very
16 good agreement. So that was the way that we bench
17 marked our finite element work, in addition to the
18 French work which was further confirmation.

19 MEMBER FORD: And the stuff that you were
20 talking about was primarily x-ray?

21 MR. PATHANIA: No these are strain gauge
22 measurements.

23 MEMBER FORD: Strain gauge, okay.

24 MR. HACKETT: And moving on to address
25 structural margins. Obviously, there's a need -- one

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1 of the bottom lines of the analysis is Professor
2 Apostolakis was getting to earlier is maintenance of
3 appropriate structural margins. Where we are with
4 this is obviously with a PFM analysis, the intent
5 would be to perform this on a best estimate basis. In
6 fact, what the second bullet goes is that at this
7 state of development we have enough uncertainties in
8 this that we're addressing that if we had to try and
9 assemble this right now we would need to be adding
10 margins in certain elements to address these
11 uncertainties. This is not the way you want to do
12 this type of analysis. That's where we would be right
13 now.

14 What we're hoping to get to is obviously
15 a greater level of refinement that we don't need to do
16 that. But in this case we had to do it, where to
17 apply the margins and what the magnitudes would be
18 problematic.

19 CHAIRMAN APOSTOLAKIS: Is this where you
20 disagree with the industry or do you disagree at all?
21 We heard earlier there was an estimate of delta CDF
22 and so on that you have not examined yet, the
23 calculations. But is it a disagreement here
24 somewhere?

25 We are being presented with programs that

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1 will calculate this and that, difficult problems and
2 so on, but in terms of real decision making in the
3 next few months, is there a disagreement somewhere?

4 MR. STROSNIDER: This is Jack Strosnider.
5 Let me interject this thought and with regard to some
6 of the plant-specific information you heard earlier
7 and we received that evaluation within the last week
8 and it's under review by the staff now. I think the
9 plan is to meet on it next Tuesday and to go into some
10 of the detailed discussions, so that review is in
11 process.

12 I think from the generic point of view and
13 from the development of this technology I don't think
14 there's disagreement. There's technical issues that
15 we need to share information on industry and NRC to
16 make sure that we come up with the most reasonable and
17 appropriate models to do this. That's really what the
18 purpose of putting out the preliminary technical
19 assessment document was, so that people -- the
20 industry and others could see where we're at in terms
21 of this assessment. And if there's information that
22 can be brought to bear, if there are some assumptions
23 or way we're interpreting information that people
24 think is incorrect we want to hear it and we want to
25 work that. So I think if you get down into some of

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1 these specific technical areas, there's certainly room
2 for discussion. If you want to call that
3 disagreement, maybe there's some issues that need to
4 be worked out, but that's the process we're working
5 through in terms of trying to develop this model.

6 MR. HACKETT: For the bottom line of
7 where we're heading for this and where the technical
8 assessment goes right now, is looking at the impact
9 and Larry Mathews covered some of this earlier,
10 inspection methods and particularly timing. This goes
11 to -- we had a lot of debate yesterday over when do
12 the cracks start and how fast are they growing.

13 Certain inspection methods for this type
14 of phenomenon have been quote unquote qualified. One
15 per the Bulletin is this qualification for leakage
16 that was discussed earlier by the industry with the
17 idea that you have the leakage path and you do have an
18 access to the bare metal that you can make the
19 determination.

20 The other one is the previous phenomenon
21 back in 1997. There was an approved methodology for
22 using Eddy currents inspection technology for looking
23 at ID cracks on the penetrations themselves.

24 Moving down further, there are other
25 methods that really remain to be qualified and I guess

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1 clarification is probably needed there and
2 qualification in this case, I was probably looking at
3 as an ASME PDI type qualification performance
4 demonstration initiative, where you're looking at
5 qualification of both methods and personnel to be able
6 to detect and size some of these type of defects. And
7 in that case, you're looking at probably both surface
8 and volumetric exams through the J-groove welds, also
9 volumetric exams for the vessel head penetrations and
10 being able to shoot through that wall to look at OD
11 cracking.

12 Bottom line there is that the
13 determination of the appropriation inspection
14 intervals from PFM will obviously depend on the
15 reliability and effectiveness of those inspections to
16 at least some degree which is really -- remains to be
17 determined.

18 Allen is going to go into some more of
19 this in detail, but just in terms of the tech
20 assessment, but just to sort of summarize where we've
21 been going, this has really been -- this is RES
22 initiatives on reactor vessel head penetrations. It's
23 very much really been a team effort at NRC between RES
24 and NRR and the research contractors to developing an
25 integrated technical perspective on this, largely

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1 using a probabilistic fracture mechanics construct.

2 As I mentioned, the conclusion at this
3 point is that the development so far indicates that
4 there is some key inputs that are lacking appropriate
5 data and/or are highly uncertain and some of that we
6 may be able to do some things about. Some of it may
7 be just what we're going to have to live with, that
8 the current state of development of these
9 uncertainties do limit the ability of this type of
10 assessment to do a lot for you. And we're hoping,
11 obviously, that the continued efforts in this area are
12 going to result in reductions in these uncertainties
13 and make this a more viable methodology for assessing
14 the overall impact of this phenomenon in the future.

15 MEMBER ROSEN: Is this a separate, or a
16 scientific search for truth or is it an attempt to
17 ultimately be able to apply these techniques to plant
18 specific situations?

19 MR. HACKETT: I guess we like to feel that
20 we're always looking for the truth in terms of the
21 research aspect of the thing. But I think the answer
22 is really more the latter, because I think we could be
23 searching for the truth for a long time, probably at
24 least the rest of a lot of careers that I can think of
25 and in this case, we have some real practical problems

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1 to come to grips with near term as Jack was mentioning
2 earlier.

3 So I think it's really going to be more
4 the practical lean and there will obviously need to be
5 compromises along the way in that regard.

6 MEMBER FORD: But my earlier question, you
7 are planning by say early spring of 2002, you will
8 have a defensible disposition algorithm?

9 MR. HACKETT: That would be the --

10 MEMBER FORD: That would be either
11 deterministic or probabilistic.

12 MR. HACKETT: That would be the goal and
13 then to have -- I think what we have now is Dr.
14 Apostolakis asked about agreements, disagreements. I
15 think with the industry and the NRC, I think there's
16 fairly wide agreement on the elements that need to go
17 into this thing.

18 MEMBER FORD: Right.

19 MR. HACKETT: I think you've seen that
20 today. I think there's just really a question on some
21 of the key input varies in discussions over
22 uncertainties in those. But I think the construct is
23 there, and I think the answer is yes. Hopefully we'll
24 be in a position.

25 MEMBER FORD: And so that will have an

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1 effect, not on inspection periodicities, but it will
2 also have a feedback into the completeness, if you
3 like, of the prediction algorithm that you're
4 currently using for privatization of inspections?

5 MR. HACKETT: That's correct.

6 MR. STROSNEYDER: This is Jack Strosneyder
7 and I'd just comment with regard to the practicality
8 of the work, and I think Allen's going to present, if
9 we get through, the material that he has. If we get
10 toward the end of that, there's some curves that are
11 in the technical assessment documents which were
12 intended to present the results of the work done so
13 far in a format such that it could be help to inform
14 decisions, recognizing that there's uncertainties and
15 it's not the best model for doing that because there
16 are still uncertainties we need to deal with.

17 But we're trying to put this work into
18 that framework so that it can be used to inform those
19 decisions.

20 MEMBER FORD: Well, we've got to see those
21 graphs. I love graphs and we're going to do it by
22 half past 10:00, so let's do it Allen.

23 MR. HISER: Let me ask your guidance.

24 MEMBER FORD: Get rid of all the pictures.

25 MR. HISER: No pictures?

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1 MEMBER FORD: Yes, pictures. Okay, I'm
2 kidding.

3 MR. HISER: There are two parts of my
4 presentation. One is the preliminary staff assessment
5 that you've had some time to look at. The other is
6 more an overview of the inspection findings and some
7 photos of some of the visual exam results.

8 MEMBER FORD: Fine.

9 MR. HISER: Which one would you like me to
10 start with?

11 MEMBER FORD: Provided that you'll promise
12 me that we'll see some actual graphs.

13 MR. HISER: Okay, you'll see some actual
14 graphs. They may be short of background and we'll
15 jump to graphs.

16 MEMBER FORD: Right.

17 MR. HISER: The first thing I'll start with
18 is just an overview of the bulletin very briefly, the
19 status of the inspections and things, and the status
20 of our understanding at this point. When we spoke to
21 the committee, in I believe it was July, we were
22 talking about a proposed bulletin. The bulletin was
23 issued in early August. We did ask questions of all
24 plants related to the plant specific aspects of
25 susceptibility, the number of nozzles, things like

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1 that.

2 We were looking at what is the type of
3 insulation on the head as it relates to the ability to
4 do visual inspections, and also that's more the
5 inspection side. We also were asking what are the
6 consequences and what structures, cabling, things like
7 that are above the head that could be damaged if a
8 nozzle were to become ejected.

9 For plant specific consideration, we did
10 have questions related to the susceptibility of each
11 plant, specific questions if they found cracking or
12 leakage, what the extent of that was, what their plans
13 and schedules for future inspections were, and then
14 also how those plans would meet the regulatory
15 requirements. That's just a brief overview of the
16 bulletin.

17 Within the bulletin, we speak of a graded
18 approach to doing examinations for plants that have
19 varying levels of susceptibility to cracking, or have
20 a history of cracking. We think that it is
21 appropriate to do different examinations. The
22 bulletin speaks of an effective visual examination,
23 and effectively what that is, is that you have access
24 to the bare metal where the nozzle intersects the head
25 and you can detect boric acid deposits. That assumes

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1 there's no insulation in the way, no other
2 impediments, that there are no other boric acid
3 deposits in all honesty. It's hard to differentiate
4 one from another.

5 So that would be, I guess if you will, the
6 lowest level of examination. The next would be a
7 plant specific qualified visual exam that's been
8 mentioned before. That's a plant specific
9 demonstration that you have a leak path, such that if
10 you get a leak in the J-groove weld, that there is a
11 way for deposits from that leak to come up to the
12 head. Then you can detect through an effective visual
13 examination.

14 The last inspection that's discussed in
15 the bulletin is a volumetric exam and this one, again,
16 is focused on the outside diameter of the nozzles to
17 detect circumferential cracking at that point.

18 MEMBER WALLIS: Does what you see give you
19 any indication of how far the crack has progressed?
20 If you see great big balloons of popcorn, that's going
21 to tell you something that's different from just
22 little clusters of popcorn?

23 MR. HISER: Within the results that we have
24 to date, in particular going back to the Oconee 3
25 results, we had 165 degree through-wall crack

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1 circumferential. There doesn't seem to be any
2 relationship to amount of deposit in extent of
3 cracking.

4 MEMBER WALLIS: Okay.

5 MR. HISER: Now, the bulletin responses
6 came in in early September. The bulletin does bin the
7 plants into four groups. The first is those that have
8 exhibited cracking or leakage. That's five plants all
9 together. The other three bins, if you will, are
10 based on the relative susceptibility ranking. In each
11 case, the bulletin provides some suggestions on what
12 would be an appropriate inspection for each bin.

13 In particular, for those plants that have
14 found cracking or leakage, the bulletin suggests that
15 a qualified volumetric exam should be performed by the
16 end of 2001. Upon looking at the responses and
17 additional consideration of things, what the staff has
18 accepted is a qualified visual exam at the last outage
19 as being a sufficient inspection method.

20 As you can see, as you go down in
21 susceptibility, there are sort of reductions in
22 intensiveness of the inspections. The staff has
23 addressed clarifications to some of the bulletin
24 responses with specific licensees, and numerous
25 licensees have provided either revised or supplemental

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1 bulletin responses. We're still actually reviewing a
2 lot of that information. As Jack mentioned, some of
3 it just came in earlier this week.

4 Now looking at the plants that have
5 performed their metal visual examinations, in all
6 cases except one these are plants that are either in
7 the high susceptibility bin or have exhibited cracking
8 or leakage at some point. The one exception is
9 Crystal River Unit 3.

10 What I'd like to indicate first of all, of
11 the ten plants that have done their metal exams within
12 the last twelve months, nine of them have come up with
13 at least relevant visual indications and that really
14 is the case for North Anna Unit 2. It's the reason
15 that their number's in parenthesis. Those are visual
16 indications that they're doing additional examinations
17 on.

18 The other eight plants have confirmed
19 cracks in the nozzles, in some cases, circumferential
20 cracks. At Oconee Unit 3, Oconee Unit 2 and Crystal
21 River 3, a number of nozzles have been repaired.
22 There are a number of nozzles that have been left in
23 service with axial cracks at this point.

24 VICE CHAIRMAN BONACA: The bottom line here
25 is you say that those plants at the bottom, Beaver

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1 Valley 1, et cetera, et cetera, have completed
2 effective visual examinations. How do they differ
3 from bare metal?

4 MR. HISER: These are the plants that are
5 in either high susceptibility --

6 VICE CHAIRMAN BONACA: Okay.

7 MR. HISER: -- or had previously had
8 cracked or leaking nozzles of the top, including
9 Crystal River 3 in that population. That's thirteen
10 plants all together, so ten of them have looked, three
11 have not. Nine of them have found at least relevant -
12 - eight have found cracking. Robinson is the only
13 plant at this point that has not found any evidence of
14 --

15 VICE CHAIRMAN BONACA: So the effective
16 visual examinations on the bottom means bare metal
17 visuals?

18 MR. HISER: Right. Right, they have not
19 done the analysis to show that leaks would put a
20 deposit on the head.

21 VICE CHAIRMAN BONACA: Okay.

22 MEMBER FORD: Allen, as you look at -- put
23 the next one up. As you look at those, do you have
24 any comments on the question I asked Larry? Can you
25 draw anything from this information about the

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1 difference between Babcock and Westinghouse reactors
2 in terms of susceptibility, or is it purely a function
3 of time at 600 plus or minus 2?

4 MR. HISER: I think it's too early to say.
5 The one comment that I can make, one observation,
6 seven BNW plants exist in the PWR population. Six
7 have looked and found cracking. Three of the six have
8 found circumferential cracking. At this point, we
9 have not seen circumferential cracking in Westinghouse
10 plants.

11 But then again, the intensity of the
12 examinations has not been as strong as the BNW plants.
13 That is what the bulletin was trying to get to, trying
14 to increase the level of inspection so that we could
15 determine whether there are any particular groups that
16 are more problematic in this area.

17 MEMBER FORD: Now, I've heard it said that,
18 maybe comment on the accuracy of it, that Babcock
19 seemed to have been using more susceptible heat for
20 whatever reason, and we don't know how to define
21 susceptible physically. Could you comment on that?
22 Is there any basis for that or not?

23 MR. HISER: I would say that we really
24 haven't looked at it to that level of detail. We
25 have, the industry has identified cracking in at least

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1 one Westinghouse plant. That plant is doing repairs.
2 We really have not assembled the data and been able to
3 try to look for those kind of conclusions.

4 MEMBER FORD: Okay.

5 MR. HISER: I think the one comment that
6 I'd make on the -- and this is very similar to Larry
7 Mathews' graph, just a little bit different colors I
8 think, different color scheme. The plants that are
9 highlighted in the red circles have identified
10 cracking recently. The one plant, North Anna 2 has
11 indicated maybe that will end up turning into a blue
12 square.

13 The bulletin made a distinction of 5 EFPY.
14 The plants to the left of that were high
15 susceptibility. Those to the right were considered to
16 be moderate susceptibility. I think that the results
17 generally support that. The one plant in this area
18 that the bulletin maybe didn't designate properly is
19 the next plant in line.

20 MEMBER FORD: Crystal.

21 MR. HISER: That's right. Crystal River
22 identified a circumferential crack. So the
23 circumferential cracks are here and here. It seems to
24 sort of span the --

25 MEMBER FORD: But the ISI 5 is purely

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1 arbitrary?

2 MR. HISER: Absolutely. Yes, the 5 was
3 just a first cut at trying to provide some data that
4 would be useful to look at. At this point, one plant
5 in the high susceptibility zone has identified no
6 cracking. Two at this point have not performed a
7 recent ISI. But it does appear that these are the
8 plants that are more susceptible.

9 As time marches on, you know, red circles
10 will begin to populate out here. This one plants was
11 included in the first bin of plants that have a
12 history of cracking, because I identified axial
13 cracking in 1994.

14 So my conclusion from this, susceptibility
15 ranking is working as intended. I mean, we don't have
16 any plants that have identified cracking at 20 or 30
17 EFPY. So, that's a good sign.

18 MEMBER POWERS: At 20 or 30?

19 MR. HISER: EFPY from Ocone Unit 3.

20 MEMBER POWERS: Have they looked?

21 MR. HISER: Some plants have looked using
22 the effective visual exam. They've looked at the bare
23 metal on the head and have identified no relevant
24 deposits. These are two plants, Kewaunee -- the other
25 two plants, I believe the one furthest out is about 22

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1 EFPY from Oconee Unit 2.

2 MEMBER POWERS: How long from the time a
3 crack exists to the time you can find deposits?

4 MR. HISER: I think an expectation is that
5 from the time that you get a through-wall crack in a
6 J-groove weld, that the time to see the deposit is
7 hopefully less than the time to initiate a
8 circumferential crack. We don't have any firm data in
9 that regard.

10 Unfortunately what we're, you know, the
11 bulletin was information gathering. We wanted to try
12 to find out the population of flaws that are out
13 there, how severe is the problem. What we're ending
14 up with is a population that's sort of one-sided. If
15 you find a leak, you do additional inspections. If
16 you don't see a leak, you don't do anything. And
17 we're not sure if that, you know that clearly doesn't
18 cover the full range of possibilities in terms of
19 behavior.

20 Moving on from there, I just wanted to
21 show some of the typical visual examination results
22 from this fall. In both of these cases, cracks were
23 identified in the nozzles and so these would be
24 classified as leakers in a classic sense.

25 For this one as well. I don't know if you

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1 -- let me show this next one. This is sort of the
2 classic popcorn appearance that the industry speaks of
3 in this area. This is what we've seen at Oconee Unit
4 3 and Unit 2 and ANO 1. That's sort of the classic
5 deposits. In this case, I think this is easy to tell
6 that you have popcorn deposits. On some of these
7 others -- How do you interpret that? Is that a
8 relevant -- is that popcorn? Is that a relevant
9 indication?

10 CHAIRMAN APOSTOLAKIS: When you say "that",
11 that is that?

12 MR. HISER: These deposits.

13 CHAIRMAN APOSTOLAKIS: That's just -- okay.

14 MR. HISER: It clearly isn't just bare
15 metal with the nozzle coming into the head. I guess
16 we don't have any on that one. But the industry has
17 treated nozzles like this in general as relevant
18 visual indications, and they've done additional exams,
19 volumetric surface exams. I think they have in
20 general done a very good job of following up
21 indications like this.

22 The interpretation the industry has tended
23 to put on this is they do not call this a leak until
24 they confirm that through volumetric or surface
25 examinations. The difficulty comes in when you get

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1 things that look like this.

2 MEMBER ROSEN: Would you go back to that
3 prior one.

4 MR. HISER: Sure.

5 MEMBER ROSEN: Because it just seems to me
6 so clear what's going on here. I'm sort of puzzled by
7 you not saying it. That looks to me like a very old
8 leak that may have somehow dried up. Clearly there's
9 damage there. It's not normal. It's not the way it
10 was built.

11 MR. HISER: One of the problems that many
12 of the plants have is they have leaking CRDM flanges,
13 CONO seals and canopy seals, and that provides boron
14 on the head, differentiating is it from the nozzle,
15 from under the head leaking out, or is it from an
16 external source, is part of the difficulty in
17 interpreting the visual exams.

18 What the industry has consistently done is
19 to say, this required more attention. They're not
20 sure if it's from a leak in a nozzle or from an
21 external source, so they've done additional exams to
22 try to determine the source.

23 This is the next one that I put up. That
24 looks similar to what we saw at Oconee and the early
25 graph that I showed. The problem though in a case

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1 like this, is trying to find where the crack is so you
2 can fix it. And, in some cases like this and also
3 with this nozzle, this is the same nozzle. These
4 kinds of indications in that area are sort of
5 ambiguous.

6 In the case of this nozzle, the licensee
7 did extensive ultrasonic and surface exams, found no
8 leaks, no surface cracking, no source of deposit. The
9 conclusion that they reached and that we agreed with,
10 was that this came from an external source, in this
11 case a CONO seal leak.

12 What I wanted to do is just give you a
13 flavor for the kind of visual examination results that
14 we're seeing and having to interpret. I think
15 overall, the industry has done a good job in following
16 up relevant deposits.

17 MEMBER ROSEN: Would you go back to that
18 for a moment?

19 MR. HISER: Sure.

20 MEMBER ROSEN: Why would you say that's a
21 CONO seal leak? Wouldn't you expect to see some
22 evidence of it coming down from above? And yet, that
23 penetration looks perfectly clean to me above the area
24 that you indicated.

25 MR. HISER: And in the case of this

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1 licensee, and I think again we're finding a lot of
2 variations from plant to plant. This licensee has a
3 very high air flow rate through the upper head area,
4 and the CONO seal leak deposits don't drop straight
5 down, but they're blown every which way.

6 Looking at videotapes of this head, you
7 can see on some nozzles where there are streaks along
8 the side of the nozzle, so the leakage comes down
9 vertically, gets caught up in the air flow and is
10 blended horizontally. There tends to be boric acid in
11 many places on the head. It tends to be fairly well
12 localized, but it's not -- I think one could -- look
13 at this case.

14 MEMBER WALLIS: The only place we see it in
15 that picture is where you would see it if it came out
16 of a crack.

17 MR. HISER: The deposits back here?

18 MEMBER WALLIS: Yes, that bottom one.

19 MR. HISER: You really have to see the
20 videos to get a full appreciation for this, but there
21 tends to be a lot of boric acid. This does not look
22 like the popcorn appearance that we've seen
23 classically with the circumferential cracks in
24 particular. This has been followed up with additional
25 exams. No relevant cracking has been found.

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1 MEMBER WALLIS: It could mean you don't do
2 a good job of finding cracks.

3 MR. HISER: The inspection methods have
4 been qualified with service cracks. Clearly, there's
5 a chance that that has happened as well.

6 MEMBER FORD: Could I suggest we move on
7 Allen? MR. HISER: Sure.

8 MEMBER FORD: I recognize that are
9 scuppering you here, but looking through here, there's
10 a lot of good information at the back here that I want
11 these gentlemen to be exposed to. Now, do I
12 understand that we are allowed to go to a quarter to
13 11:00? George?

14 CHAIRMAN APOSTOLAKIS: I'm sorry?

15 MEMBER FORD: Can we go until quarter to
16 11:00?

17 CHAIRMAN APOSTOLAKIS: No. I'm sorry. We
18 have an absolute deadline of 1:30 with the
19 commissioner coming.

20 MEMBER FORD: 10:30?

21 CHAIRMAN APOSTOLAKIS: So I can't move
22 things.

23 MR. HISER: How would you like me to
24 proceed. I can jump to the bottom line more?

25 MEMBER FORD: Why don't you jump to the

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1 bottom line if we must leave at 10:30. It's obvious,
2 I think, that we're going to be having another full
3 day meeting sometime.

4 MR. HISER: Let me speak a little bit to
5 one of the areas of contention yesterday in our
6 meeting. The crack rate is an area that we don't have
7 alignment if you will between the industry and -- at
8 this point in time. This is some data for Alloy 600.
9 The top curve illustrated here is what would be called
10 a 95/50 confidence bound on the data. The curve at
11 the bottom I believe is a 50/50 analysis of a larger
12 bulk of data.

13 What the staff has used in its preliminary
14 assessment is a 95/50 curve as an upper bound. In
15 addition, we have defined what I would call a high
16 mean value. What has been seen and has been
17 hypothesized is that the heats of the material that
18 are going to crack are the ones that are most
19 susceptible.

20 So instead of looking at the full
21 population of data, one should really concentrate on
22 the upper half of the data. We've defined a high mean
23 as the square root of the product of the 95/50 and the
24 50/50 data, so it would be a curve that lies
25 essentially in between. In this case, I think it --

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1 MEMBER FORD: From where you stand right
2 now Allen, if you were asked what disposition curve do
3 I use, would you choose the 95/50 or the 50/50, and
4 what would the industry want to do?

5 MR. HISER: I won't speak to what the
6 industry would like to do. My guess is that, well
7 what we recommend in the technical assessment is a
8 95/50 curve.

9 MEMBER FORD: Good.

10 MR. HISER: I do not believe the industry
11 would recommend the same curve.

12 MEMBER WALLIS: Where is K for your
13 situation here on the picture?

14 MR. HISER: For the nozzles, we are
15 generally in the range from 30 to 50 or 60 MPA root
16 meters.

17 MEMBER FORD: And I'm reminded there's a
18 second. There's a centimeter in 100 days. It's called
19 insignificant.

20 MR. HISER: The difference from the 50/50
21 to the 95/50 is about an order of magnitude.

22 MEMBER FORD: Yes, but the top line is not
23 an
24 insignificant crack. It's pretty rapid.

25 MR. HISER: No, it's about an inch, 30

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1 millimeters per year on that order.

2 MEMBER FORD: That's right. So again to
3 come down to the bottom line where you stand right
4 now, unless there's other information that comes
5 available the next two months, you have been
6 suggesting an inspection periodicity based on that
7 10(-9) meters per second rate?

8 MR. HISER: Based on the 95/50.

9 MEMBER FORD: Yes.

10 MR. HISER: And that puts you in that sort
11 of a crack root.

12 MEMBER FORD: PWR environment?

13 MR. HISER: Yes.

14 MEMBER FORD: In the PWR environment.

15 MR. HISER: Now there was a little bit of
16 mention earlier about the annular environment, what is
17 correct? Is PWSCC really an accurate way to
18 characterize what's going on in the environment? The
19 technical assessment indicates that if there are any
20 upset chemistries in the annulus, the effect on crack
21 root may be up to a factor of 2. I think maybe the
22 95/50 is one interpretation of it, is that it would
23 account for things like that.

24 Looking ahead to Slide 17, the staff has
25 looked at deterministic and probabilistic assessments

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1 and there's discussion of both of those in the
2 preliminary assessment. The parameters that we've
3 used are here. I think the numbers are not in
4 substantial controversy on critical flaw size, about
5 270 for a factor of safety of 2 or 3 on pressure; 342
6 is what our analysis indicates for nozzle failure and
7 possible ejection.

8 As I mentioned for crack growth rate,
9 we're using a 95/50 statistical bound. We're looking
10 at a temperature of 318°C for this conditions. You
11 get an A for the Scott Model as indicated there. For
12 the initial flaw size, we really don't know what the
13 flaw size is. Without inspection data, it's hard to
14 draw conclusions on a plant specific basis.

15 In lieu of that, our deterministic
16 assessment uses a range of initial flaw sizes to see
17 what the effect of that is. In terms of uncertainty
18 and sensitivity studies, we've looked at different
19 statistical bounds to the crack root data, the effects
20 of temperature and again, we're using an initial flaw
21 size as a parameter.

22 CHAIRMAN APOSTOLAKIS: I was just informed
23 that Commissioner McGaffigan is willing to come a
24 little later. So, you can have your fifteen minutes
25 of glory.

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1 MEMBER FORD: Thank you George.

2 CHAIRMAN APOSTOLAKIS: Thank the
3 commissioner.

4 MEMBER FORD: There's a lot of stuff here.

5 MR. HISER: This is an illustration of the
6 K that we're using as a function of crack half length.
7 It peaks at about 60 KSI root inches. This area is
8 principally due to residual stresses, mainly from
9 welding on the tail end of the curve is due to
10 pressure stresses, and we've tried to model as best we
11 can at this point in time what the K range or K curve
12 would look like for the nozzles.

13 We talked about crack sizes. Thus far,
14 five circumferential cracks have been identified
15 through inspections. The first two were verified
16 through destructive examination. The last three have
17 not. In particular, I guess what I'd like to point
18 out, the one destructively examined crack of 165°, the
19 ultrasonic record indicated an inside diameter extent
20 of 59°.

21 So clearly, there's a lot of uncertainty
22 on the ability of the ultrasonic method to size these
23 cracks. But it would be very helpful from an
24 analytical standpoint to have some sort of
25 confirmation of cracks that occur in the future,

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1 instead of just the machining the cracks away, some
2 way to confirm the size of those would be very
3 helpful.

4 For the base case, again 318°C, 95/50
5 crack growth curve. That's illustrated here as a
6 function of crack length. The maximum growth rate
7 would be about 1 3/4" per year down to about 1/2" per
8 year.

9 MEMBER FORD: Allen, could I presume just
10 to tell you what to do, because I want to make sure --

11 MR. HISER: Sure.

12 MEMBER FORD: -- all the members have time
13 to ask you questions. There's a tremendous amount of
14 work here. Could I suggest maybe you discuss Slide
15 #27.

16 MR. HISER: Okay.

17 MEMBER FORD: I'm really interested then to
18 hear the bottom line on your inspection and what the
19 next staff plans are.

20 MR. HISER: Okay.

21 MEMBER FORD: And then that would give time
22 for all the members to ask any closing questions.

23 MR. HISER: Now, as a part of the
24 uncertainty and sensitivity study, we have looked at
25 temperature and statistical bound to the crack growth

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1 data as parameters. What is indicated here is the
2 operating time from an initial crack length to the
3 nozzle failure, nozzle ejection, crack length. We
4 have different crack growth curves. As an example,
5 the 318°C bound curve would be at that temperature.
6 The 95/50 curve, the curves marked as M are not the
7 50/50. It's a curve that's between the 95/50 and
8 50/50 curve, so it's more of a high mean value.

9 As you can see, there are affects of
10 temperature. If you go from 325°, 318° to 315°,
11 reducing the temperature increases the operating time
12 to failure. More substantially, I think, is the
13 effects of statistical bound, if you go from a 95/50
14 to a mean curve, you get very substantial changes.

15 CHAIRMAN APOSTOLAKIS: When you say 95/50,
16 what do you mean?

17 MR. HISER: That means there's a 50 percent
18 probability that you've bounded 95 percent of the
19 data. That's 50 percent confidence that you have 95
20 percent bound. As an example, the 95/95 would be 95
21 percent confidence that you bounded 95 percent of the
22 data.

23 Using the 318° bounding curve, the 95/50
24 curve for flaw sizes smaller than 120°, you would have
25 at least four years before you would reach a critical

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1 flaw size.

2 MEMBER FORD: Could you just comment on
3 what you call the industry crack growth rate?

4 MR. HISER: The industry crack growth rate
5 curve is 10 millimeters per year. I'm not sure the --
6 this came to us in at least one submittal and I think
7 is more of a mean curve or maybe below mean overall.

8 MEMBER FORD: So obviously as we move into
9 the future, there's going to be a lot of discussion
10 between you and the industry as to which one of those
11 curves is appropriate for a specific plant?

12 MR. HISER: Yes, clearly one of the ideas
13 is that depending on the level of inspection could
14 impact which of those curves would be appropriate for
15 the plant to use.

16 CHAIRMAN APOSTOLAKIS: Let's see, all of
17 them start at 300 and something degrees.

18 MR. HISER: Right, 324.

19 CHAIRMAN APOSTOLAKIS: What is that now?

20 MR. HISER: Okay, what this means, if I
21 have a 60°C to start with and I'm using the 318°C
22 95/95 curve.

23 CHAIRMAN APOSTOLAKIS: Oh.

24 MR. HISER: It means I would grow to
25 failure in about eighteen months.

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1 MR. Leitch: 324 is four phase.

2 CHAIRMAN APOSTOLAKIS: Okay, and the
3 confidence you're referring to comes from the
4 percentage of the distribution on a number of
5 parameters of going to the mother, right?

6 MR. HISER: In this case, it's totally on
7 the crack growth rate.

8 CHAIRMAN APOSTOLAKIS: Oh, just the crack
9 growth rate.

10 MR. HISER: This only has crack growth rate
11 as a parameter. That's the only thing that we're
12 varying in any of these curves.

13 CHAIRMAN APOSTOLAKIS: Right.

14 MR. STROSNEYDER: This is Jack Strosneyder.
15 I'm glad that point came up because I wanted to make
16 it. There's one random variable in the plot you're
17 looking at here, and that is the growth rate for
18 circumferential cracks. All right.

19 When we talked briefly about some of the
20 other uncertainties with regard to what the stress
21 levels are and certainties in the inspection and what
22 might be left in service after inspection and those
23 sort of things, that's not reflected in this analysis.
24 Those are the things we need to develop in order to
25 come up with the full probabilistic assessment.

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1 CHAIRMAN APOSTOLAKIS: The random variable
2 is the operating time to failure.

3 MR. HISER: That's right.

4 CHAIRMAN APOSTOLAKIS: And the others are
5 the uncertainty variables, and so far you have used
6 only the crack growth rate.

7 MR. HISER: That's the one variable that we
8 have sufficient data on that we feel we can do the
9 sort of analysis.

10 CHAIRMAN APOSTOLAKIS: So, if I pick one
11 value of the crack growth rates, say the 50th
12 percentile, the median, what kind of a distribution
13 have you assumed for the operating time?

14 MR. HISER: That's what this curve shows
15 you that the median's plotted on there and you can
16 look at --

17 CHAIRMAN APOSTOLAKIS: No, there's no one
18 curve. I mean, you're down horizontally.

19 MR. STROSNEYDER: Al, explain the 95/50
20 where that's at for a 315 center. Let's just pick
21 that because it's an easy color.

22 MR. HISER: This would be a 95/50
23 representation of the crack growth rate.

24 CHAIRMAN APOSTOLAKIS: When you say "this"?

25 MR. HISER: The green curve.

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1 CHAIRMAN APOSTOLAKIS: Okay.

2 MR. HISER: The green curve.

3 CHAIRMAN APOSTOLAKIS: Okay, 95/50. So
4 this is the 95th percentile on the operating time,
5 using the 50th percentile for the crack growth rate?

6 MR. HISER: No, this is a deterministic
7 calculation. We take the crack growth rate that
8 correlates to a 95/50 bound on the crack growth data.

9 CHAIRMAN APOSTOLAKIS: Which is a 50
10 percent confidence.

11 MR. HISER: For each crack size, how long
12 it will take to grow to the failure, to the nozzle
13 failure crack.

14 CHAIRMAN APOSTOLAKIS: So this is not the
15 95th percentile of the operating time?

16 MR. HISER: No.

17 MR. STROSNEYDER: No.

18 CHAIRMAN APOSTOLAKIS: Oh.

19 MR. HISER: The 95th percentile on the
20 crack growth data.

21 MEMBER WALLIS: In the reactor environment.

22 MR. HISER: Assuming a primary --

23 CHAIRMAN APOSTOLAKIS: What is the 50 then?

24 MEMBER KRESS: It's the mean value of the
25 95 percentile. The distribution is about how well you

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1 know the 95 percentile, and this will be the mean of
2 that distribution.

3 CHAIRMAN APOSTOLAKIS: Do you have a
4 distribution on the crack growth rate?

5 MR. HISER: Yes. It's humongous.

6 CHAIRMAN APOSTOLAKIS: That's one
7 distribution.

8 MEMBER POWERS: It is an estimated
9 distribution on that and yes on confidence on how
10 accurate his estimate is.

11 CHAIRMAN APOSTOLAKIS: So that's what my
12 second question was. It's not one distribution then?
13 You have a family of distributions, each one with a
14 different degree of confidence, is that it?

15 MR. HISER: Yes, that's correct.

16 CHAIRMAN APOSTOLAKIS: So you don't have a
17 -- okay, so you don't have any other uncertainty
18 coming into the calculation of the operating time.

19 MR. HISER: Right, and if you assume
20 effectively a mean value of the crack growth rate, you
21 would predict very long operating times to failure.
22 If you assume a statistical bound 95/50, then it
23 brings it down substantially.

24 CHAIRMAN APOSTOLAKIS: So the mean value
25 then of the crack growth rate is on the relatively low

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1 side, right? That's what you're saying?

2 MR. HISER: Yes.

3 CHAIRMAN APOSTOLAKIS: And then you have a
4 long tail?

5 MR. HISER: Right.

6 CHAIRMAN APOSTOLAKIS: And the fun begins
7 when you move onto the tail.

8 MR. HISER: Absolutely. And the philosophy
9 that went into the assessment is, which nozzles, which
10 materials are going to fail in service? It's probably
11 not the mean values we're concerned about. The
12 materials that are more sensitive, where the cracking
13 would be more aggressive in the material. So from
14 that standpoint, like a 95/50 curve is more
15 appropriate from a philosophical standpoint.

16 MEMBER POWERS: I mean, I appreciate it.

17 CHAIRMAN APOSTOLAKIS:

18 I don't understand it.

19 MEMBER POWERS: The qualifying statement,
20 why not on a 95/95?

21 MR. HISER: At this point, I think that may
22 be too extreme.

23 MEMBER POWERS: What I'm trying to
24 understand is how do you decide?

25 MR. HISER: It's pretty much engineering

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1 judgment.

2 MR. STROSNEYDER: I would interject two
3 thoughts on this. One is -- this is Jack Strosneyder.
4 One thing when we look at the data, and Allen had put
5 the plot up before and remember that it's on a log
6 plot, so there really is a lot of variability, right.
7 But the other thing that comes into play here on these
8 confidence levels is that when you do this by heat,
9 there's a relatively small number, I think it's 20, 18
10 or 20.

11 MR. HISER: 11, it's actually 11.

12 MR. STROSNEYDER: So of course the
13 confidence amount is driven by the amount of data that
14 are available too, so we want to capture what we think
15 is the real variability in these data, all right. But
16 on the other hand, if you recognize you're dealing
17 with a small amount of data and you use those high
18 confidence levels, you can drive yourself to some very
19 conservative values. So, that's one way of looking at
20 it.

21 MEMBER POWERS: I understand that. I just
22 am trying to understand what goes into the engineering
23 judgment, that 95/50 is okay but 95/95 is too extreme.

24 MR. HISER: I think what we've seen so far
25 is that the 95/50 operates as an effective upper bound

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1 to the data.

2 CHAIRMAN APOSTOLAKIS: So what is up curve
3 now, 95/50? Is it there?

4 MR. HISER: It's the ones marked B.

5 MEMBER POWERS: But if I looked at the
6 data, I think in your 95/50 curve, I think I can find
7 a data point. I better be able to find a data point
8 that's above it.

9 MR. HISER: That's correct

10 MEMBER POWERS: So the 95/95 would be even
11 a better upper bound to the data.

12 MR. HISER: Correct.

13 MEMBER POWERS: I'm just trying to
14 understand your engineering judgment. I don't doubt
15 your engineering judgment. I'm just trying to
16 understand exactly how it comes out.

17 MEMBER FORD: If I could interject here.
18 Allen, I apologize for asking to put this slide up,
19 because it's started a whole lot of questions.

20 CHAIRMAN APOSTOLAKIS: That's why you got
21 15 minutes.

22 MEMBER FORD: But if the members just look
23 at Chart 31, you can just see overall what the staff
24 are planning and on that basis, I'd like to go around,
25 remembering that his meeting, the objective of this

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1 meeting is merely to inform the full committee that
2 things are moving forward and it's very obvious things
3 are moving forward.

4 CHAIRMAN APOSTOLAKIS: I mean, that's an
5 interesting point. Let's go back to that. In
6 documents like Regulatory Guide 1174, there is some
7 guidance. It says "use the figure with the bounds and
8 the limits using the mean value" but as your mean
9 value approaches some limit, there is increased
10 management of tension, which means now you're looking
11 at the tail, how much probability there is above the
12 limit, and you know, you start sending RAI's.

13 Why can't we apply the same philosophy
14 here. Instead of saying we have to select the 95/50
15 or the 95/62, apply some consistent approach and say,
16 you know, maybe I'll go with the mean but then when
17 something happens there will be increased management
18 attention.

19 MR. STROSNEYDER: This is Jack Strosneyder.
20 I just point out an application of this information,
21 it's been pointed out there is only one random
22 variable that's considered in this, and clearly some
23 judgment needs to be involved in how you take this
24 information and apply it on plant specific
25 discussions. And recognizing, not only how we're

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1 going to treat this random variable, but recognizing
2 that some of those other variables and uncertainties
3 are not yet included in the analysis process, which is
4 the work that remains to be done.

5 CHAIRMAN APOSTOLAKIS: Are you going to
6 include the model uncertainty as well? Are not these
7 equations --

8 MR. STROSNEYDER: I'm sorry, I didn't hear
9 the question.

10 CHAIRMAN APOSTOLAKIS: The equation that
11 gives you the operating time as a function of the
12 crack growth rate, is that cast in stone or there is
13 uncertainty about it?

14 MR. STROSNEYDER: That's two numbers moth
15 planned together.

16 CHAIRMAN APOSTOLAKIS: That's all.

17 MEMBER KRESS: That's all it is.

18 MR. HISER: But in terms of the K that goes
19 into determining what the crack growth rate is at each
20 crack, that's a parameter. I mean --

21 CHAIRMAN APOSTOLAKIS: My second comment is
22 that, you know, I realize there is a language that is
23 being used in this community, but again we're going to
24 try to make it consistent with the language we use in
25 the risk-informed approach. This 95/50 business, I

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1 just don't like it. I mean, we have terminology.

2 MEMBER KRESS: George, that's good
3 terminology. I like the terminology because it's very
4 descriptive.

5 CHAIRMAN APOSTOLAKIS: It covers the data?
6 What is that?

7 MEMBER KRESS: Yes, but I think you have a
8 real good point George.

9 CHAIRMAN APOSTOLAKIS: There is no
10 probability theory that says that.

11 MEMBER KRESS: Oh sure.

12 CHAIRMAN APOSTOLAKIS: If you open up a
13 epistemic distribution with the percentiles and that's
14 the state of normal distribution, that's all you do.

15 MEMBER POWERS: Nonsense. This is well-
16 developed analysis for experimental data.

17 MEMBER KRESS: Yes, absolutely. Everybody
18 does that with experimental data.

19 CHAIRMAN APOSTOLAKIS: Everybody does use
20 it.

21 MEMBER KRESS: Yes, but --

22 MEMBER POWERS: Greenfield, developing
23 experimental data uses that terminology.

24 CHAIRMAN APOSTOLAKIS: That type of data
25 goes into the distribution.

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1 MEMBER POWERS: I know PRA has never
2 recognized experimental data, but the rest of us
3 actually work with that.

4 CHAIRMAN APOSTOLAKIS: We're talking about
5 bigger people here.

6 MEMBER FORD: If I could suggest --

7 CHAIRMAN APOSTOLAKIS: Give me one
8 probability that talks about this.

9 MEMBER KRESS: Oh, I can show you two or
10 three of them.

11 MEMBER FORD: I think I've lost control of
12 this.

13 CHAIRMAN APOSTOLAKIS: Back to you, Mr.
14 Chairman.

15 MEMBER FORD: No, he's not ready yet.

16 MR. HISER: Can I just make one comment?

17 CHAIRMAN APOSTOLAKIS: Final comment, yes.

18 MR. HISER: The intent is to do
19 probabilistic fractured mechanics assessments. What
20 would go into that is this variety of crack growth
21 rates.

22 CHAIRMAN APOSTOLAKIS: I understand that.

23 MR. HISER: Along with other parameters.
24 So that would be considered under the PFM analysis.

25 MEMBER FORD: Okay. The objective of this

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1 particular meeting was just to let the full, all the
2 members know that we are advancing on this problem
3 which is a generic problem in my view. We were
4 planning on having a material subcommittee full-day
5 meeting on this in February sometime. We may need to
6 have it beforehand if we have any added value to the
7 full process.

8 On that ground rules, I'd like to go
9 around to the members and just ask if they've got any
10 closing opinions, statements, on what they've heard so
11 far.

12 MEMBER POWERS: I'm just tempted to say
13 something abusive about Dr. Apostolakis' views about
14 the distributions. I'll do that on the fly.

15 MEMBER FORD: Jack? George?

16 CHAIRMAN APOSTOLAKIS: I have a lot to say
17 but I think it's too late.

18 MEMBER KRESS: One point. You know, we
19 were debating about the source of which confidence
20 level and which confidence on that we would use, and
21 if you're going to use it in an overall probabilistic
22 fractured mechanics, you ought to use them all to get
23 a final distribution. But that doesn't solve your
24 problem because then you're going to have to look at
25 final distribution and say which part of it is of

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1 interest to me?

2 I'd like to point out that Dr. Apostolakis
3 has said many times that this is good place to use
4 formal decision theory in order to decide where to use
5 it.

6 MEMBER POWERS: He's just as wrong about
7 that as he is about unprobability distributions too.

8 MEMBER KRESS: Yes, so I just wanted to
9 make that comment.

10 MEMBER FORD: Steve?

11 MEMBER ROSEN: I'd like to make a comment
12 on the pictures being worth a thousand words. The
13 discussion that we had earlier seems to be
14 extraordinarily tortured in trying to say that, for
15 example, this picture is not in fact some evidence of
16 leakage from a crack, and, I'm left very unconvinced
17 of all that rationale.

18 MEMBER LEITCH: I'm a little confused by
19 initial crack size versus crack growth. I don't have
20 any idea -- I'm sorry. I said I'm a little confused
21 by initial crack size versus crack growth. Do we have
22 any idea that when these cracks occur, they go to some
23 particular depth immediately.

24 And, what we're talking about here is the
25 growth after that initial cracking? Until we know

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1 what that initial depth might be, is there any thought
2 or discussion on that, or -- in other words, do they
3 grow at the rates we've been talking about here from
4 zero, or what I'm saying, isn't there an initial crack
5 and then what we're talking about is growth rate?
6 That's what I don't quite understand. I don't know if
7 there's any information in that regard.

8 MEMBER FORD: Quickly within the next ten
9 seconds.

10 MR. HISER: There is uncertainty on
11 exactly what is going on. Clearly the crack growth
12 rate that we're using is fracture mechanics based.
13 It has certain assumptions to it, and does not apply
14 from zero, from the incipient crack. That is the kind
15 of thinking that we need in a more phenomenological
16 model to be able to extend this in a more scientific
17 basis overall.

18 MEMBER FORD: Graham?

19 MEMBER WALLIS: All this is based on crack
20 growth and PWR environments. I think you need to do
21 more on crack growth in a crack environment with the
22 real, some assessment or enough assessment of chemical
23 flow or electromagnetic, all the things that are going
24 on there, and I don't have a good factor for it.

25 But conceivably, you could have fluid

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1 coming out of there at Mach 5 or something, whatever
2 it is, you know, drifting away to it. I don't have a
3 clue. But you haven't really said anything about what
4 happens to flow dynamically, chemically and all of
5 that and that is part of the problem.

6 MEMBER FORD: I'd like to finish off just
7 by thanking all the presenters and apologizing for
8 pushing you so much. We had only a little time. The
9 main objective, as I said before, was just to let the
10 full committee know that we are moving forward on this
11 problem.

12 I think we have a material subcommittee
13 potentially planned for February sometime, and if
14 there's any value added, as I say, to our involvement
15 before then, we're open.

16 George, I pass it back to you.

17 CHAIRMAN APOSTOLAKIS: Thank you, Peter.
18 We will recess until five minutes after 11:00.

19 (Whereupon, the above-entitled matter went
20 off the record.)

21 CHAIRMAN APOSTOLAKIS: Okay? The next item
22 is licensing approach for the Pebble Bed Modular
23 Reactor Design. Doctor Kress will guide us through
24 this topic.

25 MEMBER KRESS: All right. There's two

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1 parts to this. You say one of them talks about the
2 future plant design workshop that Dana Powers and I
3 have participated in on October 10th and 12th.

4 I don't intend to say anything about that
5 because Dr. Powers once again has issued a remarkable
6 trip report on this, and I recommend to read it to get
7 the summary of that. I don't know if Dana wanted to
8 say anything about that particular workshop more than
9 his trip report or not?

10 MEMBER POWERS: No, I do note that Dr.
11 Kress listed a set of 17 or 18 regulatory challenges
12 that he distilled out of the meeting that also should
13 be examined in conjunction with the trip report.

14 MEMBER KRESS: Yes, those didn't
15 necessarily all come from that one workshop, but --
16 yes. Also, I remind the committee that during our
17 October ACRS meeting, we had a presentation from
18 Exelon giving us their proposed licensing approach for
19 the next PBMR.

20 I won't have to remind you of what that
21 approach is because I'm pretty sure the staff plans on
22 reminding us of what it was. I thought it was a very
23 interesting approach and, in fact, I thought it was a
24 pretty good one. But today, we're hearing from the
25 staff what their view of this approach is and perhaps

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1 what issues, policy and otherwise that it might raise.
2 Then I guess I'll turn it over to who over here?

3 MR. LYONS: I guess I'll start off.

4 MEMBER KRESS: Okay.

5 MR. LYONS: I'm Jim Lyons. I'm with NRR.
6 I'm the Director of the New Reactor Licensing Project
7 Office. Today, as Tom was saying, we want to come
8 back and talk to you a little bit about the licensing
9 approach that Exelon is proposing, and we've got a
10 presentation to go through how we are seeing this.
11 Actually, here's Tom. Do you have some opening
12 remarks Tom that you want to make?

13 MR. KING: You may hear a status report on
14 what we think of the Exelon proposal for fitting their
15 design, the Pebble Bed into today's set of
16 regulations. You're going to hear our thoughts on how
17 we're looking at that, what criteria, thoughts we're
18 using to try and make a judgment on whether that's
19 okay or not okay, and again recognize that there's no
20 final decisions.

21 There's probably some policy issues that
22 are going to come out of this that ultimately the
23 commission's going to decide. But at least it will
24 make you aware of what they're proposing and what our
25 thoughts are at this point on it.

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1 CHAIRMAN APOSTOLAKIS: Okay.

2 MR. KADAMBI: Thank you. Good morning Mr.
3 Chairman, and members of the advisory committee. My
4 name is Prasad Kadambi. This is Eric Benner and this
5 is a joint NRR research presentation.

6 We had an abbreviated presentation last
7 month and we'll try not to repeat some of the things
8 that were covered in some detail. This presentation
9 is somewhat preliminary, only to the extent that we
10 are looking for feedback from the committee, and we
11 want to take into account whatever we can glean from
12 the questions and comments, et cetera, so we can
13 reflect it in the commission paper which is due this
14 month.

15 We are looking for your questions,
16 concerns about the proposed licensing approach, and
17 our assessment of the licensing approach. We'd like
18 to --

19 CHAIRMAN APOSTOLAKIS: Excuse me. We will
20 review that document you will send to the commission?

21 MR. KADAMBI: Well, a predecisional draft,
22 I believe, has been provided. I mean, we are looking
23 for this feedback during the meeting and a letter if
24 you feel it's necessary, but we are not necessarily
25 requesting a letter.

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1 The presentation that we will make broadly
2 follows the format of the paper. The message that we
3 got last month was that the ACRS wanted to hear more
4 about the staff's overall approach, including any new
5 ideas that we may bring to the table.

6 Our overall approach is to use the
7 commission's directions, decisions, and policy
8 statements to build a foundation for the PBMR
9 Licensing Review. We found a lot of guidance in these
10 documents and we feel that there is enough to proceed
11 along the lines that we'll describe.

12 What we did not set out to do was, if I
13 may so say, build a better mousetrap where, you know,
14 we would start from a clean sheet of paper and try to
15 invent a regulatory system or framework. We believe
16 that a separate effort is underway. We don't know
17 very much about it, but we believe that NEI is going
18 to be undertaking something like that.

19 As we said, the licensing of Fort St.
20 Vrain more or less began our venture into using the
21 current regulations into licensing something that is
22 not a lightwater reactor. Eric, do you want to talk
23 about that?

24 MR. BENNER: Yes, and again to emphasize
25 what Prasad was saying, and I believe you heard some

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1 of this yesterday, that there are activities going on
2 both with the DOE NERI Project and NEI and looking at
3 building on 3, to look at a more clean sheet of paper
4 approach.

5 There's a commission paper due on that
6 middle of next year to look at various options, and I
7 believe one of the options that's going to be
8 considered is, you know, how would you apply the
9 current regulations with some other sources of
10 information to see how they fit, along with the clean
11 sheet of paper to see the relative merits of the
12 different approaches.

13 Basically, the group that was accessing
14 Exelon's approach looked at the licensing of Fort St.
15 Vrain more to assure itself that there is a way that
16 you could use the current regulatory structure to
17 license a non-lightwater reactor, and the meat of that
18 was really the applicability of the GDC, which for the
19 most part are pretty general. And, at that time, the
20 staff also focused on some of these higher level
21 topics of defense-in-depth and multiple concentric
22 barriers to contain radiation.

23 This was sort of the stepping stone for
24 the staff's look at Exelon licensing approach just to
25 see whether there was merit to moving forward with

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1 using the existing regulations as a licensing
2 approach.

3 The next thing the staff looked at was the
4 pre-application review for the MHTGR. The meeting
5 that took place in the mid-'80's, the MHTGR was a gas-
6 cooled reactor. At that time, it had a steam cycle
7 and recently General Atomics has somewhat modified
8 this design to make it direct cycle, and we're going
9 to be talking about the application review of that
10 sometime in the future with the ACRS.

11 But for this review, there was extensive
12 staff work and DOE work on a licensing approach that
13 was very similar to what Exelon is proposing, and at
14 that time, the staff looked at conformance of the
15 approach with the advance reactor policy statement as
16 well as, just like in the case of the Fort St. Vrain,
17 the NRC regulations, reg. guides and standard review
18 plan that they found to be applicable.

19 Staff provided assessments in a new reg in
20 1989. After that time, there were the design
21 certification reviews going on for AP600, ABWR, and
22 System 80 Plus, and during those design
23 certifications, whenever the staff distilled an issue
24 that they thought would be applicable to the MHTGR,
25 they kind of put it off to the side and tried to

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1 address it in the communications that were going back
2 and forth between the commission and the staff.

3 The staff basically wrapped all those up
4 in a paper to the commission containing a draft new
5 reg in 1985 and kind of discussed where they were
6 applicable and how they were applicable to the MHTGR,
7 and essentially the gas-cooled reactor technology.

8 So, we have used a lot of the findings
9 that the staff provided at that time also as a basis
10 for our review.

11 MR. KADAMBI: What we have tried to do in
12 trying to identify the main considerations that would
13 be the basis for the staff's review is to more
14 specifically sort of identify the particular
15 commission directives and decisions and the policy
16 statements in the context of the agency's strategic
17 plan and performance goals.

18 So what I'll try to do over here is try
19 and describe the individual components that we feel
20 are relevant in doing this. The advance reactor
21 policy statement in a sense provides a guidepost,
22 although it's not a qualitative one, it does say that
23 as a minimum, an advanced reactor should provide the
24 same degree of protection as the current fleet of
25 operating reactors.

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1 CHAIRMAN APOSTOLAKIS: How do you mention
2 that?

3 MR. KADAMBI: Well, in a sense that's a
4 separate question which, you know, at this point I'm
5 trying to in a sense define the problem areas.

6 CHAIRMAN APOSTOLAKIS: As a guidance?

7 MR. KADAMBI: Yes.

8 CHAIRMAN APOSTOLAKIS: Okay.

9 MR. KADAMBI: So, trying to just lay out
10 the framework, if I can use that word, the policy
11 statement also says that the commission expects that
12 using simplified inherent passive or other innovative
13 means that enhanced safety margins would be realized.

14 MEMBER WALLIS: How can you have the same
15 degree of protection and enhance safety margins at the
16 same time? No, it's at least the same.

17 MR. KADAMBI: Yes.

18 MEMBER WALLIS: Oh, at least. Okay.

19 MR. KADAMBI: And I believe that one way of
20 looking at it, at least this is the way I look at it
21 and some of these things are my own thoughts right now
22 is that you ought to have more confidence that you're
23 achieving a given level of safety on some distribution
24 when you're using these simplified methods, et cetera.

25 MEMBER WALLIS: Oh, you should go with the

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1 95/95 one.

2 MR. BENNER: During the design
3 certifications that we did go through, some of that
4 expectation was realized through some of the severe
5 accident management expectations. So that may be
6 another way where we talk about enhanced margins for
7 this particular advanced design.

8 MR. KADAMBI: In fact, the decisions that
9 were taken on AP600, System 80 Plus, et cetera, do
10 show us how the advanced reactor policy statement and
11 the current set of regulations are brought together in
12 order to accomplish what the commission wanted.

13 In all, this is what we perceive as
14 essential to the role of defense-in-depth philosophy.
15 This can not be stressed enough.

16 MEMBER WALLIS: Sounds like a religious
17 statement, invoking.

18 MR. KADAMBI: In many ways --

19 MEMBER WALLIS: It is.

20 MR. KADAMBI: -- it has become that.

21 CHAIRMAN APOSTOLAKIS: Is what? I didn't
22 get it.

23 MEMBER WALLIS: Religious statement,
24 invoking virtue by appealing to the sainthood so the
25 sanctity of the defense-in-depth.

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1 MEMBER POWERS: Yes, but it's --

2 MEMBER WALLIS: Sure, some of us.

3 CHAIRMAN APOSTOLAKIS: Raise the slide
4 please.

5 MR. KADAMBI: It's such a vague thing.

6 CHAIRMAN APOSTOLAKIS: Put it higher, the
7 slide itself.

8 MEMBER WALLIS: Like saluting the flag or
9 something.

10 MEMBER POWERS: Well, I don't know that I
11 would agree with you that the depth is vague.

12 MR. KADAMBI: At least if I may, I'd like
13 to go to what we have found from the commission's,
14 again various documents that we have seen to identify
15 the individual attributes that feed into defense-in-
16 depth, and to some extent this is where, you know --
17 we begin with the basic objective of finding a
18 defensible basis for making an adequate protection
19 finding, and because defense-in-depth is so key to
20 that, there are several sources where we can find
21 guidance on what we look for on defense-in-depth.

22 The white paper called Risk Informed and
23 Performance Based Regulation, which was issued in
24 March of 1999, you know, it was issued to the public
25 and to the staff with the commission direction that it

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1 should be used. You know, it says that defense-in-
2 depth is the employment of successive compensatory
3 measures of prevention and mitigation.

4 It is something that does not wholly
5 depend on any single element of design construction,
6 maintenance or operation. It's something that if it
7 is done right would be more tolerant of failures and
8 external challenges.

9 MEMBER WALLIS: All of which needs to be
10 quantified in some way.

11 MR. KADAMBI: Certainly as we get into the
12 details of a given design, you know, these are the
13 sorts of things that we would seek to quantify.

14 Further in specific applications, relative
15 to the risk informing effort of Part 50, Option 3, the
16 staff further identified elements of defense-in-depth
17 that are dependent on risk insight and those that are
18 independent of risk insight.

19 Examples of those that are dependent on
20 risk insight are limiting initiating events, cold
21 damage frequency releases, et cetera, and achieving
22 the kind of safety function probabilities that would
23 be consistent with what needs to be achieved.

24 The elements that are independent of risk
25 insight are things like balance between prevention,

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1 containment, consequences, the avoidance of reliance
2 on programmatic activities and, you know, adhering to
3 the principles of the general design criteria.

4 So, you know, these sorts of things that
5 we have done in the recent past give us, we believe,
6 a sufficient high level of guidance on how we can deal
7 with the concept of maintaining safety.

8 The next performance goal I'd like to
9 address is increasing public confidence. Again, I see
10 some significance to the vector that's associated with
11 the performance goal, that this is something that we
12 want to increase, and I believe that increase would be
13 relative to where we are on the current generation of
14 reactors.

15 MEMBER POWERS: Before you go on to public
16 confidence, could I come back to maintain safety?

17 MR. KADAMBI: Sure.

18 MEMBER POWERS: It seems to me that there
19 is an element missing here and it's born of the fact
20 that when you look for guidance from the regulations
21 that have transpired over the last 25-30 years, you're
22 looking at a fairly well established technology as far
23 as the material.

24 And yet, just minutes ago we heard a
25 presentation on where this relatively established

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1 materials and technology is surprising those that have
2 tended and cared for it, because things break that
3 they didn't anticipate breaking.

4 Now, with some of these new concepts,
5 either the gas-cooled reactor, you're wandering into
6 an area of materials that you have relatively little
7 experience with, relative to the kind of support
8 infrastructure that you have with metals and things
9 like that. And I'm wondering if there isn't room in
10 this for some appeal to a generally conservative
11 design philosophy in your list of things that you're
12 looking at?

13 MR. KADAMBI: I think --

14 MR. BENNER: One of the things we have been
15 doing, and I can't speak for the staff in research,
16 but I'm sure they're doing this, the material staff
17 and NRR has been working with ASME to start talking
18 about what some of the materials challenges are going
19 to be for the licensing of future designs. And as far
20 as whether there will be, you know, that we'll try to
21 employ general conservatism overall or just in those
22 specific areas where we don't feel comfortable with
23 materials, I don't think we've gone that deep into the
24 infrastructure.

25 MEMBER POWERS: I think you need to

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1 recognize no matter how much talking with ASME you do,
2 even they will not have the kind of database and
3 experiential base that you have with the metals that
4 you're using in the current fleet of reactors.

5 MR. BENNER: That's been a struggle is
6 trying to get materials data and Raj Pathania of
7 research has been working to get access to a graphite,
8 a radiated graphite materials database from IAEA as
9 one source, and obviously the staff's going to have to
10 look at the available data and determine.

11 MR. KING: I think it's important to
12 recognize that Fort St. Vrain was not the only
13 graphite reactor run in this country, that there was
14 a very large one up in the northwestern part of the
15 United States, and that they have quite a lot of data.
16 Unfortunately you can't get their kind of graphite,
17 so.

18 MEMBER POWERS: But I think what your point
19 is how do you compensate for the lack of data, whether
20 it's materials, graphite or anything else? In
21 principal, the way you do that is you develop a
22 monitoring program that maybe is more extensive than
23 you would if you had such data. I think it's part of
24 the research and part of looking at what we ought to
25 do in licensing these plants.

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1 I think monitoring is one aspect to it.
2 I think holding people to a more conservative design
3 standard is another one. There's probably a trade-off
4 there someplace, but it's not a complete substitution.
5 A lot of what we're doing in the regulatory body
6 nowadays could be interpreted as a liberalization born
7 of the fact, you know, we have 3,000 reactor years of
8 operating experience with the current fleet and we
9 shouldn't leap to the belief that that liberalization
10 is applicable to some new design.

11 MR. KADAMBI: I think we agree.

12 MEMBER POWERS: I encourage you to
13 articulate that.

14 MR. KADAMBI: I hope we will as we go
15 through this. I think it's really part of what
16 underlies everything we have to say about how we will
17 proceed with the review.

18 Anyway, on the matter of increasing public
19 confidence, again we believe the advance reactor
20 policy statement did state that we should provide
21 stakeholders a timely and independent assessment and
22 that's one of the reasons we are trying to abide by an
23 aggressive schedule to bring out, you know, what the
24 current thoughts that the staff have are on this
25 matter. And also, we are of course being very careful

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1 to provide opportunity for feedback and comment on the
2 part of all stakeholders at every opportunity.

3 Now in terms of increasing efficiency,
4 effectiveness and realism, we find many of the
5 elements that have been described in Reg. Guide 1.174,
6 again the white paper, and the Option 3 Framework to
7 be useful in proceeding. Reg. Guide 1.174 does talk
8 about using appropriately the exemption process.

9 Again, being consistent with defense-in-
10 depth philosophy, assessing safety margins very
11 carefully, paying attention to performance monitoring,
12 the safety goal policy, all these things come together
13 in terms of how the particular issues that were dealt
14 with in Reg. Guide 1.174 were dealt with, even though
15 that was really in the context of making changes to
16 the licensing basis.

17 In the white paper, there is reference to
18 performance based approaches and the staff has issued
19 high level guidelines for performance based activities
20 which in some matter may appropriately be applicable
21 in increasing efficiency effectiveness and realism.

22 The Option 3 Framework also stressed
23 defense-in-depth philosophy, and consideration of core
24 damage accidents. By the way some of these things,
25 you know, we just don't really know what the

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1 equivalent would be in a Pebble Bed reactor, but at
2 least conceptually these are the things we would be
3 looking for, and of course, the stress on all the
4 different types of uncertainties that one should pay
5 attention to.

6 On the fourth performance goal of reducing
7 unnecessary regulatory burden, what we find is that
8 the commission has over the years stressed the rule of
9 the safety goal policy statement as defining -- I
10 mean, at least providing a basis for saying how safe
11 is safe enough? You know, of course this raises
12 policy issues some of which we will talk about later,
13 but in addition to this performance based approach,
14 where appropriate could mitigate some regulatory
15 burden by providing licensee flexibility, provided the
16 margins are maintained.

17 Now this picture you saw last month and we
18 wanted to make it available here just to provide a
19 basis for how we are viewing this effort of screening
20 of the regulations. What we'd like to stress is, we
21 will independently, you know, undertake the kind of
22 screening required, but the process itself, the logic
23 flow seems to be adequate to proceed.

24 CHAIRMAN APOSTOLAKIS: Now, let me
25 understand this a little better. I see under the

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1 diamond that says "compare completely applicable,
2 partially not applicable, PBMR specific." So, where
3 is it that we're adding things, adding regulations to
4 replace the ones that aren't applicable, under PBMR
5 specific?

6 MR. KADAMBI: Correct, although they may
7 not be regulations. They may be regulatory
8 requirements through license conditions.

9 MR. BENNER: I think there are two things
10 that go in that box, and there are some places where
11 a regulation may not be applicable just on its face
12 because of the language, but there's an underlying
13 concern that drove the staff to move towards a
14 regulation.

15 CHAIRMAN APOSTOLAKIS: Which was my next
16 point. If you go up to the left, it says "function
17 level or intent of regulations." So when it says
18 "partially applicable" is it referring to the
19 regulation itself or its intent?

20 MR. BENNER: The Exelon approach talks
21 about partially applicable, as when you have a
22 regulation that has three parts and two parts are
23 applicable and one is not; whereas, there are like we
24 just talked about, applications that on their legal
25 face may not apply, but there's an intent there, and

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1 how that gets handled as applicable or have to come up
2 with a PBMR specific license condition, we're still
3 working with OGC on that.

4 MEMBER WALLIS: I'm a little bit puzzled by
5 the logic flow here. I don't see how you can design
6 a PBMR if you don't know what the rules are. You sort
7 of assume the thing is designed and then someone
8 figures out how to regulate it?

9 MR. KADAMBI: Well, I mean the design, I
10 believe a case that's been presented to us so far,
11 which is at a relatively high level, it doesn't have
12 a lot of details in it, but it's based on certain
13 physical principles that will --

14 MEMBER WALLIS: So what can you change, how
15 it's operated or what?

16 MR. KADAMBI: I mean certainly at some
17 point, you know, if we don't have sufficient assurance
18 of some physical capability beyond the operational
19 aspect may have to be changed. But right now, we see
20 the PBMR specific box being populated entirely by, or
21 substantially by, you know, the right side of this
22 diagram. And so, you know, it's not that we don't
23 know anything about the PBMR, but we certainly don't
24 know enough to see --

25 MEMBER WALLIS: So a cynic might claim that

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1 you're going to be confronted with an existing design
2 and you're going to be told "find a way to license
3 it."

4 MR. BRENNER: Well, part of the pre-
5 application review and part of the discussions we're
6 having with Exelon is to, as we get some design
7 assumptions, to determine what regulations are
8 applicable so that they can make changes to the design
9 now as opposed to when they come in during the
10 licensing phase.

11 MR. KING: That's the main purpose of the
12 pre-application phase to dig out these things up front
13 before they've gone through and spent a lot of money
14 to develop a final design.

15 CHAIRMAN APOSTOLAKIS: Part of the problem
16 with this approach though, which you have not said you
17 have accepted or whatever. I realize you're
18 presenting what Exelon has presented. It's something
19 I think Tom King also referred to yesterday. If you
20 just do it this way you may, you know, be gaining
21 perhaps efficiency in the short term, but in the long
22 term maybe not because now what do you do? Next time
23 you have an IRIS, then you do the same thing and now
24 you have IRIS specific, then something else.

25 Wouldn't it be better to try to think a

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1 little more broadly and see what kinds of fundamental
2 principles and requirements we want to have for all
3 technologies, and then have the box that says this is
4 technology specific, not technology specific.

5 MR. BENNER: I think that's the goal of
6 where eventually we're trying to get to, because some
7 of the people on the working group looking at this
8 approach are also supporting and looking at Option 3
9 and advance reactor regulatory framework so that
10 hopefully in going through this, we're trying to keep
11 our eyes open for where, you know, because of
12 something that the staff and the applicant wrestled
13 with, does a principle come out of that that needs to
14 go up to the highest level. And also, have we
15 identified a gas cooled reactor specific requirement
16 that needs to go on the lower level, whatever it ends
17 up being, whether it be a regulation or a guidance
18 document.

19 VICE CHAIRMAN BONACA: It has to be high
20 enough and flexible enough that it doesn't prevent
21 innovation in designs. What I mean is I totally
22 agree.

23 MEMBER KRESS: Well, they have two
24 problems. One of them, Exelon has come in with this
25 as a proposed approach and they want to know what the

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1 staff thinks about it, so they have to focus on that.
2 But how many times they've done, they can be thinking
3 about how to have general principles that focus their
4 attention on what they think about it.

5 VICE CHAIRMAN BONACA: Sure.

6 MEMBER KRESS: I think they're working both
7 sides of it.

8 MR. KING: And the two compliment each
9 other, because the PBMR illustrates a number of issues
10 that we're going to have to deal with on future
11 plants, containment issue, the emergency planning
12 issue, a number of these key issues. So, it's useful
13 to have the two going on in parallel because they do
14 cross fertilize each other.

15 MR. BENNER: We can go on. I think we've
16 really covered most of what was on the slide in the
17 discussion of the graphic. So, basically it's screen
18 the regulations, find out the applicable ones, apply
19 them, and final determinations will be made by the
20 regulator.

21 MR. KADAMBI: You have seen this before
22 also, and we just present it to refresh your memory on
23 it.

24 VICE CHAIRMAN BONACA: Yes. One question
25 I have on this. This clearly is not -- we discussed

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1 it. It was not a frequency consequence curve in the
2 sense of integrating all of the results. It is
3 actually a very useful curve to determine initiators
4 and frequency that should be associated with them.
5 Would you plan to have also a frequency consequence
6 curve that provides the outcome? I mean, when you
7 integrate all of this?

8 MR. BENNER: In one of the rounds of
9 questions we had with Exelon we saw, as one of the
10 things they need to do, was to somehow sum up the
11 consequences of all the events, or at least show that
12 the events they've identified represent the majority
13 of the risk, and somehow compare that to the safety
14 goals.

15 CHAIRMAN APOSTOLAKIS: So how is this
16 curve going to be used? Can you explain to me -- I
17 mean --

18 MR. BENNER: We see this, really, as a
19 plot of the -- some of the high-level regulations that
20 are applicable to the PBMR. So it's useful to
21 illustrate what some of the bounds are.

22 MEMBER WALLIS: This is a continuous curve
23 and events are all discrete.

24 MR. BENNER: Discrete.

25 CHAIRMAN APOSTOLAKIS: But if I enter,

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1 say, at .1 rem, right, on the horizontal axis, and I
2 go up and I hit the mean frequency of $2.5 \cdot 10^{-2}$ per
3 reactor year, what does that say in terms of the
4 design? How am I going to use this? That's what I
5 don't understand.

6 MR. BENNER: I think the way the staff
7 sees this as being used as just -- we are going to
8 apply the regulations that they reference as they are
9 intended to be applied. This just provides a
10 graphical representation. Basically, we identify, you
11 know, events that need to be designed for in the
12 design basis region, and they meet -- need to meet
13 10 CFR 50.34.

14 So there -- you know, that's why we don't
15 really consider this a frequency consequence curve,
16 because that regulation was designed to apply to
17 discrete events.

18 VICE CHAIRMAN BONACA: I mean, they were
19 very clear that this was the equivalent of what was
20 used in the FSARs when you set the categories, you
21 know, anticipated transients and LOCA, and so on. I
22 mean --

23 CHAIRMAN APOSTOLAKIS: But that doesn't
24 make it right.

25 VICE CHAIRMAN BONACA: No.

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1 CHAIRMAN APOSTOLAKIS: Because, again, you
2 know, I have a lot of flexibility in defining the
3 events. That's the problem. If you say -- you make
4 it workable if you say all the events that may lead to
5 .1 rem or greater must have a frequency smaller than
6 the bound, then it makes sense. So --

7 MEMBER ROSEN: All the events individually
8 or summed?

9 CHAIRMAN APOSTOLAKIS: All together.

10 MEMBER ROSEN: All of them, if you sum
11 them up --

12 CHAIRMAN APOSTOLAKIS: If you sum them up,
13 their frequency should be less than $2.5 \cdot 10^{-2}$.

14 MEMBER ROSEN: Well, that's what this
15 curve says.

16 CHAIRMAN APOSTOLAKIS: No, no.

17 VICE CHAIRMAN BONACA: We're talking about
18 individual it will be the frequency. This is
19 individual. This is like saying, for example --

20 CHAIRMAN APOSTOLAKIS: Pick one.

21 VICE CHAIRMAN BONACA: -- assume you apply
22 this to the current set of reactors. You would say
23 that a LOCA, which has a frequency of 10^{-4} cannot
24 have, you know, a dose higher than -- and you go to
25 the right and you find the dose limit for the LOCA.

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1 Okay? All LOCAs individually have a dose higher than
2 that.

3 MEMBER ROSEN: So if Exelon says it's --
4 you take it event by event, and George has just
5 postulated that different one, which is to sum all of
6 the events, it should be --

7 VICE CHAIRMAN BONACA: That's why I asked
8 the question -- the first question about a frequency
9 consequence curve that would, in fact, integrate.

10 CHAIRMAN APOSTOLAKIS: That's right. But
11 that was the original intent of the Farmer curve. It
12 was confused and the interpretation was not clear for
13 a number of years.

14 MR. BENNER: We're looking at that two
15 ways. One is --

16 CHAIRMAN APOSTOLAKIS: By the way, it will
17 not be -- it doesn't have to be the same curve you are
18 showing there if you interpret it correctly. You may
19 have --

20 MR. BENNER: And that's one of the things
21 we brought up with Exelon about the safety goals
22 dealing with the integral. The other thing we're
23 talking about is maybe integrating somehow the area
24 under this curve to see where that compares to the
25 safety goals, so that while these will be a

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1 representation of the current regulations, it will
2 also give us some guidance as to, you know, maybe for
3 the future for developing a frequency response curve.

4 VICE CHAIRMAN BONACA: I want to say
5 actually that the existence of this curve -- it's
6 confusing.

7 MEMBER WALLIS: Do you rely on Exelon to
8 determine what the events are, or are you guys going
9 to tell them what the events are they must consider?

10 MR. KADAMBI: Well, we will take full
11 liberty to, you know, make sure that the events we
12 think are important are considered, along with
13 whatever that Exelon proposes.

14 MEMBER WALLIS: Are you going to imagine
15 all of the scenarios and then tell them they ought to
16 consider these?

17 MR. KADAMBI: In some ways, that's part of
18 what goes into it is to imagine the scenarios and to
19 -- to make sure that --

20 CHAIRMAN APOSTOLAKIS: Which means to do
21 a PRA, right?

22 MR. KADAMBI: Well, yes. Eventually,
23 that's what it will all lead to.

24 MEMBER KRESS: Basically, I think in your
25 Chapter 15 for LWRs, you have a set of design basis

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1 events. And these are things like you have holes and
2 you lose coolant or you inject a rod or you have an
3 ATWS event or loss of power, and various sets of
4 events that have been chosen for -- to look at as
5 design basis events.

6 Now, I viewed this as an attempt to decide
7 what those events would be for the Pebble Bed Modular
8 Reactor. And you would start out by using similar
9 type of things, I think. Overall grand events like a
10 -- like --

11 CHAIRMAN APOSTOLAKIS: Let's not forget,
12 though, that even for the design basis events, after
13 we did the PRAs, we did extra things to mitigate, I
14 think, consequences, didn't we? The Level 2 stuff?

15 MEMBER KRESS: Well, you had --

16 CHAIRMAN APOSTOLAKIS: I mean, you can do
17 the same thing here.

18 MEMBER KRESS: You had principles like a
19 single failure principle, and then you had to meet
20 certain figures of merit. And then, you know, there's
21 questions about what --

22 CHAIRMAN APOSTOLAKIS: The station
23 blackout was not a design basis event, was it?

24 MR. KING: No. That came because of PRA
25 insights.

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1 CHAIRMAN APOSTOLAKIS: PRA, that's what
2 I'm saying.

3 MEMBER KRESS: Yes. But now that we know
4 that it was an important thing, we might look at it
5 for this.

6 CHAIRMAN APOSTOLAKIS: No. The point is
7 that, again, curves like this -- I mean, we have a lot
8 of discussion in Regulatory Guide 1.174 about it
9 should not be taken as absolutes with bright lines,
10 and so on.

11 MEMBER KRESS: Right.

12 CHAIRMAN APOSTOLAKIS: And all of that
13 stuff. But I think that the question, how do you
14 determine the so-called design basis events, or
15 whether you actually need that, is a good one. It's
16 an important one. One way of doing it is what Dr.
17 Kress just suggested. But there may be other ways,
18 too, or a combination of ways.

19 VICE CHAIRMAN BONACA: One thing I want to
20 note is that to some degree that curve that we liked
21 last time at the meeting creates confusion, because
22 what I --

23 CHAIRMAN APOSTOLAKIS: No, I didn't like
24 it.

25 VICE CHAIRMAN BONACA: No. Because we all

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1 understood -- I understood there was, at the
2 beginning, a frequency consequence curve and then we
3 discovered it wasn't.

4 CHAIRMAN APOSTOLAKIS: It was not.

5 VICE CHAIRMAN BONACA: Typically, the
6 expectation for it is to be that, and the fact that
7 this is already on paper leads one to believe that it
8 has been developed and it hasn't been developed.
9 So --

10 MEMBER KRESS: But I think if you use that
11 kind of curve to select design basis events in a
12 particular way, and then you go to frequency
13 consequence curves as your figure of merit --

14 VICE CHAIRMAN BONACA: No, I understand.

15 MEMBER KRESS: -- to see if -- see if
16 these things are -- the design part of these events
17 are acceptable.

18 VICE CHAIRMAN BONACA: I completely agree
19 with you. I'm only saying that the fact that it was
20 presented almost made everybody feel, oh, we got it.
21 And, well, we haven't got it.

22 MEMBER ROSEN: Well, I see the value of
23 this is that it avoids the arguments about when
24 someone postulates a new event, someone typically
25 reacts, "Well, that's well beyond the design basis.

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1 We're not going to think about that."

2 MEMBER KRESS: Yes.

3 MEMBER ROSEN: And that -- this gets away
4 from that completely.

5 MEMBER KRESS: This -- yes, that gives you
6 a way to --

7 CHAIRMAN APOSTOLAKIS: But it has to be
8 right. It has to be -- the concept of having the
9 curve does that.

10 MR. BENNER: And I think that's a good
11 lead-in to our concern about licensing basis events,
12 that we do --

13 CHAIRMAN APOSTOLAKIS: By the way, have
14 you seen what the Dutch have done along these lines?
15 They had passed a regulation I think in the late '80s
16 where they actually used frequency consequence curves
17 in regulating nuclear and chemical plants. And then
18 a few years later somehow they got out of it or part
19 of it for some practical reasons that came from
20 experience. So that probably would be another source
21 of information for you.

22 MR. KADAMBI: We'll make note of that.

23 MEMBER WALLIS: To get back to Dana's
24 point about conservative design, in trying to license
25 water reactors there was a lot of experimental

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1 evidence in terms of LOF tests, and so on, and scale
2 tests of this, that, and the next thing, because we
3 didn't rely just on calculating things.

4 And the impression I get is that this is
5 supposedly a more calculable system, so you don't need
6 to do a whole lot of these tests?

7 MR. BENNER: No, I think in -- in some of
8 the documentation back to Exelon that we're struggling
9 right now with what level of testing is going to be
10 necessary to validate any assumptions they may be
11 making.

12 MEMBER WALLIS: So is there data on
13 combustion of piles of graphite balls in various
14 configurations, and so on? All of that stuff is
15 there?

16 (Laughter.)

17 MR. KING: That's part of the -- part of
18 what we're trying to do now is gather what information
19 is out there that supports graphite behavior, fuel
20 behavior, high temperature materials behavior, and
21 then some judgment is going to have to be made on what
22 the licensee or applicant has to do to expand that to
23 apply to his design and what we, NRC, want to do to
24 have some confirmation of what the licensee is telling
25 us, or to push the margins and see where the cliffs

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1 are.

2 That's the thing we talked about yesterday
3 when I said for the HTGR we're developing a research
4 plan over the next several months, and we're going to
5 come to the committee hopefully in February and talk
6 about that.

7 MEMBER WALLIS: But if it's something like
8 the LOF tests, then this thing is dead in the water
9 because there's not that much money around from the
10 agency and the licensees to do those LOF-like tests.

11 MR. KING: Yes. But maybe you don't need
12 a LOF-like test for a helium reactor. You know, maybe
13 you need some smaller scale phenomenology-type test,
14 fuel performance, graphite performance. But those
15 questions are still on the table and are going to have
16 to be worked out.

17 Part of the pre-application review is to
18 try and settle those things up front. So the licensee
19 or the applicant knows if we're expecting a large-
20 scale test on some phenomena, that he knows that now.
21 He doesn't know that, you know, two years after he
22 submits an application.

23 MEMBER LEITCH: This mean frequency curve
24 has units of per plant year. Do you know if that --
25 by that nomenclature is it meant a module?

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1 MR. BENNER: No, it's up to 10 modules.

2 MEMBER LEITCH: Up to 10 modules.

3 MR. BENNER: That's how they're planning
4 on --

5 CHAIRMAN APOSTOLAKIS: So you are
6 automatically, then, doing what I suggested at the
7 workshop that Exelon didn't seem to like. You are
8 reducing the goals per unit. Are they aware of that?

9 MR. KING: It's their proposal. They came
10 in and said that's the way they're designing.

11 CHAIRMAN APOSTOLAKIS: Did they make it
12 clear this is the plant or the unit, the module?

13 MR. KING: No. Exelon said, "We are
14 considering a plant is up to 10 modules." And,
15 therefore, for an individual module --

16 CHAIRMAN APOSTOLAKIS: Ah, for an
17 individual module the curve --

18 MEMBER KRESS: -- risk goals will be, you
19 know, a factor of 10 less.

20 CHAIRMAN APOSTOLAKIS: But that's not what
21 Eric just told us. This is for 10 --

22 MR. BENNER: I thought they flipped it
23 around, that these would be applicable to --

24 CHAIRMAN APOSTOLAKIS: Ten modules.

25 MR. BENNER: -- 10 modules.

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1 MR. KING: Yes, for common -- where
2 there's common cause failures, you know, that they
3 would expect all 10 modules to meet that. Right.

4 CHAIRMAN APOSTOLAKIS: As a group.

5 MR. KING: As a group.

6 CHAIRMAN APOSTOLAKIS: So, in essence, for
7 -- on a per module basis, we're going down, the goals
8 go down. Right?

9 MR. KING: Yes. Certainly things like
10 CDF, if we can define a CDF for this, it would go
11 down.

12 MEMBER ROSEN: It would seem to me
13 irrational to do anything else. I mean, you have 10
14 nuclear reactors there.

15 CHAIRMAN APOSTOLAKIS: That's right.

16 MR. KING: Yes.

17 CHAIRMAN APOSTOLAKIS: The problem is
18 still -- they can come back and say, "Look, we may not
19 build all 10 of them," so there may be a period of
20 many years where there will now be two. But, again,
21 you know --

22 MEMBER ROSEN: So you have two critical
23 reactors on the site. But you have to -- you can't
24 say that we really -- if you have seven, that you
25 really only have one. That's irrational.

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1 MEMBER POWERS: Yes. But I guess that
2 raises the question, suppose I have one, but I may or
3 may not have 10 in the future. Does that mean while
4 I have one I can run that sloppy, and I only have to
5 clean my act up when I start adding other modules?

6 (Laughter.)

7 MEMBER KRESS: That's a rationalist
8 position.

9 (Laughter.)

10 MEMBER WALLIS: The tenth one has to be
11 absolutely perfect. Pristine.

12 MR. BENNER: I actually think we've
13 covered most of this slide.

14 CHAIRMAN APOSTOLAKIS: Yes.

15 MR. BENNER: To the concern about being
16 able to raise up additional --

17 CHAIRMAN APOSTOLAKIS: Is licensing basis
18 events a new terminology?

19 MEMBER KRESS: It's like design basis.

20 CHAIRMAN APOSTOLAKIS: I know. But it's
21 new.

22 MR. BENNER: And it's supposed to cover
23 the spectrum, both above and below design basis.

24 CHAIRMAN APOSTOLAKIS: Well, I mean, it's
25 everything.

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1 MEMBER KRESS: That's right.

2 CHAIRMAN APOSTOLAKIS: You have already
3 assumed, then, that we need licensing basis events?
4 I mean, there would be other ways.

5 MR. BENNER: Well, I think some of that
6 gets into -- for licensing of the first PBMR using the
7 current regulations as -- as the scheme. That seems
8 to be an inherent part of how the regulations work.

9 CHAIRMAN APOSTOLAKIS: In any case, the
10 licensing basis is broader, so you have a home there
11 to add that in.

12 MEMBER KRESS: If you had an FC acceptance
13 curves you could use the whole spectrum of sequences
14 as your --

15 CHAIRMAN APOSTOLAKIS: On the other hand,
16 there is a lot of value to the --

17 MEMBER KRESS: Oh, yes.

18 CHAIRMAN APOSTOLAKIS: You make it --

19 MEMBER KRESS: It really helps --

20 CHAIRMAN APOSTOLAKIS: It helps everybody
21 focus.

22 MEMBER KRESS: -- focuses a lot of --

23 CHAIRMAN APOSTOLAKIS: Okay.

24 MR. BENNER: I think -- there is where we
25 talk a little bit more about what would the licensing

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1 basis for the PBMR be, and we see it as the set of
2 requirements that apply to all of your safety-related
3 structure systems and components.

4 One of the concerns we see in trying to
5 assess the acceptability of the design is it relies a
6 lot on inherently reliable passive components. And
7 you get into the concerns of what special treatments
8 do you need to make sure that, you know, those
9 inherently reliable components retain the quality that
10 you're assuming of them.

11 Another aspect that came up in the design
12 certification reviews was the concept that, you know,
13 you would have a lot of these passive systems, which
14 would be what you would rely on to mitigate an event,
15 but you would also have active systems which would
16 provide a defense-in-depth function. And the
17 Commission provided some guidance on how the staff
18 should treat those -- those components.

19 One of the things that Exelon proposes,
20 which the staff is struggling with, is component-level
21 special treatment. And in the development of the
22 special treatment work done on South Texas Project,
23 the staff found that that was virtually impossible.
24 That you could look at functions, you could look at
25 system requirements, but to try and bring that down to

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1 the individual component level was very difficult.

2 Now, we're not precluding that. It may be
3 able to be done for the PBMR. We're just raising that
4 as a potential challenge.

5 VICE CHAIRMAN BONACA: Although I think
6 the considerations that Dr. Powers mentioned before
7 very much apply here, that, you know, for a lot of
8 these materials maybe you have to be more than
9 conservative.

10 MEMBER ROSEN: Well, I think in the case
11 of South Texas, the argument was that we had a lot of
12 performance-based information about equipment. And as
13 Dr. Powers said, we have a lot of new equipment here,
14 and with no history or very little history. So the
15 conditions are different.

16 CHAIRMAN APOSTOLAKIS: What is the third
17 bullet, defense-in-depth also provided for non-safety-
18 related SSCs? What does that mean?

19 MR. BENNER: That was a concept that was
20 really brought up in the review of the AP600, where to
21 call it a passive design, they wanted to identify only
22 the passive systems as safety-related.

23 CHAIRMAN APOSTOLAKIS: So that was the
24 regulatory requirements for non-safety-related --

25 MR. BENNER: Exactly. That's exactly it.

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1 CHAIRMAN APOSTOLAKIS: And we are keeping
2 the terminology of safety-related versus non-safety-
3 related?

4 MR. BENNER: I think at this point, yes.

5 MEMBER ROSEN: Why?

6 CHAIRMAN APOSTOLAKIS: But that's a
7 problem now. We are keeping everything from the
8 existing regulations that in another arena we're
9 trying to get rid of. I realize the problem you are
10 having, but at least say that it's something you're
11 going to think about. I realize that, you know, you
12 really have to start somewhere and proceed.

13 MR. KADAMBI: And also, this is part of
14 what Exelon has proposed. You know, they have kept
15 the terminology, and they are defining it in a certain
16 way, and we are looking at it in the context of, you
17 know, can it be applied in the context that they
18 are --

19 CHAIRMAN APOSTOLAKIS: Well, is there a
20 methodology in the existing regulations for defining
21 what is safety-related?

22 MEMBER KRESS: Sure. It's what's needed
23 to meet the figures of merit for the design basis --

24 MEMBER POWERS: But, I mean, this does
25 strike me as one of the areas I -- this is going to

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1 pain me to admit -- where -- that's the strength of
2 the probabilistic-type analysis methods, were you can
3 look at the plant in some sort of an integrated
4 fashion and escape the problems that arise when you
5 look at it in train-by-train fashions that it was done
6 in the past. It was done by necessity in the past.

7 It seems to me that this is one area that
8 the -- where the rationalists and the structuralists
9 really agree on this is this -- in the categorization
10 of equipment is where the PRA really has a strength.

11 MEMBER KRESS: And like they say, there's
12 a problem doing that down at the component level.

13 MEMBER POWERS: Because it'll show up in
14 the PRA.

15 CHAIRMAN APOSTOLAKIS: I must say, though,
16 that I'm very happy that Dr. Powers has not entirely
17 lost his ability to reason rationally.

18 (Laughter.)

19 MEMBER ROSEN: He is a structuralist with
20 some rational tendencies.

21 CHAIRMAN APOSTOLAKIS: Flashes of
22 rationalism.

23 MEMBER ROSEN: Flashes, yes.

24 (Laughter.)

25 Whereas I am a rationalist with some

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1 structuralist tendencies.

2 MR. KADAMBI: We have tried to identify
3 some potential policy issues. At this stage, it's a
4 little premature to present this to the Commission as
5 policy issues. We're still working on them. We have
6 to keep in mind that this is the review that we did of
7 a submittal that we got in August -- on August 31st,
8 and we are still, you know, developing information.

9 But the sorts of things that will
10 certainly lead to policy issues are the use of
11 probabilistic criteria, where maybe they have not been
12 used before.

13 MEMBER KRESS: Haven't we always done
14 that, though?

15 CHAIRMAN APOSTOLAKIS: For seismic, I
16 think we have. We've always --

17 MEMBER KRESS: I thought we've always done
18 that, even with the fully structuralist deterministic
19 process.

20 MR. KING: Well, we've done it
21 qualitatively. I mean, everybody has sort of had, you
22 know, something qualitative --

23 CHAIRMAN APOSTOLAKIS: But that -- with
24 one PRA, I mean --

25 MR. KING: But, remember, what's being

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1 proposed are some quantitative frequency guidelines
2 that you would decide what's in and what's out for the
3 design, and that's going beyond what we've done in the
4 past.

5 Now, maybe we've done it probably in a
6 couple limited situations. We've put some numbers in
7 a Reg. Guide or a standard review plan. But this is
8 across the board, everything.

9 MEMBER POWERS: But we always defined
10 accidents and scenarios based on whether they were
11 credible or not. And some people I think define
12 credulity with a number, but the fact is we've always
13 used risk as a --

14 VICE CHAIRMAN BONACA: But one thing I
15 wanted to say is that it is also true that there are,
16 for example, events -- and I think it's important for
17 the presentation we had this morning, like rodejection
18 accident. At some point, it was a true proposal on
19 the floor for years to eliminate it because it cannot
20 happen.

21 Well, I mean, we are not looking now at
22 cracks in CRDM nozzles, and suddenly, you know, this
23 exercise in reactivity insertion becomes more
24 credible. So I think -- I think it's a dilemma
25 they're facing. Sure, I mean, because at some point

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1 in time you might find something like this so unlikely
2 that you just don't consider it.

3 CHAIRMAN APOSTOLAKIS: But the thing is --
4 I think Tom is right. I mean, if you say go with
5 option 3, which gives you high-level frequencies for
6 core damage for LWRs and protection, and so on, then
7 what do you do with that? I mean, you have to keep
8 going down to the design, right, and have some
9 quantitative criteria or goals or guidance -- not
10 criteria -- guidance for function level on
11 availabilities, and so on. And I think that's fine.
12 I mean, it is something that the Commission should
13 explicitly comment on and decide on.

14 MR. KING: But see, option 3 is looking at
15 an existing set of regulations and hopefully approving
16 them. This is taking a clean sheet of paper and a
17 design and saying, "I'm going to use probabilistic
18 numbers to decide what we'll design for and what we
19 don't design for." That goes beyond where we've used
20 probabilistic information in the past.

21 CHAIRMAN APOSTOLAKIS: Yes. But option 3,
22 even for LWRs, I mean, it just says the core damage
23 frequency should be this. But, I mean, if you wanted
24 to design in your reactor -- a new LWR with that, you
25 will need some guidance how far down to go with these

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1 numbers.

2 MR. KING: And you could take the option 3
3 guidelines and design a reactor to those. The policy
4 question I see for the Commission is, do we want to go
5 that far in applying probabilistic -- quantitative
6 probabilistic guidelines?

7 CHAIRMAN APOSTOLAKIS: Yes.

8 MR. KING: And what other factors do we
9 want to bring into this decision?

10 CHAIRMAN APOSTOLAKIS: I think it's going
11 to be a combination. There's no question about it.
12 It's not going to be just the numbers.

13 MEMBER ROSEN: I heard an answer from
14 someplace over in the rational corner here. But I
15 want to -- the question I have is about the process.
16 Are we going to weigh in as ACRS on these questions?

17 MEMBER KRESS: Oh, probably eventually,
18 maybe not right now. We're already weighing in a
19 little bit. But as I see it, Tom, the -- we -- these
20 policy issues come head to head with our -- what our
21 definition, and I consider it a limited definition, of
22 defense-in-depth.

23 That's where there is a collision here,
24 and the question is, if you just use pure
25 probabilistic criteria, you have to decide on where

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1 defense-in-depth fits into that choice to making these
2 decisions. I think that's the issue, and I think it's
3 going to require a little bit different thinking than
4 on what defense-in-depth is, more than what's in 1.174
5 and more than what's in option 3.

6 MR. KING: Yes, I agree with you. And at
7 this point, we're not asking for the Committee to
8 weigh in on these policy matters, because we haven't
9 reached a position yet on it. Just for information,
10 you know, that these are coming down the road at some
11 point.

12 CHAIRMAN APOSTOLAKIS: I think the first
13 bullet, though, might scare people.

14 MEMBER WALLIS: I don't understand the
15 first bullet. Do you mean --

16 CHAIRMAN APOSTOLAKIS: Why don't you say
17 use the risk-informed approach to selecting licensing
18 basis events.

19 MEMBER WALLIS: But you first have to
20 analyze a whole lot of events. Then you --

21 CHAIRMAN APOSTOLAKIS: Well, the
22 implementation is somebody else's problem. But here
23 they talk about criteria, which I think is going to
24 scare everybody. It would be a risk-informed approach
25 to selecting the licensing basis events, right?

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1 That's what you are talking about.

2 MR. BENNER: Well, and I think that's part
3 of our concern is that we see in the approach being
4 proposed that it -- that it does have the use of
5 probabilistic criteria --

6 CHAIRMAN APOSTOLAKIS: Yes.

7 MR. BENNER: -- where we're saying in the
8 risk-informed approach idea that, well, you need to
9 have some deterministic portion that --

10 MEMBER KRESS: Yes. And my point about
11 defense-in-depth needing a new interpretation had to
12 do with if you just look at the, say, frequency
13 consequence type thing to get a selected event that
14 you design against, I think you have to look very
15 strongly at the uncertainties associated with each
16 frequency, its contribution to the uncertainty. And
17 you can't just use the number as is, and that's where
18 you go a little deeper in your defense-in-depth
19 theory.

20 MR. KING: Yes, I agree. What confidence
21 level do you want? And, you know --

22 VICE CHAIRMAN BONACA: Well, and there has
23 to be the balance there, because, I mean, again, I
24 want to say that for extreme events that often times
25 one could say you can't rule it out, the -- the

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1 assumption of those events, in the current generation
2 of plants, led to -- to the design of certain
3 parameters that served us very well for more probable
4 events.

5 I'm trying to say, for example, all of the
6 characteristics that we implemented in -- for negative
7 coefficient reactivity, and so on and so forth, there
8 were results of some evaluation of extreme events that
9 we thought were very improbable or unlikely and maybe
10 couldn't happen. But the fact that you assumed it
11 purely for the purpose of certain characteristics of
12 the reactor, that it served you well for less severe
13 accidents that are more probable.

14 So I think it's a very -- it's a very
15 critical area, this one here.

16 MEMBER ROSEN: But you will acknowledge
17 the trap in that as well.

18 VICE CHAIRMAN BONACA: Of course, I'll
19 acknowledge the trap. I'm only saying that in design
20 -- when you design something, you don't assume
21 necessarily only what is going to happen. You assume
22 you bound certain conditions so that you can define
23 coefficients and certain characteristics of the plant
24 that will serve you well for less severe but more
25 probable events, and --

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1 MEMBER ROSEN: But never assume the vest
2 of invincibility simply because you have --

3 VICE CHAIRMAN BONACA: Of course.

4 MEMBER ROSEN: -- created some design
5 basis events, and, therefore, everything less than
6 that is okay. We know from bitter experience that
7 that's not true, that you have to go event by event
8 and think -- and think each event through.

9 VICE CHAIRMAN BONACA: Well, and say that
10 you do that, and --

11 CHAIRMAN APOSTOLAKIS: Right. Let's come
12 back to these fellows. Anything else you would like
13 to say?

14 MR. KADAMBI: I think we're about ready to
15 wrap it up.

16 CHAIRMAN APOSTOLAKIS: Very good. Have
17 you wrapped it up?

18 MR. KADAMBI: Well, unless there are any
19 questions, I believe that we are done.

20 MEMBER WALLIS: My feeling is all of this
21 sort of theoretical. It's an approach, and I think
22 that if you start looking at specific events which are
23 unique to this particular system, like if we're
24 getting into the compressor and there's a loss of
25 compressor accident, what happens, see whether you can

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1 handle it using some of the ideas you've got here, or
2 whether you come up against something else which you
3 haven't thought of that you have to think about at the
4 fundamental level.

5 MR. BENNER: And that's what we've tried
6 to feed back to Exelon, that we may not need a
7 complete design to start exercising this approach, but
8 if we wanted to take some -- you know, some select
9 event and determine what --

10 MEMBER WALLIS: There's things having to
11 do with water reactors that you have to think about,
12 just see how far you can go. If you try to use --
13 apply some of these things, you might find --

14 MR. KADAMBI: The only thing I would add
15 is that this exercise was, you know, put into practice
16 for the HTGR to some extent. You know, they did go
17 through what they call bounding events which were not
18 proposed by DOE at the time. And, you know, it
19 provided sort of a check of how well did the design
20 accommodate or take -- tolerate these things.

21 So that's -- Mr. Chairman, that's our
22 presentation.

23 MEMBER KRESS: Well, I think --
24 personally, I don't see the need for a letter at this
25 time. I think we've made -- given some feedback with

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1 our comments, and I don't know having them in a letter
2 would be any more useful to you.

3 So I look forward to continuing the
4 conversation with you as you get further along in
5 this. I personally think you're at least asking the
6 right questions. And so --

7 MR. KADAMBI: Thank you very much.

8 CHAIRMAN APOSTOLAKIS: Thank you. We will
9 start the interviews with the candidates half an hour
10 from now, 12:40.

11 MEMBER WALLIS: George?

12 CHAIRMAN APOSTOLAKIS: Everything has been
13 shifted.

14 MEMBER WALLIS: George?

15 CHAIRMAN APOSTOLAKIS: Yes.

16 MEMBER WALLIS: Could you tell the
17 membership that the staff is going to --

18 CHAIRMAN APOSTOLAKIS: Yes. Well, go
19 ahead. Go ahead.

20 MEMBER WALLIS: I had a telecon with
21 Exelon and GE about this business of the distribution
22 of flux and fuel, and so on. And it turns out that
23 it's a real jungle. It isn't the simple matter at all
24 to say there isn't really flux flattening. There's a
25 very, very complicated fuel management program

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1 necessary in order to meet the regulations. It's not
2 -- there's no simple explanation that you can put in
3 a few sentences and put in a letter.

4 And the staff agreed to come at 3:00, and
5 in 10 minutes or so tell us how, with all of this
6 complicated stuff going on, can they assure themselves
7 that the core uprate -- this power uprate is okay.

8 CHAIRMAN APOSTOLAKIS: And also, I remind
9 you, the Commissioner is coming at 2:00. That's why
10 we have this flexibility.

11 MEMBER ROSEN: He is pushed back a half
12 hour.

13 CHAIRMAN APOSTOLAKIS: Yes. His assistant
14 was here. He heard us talk about it, and I said
15 absolutely. He called the Commissioner, and he said,
16 "I'll come half an hour later." So the ACRS will have
17 -- Dr. Ford will have more time to run over time.

18 (Whereupon, at 12:14 p.m., the
19 proceedings in the foregoing matter went
20 off the record for a lunch break.)

21 CHAIRMAN APOSTOLAKIS: Can we start before
22 2:00?

23 MR. MCGAFFIGAN: Is Graham Wallis still
24 here?

25 CHAIRMAN APOSTOLAKIS: He's coming.

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1 MEMBER POWERS: Yes, George. You may
2 start before 2:00.

3 CHAIRMAN APOSTOLAKIS: We are back in
4 session. We are very pleased to have Commissioner
5 McGaffigan with us for an exchange of views.

6 So we'll let you go first, Commissioner.

7 MR. MCGAFFIGAN: Well, thank you. You can
8 see I've shown up with a blank piece of paper, so I
9 don't have long remarks to make. I'm here more to
10 play a reverse role. We get to sit in the Commission
11 meeting room and ask you questions, so I'll make
12 myself available so you can ask me questions.
13 Hopefully I will do as well as you guys do before us.

14 I will preface it. I just heard Dana
15 talking about I guess some of the discussions you had
16 this morning about cracking and control rod drive
17 mechanism housings and whatever. There are some
18 issues that are going to come before us I am not sure
19 you are fully on top of. That is whether we are going
20 to shut down some people early by order. Davis-Besse
21 was before you. They are probably the one with the
22 most at stake. There's one other plant that staff
23 hasn't reached resolution with. Earlier we were
24 arguing with some plants over ridiculously small
25 numbers of days, but I think in Davis-Besse's case we

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1 are arguing about 100 days or so compared to when they
2 would like to go into their outage, and we might force
3 them into an outage.

4 I am not an expert about control rod drive
5 mechanism cracking. I do know that we have some
6 additional -- just orally, we have some additional
7 data from TMI in recent days. All the cracks were
8 axial, not circumferential. They were axial. They
9 are just going to be ground out, and that is going to
10 be it.

11 I don't know where things stand, to be
12 honest with you, except that the staff is working on
13 this sort of two-parallel path process. One, trying
14 to negotiate with these two licensees who remain in
15 their bullseye. The other, drafting contingency
16 orders for ordering early shutdowns to do inspections
17 that they feel are appropriate, and I think we all
18 would like to have inspection results.

19 It's a fairly profound question, whether
20 you order somebody down early. So if you all have any
21 comments for me on that or for the Commission as a
22 whole, nothing is going to happen until the end of
23 December. It would be interesting for us to hear
24 those comments and understand your perspective. This
25 is a sort of hard technical issue that's exactly up

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1 your ally.

2 MEMBER POWERS: Certainly the Davis-Besse
3 folks came in and made a probabilistic argument to us
4 today on why they should not be. I guess I look at it
5 a little bit and say well, OConee ran for at least
6 half a cycle with these cracks. Why do I want to
7 worry about 90 days, or maybe it's 120 days?

8 MR. MCGAFFIGAN: As I understand, again,
9 I have heard these arguments. The staff argument is
10 that in an ideal situation, they would have liked to
11 have already had the data. So it is a matter of
12 giving them an extra 90 days beyond where they feel
13 comfortable.

14 As I understand it, the issue has to do
15 with the rapidity with which the circumferential
16 cracks might grow. There is a range of possible
17 numbers. The staff is taking a very conservative
18 number in the absence of data. They admit, and I
19 think it's just true that there isn't a lot of data.
20 I think they also, as I understand it, would like to
21 have some data. What licensees are doing is they find
22 anything, they are just repairing it and getting on
23 with it rather than stay in outage to do science
24 projects.

25 MEMBER POWERS: My initial reaction is to

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1 say their number isn't all that conservative. It's
2 what I would have picked. Then I realized I am very
3 conservative so --

4 MR. MCGAFFIGAN: As I say, it's an issue
5 that I think as you guys think about this stuff
6 theoretically, there is this -- the way the staff
7 process works is if they don't get to yes, with the
8 two licensees, they will come to us with an order and
9 we'll have sort of five days of negative consent on
10 which to think about whether we want to go along with
11 that order, because an order is an enforcement action.
12 For high visibility enforcement actions, that is the
13 process that we -- so there isn't a Commission vote on
14 it unless the Commission chooses to weigh in. I doubt
15 the Commission would weigh in unless there were strong
16 technical arguments on the -- you know, that were
17 presented to us as to why the staff was being overly
18 conservative and we could wait the extra 90 days or
19 100 days, whatever number of days we are arguing
20 about.

21 I don't necessarily want you to tell me
22 the answer right now. It's just of all the technical
23 issues -- you know, most of the other issues honestly
24 before us at the moment start and end with security
25 and physical protection. Everything else is done on

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1 the side as we have time, but we are fairly consumed
2 with the September 11th follow-up. I don't know
3 whether the staff has talked to you about -- and much
4 of that is appropriately classified and we wouldn't be
5 talking about it in this room. I think you obviously
6 all have clearances. I think there could be a role
7 for ACRS in thinking about design-basis threat
8 adjustments and other things. You know, obviously if
9 we were to do rulemaking with regard to enhancing
10 security at say spent fuel pools and ISFSIs, you all
11 see rulemakings and can comment on them.

12 MEMBER KRESS: We do have an interest in
13 this of course. We have one of our staff members
14 taking part in most of the activities that are going
15 on. He is going to brief us later today I think.

16 MR. MCGAFFIGAN: In a closed meeting?

17 MEMBER KRESS: In a closed meeting. Then
18 we will of course have some subcommittee meetings
19 later on.

20 MR. MCGAFFIGAN: Yes. We are trying to
21 figure out how much funding we have in this area. We
22 have made a submittal to the Office of Management and
23 Budget for some of the funds that are at the
24 President's discretion. We will need some significant
25 funding. There have been provisions.

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