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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

SUBCOMMITTEE ON THERMAL HYDRAULICS

+ + + + +

MEETING

+ + + + +

TUESDAY,

JULY 19, 2005

+ + + + +

The meeting came to order at 8:30 a.m. in room O-1G16 of White Flint One, Rockville, Maryland, VICTOR H. RANSOM, Vice Chairman of the subcommittee, presiding.

COMMITTEE MEMBERS:

- GRAHAM B. WALLIS Chairman
- VICTOR H. RANSOM Vice Chairman
- RICHARD S. DENNING Member
- THOMAS S. KRESS Member
- WILLIAM J. SHACK Member
- JOHN D. SIEBER Member
- RALPH CARUSO Designated Federal Official ALSO

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PRESENT:
RICHARD LOBEL NRR
MARTY STUTZKE NRR
DAVID LOCHBAUM UNION OF CONCERNED SCIENTISTS
BILL SHERMAN VERMONT DEPARTMENT OF PUBLIC
 SERVICE

I-N-D-E-X

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Adjourn	

1 P-R-O-C-E-E-D-I-N-G-S (8:39 a.m.)

2 INTRODUCTION

3 VICE CHAIRMAN RANSOM: The meeting will
4 now come to order. This is a meeting of the Advisory
5 Committee on Reactor Safeguards, Subcommittee on
6 Thermal Hydraulic Phenomena. I am Victor Ransom, Vice
7 Chairman of the Subcommittee. I may look like Graham
8 Wallis, but I am substituting for him. Subcommittee
9 members in attendance are Graham Wallis, Tom Kress,
10 Jack Sieber, Bill Shack, and Rich Denning.

11 I was asked announce that no food nor
12 drink will be allowed in the Committee meeting room.

13 The purpose of the meeting today is to
14 discuss the staff's proposed revision to Regulatory
15 Guide 1.82, "Water Sources for Long-Term Recirculation
16 Cooling Following a Loss of Coolant Accident, LOCA."

17 Tomorrow the staff will present the
18 results of its ongoing staff research program
19 associated with chemical interactions of coolant and
20 debris within a containment during a loss-of-coolant
21 accident.

22 The Subcommittee will hear presentations
23 by and hold discussions with representatives of the
24 NRC staff and other interested persons regarding these
25 matters. The Subcommittee will gather information,

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1 analyze relevant issues and facts, and formulate
2 proposed positions and actions as appropriate for
3 deliberation by the full Committee.

4 Ralph Caruso is the designated federal
5 official for this meeting. The rules for
6 participation in today's meeting have been announced
7 as part of the notice of this meeting previously
8 published in the Federal Register on July 8th, 2005.

9 A transcript of the meeting is being kept
10 and will be made available as stated in the Federal
11 Register notice. It is requested that speakers first
12 identify themselves and speak with sufficient clarity
13 and volume so that they can be readily heard.

14 This meeting is also being made available
15 on a telephone bridge connection, and a number of
16 stakeholders are listening in. I would ask all of the
17 participants to speak clearly and distinctly so that
18 the people on the telephone can hear you.

19 We have received requests from two members
20 of the public to make presentations today. Mr. Bill
21 Sherman from the Vermont Department of Public Service
22 will make a presentation with the assistance of Mr.
23 David Lochbaum from the Union of Concerned Scientists.
24 Mr. Raymond Shadis from the New England Coalition will
25 make a brief statement.

1 I would remind all presenters that the
2 topic of today's meeting is the proposed staff
3 regulatory guide and not any particular licensing
4 activity that is associated with a particular plant.

5 In looking this over, I won't attempt any
6 history. Hopefully Mr. Lobel will go over the history
7 of this. But this Reg Guide 1.82 first was issued in
8 1974 and several revisions intervening.

9 We'll now proceed with the meeting. And
10 I call upon Mr. Lobel of the NRC staff to begin.

11 2. OVERVIEW OF REVISED REGULATORY GUIDE

12 MR. LOBEL: Good morning. My name is
13 Richard Lobel. I am a senior reactor systems engineer
14 in the Office of Nuclear Reactor Regulation. Seated
15 to me is Mr. Marty Stutzke, who is a senior
16 reliability and risk analyst, also in NRR.

17 Next slide, please. We're here today to
18 discuss a proposed revision to Reg Guide 1.82,
19 Revision 3, as well as several other related
20 documents. The purpose of the revision is to make the
21 regulatory guidance on NPSH consistent between these
22 documents and to revise the regulatory position on
23 credit and containment accident pressure in
24 determining NPSH margin.

25 As part of this effort, the staff has

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1 reassessed our position on the use of containment
2 accident pressure in determining NPSH margin. And a
3 large portion of our talk is devoted to this
4 reassessment.

5 The purpose of the presentation is to
6 request ACRS approval to issue this proposed revision
7 to Reg Guide 1.82, revision 3 for public comment.

8 Next slide, please.

9 CHAIRMAN WALLIS: The ACRS does not meet
10 until September.

11 MR. LOBEL: Right.

12 CHAIRMAN WALLIS: Are you expecting a
13 letter in September? Is that what you were looking
14 for?

15 MR. LOBEL: Yes. And we would be prepared
16 to come back and address the full Committee if you'd
17 like.

18 CHAIRMAN WALLIS: So part of our job is to
19 tell you if we think you are ready?

20 MR. LOBEL: I guess, yes.

21 CHAIRMAN WALLIS: All right.

22 MR. LOBEL: The documents being revised
23 are the Reg Guide itself, Reg Guide 1.82, revision 3,
24 which is "Water Sources for Long-Term Recirculation
25 Cooling Following a Loss of Coolant Accident." Reg

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1 Guide 1.1, "Net Positive Suction Head for Emergency
2 Core Cooling and Containment Heat Removal System
3 Pumps," Standard Review Plan section 6.2.2,
4 "Containment Heat Removal Systems," and the review
5 standard for extended power uprate.

6 The lats document hasn't been revised yet.
7 The staff intends to revise the EPU guidance later
8 this year. and the NPSH revisions will be made at that
9 time. Actually, the staff's intent is to revise Reg
10 Guide 1.82, revision 3, and reference the revision in
11 the other documents.

12 Some of these documents deal with broader
13 issues than NPSH, but we're here today only to discuss
14 NPSH. No substantive changes have been made to these
15 documents in any other area.

16 Next slide, please. The NPSH guidance
17 applies mainly to ECCS and containment heat removal
18 pumps during a LOCA. When PWR pumps are taking
19 suction from the emergency sump and BWR pumps are
20 taking suction from the suppression pool, the main
21 focus is on the design basis LOCA, but as part of the
22 reassessment, we examined all pertinent events.

23 Next slide. We divided the presentation
24 into several subjects. In order to understand the
25 current status, it's probably helpful to understand

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1 some of the history. So we'll begin with a regulatory
2 background.

3 Next I'd like to present the proposed
4 changes to Reg Guide 1.82. And then we'll provide the
5 technical justification for crediting containment
6 accident pressure and determining available NPSH.

7 Next slide.

8 MEMBER DENNING: Incidentally, I don't
9 think we're getting the slides.

10 MR. CARUSO: I know because we don't have
11 electronic copies that we can use on the track yet.
12 We're getting that many. So right now we just have --

13 MEMBER DENNING: So you are just telling
14 us to change.

15 MR. LOBEL: Right, yes.

16 CHAIRMAN WALLIS: You say here "Accident
17 pressure"?

18 MR. LOBEL: Yes.

19 CHAIRMAN WALLIS: Isn't there something
20 about maximum temperature, minimum pressure?

21 MR. LOBEL: Yes. I'll get to that.

22 CHAIRMAN WALLIS: That seems almost sort
23 of inconsistent because usually high temperature means
24 high pressure, doesn't it? I'm just wondering how you
25 achieve this mysterious nonphysical situation of

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1 having a minimum pressure and a maximum temperature.

2 MR. LOBEL: Well, you do the containment
3 analysis with assumptions that kind of lead you in
4 that situation. I'll go through some of the
5 assumptions.

6 CHAIRMAN WALLIS: We're going to get to
7 that. Okay.

8 MEMBER KRESS: They're not real
9 conditions. They're calculated conditions --

10 MR. LOBEL: Right.

11 MEMBER KRESS: -- that are intended to
12 have conservatism.

13 MR. LOBEL: Right.

14 CHAIRMAN WALLIS: I think that it may be
15 if we were rational, we would look at the statistics
16 of this thing and we would say, "Is that a likely
17 situation at all?" Maybe it's a very unlikely
18 situation.

19 MR. LOBEL: Well, that's part of my punch
20 line to the talk.

21 CHAIRMAN WALLIS: Okay.

22 MR. LOBEL: But basically to answer your
23 question briefly, yes, you aim the analysis in the
24 direction that gives you both. For instance, you
25 assume a break. You assume the distribution of the

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1 flow out of the break in a way that gives the minimum
2 pressure in the containment atmosphere and drops the
3 hot fluid directly into the sump so that you maximize
4 the sump. And the more mechanistic --

5 CHAIRMAN WALLIS: Put all of the heat into
6 the sump, instead of into the container.

7 MR. LOBEL: Right, that kind of analysis.

8 CHAIRMAN WALLIS: Okay.

9 MR. LOBEL: The technical justification is
10 divided into five categories: containment integrity,
11 will the credited pressure be available; calculation
12 conservatism, confidence that the licensees will not
13 underestimate the NPSH margin and the additional issue
14 of whether there may actually be too much conservatism
15 in these calculations; pump design, what would happen
16 to a safety-related RHR core spray or containment
17 spray pump if the pump were cavitating.

18 CHAIRMAN WALLIS: Now, when you say
19 "NPSH," do you take this definition that seems to be
20 common of a three percent decrease in head? The pumps
21 might work satisfactorily with a ten percent decrease
22 in head for the purposes of sprays.

23 MR. LOBEL: Right. That's right. And
24 that's also part of --

25 CHAIRMAN WALLIS: Also part of your

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1 discussion?

2 MR. LOBEL: Yes, the experience. And
3 there's been some experience with actual RHR core
4 spray containment spray pumps action operating at --

5 CHAIRMAN WALLIS: Is that why you have so
6 many slides, because you're going to get into all of
7 this stuff?

8 MR. LOBEL: Right.

9 MEMBER SIEBER: Of course, even though
10 most pumps operate in a cavitating mode, when you
11 cavitate to the extent of ten percent, the flow and
12 the head are both down on the pump.

13 MR. LOBEL: Right.

14 CHAIRMAN WALLIS: It's a cliff. You go
15 over pretty soon, don't you?

16 MEMBER SIEBER: Yes. There's a drop-off
17 where everything just quits. You vaporize the fluid
18 to the vortex of the suction, and you just --

19 MR. LOBEL: What you try to do is you try
20 to operate on what the pump vendors call the knee of
21 the curve before you get the precipitous drop.

22 MEMBER SIEBER: Right.

23 VICE CHAIRMAN RANSOM: An interesting
24 point that was made in a recent article was that the
25 most damaging point is between zero and three percent.

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1 MEMBER SIEBER: Yes.

2 CHAIRMAN WALLIS: But you don't care about
3 damage. You just care about saving the reactor.

4 MEMBER SIEBER: Well, you do care about
5 damage if you have a mission time and a certain --

6 CHAIRMAN WALLIS: Yes. It was a certain
7 time. Well, this is probably a slow rate of damage to
8 the pump.

9 MEMBER SIEBER: Yes.

10 MR. LOBEL: You have to remember, too --
11 and I was going to get to this later -- that we're not
12 talking about pumps that are operating for months or
13 years. We're talking about these pumps only having to
14 operate in cavitation for the time that the sump
15 temperature of the sump or the suppression pool
16 temperature is high enough that they get into the
17 problem. But I was going to talk about that more
18 later.

19 Then I would like to talk a little about
20 the emergency operating procedures, what is the effect
21 on the emergency operating procedures taking credit
22 for containment accident pressure. And then Marty
23 will talk about the risk impact of this assumption or
24 this way of doing the analysis.

25 The last ACRS letter on this topic stated

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1 that "We are concerned, however, with the completeness
2 of the staff's evaluation with respect to the full
3 spectrum of accident sequences." And the staff
4 interpreted this to be beyond design basis accidents.

5 And the letter went on. "We recommend
6 that future decisions be guided by a more extensive
7 PRA evaluation of the NPSH status for the specific
8 plan of interest over a broader range of accident
9 sequences."

10 The ACRS also questioned the justification
11 for crediting containment accident pressure in terms
12 of pump degradation due to cavitation and adequate
13 discharge flow. And we intend to address all of these
14 issues today.

15 Next slide, please.

16 MR. CARUSO: You've got it there,
17 actually.

18 CHAIRMAN WALLIS: Hey. I congratulate
19 you, Ralph, on making it work.

20 MR. CARUSO: Here's your mouse.

21 MEMBER SIEBER: You can start over now.

22 CHAIRMAN WALLIS: Do you need ACRS help
23 with this?

24 MR. LOBEL: Here we go. Okay. I think
25 we're in business again. The original Reg Guide 1.82

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1 was issued in June 1974 and provided guidance on the
2 design of PWR sumps.

3 Among the positions was a position that
4 blockage of the sump screens should be considered.
5 Fifty percent of the sump screen area should be
6 assumed to be blocked. The flow area should be 50
7 percent of the total sump screen area. This is still
8 the licensing basis for some plants.

9 Revision 1 to Reg Guide 1.82 was issued in
10 November 1985. It incorporated the findings from USI
11 A-43 on containment emergency sump performance. The
12 position on screen blockage was revised based on the
13 findings of the USI to the assumption of uniform
14 debris coverage of the sump screen.

15 Revision 2 to Reg Guide 1.82 was issued in
16 May 1996 and incorporated the work done in
17 investigating blockage of BWR suction strainers.

18 Revision 3 to Reg Guide 1.82 was issued in
19 November 2003 and incorporated the findings supporting
20 NRC bulletin 2003-01 dealing with PWR sump screen
21 blockage.

22 As I'll discuss later, revision 3 also
23 incorporated NPSH guidance for safety-related pumps
24 taking suction from the PWR emergency sump or BWR
25 suppression pool.

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1 The revision to Reg Guide 1.82, revision
2 3, which we're here discussing today --

3 CHAIRMAN WALLIS: Although, now, I looked
4 at this revision. And there seemed to be a tremendous
5 amount of strike-out. Why is there so much strike-out
6 in this revision?

7 MR. LOBEL: Part of it was that I noticed
8 when I was going through it that there was some long
9 discussion in both the PWR section and the BWR section
10 that were identical. And so I struck out --

11 CHAIRMAN WALLIS: So you moved it
12 somewhere else?

13 MR. LOBEL: -- those and moved it to a
14 place where it --

15 CHAIRMAN WALLIS: So it hasn't been lost?
16 It hasn't disappeared?

17 MR. LOBEL: No, no.

18 CHAIRMAN WALLIS: Okay.

19 MR. LOBEL: It didn't disappear.

20 CHAIRMAN WALLIS: I couldn't quite figure
21 out what was going on looking at this.

22 MR. LOBEL: It didn't disappear. And then
23 as the draft was going through review, different
24 people wanted to make different editorial changes to
25 the reg guide also, some in areas that don't apply to

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1 NPSH, but I think I could say that I believe they were
2 all just editorial changes, just picking a better word
3 and nothing that was a substantive change in any other
4 technical position.

5 Next slide. Okay. The NRC has allowed
6 credit for the calculated containment accident
7 pressure in determining the available NPSH of the
8 emergency core cooling system and containment heat
9 removal pumps in some BWRs and in fewer cases in PWRs.

10 We allowed this credit when a conservative
11 analysis has demonstrated that this amount of pressure
12 will be available for the postulated design basis
13 accident and when examined from a broader perspective;
14 that is, beyond design basis accidents, that the level
15 of risk is acceptable. This is the current staff
16 position.

17 CHAIRMAN WALLIS: That's the current staff
18 position?

19 MR. LOBEL: Right. And it's really been
20 our position for --

21 CHAIRMAN WALLIS: You know, we had a
22 meeting on this, which has been quoted several times
23 by folks. In the transcript, it appeared that you
24 didn't have a position at all, that you sort of had
25 some judgment that could be used to give credit when

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1 it seemed to be appropriate. There wasn't a specific
2 position which said that these were the comments you
3 had to make.

4 MR. LOBEL: No, there wasn't, but in doing
5 the reviews, this is pretty much how the reviews were
6 done, not so much the broader perspective but
7 definitely demonstrating conservatism in the
8 calculations that the amount of pressure that was
9 being credited was there based on a calculation that
10 was minimizing the pressure.

11 CHAIRMAN WALLIS: I thought there was
12 another consideration which had something to do with
13 it being difficult to modify the plant or something
14 like that. Isn't there another -- do you remember
15 that?

16 MR. LOBEL: Yes. I'm going to get to that
17 in a minute.

18 CHAIRMAN WALLIS: But that isn't part of
19 this statement you've got here?

20 MR. LOBEL: No, no. In fact, I think
21 that's coming up.

22 MEMBER SHACK: It's the second bullet that
23 seems new. I don't think that we've really seen that
24 very much.

25 MR. LOBEL: The second bullet is new. We

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1 have only recently given a detailed look at risk and
2 beyond design basis accidents. And Marty will talk
3 about that later.

4 MEMBER SHACK: That seems to be critical.
5 I mean, it's one thing to demonstrate conservatism in
6 a few design basis sequences, but there are lots of
7 other things out there that are going on.

8 MR. LOBEL: Right. Right. And, actually,
9 as you'll see in a little while, we broke up the risk
10 part of this talk into two parts. And one part talks
11 about the design basis accidents and other accidents
12 and other accidents that aren't considered design
13 basis but that we went through as part of the review,
14 ATWS, appendix R fire, those kinds of things, and the
15 effect that they have in generating debris and in
16 increasing the temperature of the sump or the
17 suppression pool. We did look at those. But we
18 haven't done a detailed look at risk until just
19 recently.

20 CHAIRMAN WALLIS: While we're talking
21 about debris, debris affects the screen.

22 MR. LOBEL: Right.

23 CHAIRMAN WALLIS: But also cavitation is
24 affected by articles in the water, isn't it?

25 MR. LOBEL: To some more nucleation sites.

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1 CHAIRMAN WALLIS: Doesn't that change the
2 NPSH curves? You've got dirty water. You've got a
3 different NPSH curve.

4 MR. LOBEL: It theoretically does. I
5 don't know to what extent. I haven't seen any --

6 CHAIRMAN WALLIS: Dissolved air makes a
7 difference.

8 MR. LOBEL: Dissolved air makes some
9 difference in --

10 CHAIRMAN WALLIS: Particulate matter makes
11 some difference. Maybe if you have enough, it doesn't
12 matter how much you have. But I don't know.

13 MR. LOBEL: I don't know either. I have
14 never seen any data.

15 CHAIRMAN WALLIS: If you use distilled
16 water, de-gassed, you get a very different answer.

17 MR. LOBEL: Right. And it's my
18 understanding when the pump vendors derived their
19 required NPSH curves, it's usually done --

20 CHAIRMAN WALLIS: You use dirty water.

21 MR. LOBEL: With de-aerated water.

22 CHAIRMAN WALLIS: De-aerated?

23 MR. LOBEL: Yes.

24 CHAIRMAN WALLIS: That's different.

25 MR. LOBEL: It is different.

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1 MEMBER SIEBER: More severe.

2 MR. LOBEL: Yes.

3 CHAIRMAN WALLIS: Because the bubbles push
4 and they collapse.

5 MR. LOBEL: Right. You put some --

6 CHAIRMAN WALLIS: But if you're not
7 interested in cavitation damage. You're interested in
8 the effect on head. So you're interested in void
9 fraction in the pump, really. The bubbles make more
10 void fraction. Performance falls off, but the pump
11 doesn't get damaged so much. And you have to separate
12 these two.

13 MR. LOBEL: See, the guidance on the
14 effect of air hasn't changed. That was addressed back
15 in NUREG 0897. And they came up with a correction
16 factor for the void fraction of air. And that hasn't
17 changed, and the limit is, I believe, two percent of
18 air, volume air.

19 MEMBER KRESS: On your second bullet, will
20 we find out what your criteria is for an acceptable
21 level of safety.

22 MR. LOBEL: Well, I'm going to get into
23 that a little later, too, but that gets into the
24 conservatism in the calculation and the use of the
25 required NPSH being equal to the available NPSH, those

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1 factors.

2 MEMBER KRESS: In this assessment, are we
3 concerned with damage to the pump or just loss of
4 head?

5 MR. LOBEL: Damage to the pump.

6 MEMBER KRESS: The damage takes place over
7 a time period, and it's --

8 MR. LOBEL: But it isn't one or the other.

9 MEMBER KRESS: It's both?

10 MR. LOBEL: Yes, it's both. You would
11 have to account for both. And the people who have
12 done tests where they have tested a pump in cavitation
13 have measured the drop and looked for damage to the
14 pump itself.

15 MEMBER SIEBER: But only to the extent
16 that that damage would make the pump inoperable,
17 right?

18 MR. LOBEL: Right. If the pump keeps
19 pumping, it's not a problem.

20 MEMBER KRESS: But that was basically my
21 question. Yes.

22 MR. LOBEL: Like I'll show, the tests that
23 have been done haven't found any damage in the amount
24 of time that the pump has been tested.

25 MEMBER KRESS: Yes. That was the basis of

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1 my question.

2 MR. LOBEL: Yes. I mean, don't get me
3 wrong. I'm not trying to say that the pump will never
4 be damaged in cavitation. The experience doesn't
5 support making a statement like that. But for the
6 time period that the pumps have been tested, licensees
7 have taken credit for that amount of operation, that
8 time period of operation.

9 MEMBER KRESS: Well, I'm concerned about
10 the mission time for how long that pump --

11 MR. LOBEL: And that's why the pump has to
12 remain operable. Mission time can be 30 days or more.

13 MEMBER KRESS: So you certainly could get
14 damage that would make the pump inoperable in that
15 time frame.

16 MR. LOBEL: But, again, like I said before
17 and like I'll talk about later, you have to remember
18 that the cavitation time is some shorter amount of
19 time. It's only the time when the suppression pool or
20 sump temperature is high enough that you have
21 cavitation. The rest of the time you're at some
22 higher available NPSH.

23 VICE CHAIRMAN RANSOM: On your first
24 bullet, there still seems to be some problems in the
25 language. Under 1.311, for example, it states how the

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1 containment pressure should be evaluated. And it
2 seems very explicit that it will either be the initial
3 value or based on the vapor pressure of the water at
4 the temperature of the sump.

5 And then the next paragraph goes on to say
6 that, well, you can. It doesn't say under what
7 conditions. We can talk about that later, but it's as
8 though the one is prescriptive and then the other one
9 says, well -- it doesn't say you can't take credit.
10 It says it may be credited in determining NPSH.

11 MR. LOBEL: Yes. I had some problem with
12 the wording. And any suggestions -- this is going out
13 for public comment. And hopefully somebody will
14 comment on that.

15 The idea was that if -- I'm not sure how
16 to word this correctly, but if you're taking credit
17 for containment accident pressure, it's acceptable if
18 you do this conservative analysis.

19 A lot of licensees still assume only the
20 pressure prior to the accident. And some PWRs make
21 this assumption that the pressure is equal to the
22 vapor pressure at the temperature of the sump water.
23 And what that does, of course, is it doesn't give you
24 any credit for the containment atmosphere. The only
25 thing you're getting credit for is the height of water

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1 between the surface and the pump suction.

2 MEMBER SIEBER: Would that be the case,
3 for example, in subatmospheric containment? How do
4 those kinds of containments treat this?

5 MR. LOBEL: The subatmospheric
6 containments are a little special. They, I believe,
7 all have taken credit for containment accident
8 pressure since initial licensing because they're
9 starting off at such a low --

10 MEMBER SIEBER: Yes.

11 MR. LOBEL: And so the standard review
12 plan says that they can take credit for containment
13 accident pressure during the injection phase of the
14 accident, but during the recirculation phase, they
15 can't.

16 MEMBER SIEBER: Well, that's the only time
17 when you need it, is during a recirculation.

18 MR. LOBEL: Well, the problem is in the
19 subatmospheric containments, they start off with a low
20 pressure, of course. And then the pumps that we're
21 really talking about are the recirculation spray
22 pumps.

23 MEMBER SIEBER: Spray, right.

24 MR. LOBEL: Initially during a
25 recirculation phase, when you say "recirculation,"

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1 usually you think of taking suction from the RWST. So
2 this isn't an issue usually.

3 Some plants are vulnerable at the
4 switchover from the RWST to the sump. When you have
5 recirculation spray pumps like the subatmospheric
6 containment, they're vulnerable from the beginning
7 because you haven't put that much water on the floor
8 yet into the sumps.

9 MEMBER SIEBER: Right.

10 MR. LOBEL: And so they need this
11 additional credit. And they have always been given
12 that credit since initial license.

13 MEMBER SIEBER: In that case, the most
14 severe accident is something smaller than a full
15 guillotine break, right?

16 MR. LOBEL: I'm not sure. I don't know.

17 MEMBER SIEBER: The pressure is lower. It
18 takes longer to put water in the sump. Of course, it
19 takes longer to the time when you need to recirculate,
20 too.

21 MR. LOBEL: Right, right. And one of the
22 conservative assumptions is that you try to get the
23 switchover from the RWST to the sump as soon as you
24 can because that leaves the most water in the RWST and
25 gives you less water in the sump.

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1 MEMBER SIEBER: Yes, but it also gives you
2 less head and higher temperature, --

3 MR. LOBEL: Right, right.

4 MEMBER SIEBER: -- which is not good.

5 MR. LOBEL: Right. Well, yes. All of
6 that is on the conservative side.

7 MEMBER SIEBER: Right.

8 MR. LOBEL: You're trying to leave as much
9 water as you can in the RWST so the head is less on
10 the pump.

11 MEMBER SIEBER: Thank you.

12 MR. LOBEL: Sure.

13 VICE CHAIRMAN RANSOM: Rich, are you
14 planning to go through all of these slides or --

15 MR. LOBEL: I was.

16 VICE CHAIRMAN RANSOM: -- right now?

17 MR. LOBEL: Oh. I'm sorry. I was just
18 supposed to do an introduction, wasn't I?

19 CHAIRMAN WALLIS: That's right.

20 MR. LOBEL: I got carried away.

21 MEMBER SIEBER: A pretty good
22 introduction.

23 MR. LOBEL: I apologize.

24 MR. CARUSO: I think at the point right
25 now you are on a break point on the regulatory

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1 background. How about if we stop here?

2 MR. LOBEL: Yes. I apologize.

3 CHAIRMAN WALLIS: While we are on this
4 question of minimizing, albeit conservative, would you
5 accept a submission where what they did was to
6 statistically look at all of the uncertainties in
7 containment calculation and then could convince you
8 that there was a 95 percent probability with 95
9 percent confidence that the pressure would be bigger
10 than a certain amount? Is that acceptable to you as
11 conservatively minimizing something?

12 MR. LOBEL: Yes. That is back here
13 somewhere, too.

14 CHAIRMAN WALLIS: That's in there, too?

15 MR. LOBEL: Yes. We have had
16 conversations with some people in the industry about
17 doing that, but nothing's come of it yet.

18 MEMBER SHACK: That's just for design
19 basis accidents, as I understood it, that you really
20 weren't looking over a wider range of sequences that
21 included that.

22 MR. LOBEL: That would probably have to be
23 for -- well, it wouldn't have to be just for design
24 basis accidents, but it would have to be you would
25 obviously have to be able to define pretty well the

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1 analysis so you would know what variables to put in --

2 CHAIRMAN WALLIS: So we're going to get to
3 that later?

4 MR. LOBEL: Yes.

5 CHAIRMAN WALLIS: Okay. So you're going
6 to tantalize us by now going away and coming back
7 later?

8 MR. LOBEL: Somebody put out the hook. So
9 I'm going for a while.

10 CHAIRMAN WALLIS: So we have to change
11 gears.

12 MEMBER SIEBER: So this is for primarily
13 a Bill Sherman presentation, is it, with help from the
14 --

15 MR. SHERMAN: Both of us.

16 3. STAKEHOLDER COMMENTS

17 MR. SHERMAN: Good morning, Chairman
18 Wallis and members of the Subcommittee. I'm Bill
19 Sherman. I'm the state nuclear engineer for the State
20 of Vermont representing the State of Vermont.

21 We have asked David Lochbaum, whom I think
22 you know from Union of Concerned Scientists, to assist
23 us in some of the workload associated with our concern
24 on the containment over-pressure issue.

25 I have four preliminary matters that I

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1 would like to mention before I get into the
2 presentation directly. First, with us today in the
3 audience, sitting over here is Sarah Hofmann, the
4 Vermont director of public advocacy; and Mr. Anthony
5 Roisman. Tony is an attorney who is assisting us in
6 our pursuing this issue.

7 A second preliminary issue is that we have
8 a lot of slides. Our presentation is a little bit
9 long. We think that we've got it timed correctly, and
10 we're going to try and move through it quickly.

11 Another item, we adjusted our slide show
12 from what we had provided you originally. And I think
13 you have our new slides. The message is the same.
14 We've adjusted it just a little bit, but the message
15 is the same that you saw earlier in the month.

16 Finally, let's see. Looking on this next
17 slide, the last preliminary item, we're involved in an
18 Atomic Safety and Licensing Board issue related to
19 Vermont Yankee's extended power uprate. However, we
20 recognize that this is a generic meeting. And we're
21 going to speak generically about the over-pressure
22 issue.

23 There are some places in the presentation
24 that we'll be speaking about examples. We've
25 identified it as the reference plant. There's no

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1 mystery the reference plan is Vermont Yankee, but
2 we're using that only as an example.

3 MEMBER SIEBER: Could you say just a
4 couple of words about the subject matter of the ASLB
5 hearing? What is the issue?

6 MR. SHERMAN: Our concern was exactly in
7 this area. That is, taking credit for containment
8 over-pressure for demonstrating UCCS pump adequately.

9 MEMBER SIEBER: Right.

10 MR. SHERMAN: And we have an admitted
11 contention, which essentially says that the
12 uncertainties are great enough such that over-pressure
13 credit shouldn't be granted. And then, of course, the
14 ASLB process requires lots of work toward proving
15 that.

16 MEMBER SIEBER: Yes. It's an informal
17 hearing process. I asked the question mainly because
18 I look at things as sort of divided into boxes. You
19 know, there are legal issues, there are policy issues,
20 and there are technical issues.

21 And even though sometimes the ACRS travels
22 a little bit beyond the boundaries, I think it's
23 important for me to discipline myself to try not to do
24 the job of the ASLB or the commissioners themselves
25 when they endeavor to come up with policy. So it's

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1 helpful for me when you tell me where you're
2 interacting and what the issues are.

3 MR. SHERMAN: It is interesting because
4 from the State of Vermont's perspective, we do not in
5 any way oppose the power uprate. We are concerned
6 about this specific technical issue.

7 MEMBER SIEBER: Okay.

8 MR. SHERMAN: So that sort of
9 characterizes where the state is.

10 MEMBER SIEBER: I'm eager to hear your
11 presentation.

12 MR. SHERMAN: Thank you.

13 The next slide is a rough summary of the
14 history Mr. Lobel identified. And I'm not going to
15 spend hardly any time on this slide at all except that
16 for BWRs, there have been two times at the plate to
17 solve the issue: in 1985 and then again in 1995, in
18 the mid '90s.

19 We think that there are some new issues
20 that affect BWRs now that may require another time at
21 the plate for another slide adjustment. We'll mention
22 those in the presentation.

23 Next. The next slide is -- we think your
24 current statement on this is from December 12, 1997.
25 There may be others, but in '97, your statement was

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1 "We concur with the NRC staff position selectively
2 granting credit for small amounts of over-pressure in
3 a few cases may be justified."

4 CHAIRMAN WALLIS: So we are responsible
5 for a statement made by our predecessors, a few of
6 whom may still be around?

7 MR. SHERMAN: You know, that institutional
8 history is that way. In that same letter, you
9 identified, "We recommend that, instead of using
10 qualitative arguments, restricting attention to a
11 limited range of accident sequences. Decision-making
12 process should consider the time variation of NPSH,
13 broad range of accidents typically found in PRAs.

14 The current staff guidance we think is the
15 Reg Guide 1.82, rev 3 from November of 2003. We
16 interpret that staff guidance simply. No
17 over-pressure credit should be granted except where
18 needed and where the design cannot be practicably
19 altered. We can point to the lines where they're
20 taking that out in rev. 4 if you like, but that's what
21 we think.

22 CHAIRMAN WALLIS: The second one is a
23 rather peculiar statement. Does that mean that you
24 can't afford a new pump or something or what does it
25 mean?

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1 MR. SHERMAN: Well, the need and
2 practicably altered, certainly there must be some
3 meaning to that that was intended in rev. 3. And I'm
4 going to speak about that in just a minute.

5 We wrote a letter in December of 2003,
6 right after the rev. 3 was approved asking about the
7 application of this particular reg guide.

8 It took the staff six, seven months to
9 answer the state. Basically they identified to us
10 that they weren't following this particular provision
11 of rev. 3. And we're here because we believe that
12 they should have and that they should continue to
13 follow this type guidance.

14 What we hope to show today, we hope to
15 show today, first, that defense-in-depth should not be
16 compromised by creating barrier dependencies
17 unnecessarily. I think the key word here is
18 "unnecessarily."

19 The concern, our concern, is not just that
20 the containment might fail, but it's also that the
21 uncertainties are great enough that the NPSH
22 conservatism that is provided, has always been
23 provided, has always been over-pressure, that it ought
24 not to be abandoned again unnecessarily.

25 While there might be reasons to

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1 selectively grant credit for small amounts of
2 over-pressure in a few cases, you will recognize that
3 as a quote from what we think is your predecessor's
4 letter in '97.

5 Extended power uprate is a voluntary
6 endeavor that doesn't create a necessity, the obvious
7 that nuclear plants don't need to uprate.

8 Furthermore, there are practicable
9 alternatives for extended power uprate plants to avoid
10 crediting containment over-pressure.

11 CHAIRMAN WALLIS: Yes. I was interested
12 in that. I mean, what are these alternatives? Are
13 you going to tell us what they are?

14 MR. SHERMAN: Yes. In my next slide, it
15 says a word about --

16 CHAIRMAN WALLIS: You could have an uprate
17 of 20 percent, and you still wouldn't need to credit
18 the containment over-pressure because you have done
19 something else?

20 MR. SHERMAN: Exactly so. On this side,
21 we have looked at the meaning of need and practicable
22 alternatives. And we actually think its essence is in
23 the backfit rule.

24 We're not real experts on the backfit
25 rule, but we know that in order to take something that

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1 exists and put on it additional requirements there,
2 there is review that must be done according to 10 CFR
3 50.109.

4 And over-pressure credit may have been
5 considered necessary in regard to the backfit rule,
6 but extended power uprate does not come under the
7 backfit rule.

8 MEMBER SIEBER: Right.

9 MR. SHERMAN: It's voluntary. Now,
10 there's a term of art in extended power uprates called
11 the pinch point analysis, but, simply stated, when
12 these plants do uprate, they go through analysis. And
13 they see that if we change this piece of equipment and
14 spend this amount of money, we can get this increment
15 additional percentage of power. If we commit this
16 amount more money and change this equipment, then we
17 can get additional power.

18 And as you're familiar with the extended
19 power uprates that had been approved, the percent
20 power on BWRs has gone up to 20 percent. But there
21 have been some that have only been uprated to, I
22 think, 17 percent.

23 And it's basically an economic analysis
24 that the licensee goes through. And we actually
25 provided you a copy of the reference plant's pinch

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1 point analysis.

2 Unfortunately, the numbers were all
3 blotted out. You couldn't see the cost because that
4 was confidential. But it is a public number that this
5 reference plant has spent over \$60 million on
6 equipment changes and other changes, probably closer
7 to 80 or 90 million but at least 60 million.

8 CHAIRMAN WALLIS: So in the case of, say,
9 a power uprate, you go turbine won't produce the
10 amount of power. Then you have to change the turbine.

11 MR. SHERMAN: Exactly so. And, as a
12 matter of fact --

13 CHAIRMAN WALLIS: Because the turbine is
14 a limiting system. Now, in the case of the
15 containment and the pumps and so on, they also may
16 find that they're pushing the limit there, --

17 MR. SHERMAN: Exactly so.

18 CHAIRMAN WALLIS: -- which is why NPSH
19 comes into it. And I think you're going to tell us
20 that there are some alternatives to claiming --

21 MR. SHERMAN: We believe that they have
22 the opportunity --

23 CHAIRMAN WALLIS: Past that pinch point.
24 They won't be limited by NPSH any more.

25 MR. SHERMAN: Exactly so. On the

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1 reference plant, they did change out the high-pressure
2 turbine, which cost a number of millions of dollars.
3 And we believe that a properly done pinch point
4 analysis would have identified the necessity for pumps
5 that have different NPSH characteristics, which would
6 not have required containment over-pressure.

7 CHAIRMAN WALLIS: So you could change out
8 the pumps, then?

9 MR. SHERMAN: That's what we believe.

10 CHAIRMAN WALLIS: Okay.

11 MR. SHERMAN: Before I get into our
12 discussion of uncertainties, let me just make a
13 comment about defense-in-depth. Fundamental to
14 nuclear regulation and nuclear operation is
15 defense-in-depth. Fundamental to defense-in-depth is
16 the three-barrier concept.

17 When one practices emergency planning
18 drills, one always has in mind the barrier concepts.
19 And the three barriers are the fuel cladding, the
20 reactor coolant pressure boundary, and the containment
21 boundary, any one of which intact prevents
22 radiological consequences, adverse radiological
23 consequences, to the public.

24 Often in emergency drills and
25 considerations, a loss-of-coolant accident is

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1 considered or a small loss-of-coolant accident, even
2 such a thing as relief valves not reseating. And
3 these events, therefore, consider the reactor coolant
4 pressure boundary being degraded. But you have two
5 boundaries that remain: the fuel cladding and the
6 containment boundary.

7 When you grant credit, -- this is really
8 speaking to the obvious because all of you understand
9 this very clearly -- when you grant over-pressure
10 credit, you are creating a dependency. The fuel
11 cladding boundary depends on the containment boundary.

12 In other words, with the adverse events
13 that could occur, if the containment boundary fails
14 and you don't have the necessary over-pressure that is
15 credited, then you don't develop enough cooling flow,
16 then that has the potential of damaging the cladding
17 barrier.

18 CHAIRMAN WALLIS: So you've essentially
19 got one --

20 MR. SHERMAN: Actually, you --

21 CHAIRMAN WALLIS: After the LOCA, you've
22 got one difference, which is the containment?

23 MR. SHERMAN: That's correct.

24 VICE CHAIRMAN RANSOM: One thing that I
25 don't understand about this in a way is why the

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1 containment isn't treated just like any other
2 component in the nuclear power system.

3 And, in fact, granting over-pressure
4 credit isn't a matter of breaching the containment.
5 It's simply utilizing the pressure, which is going to
6 be there in an accident scenario that you have
7 assumed.

8 MR. SHERMAN: That's absolutely true, sir.
9 And, yet, in the development of the nuclear industry
10 for the 45-50 years that developed, this
11 defense-in-depth barrier concept with the containment
12 not as a component, like one pump, but, rather, as a
13 significant barrier, has always been significant. You
14 can find discussion of this in the general design
15 criteria.

16 And so no question that there is
17 containment pressure, but this defense-in-depth
18 concept we think is important.

19 CHAIRMAN WALLIS: So you're looking at a
20 scenario where the containment boundary fails before
21 the fuel fails, which usually it is the other way
22 around.

23 MEMBER SIEBER: I think you have to sort
24 of reach beyond the design basis base in order to show
25 a causal linkage between an incident in a plant, like

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1 a LOCA or what have you, and the failure containment.

2 In BWR early plants, the suspected linkage
3 that has been analyzed is the vacuum breakers. On the
4 other hand, you have to assume failures beyond the
5 design basis in order to be able to show or even cause
6 an analysis of the failure of the vacuum breaker to
7 cause this kind of interaction.

8 So you have to sort of be careful what
9 you're assuming, what actions you're assuming and what
10 failures you're assuming to stay in design basis base,
11 as opposed to severe accidents that are beyond the
12 design basis.

13 I think that was always -- the big
14 question is, is there some kind of accident that gives
15 you these conditions that is a design basis accident
16 where containment pressure wasn't there to assist in
17 establishing the right --

18 CHAIRMAN WALLIS: Are there some human
19 actions which somehow bypass the containment that you
20 didn't know about?

21 MEMBER SIEBER: That's right.

22 CHAIRMAN WALLIS: Then you had this
23 accident.

24 MEMBER SIEBER: Right.

25 MEMBER KRESS: For example, under shutdown

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1 conditions, you may have the containment open.

2 CHAIRMAN WALLIS: Right.

3 MEMBER SIEBER: Yes.

4 MEMBER DENNING: And there is also the
5 question if there is failure to isolate the
6 containment. It's not necessarily some severe
7 accident event that caused this failure.

8 MEMBER SIEBER: Yes. On the other hand,
9 if you're shut down, the energy available to cause the
10 accident is really not there either.

11 MEMBER KRESS: That's debatable.

12 CHAIRMAN WALLIS: Unless it goes critical
13 while it is shut down.

14 MEMBER KRESS: No, no, no. Shutdown risks
15 show that the decay heat is sufficient to cause you
16 severe --

17 MEMBER SIEBER: Yes. If you can't do
18 anything, if you eliminate all your safety systems,
19 you get heat. Sooner or later, it will get you, but
20 it's slower.

21 MEMBER KRESS: It's a little slower.

22 MEMBER SIEBER: Yes.

23 MR. SHERMAN: I actually have a little bit
24 more to say in this area a little bit later. And
25 we'll get to some more to say in --

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1 CHAIRMAN WALLIS: I think we are following
2 your logic, though.

3 MEMBER SIEBER: Yes.

4 MR. SHERMAN: Thank you very much.

5 I'm sorry. I wanted to point out what I
6 think is a current statement from the Committee again
7 or your predecessors from '99. "The uncertainties
8 that are intended to be compensated for by
9 defense-in-depth include all uncertainties,
10 predictable or unpredictable. Not all of these are
11 directly assessed in the normal PRA uncertainty
12 analysis."

13 That was true six years ago. We think
14 that is true now, although we're anxious to hear the
15 rest of the staff's presentation because it's possible
16 that they will deal with some of the concerns that
17 we've got here.

18 Now, the uncertainties are listed on this
19 slide. I'm going to read them all for the purpose of
20 the transcript. We'd like to discuss: One, maximum
21 temperature and minimizing pressure; two, adequate
22 NPSH margin; three, debris head loss; four, required
23 NPSH; five, operator confusion; six, unexpected
24 containment phenomena; seven, inadequacy of the single
25 failure assumption; and, eight, PRA issue of

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1 accounting for the unexpected.

2 We'll be brief with each one of these. We
3 have something to say about each one of them. And we
4 will be brief in doing that.

5 CHAIRMAN WALLIS: I think neither PRA nor
6 anything else can account for something which you
7 didn't expect.

8 MR. SHERMAN: Well, we do want to say
9 something about that, sir. So, now, the next part of
10 our presentation, this first one, Mr. Lochbaum will
11 speak on.

12 MR. LOCHBAUM: Thank you, Bill. Good
13 morning.

14 The first incident was maximizing
15 temperature and minimizing pressure. The calculations
16 to do so are quite complicated. And evidence has
17 shown that they haven't been done consistently in the
18 past, leading to our concern that the proposed
19 guidances in the draft regulatory guide don't ensure
20 consistency in the future or don't correct the problem
21 that exists.

22 Slide 14, please.

23 CHAIRMAN WALLIS: So you are claiming that
24 the calculations can be done in all kinds of ways and
25 still appear to meet the guidance?

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1 MR. LOCHBAUM: That's correct.

2 CHAIRMAN WALLIS: The guidance says, "You
3 go do the calculation." It doesn't tell you how to do
4 it. So there's a great deal of freedom.

5 MR. LOCHBAUM: That's correct. That's it
6 in a nutshell.

7 The next slide, what is in the draft
8 regulatory guide is the factors that can affect the
9 outcomes: Heat transfer to containment structures,
10 containment leakage, containment spray operation, et
11 cetera. All of those are listed in the regulatory
12 guide. There's not much guidance about how do you
13 treat those factors within the calculations.

14 Next slide. This has been identified in
15 the past in a study done for the NRC in 1997 following
16 the generic letter on NPSH and BWRs. The consultant
17 or the contractor who did the report for the NRC did
18 show after reviewing a number of the calculations that
19 the guidance had not been established. And several
20 utilities were using calculations with assumptions
21 that cannot be justified.

22 The next slide. For example, this
23 contractor looked at the Duane Arnold over-pressure
24 analysis and found that it was not adequate because
25 the analysis had been overly simplified and did not

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1 consider all forms of containment cooling, such as in
2 this case heat transfer to structures in the
3 containment.

4 Next slide. The contractor also did 11
5 case studies of containment response. And they varied
6 parameters for each of those 11 case studies, as shown
7 in this table.

8 The next slide explains what some of those
9 parameters were. The end result or what they ended up
10 doing was comparing the results by varying the
11 parameters. On slide 19, there is a their summary of
12 the results from those case studies.

13 The point I wanted to make with this slide
14 in this presentation was that by varying the input
15 parameters, which isn't going to be rocket science
16 here, you can have a huge change in the output from
17 the calculations.

18 And we're not advocating or suggesting
19 that licensees or anybody is out there gaming in order
20 to get the inputs they wanted.

21 CHAIRMAN WALLIS: This could be the basis
22 of this 95/95 type analysis, where you vary all these
23 things according to some kind of probability. And
24 then you see what's the probability that you fall
25 outside some desired range.

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1 If it's less than something, it might then
2 be acceptable. If this were spelled out, would you
3 satisfy you, then? It's not prescriptive in the sense
4 it's probablistic, but at least it's a prescription
5 for doing a probablistic analysis.

6 MR. LOCHBAUM: Yes. The goal would be to
7 have a process defined so that if 20 people chose it,
8 so that it would be repeatable and reliable and they
9 would ultimately get the same answer, not be all over
10 the map.

11 CHAIRMAN WALLIS: So some independent
12 consultant could do the same thing and get the same
13 answer.

14 MR. LOCHBAUM: Right. We feel the
15 guidance is lacking in achieving that outcome. And,
16 with it, I'll turn it back to Bill for the rest of the
17 --

18 MR. SHERMAN: The second uncertainty that
19 I mentioned was adequate NPSH margin. There is an
20 ANSI standard that's referred to by the Reg Guide
21 1.82. We provided you a reference of table 9-611 from
22 that standard, which identified that for nuclear
23 pumps, there is a recommended NPSH margin that's
24 actual over-required of 1.5, a 50 percent margin.

25 CHAIRMAN WALLIS: I didn't understand

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1 this, 1.5 or 3 feet, whichever is greater. Well, 3 is
2 bigger than 1.5. So what does that mean or does 1.5
3 go with A and 3 go with R or --

4 MR. SHERMAN: No. 1.5 is the ratio of the
5 actual over the required.

6 CHAIRMAN WALLIS: Oh. 1.5 isn't feet?
7 1.5 is a ratio?

8 MR. SHERMAN: That's correct. 1.5 isn't.

9 CHAIRMAN WALLIS: Oh, okay.

10 MR. SHERMAN: Or three feet, whichever is
11 greater. Sorry about that.

12 NPSH-r is traditionally defined as the
13 NPSH with a three percent head drop.

14 CHAIRMAN WALLIS: Could you tell me what
15 A and R mean here because they seem to mean different
16 things in the literature.

17 MR. SHERMAN: A means the actual.

18 CHAIRMAN WALLIS: The actual, right.

19 MR. SHERMAN: And R means the required.

20 CHAIRMAN WALLIS: R is the three percent
21 drop-off thing. Is that the --

22 MR. SHERMAN: Yes, sir.

23 CHAIRMAN WALLIS: Okay. And A is whatever
24 you've got?

25 MR. SHERMAN: A is whatever you have.

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1 CHAIRMAN WALLIS: All right.

2 MR. SHERMAN: We provided you with two
3 papers, one by a Mr. Terry Henshaw.

4 CHAIRMAN WALLIS: 1.5 looks very
5 conservative. Excuse me.

6 MR. SHERMAN: Yes, sir.

7 CHAIRMAN WALLIS: Oh, okay.

8 MR. SHERMAN: A paper by the staff
9 practice. It's pretty conservative. Even more, what
10 we're going to say here, which is we provided you a
11 paper by Mr. Terry Henshaw, a pump expert who
12 identified -- and then we provided comments by other
13 experts on Mr. Henshaw's paper in agreement, which
14 first stated that at NPSH-r, -- that's the three
15 percent head drop -- the pumps are cavitating a lot.
16 And I think that's a common understanding among pump
17 experts.

18 Furthermore, in order to prevent
19 cavitation, the standard itself says that you need 2
20 to 20 times NPSH-r to prevent cavitation.

21 Finally, the statement of Mr. Henshaw is
22 that the actual maximum cavitation point, which was
23 discussed earlier in this meeting, is not below NPSH-r
24 minus three percent, but it's actually between the no
25 NPSH point and the three percent value somewhere. And

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1 the experts in these papers agreed with that.

2 MEMBER KRESS: Pardon me. A question I
3 have about that -- it is probably certainly true and
4 they had good reasons for this happening.

5 MR. SHERMAN: Yes.

6 MEMBER KRESS: A question I might have is
7 if you were operating, say, at the peak damage
8 condition, --

9 MR. SHERMAN: Yes.

10 MEMBER KRESS: -- how much would that
11 compromise the capability of the pump or its emission
12 time? Would the damage be sufficient so that the
13 emission time is not met where it might be otherwise?
14 Do we have that kind of information?

15 MR. SHERMAN: Well, that question is
16 exactly our point in that we are presenting this as an
17 uncertainty.

18 MEMBER KRESS: We just don't know what
19 happens.

20 MR. SHERMAN: In other words, let me turn
21 it over, the same with the item that Mr. Lochbaum
22 mentioned. There is some probability that the lack of
23 this margin will result in damage. And that
24 probability probably isn't known very well, but it's
25 a real probability which needs to be taken into

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1 account in either conservativisms or in PRA space. And
2 we're going to mention both of those here.

3 MEMBER KRESS: What we know is that the
4 potential for --

5 MR. SHERMAN: Yes, it's a potential. And,
6 actually, the standard -- you know, the standard, as
7 Dr. Wallis mentioned, you know, the 1.5, that's 50
8 percent margin. That's quite high. And you're --

9 MEMBER KRESS: That was the other question
10 I was going to ask. So that gets you above this peak
11 position?

12 MR. SHERMAN: I'm sorry?

13 MEMBER KRESS: Will that give you a net
14 positive suction head that's above this peak damage
15 condition?

16 MR. SHERMAN: According to the experts in
17 the references that we provided you, the answer is
18 yes.

19 MEMBER KRESS: Okay. That's enough to get
20 you beyond this peak period?

21 MR. SHERMAN: That was their statement.
22 The statement in their references is that the peak
23 damage is probably a number of percentages above the
24 NPSH-r minus three percent.

25 Let me show you this slide, which

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1 identifies -- this is from the reference plant. And
2 it will take a little bit of explanation, but I will
3 try and be very brief.

4 I want to talk about the red line first,
5 the green line next, and the blue line. And so I
6 guess you have to look above to see the color.

7 CHAIRMAN WALLIS: It's okay.

8 MR. SHERMAN: The red line is the margin
9 for the reference plant for one of its applications,
10 one of its pumps with its requested over-pressure
11 credit.

12 CHAIRMAN WALLIS: I don't quite
13 understand. It looks worse than no over-pressure.
14 And I thought having higher NPSH-r margin was good.

15 MR. SHERMAN: It is. And that -

16 CHAIRMAN WALLIS: So that they don't
17 credit over-pressure?

18 MR. SHERMAN: Let me explain as I go
19 through this. The bottom line is the margin with the
20 over-pressure credit that they are requesting. The
21 green line is the margin with their actual situation
22 and their calculated pressure because they're not
23 asking for all of the over-pressure credit. And so
24 when you consider all of their calculated pressure --

25 CHAIRMAN WALLIS: It gets better.

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1 MR. SHERMAN: Correct. And the top line
2 is what the margin would be if they provided
3 sufficient NPSH without any over-pressure credit.

4 CHAIRMAN WALLIS: You mean having a
5 different pump?

6 MR. SHERMAN: Having a different --

7 CHAIRMAN WALLIS: Something different.

8 MR. SHERMAN: Or something different.

9 CHAIRMAN WALLIS: Because if they use the
10 present pump with no over-pressure credit, the curve
11 would be below all of these presumably?

12 MR. SHERMAN: Correct, without any
13 over-pressure. But I'm trying to give you what the
14 actual situation is.

15 CHAIRMAN WALLIS: It's interesting to show
16 that, too. So they need over-pressure credit --

17 MR. SHERMAN: Correct.

18 CHAIRMAN WALLIS: -- to show what the
19 curve would be because I assumed that this no
20 over-pressure credit was for existing pumps. And I
21 expected to see it below all of the other curves.

22 MR. SHERMAN: Yes. I see what you're
23 saying. And that curve could have been put on here,
24 but what the no over-pressure credit represents on
25 this graph is if they had --

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1 CHAIRMAN WALLIS: A different pump?

2 MR. SHERMAN: If they had a different pump
3 that provided the --

4 CHAIRMAN WALLIS: Screens, different
5 everything?

6 MR. SHERMAN: Right.

7 CHAIRMAN WALLIS: Different elevation, had
8 different --

9 MR. SHERMAN: But the point I wanted to
10 make in words was that at their requested
11 over-pressure credit, they are at a 1.1 margin, which
12 is probably pretty close to the maximum cavitation
13 point or with their real pressure that they've got,
14 1.2 margin is what it looks like, which, again, is
15 somewhere close or in the range of the maximum
16 cavitation point.

17 It would be better if they did not have to
18 take credit for over-pressure and this over-pressure
19 remained as an additional conservatism above. Then
20 you have something like the kind of margins that the
21 standard is asking for, at least at the maximum
22 pressure.

23 MEMBER SIEBER: Why would that be better?
24 Why would that be better? I mean, it's the same pump
25 under the same conditions.

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1 MR. SHERMAN: No. I'm saying that you
2 would need a different pump. And then you would have
3 the over-pressure as a conservatism, not credited but,
4 rather, an extra-conservatism above the --

5 MEMBER SIEBER: So how did you select the
6 pump that gave you that top curve?

7 MR. SHERMAN: I didn't select the pump.
8 I only assumed that the pump and the rest of the
9 system, frictions and head losses and so forth,
10 resulted in them having the required NPSH without
11 over-pressure. And then that curve represents the
12 additional margin that the pressure would provide
13 above NPSH-r.

14 CHAIRMAN WALLIS: So does this go back to
15 your earlier argument that there was an alternative
16 design which would get them past this pinch point --

17 MR. SHERMAN: Yes, sir.

18 CHAIRMAN WALLIS: -- without getting any
19 credit for over-pressure?

20 MR. SHERMAN: Yes.

21 CHAIRMAN WALLIS: You're saying what they
22 should do is spend money on a pump, rather than spend
23 money to NRC?

24 MR. SHERMAN: I believe what we're saying
25 is that we don't think that this reduction in

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1 conservatism should be done unnecessarily.

2 CHAIRMAN WALLIS: But you're saying that
3 there is an alternative?

4 VICE CHAIRMAN RANSOM: Is there something
5 that characterizes that particular pump that you
6 selected? I mean, presumably there would be a range
7 of NPSH capabilities at different pumps. It seems to
8 match at the end of the 55.6 hours. I'm just
9 wondering if there were some criteria or what criteria
10 was used to select that pump.

11 MR. SHERMAN: The pump in the example is
12 the 30-year-old pump that has been used for this
13 application from the beginning. And then there have
14 been many changes over the 30 years: sump strainer
15 redesigns, sump clogging issues.

16 Well, actually, my next point will say
17 more, but go ahead. Ask --

18 VICE CHAIRMAN RANSOM: Is this the same
19 pump you're saying, you're addressing now?

20 MEMBER SIEBER: No.

21 MR. SHERMAN: Oh. What you're asking is
22 what the characteristics would be of a new pump?

23 VICE CHAIRMAN RANSOM: Right. Why
24 couldn't I select just a wide variety of pumps? I
25 mean, what criteria is used to specify how much

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1 increase in NPSH margin was demanded of that pump, I
2 guess?

3 MR. SHERMAN: In basic engineering and
4 with this situation 30 years ago, one looks at what
5 the system requirements are and then one goes to pump
6 manufacturers and finds a pump that will meet those
7 requirements.

8 In the situation that they have, as I'll
9 show in the next slide, they have higher temperatures
10 in the sump. The torus water has higher temperature.
11 That creates an additional requirement for NPSH. They
12 would need to select a pump which had different NPSH
13 requirements that met the new requirements.

14 VICE CHAIRMAN RANSOM: What criterion was
15 used? I mean, how high is good enough?

16 MR. SHERMAN: Thirty years ago the torus
17 temperature wasn't as high.

18 VICE CHAIRMAN RANSOM: Well, is this 30
19 years ago, this pump?

20 MEMBER SHACK: I think the line is the
21 credited over-pressure pump. Now, as I understand
22 what you're arguing, you picked the pump that was one
23 with no over-pressure credit. And then that no
24 over-pressure line is the actual NPSH margin you have
25 with the pressure. Is that --

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1 MR. SHERMAN: I didn't really pick a pump.
2 I only assumed that the pump and system had --

3 MEMBER SHACK: The one.

4 MR. SHERMAN: -- NPSH-r. In other words,
5 the calculation resulted in the required NPSH to show
6 you what additional margin over the containment
7 pressure would provide if the system already had
8 NPSH-r.

9 MEMBER KRESS: That means you started this
10 curve at times zero at a ratio of one.

11 MR. SHERMAN: Correct.

12 MEMBER KRESS: What Bill was saying.

13 MR. SHERMAN: Correct.

14 MEMBER KRESS: And the rest is just the
15 temperature and pressure you get.

16 MR. SHERMAN: That's exactly it. Yes,
17 sir.

18 MEMBER KRESS: During the actual --

19 MR. SHERMAN: Yes.

20 MEMBER KRESS: The question is, what
21 accident are we dealing with here? Is the design
22 basis the worst one or --

23 MR. SHERMAN: This is actually the design
24 basis LOCA. And you're right. I did not specify
25 that.

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1 MEMBER KRESS: This is for the design
2 basis LOCA?

3 MR. SHERMAN: Yes, sir.

4 MEMBER KRESS: Okay.

5 MEMBER SIEBER: The curves that represent
6 the so-called new pump, they actually don't represent
7 a physical pump that you could go out and buy.

8 MR. SHERMAN: That's correct.

9 MEMBER SIEBER: And, in fact, there
10 probably isn't such a pump that would give you these
11 numbers unless you changed the entire design envelope,
12 which means put the pump deeper in the ground to
13 provide additional head and so forth, which typically
14 is either impossible or inordinately expensive to do.
15 We're really talking about a hypothetical pump here.

16 MR. SHERMAN: That's correct. And, as a
17 matter of fact, in other space, in the legal space
18 that you asked me about earlier, we have asked them,
19 have they done an evaluation and what costs they had
20 for pumps that would meet that. And the answer that
21 we had at that point was that they had not done that.
22 So they had not looked to see if they could. And we
23 think that's what the situation is now with the
24 reference plant.

25 We don't want to get -- may I go on to the

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1 next uncertainty?

2 MEMBER SIEBER: Thank you.

3 MR. SHERMAN: We believe that there is
4 also an uncertainty with head loss. As a matter of
5 fact, you have dealt with that a lot. And Reg Guide
6 1.82 deals with that directly on point.

7 I thought it would be interesting again to
8 provide a sample calculation from the reference plan
9 to give you order of magnitudes. The NPSH-r for this
10 particular application -- it is the same one that was
11 graphed before -- is about 32 feet.

12 I've given you the calculation at 170
13 degrees Fahrenheit and the calculation at 195 degrees
14 Fahrenheit torus temperature. Actually, 195 is their
15 maximum calculated torus temperature.

16 You can see a number of things from this
17 calculation. Number one, you can see that at 170
18 degrees Fahrenheit, they almost have sufficient NPSH-a
19 without having to credit over-pressure. 29.17 feet is
20 close to 32. They need a little bit of over-pressure,
21 a credit at 170.

22 CHAIRMAN WALLIS: Doesn't this 32 feet
23 depend on temperature? The NPSH-r must be a function
24 of temperature?

25 MR. SHERMAN: It is, but it is not

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1 generally adjusted for temperature.

2 CHAIRMAN WALLIS: Well, if the temperature
3 were boiling point, presumably it would be zero.

4 MR. SHERMAN: The NPSH-r is a function of
5 the pump and system. You know, the actual depends on
6 temperature, but what you have to develop, there is a
7 relationship to temperature, but it's not credited.

8 CHAIRMAN WALLIS: That seems very strange.
9 I would think that NPSH-r must depend on temperature.
10 Why is the pressure head so different at these two
11 conditions here?

12 MR. SHERMAN: The pressure head is
13 different. And that's one of the things that I wanted
14 to show in this, that the whole reason for needing
15 over-pressure credit is because of the increase in
16 temperature. You can see that at the higher --
17 basically it's because the density of water is less at
18 higher temperatures.

19 CHAIRMAN WALLIS: It doesn't change very
20 much, though.

21 MR. SHERMAN: But in the calculation, it
22 does. And you can see that the increase in
23 temperature from 170 to 195 actually reduces the
24 actual NPSH by about a third, from roughly 30 to
25 roughly 20.

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1 And, therefore, what you're asking for at
2 the maximum situation is about -- you're asking for
3 over-pressure credit to make up about one-third of
4 your actual NPSH.

5 CHAIRMAN WALLIS: What is this pressure
6 head term here? I don't quite understand there.

7 MR. SHERMAN: Well, I probably should have
8 made a slide that shows it, but it's actually the
9 atmospheric pressure minus the vapor pressure.

10 CHAIRMAN WALLIS: So that's where the
11 temperature comes in?

12 MR. SHERMAN: Yes, it does. At times the
13 specific --

14 CHAIRMAN WALLIS: Okay. Okay. So that's
15 assuming the containment is at atmospheric pressure?

16 MR. SHERMAN: That's correct. This does
17 not assume over-pressure.

18 CHAIRMAN WALLIS: Okay. And the debris
19 loss is not a contributor here?

20 MR. SHERMAN: That's the other point that
21 I wanted to show you for the reference plant, that the
22 debris loss term is almost negligible. It's only a
23 third of a foot in the calculation.

24 Let me move on. My point with this is
25 that in this area, the debris head loss term, which in

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1 the reference plant I showed you was very small, there
2 is uncertainty. There is some probability that that
3 is not the right value and that it is going to be
4 more.

5 I've listed on the slide four things,
6 which I'll just say real quick. But you know this
7 from the work that I have seen in your transcripts.
8 You know that the research in translating the research
9 into equations and methods, there are many, many
10 assumptions that are used. The assumption of --

11 CHAIRMAN WALLIS: That's separate from the
12 NPSH question. If you have enough debris, you clog
13 the screen. And the pump can suck as much as it
14 likes. It's not going to get much closer there.

15 MR. SHERMAN: But, as you see, you know,
16 in the calculation for the record for this example,
17 they are not showing much head loss. And our overall
18 point is that there is some probability, whatever it
19 is, that that head loss term is too low and that it
20 should be higher or might be higher.

21 Homogeneity is a big assumption, you know,
22 assuming all the debris is similar size particles and
23 all mixed evenly and all deposited evenly. That's a
24 huge assumption.

25 CHAIRMAN WALLIS: So did you look into

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1 this? Did they compute this using the present
2 regulation, which is 50 percent at the screen as
3 clogged? Is that --

4 MR. SHERMAN: No, no. They used the head
5 loss correlation from NUREG --

6 CHAIRMAN WALLIS: Did they assume that the
7 screen was then clogged uniformly or 50 percent?
8 Fifty percent is the present rule I understand.

9 MR. SHERMAN: I think uniformly.

10 CHAIRMAN WALLIS: Uniformly?

11 MR. SHERMAN: Uniformly.

12 CHAIRMAN WALLIS: Okay.

13 MEMBER SIEBER: And that's actually the
14 worst case, right, because if it's not uniformly, then
15 there are places where the flow can --

16 CHAIRMAN WALLIS: It's uniformly over the
17 screen but not necessarily within the bed. You know,
18 there's this steam bed business and all that stuff.

19 MR. SHERMAN: But that's just the
20 question. Yes, probably the worst case, although you
21 have got little bits of foil that are down there. And
22 there are assumptions about what happens with this
23 foil. You have got all manner of -- you've got this
24 huge conflagration going on. And there are just many
25 assumptions.

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1 But one particular assumption I have
2 listed here is the reference plant paint chip
3 assumption. In the specific case of the paint chips
4 in this plant, they assumed that all of the
5 unqualified paint in containment fails. They assumed
6 that all of the unqualified paint is transferred to
7 the torus. They assumed that no paint chips are
8 deposited on the strainer. And they do that. They --

9 CHAIRMAN WALLIS: What goes through the
10 strainer?

11 MR. SHERMAN: No. It all settles on the
12 floor.

13 CHAIRMAN WALLIS: The floor. I see.

14 MR. SHERMAN: And the assumption is based
15 on Ogden Research Lab tests. So that they have done
16 what is prudent for plants to do. They have done
17 testing.

18 Our point is that there is some
19 probability that that is not right and that somehow
20 that probability of that not being the best assumption
21 needs to be considered. It's an uncertainty. And
22 we're going to say more about it when we get to the
23 end. We can go faster.

24 MEMBER SHACK: The reference plant would
25 probably argue that that debris loss is conservative.

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1 They would not argue that it is accurate.

2 MR. SHERMAN: Well, heat is probably
3 right. Yes, sir. Yes, sir.

4 CHAIRMAN WALLIS: Do you know how much of
5 the paint is unqualified? Is this all of the paint in
6 the containment?

7 MEMBER SIEBER: No.

8 MR. SHERMAN: I would have to do research,
9 but, to the best of my knowledge, the top coat is
10 unqualified. And there is a certain percentage of it
11 left. A lot of it is peeled off already.

12 The bottom coat adheres. The primer coat
13 adheres. But I'm doing that from memory.

14 MEMBER SIEBER: That is an epoxy paint?

15 MR. SHERMAN: Yes. My next item, I'm
16 going to try and go a little bit faster. My next item
17 has to do with required NPSH itself. It turns out
18 that in the reference plant, the witness pump tests
19 for the reference plant 30 years go.

20 Well, things were different 30 years ago
21 or 40 years ago. And so they weren't run long enough.
22 They didn't take vibration readings. They weren't
23 done in exactly the ranges that they're operating now.

24 And so it turns out that to get an NPSH-r,
25 they have had to go back and sort of rebuild this. In

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1 rebuilding this, they have had to do a lot of
2 extrapolation for areas where they didn't have that.

3 I'm not questioning pump science. I think
4 the extrapolation methodologies are correct. They
5 have had to use as a basis not the pumps from their
6 own plant but pumps from other plants where they had
7 had data, pumps that didn't even run at the same
8 speeds, which meant that they have had to adjust the
9 speeds.

10 My only point here is that in the NPSH-r
11 that they're using, there is some uncertainty or
12 question. There is some probability that that is not
13 adequate and that what they developed is not the right
14 one.

15 MEMBER SIEBER: Just for my own
16 information, the reference plant, what was its
17 commercial operation date?

18 MR. SHERMAN: Nineteen seventy-two.
19 Construction permit, '68; operation, '72.

20 MEMBER SIEBER: Okay. I'm just trying to
21 think of what the testing programs were. Plants in
22 that time frame used to run 30-day tests.

23 MR. SHERMAN: Well, that's one of the
24 difficulties, that these pumps weren't run very long
25 at each point enough to really see that the data had

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1 --

2 MEMBER SIEBER: That's all they did, get
3 a head loss curve?

4 MR. SHERMAN: Yes, that's correct.

5 MEMBER SIEBER: But not a duration curve?

6 MR. SHERMAN: Correct.

7 VICE CHAIRMAN RANSOM: Are these the
8 original head flow tests --

9 MR. SHERMAN: Yes.

10 VICE CHAIRMAN RANSOM: -- that were made
11 with the pumps?

12 MR. SHERMAN: Yes, sir.

13 VICE CHAIRMAN RANSOM: Those are the ones
14 that we have which are the graphs which are difficult
15 to read because of the --

16 MR. SHERMAN: Yes, that is correct.

17 VICE CHAIRMAN RANSOM: -- black background
18 and --

19 MR. SHERMAN: Yes. We provided you that
20 as one of the references we provided.

21 CHAIRMAN WALLIS: So I think what you are
22 saying is there are quite a few uncertainties here
23 which you don't think are being suitably taken into
24 consideration in whatever the plant is claiming?

25 MR. SHERMAN: Yes. And we are going to

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1 show that on a graph. And we are going to conclude
2 that we shouldn't give away the credit unnecessarily.

3 CHAIRMAN WALLIS: So if they did this, if
4 they actually did a more sophisticated analysis and
5 put in uncertainties and all of that stuff, they might
6 come up with something acceptable there?

7 MR. SHERMAN: Or it might clearly state
8 that we ought not to give this --

9 CHAIRMAN WALLIS: It might. It might
10 reach a negative conclusion. Sure.

11 MR. SHERMAN: That's what we think.

12 CHAIRMAN WALLIS: All right.

13 MR. SHERMAN: Number five is operator
14 confusion. When you grant over-pressure credit, we
15 think you create a human factors problem because we
16 all know that in the type of accidents that are
17 considered, one of the primary functions of the
18 operator is to reduce containment pressure, to reduce
19 leakage. And operators have trained and trained and
20 trained on that.

21 And now what you do with over-pressure is
22 you're telling the operator, "Do that, but, on the
23 other hand, make sure that you save some containment
24 pressure because we're taking credit for it."

25 MEMBER SIEBER: This might be in using

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1 containment sprays, for instance, if they were
2 installed.

3 MR. SHERMAN: Right.

4 MEMBER SIEBER: I don't know if this is a
5 different sort of -- in some plants, perhaps not this
6 one, there would be containment sprays.

7 MR. SHERMAN: There are sprays in this
8 plant. And we spoke with the reference plant. And
9 they identified to us that they did not intend to
10 change their emergency operating procedures based on
11 containment over-pressure credit.

12 What we expected to see is some statement
13 in the EOPs that said "Assure that for this period you
14 keep this amount of pressure," but they don't do that.
15 What they do is they operate on a family of curves for
16 each of the pumps in question.

17 And the family of curves basically has
18 containment pressure plotted against some temperature.
19 And the family of curves is flow curves such that
20 given the pressure of the containment and the
21 temperature of the sump, you can see an acceptable GPM
22 flow rate from the pumps.

23 Now, our concern is this. We think that
24 the operators have pretty fine control over the pump
25 flow rates. We think they have much less fine control

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1 of the containment pressure. But what they're asked
2 to do is they're asked to reduce pressure just right
3 and then stop it at the right flow.

4 But what we think is more likely is that
5 they are going to reduce pressure and then they're
6 going to get to a point where they turn off the sprays
7 and pressure is going to go somewhere, likely below
8 where they need. And then in order to keep the pump
9 in range, they're going to have to reduce pump flow --

10 MEMBER SIEBER: Yes.

11 MR. SHERMAN: -- and in reducing pump
12 flow, have less flow than is credited in the accident
13 delivery analysis. Our only point here is that there
14 is a probability that the operators won't do this
15 right. And we think that it is a probability that is
16 higher than just the regular human factors
17 probabilities because of the confusion that is
18 incorporated in this. It is one of the six
19 uncertainties that we have for you today.

20 Yes, sir?

21 MEMBER SIEBER: You can help me make sure
22 that I have this properly in my mind. In order for me
23 to explain what I think is going on, you have to make
24 an assumption that everything is sort of homogeneous
25 inside containment.

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1 It would seem to me that if you reduce
2 containment pressure, you do it by cooling the vapor
3 in containment.

4 MR. SHERMAN: Yes, sir.

5 MEMBER SIEBER: And, as you cool that
6 vapor, you're reducing the temperature of the water in
7 the sump. Otherwise, it would boil and keep the
8 pressure up.

9 And so the pressure that contributes to
10 NPSH is declining as the operators are cooling off
11 containment, but, at the same time, the sump water is
12 also declining, which makes it less critical from the
13 standpoint of required head for that pump to operate.

14 Doesn't that all sort of balance out? And
15 the only real sticker is the assumption that
16 everything is a so-called equilibrium, which probably
17 is the case because, you know, it's a saturated
18 system?

19 MR. SHERMAN: Two comments, sir.

20 MEMBER SIEBER: Okay.

21 MR. SHERMAN: Comment number one is --

22 MEMBER SIEBER: Help me out.

23 MR. SHERMAN: The simplest answer is yes.
24 But the two comments are it depends on where you are.
25 I mean, it depends on where the temperature starts.

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1 If the temperature is high, granted, you're coming
2 down with containment pressure, but obviously that
3 temperature is high enough such that in some
4 calculations, they needed to ask for containment
5 over-pressure credit.

6 So, stated simply, in some space, the
7 power uprate, the addition of power that is produced,
8 has created a higher temperature that has brought all
9 of this up higher than it was previously. And,
10 therefore, we're in an area of concern.

11 And then the second thing is that there
12 probably is a lag between containment pressure and
13 sump temperature drop in torus water temperature.

14 So it probably doesn't track exactly one
15 to one. There's probably some physical time lag.

16 MEMBER SIEBER: I would imagine. Yes.
17 That's why I said that equilibrium had to be an
18 assumption.

19 MR. SHERMAN: Yes.

20 MEMBER SIEBER: You know, it probably
21 doesn't exit, particularly in BWRs because the
22 containment is sort of complex in the BWR from the
23 standpoint of --

24 MR. SHERMAN: The dry well is up there and
25 --

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1 MEMBER SIEBER: Yes. Intercommunication
2 of various parts of the containment. Okay. That
3 answers my question.

4 CHAIRMAN WALLIS: So what you are really
5 saying is that depending on what the operator does,
6 these curves are pressure and temperature. And NPSH
7 vary with time over days maybe.

8 MR. SHERMAN: Yes, although one point I
9 didn't exactly state before is that the reference
10 plant is asking for over-pressure credit for the -- I
11 showed it on one early curve -- for 55 hours. So in
12 this situation, they are asking for --

13 MEMBER SIEBER: For how long do they need
14 it?

15 MR. SHERMAN: Fifty-four hours.

16 MEMBER SIEBER: For 55 hours?

17 MR. SHERMAN: More than two days.

18 MEMBER SIEBER: Okay.

19 MR. SHERMAN: More than two days of run.

20 MEMBER SHACK: But, again, just to address
21 your point, I mean, it's not really surprising that
22 there's no change in EOPs. Even if they don't get
23 credit for containment over-pressure, they've been
24 trying to maintain it.

25 MR. SHERMAN: Well, the family of pump

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1 curves exists. And they exist in current EOPs. The
2 necessity for over-pressure credit, as I say, just
3 raises you up on that curve and makes it more
4 critical.

5 And I do believe that it is more likely --
6 I need to say it differently. There is a probability
7 that the operator will not be able to catch the
8 containment pressure at the level he or she needs such
9 that they would need to reduce pump flow in order to
10 stay within their family of curves.

11 And my only point is that that probability
12 needs to be taken into account. We'll get to the
13 graph that shows that here.

14 MR. LOCHBAUM: I just want to add one
15 brief comment in that while it's true that they may
16 have been always wanting to maintain it, now power
17 uprate might impose a consequence if they don't
18 maintain it that wasn't there before.

19 So the EOP should address that so the
20 operator doesn't inadvertently wander into some space
21 that they should not be. So that's why the
22 expectation was that the EOPs would address that new
23 need or new precaution.

24 CHAIRMAN WALLIS: So you're saying they
25 control the pump flow rates in response to the

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1 pressures and temperatures. So to avoid cavitation,
2 they might reduce the pump speed?

3 MR. SHERMAN: Yes, pump speed.

4 CHAIRMAN WALLIS: What would they do?

5 MEMBER SIEBER: Not the speed.

6 MR. SHERMAN: I'm sorry. They would
7 control it with valves.

8 CHAIRMAN WALLIS: With valves?

9 MEMBER SIEBER: They throttle the
10 discharge.

11 CHAIRMAN WALLIS: They throttle the
12 discharge. Okay.

13 MEMBER SIEBER: Yes.

14 CHAIRMAN WALLIS: But the speed is still
15 the same?

16 MR. SHERMAN: Yes, sir.

17 MEMBER SIEBER: It's a regular --

18 CHAIRMAN WALLIS: If you shut down the
19 pump and run it, it cavitates merrily. It boils in
20 the pump if you shut --

21 MEMBER SIEBER: It shouldn't. The pump is
22 probably the lowest point in the system. There may be
23 boiling going on someplace.

24 CHAIRMAN WALLIS: There's no flow through
25 it. It just heats the water until it --

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1 MEMBER SIEBER: If the pump is shut off,
2 it is not going to boil there. If the pump is running
3 but the discharge valve is closed, it will boil.

4 CHAIRMAN WALLIS: That's right. That's
5 what I mean.

6 MEMBER SIEBER: Okay.

7 CHAIRMAN WALLIS: So a lot of things are
8 interwoven here.

9 MR. SHERMAN: These last three are very
10 quick.

11 CHAIRMAN WALLIS: So he might throttle the
12 discharge, then, if he was approaching cavitation?
13 And then you're saying this might not cool the coil
14 sufficiently?

15 MR. SHERMAN: Well, I believe that in this
16 regime, the attempt would be to control according to
17 containment pressure.

18 CHAIRMAN WALLIS: I think it's much more
19 important to cool the coil than to try to avoid some
20 minor cavitation damage to the pump.

21 MR. SHERMAN: Well, that's another issue.

22 MEMBER SIEBER: The difficulty is that the
23 operator can't go and look at the pump or see it or
24 hear it, you know, because if you had an accident,
25 that whole area --

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1 VICE CHAIRMAN RANSOM: I thought the main
2 issue was inadequate cooling, not damage to the pump,
3 because even if you go beyond the three percent,
4 there's less --

5 MEMBER SIEBER: Up to about three percent.

6 VICE CHAIRMAN RANSOM: -- probability of
7 damage to the pump but --

8 MEMBER SIEBER: You're probably okay. And
9 I agree that a little bit of cavitation can sometimes
10 be worse than more cavitation because it kills the
11 bearings. It knocks the seals. And so you may end up
12 with a pump that leaks, which is not a good idea if
13 it's pumping radioactive water.

14 On the other hand, it will still pump. It
15 takes a fairly long period of time before you do
16 damage to the impeller to the extent that the pump
17 won't run or it won't pump.

18 VICE CHAIRMAN RANSOM: So the main
19 concern, I guess, is loss of head, right? Inadequate
20 cooling?

21 MEMBER SIEBER: Well, once you run beyond
22 the need of the curve, then the pump stops pumping at
23 all.

24 VICE CHAIRMAN RANSOM: Right.

25 MEMBER SIEBER: And it may chug. It may

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1 quit. And then damage occurs very rapidly because
2 you're pouring a lot of --

3 VICE CHAIRMAN RANSOM: Well, that's not
4 what I read in those articles that you provided. As
5 a matter of fact, they said, you know, if you run
6 beyond the three percent point, that the pump has no
7 problem with that.

8 MEMBER SIEBER: Well, the pump --

9 VICE CHAIRMAN RANSOM: Basically it's more
10 or less like homogeneous --

11 MEMBER SIEBER: Pump about ten percent,
12 but there comes --

13 VICE CHAIRMAN RANSOM: Right. The head is
14 down.

15 MEMBER SIEBER: Yes. There comes a point
16 where it won't pump at all and you get basically a
17 void at the vortex of the suction. And, you know,
18 there's just no way to move the fluid through it. But
19 that's well beyond the low NPSH values that the
20 required values are set.

21 MR. SHERMAN: It's interesting because on
22 the reference plant that we're speaking about, they
23 actually don't use the NPSH-r as the three percent
24 value.

25 What they end up using is a curve from the

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1 pump vendor that says that from zero to seven hours,
2 you can operate at this NPSH. And it will be
3 satisfactory. In other words, that takes into account
4 what you're saying about --

5 MEMBER SIEBER: The damage.

6 MR. SHERMAN: And the zero to seven-hour
7 range is less than NPSH minus six percent. So it's
8 down lower.

9 MEMBER SIEBER: Yes. Those kinds of
10 vendor statements are not unique to the reference
11 plant.

12 MR. SHERMAN: Correct. That's exactly --
13 and that's our point. And for the long term, they are
14 given another value that is a little bit higher than
15 NPSH minus three percent. Actually, it looks to be
16 close to the maximum cavitation point.

17 But they're given a vendor statement. And
18 presumably there is vendor information which backs
19 this up, though we haven't seen it. Presumably it
20 exists. I don't know if the staff has seen it, but on
21 the reference plant. Presumably that type of data
22 exists.

23 MEMBER SIEBER: Well, I don't --

24 CHAIRMAN WALLIS: There are at least four
25 parties involved here. There's you. And then there's

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1 the licensee, and there's the NRC. And there's us.

2 You're raising all of these questions. I
3 would think they could be answered by the licensee.
4 Are you telling us that you're not getting
5 satisfactory answers from Vermont Yankee? Is that
6 what you're telling us?

7 MR. SHERMAN: I'm not making any
8 statements around in that area.

9 CHAIRMAN WALLIS: Do you see? I mean, it
10 seems sort of strange. Are you asking us to ask
11 Vermont Yankee these questions? Are you asking us to
12 ask the staff to ask Vermont Yankee or what?

13 MEMBER SIEBER: I think that's the only
14 path they can do.

15 MR. SHERMAN: No, sir. No, sir, not at
16 all. We are here to demonstrate that these are
17 uncertainties that exist in the particular plant we
18 have looked at.

19 CHAIRMAN WALLIS: I would say go away and
20 resolve them, you know. Tell us when it's sorted out.

21 MEMBER SIEBER: The only way that these
22 folks can talk to the licensee is through the staff.
23 They can't do it directly.

24 CHAIRMAN WALLIS: They can't?

25 VICE CHAIRMAN RANSOM: We're dealing with

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1 Reg Guide 1.82, --

2 MEMBER SIEBER: It depends on what their
3 --

4 VICE CHAIRMAN RANSOM: -- I think. And so
5 what you're concerned with is there may not be a
6 prescriptive enough way of dealing with the
7 uncertainties?

8 MR. SHERMAN: That is exactly it. We feel
9 that these uncertainties exist. But let me run
10 through these last three. And then I'll make that --

11 CHAIRMAN WALLIS: I guess we are talking
12 about 1.82, right? 1.82 has a litany of things that
13 thou shalt consider, but it doesn't tell you how to do
14 it.

15 MR. SHERMAN: Exactly. I have an
16 uncertainty here of unexpected containment phenomena.
17 The reason that we put this in is this exactly ties to
18 the defense-in-depth. This is the one where the
19 containment doesn't function the way you expect.

20 Since, in addition to these
21 considerations, you are very much aware that the
22 containment leak test frequency is much less than it
23 used to be, it used to be every other outage, now it's
24 every ten years, the reference plant I think has a
25 waiver to go 15 years. And that changes your

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1 probability function based on the extension of the
2 test frequency.

3 MEMBER SIEBER: What function are you
4 talking about?

5 MR. SHERMAN: Well, I'm talking about
6 whatever the probability is that there is some leakage
7 that you don't know about.

8 MEMBER SIEBER: Yes, but that doesn't
9 impact the way the pump operates. That impacts --

10 MR. SHERMAN: If you give containment --

11 MEMBER SIEBER: -- Part 100.

12 MR. SHERMAN: No. If you give containment
13 over-pressure credit, it does because you're relying
14 on --

15 MEMBER SIEBER: You would really have to
16 leak a lot.

17 MR. SHERMAN: Well, the amount of leakage
18 and whether it affected the overall pressure is an
19 issue, you know.

20 MEMBER SIEBER: Yes. But, like I say,
21 that would not be your first concern that you're
22 losing. Your first concern --

23 MR. SHERMAN: Would be radiation.

24 MEMBER SIEBER: Radiation?

25 MR. SHERMAN: Radiation. But I wanted to

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1 point out the specific reference plant issue related
2 to the main steam isolation valves. In the last five
3 outages at the reference plant, they test all eight
4 main steam isolation valves, each outage.

5 MEMBER SIEBER: Right.

6 MR. SHERMAN: And, therefore, in the last
7 5 outages, that would be 40 valve tests. In those 40
8 valve tests, they've had 10 valve failures, 10 MSIV
9 failures.

10 CHAIRMAN WALLIS: What do you mean by
11 "failure"?

12 MEMBER SIEBER: Excess leakage, right?

13 MR. SHERMAN: Excess leakage.

14 CHAIRMAN WALLIS: Do you mean that there's
15 a leakage in the pipe? It's not to the outside world?

16 MR. SHERMAN: Correct.

17 CHAIRMAN WALLIS: It just flows through
18 the valve when it's -- it's set to the flows, but
19 there's a flow-through in it.

20 MR. SHERMAN: Correct. Some of the
21 failures were failures to -- they did pressurize, but
22 the leak rate through them was higher than allowable.
23 But there were others of these failures where they
24 wouldn't pressurize.

25 MEMBER SIEBER: They wouldn't pressurize

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1 at all?

2 MR. SHERMAN: To the best of my knowledge,
3 there was at least one that was in that category,
4 maybe more. I'm not sure. I'd have to look at the --

5 MEMBER SIEBER: I'll have to --

6 MR. SHERMAN: I provided the reference to
7 you.

8 MEMBER SIEBER: All right.

9 MR. SHERMAN: My point is that this is a
10 particular feature. This is a particular attribute of
11 the reference plant. But there may be other
12 situations out there like this.

13 MEMBER SIEBER: Well, so when you call out
14 the main steam isolation valves, that's not a
15 containment boundary for this plant. You call it out
16 by analogy that if this leaks, something else must
17 leak or explain to me how I'm to draw a --

18 CHAIRMAN WALLIS: Isn't it a containment
19 in a BWR? What is the --

20 MR. SHERMAN: It is a containment boundary
21 in the BWR in that if you have a loss of coolant
22 accident, then you have --

23 MEMBER SIEBER: It's supposed to close,
24 yes.

25 MR. SHERMAN: -- then you have an open

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1 pathway. And if the valves aren't failing, then you
2 have an open pathway of the containment atmosphere.

3 MEMBER SIEBER: Right, yes.

4 MR. SHERMAN: Number seven has to do with
5 deterministic calculations. It has to do about the
6 single failure assumption. I go way back in the
7 nuclear industry, all my working career.

8 The single failure assumption has been in
9 my view the backbone of nuclear design. That's why we
10 have redundant systems. And it's why we have such a
11 good safety record for the nuclear industry.

12 But when you get to calculations like
13 we're talking about here, the single failure
14 assumption has a detriment to it. And that is that
15 when real transients occur, David and I had a
16 difference in discussion. You know, I think about one
17 out of three transients, you have more than one
18 failure. David said one out of two. But, at any
19 rate, the real history of transients is that you get
20 more than one failure.

21 You add that to the emergence, at the
22 bottom bullet point, of what is called LCO, or online
23 maintenance. As you know, in these later years, all
24 the nuclear plants are intentionally taking out
25 safety-related equipment to do maintenance for up to

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1 a period of a week or so.

2 As a matter of fact, in the recent
3 Fitzpatrick event, which you're probably aware of,
4 with its torus, the diesel generator, one diesel
5 generator, was out when that was discovered, I
6 believe.

7 My only point here is that when you're
8 doing calculations like the calculations that Mr.
9 Lochbaum spoke about, maximizing temperature,
10 minimizing pressure, you assume the worst single
11 failure. But there's a sort of a non-conservatism in
12 that assumption because there is some possibility that
13 you're going to get more than one failure.

14 MEMBER SIEBER: But the design basis and
15 the licensing basis require you to assume an act of
16 failure along with whatever passive failure caused the
17 event.

18 MR. SHERMAN: Passive failure to cause the
19 event and then --

20 MEMBER SIEBER: And so the way you assure
21 yourself beyond the design basis is to look at the
22 probabilities of multiple failures through PRA and not
23 --

24 MR. SHERMAN: Well, that's exactly where
25 I was going with the next slide.

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1 MEMBER SIEBER: -- cause risk, additional
2 risk.

3 MR. SHERMAN: In other words, what has
4 happened is that to answer this question about more
5 than one single failure with deterministic
6 calculations, --

7 MEMBER SIEBER: Well, you can't.

8 MR. SHERMAN: -- we go to PRAs.

9 MEMBER SIEBER: Well, it's no longer
10 deterministic when you do that.

11 MR. SHERMAN: Correct.

12 MEMBER SIEBER: The deterministic thing
13 says, "Here is what you are required to assume." And
14 then you go and get the answer and see if it's a good
15 answer or a bad answer. Once you go beyond the design
16 basis, you will get it in terms of risk probabilities.

17 MR. SHERMAN: Exactly so. And let me --

18 MEMBER SIEBER: You're going to go through
19 there anyway.

20 MR. SHERMAN: We're going to jump right
21 there. With PRAs, the hard part about PRA that
22 Chairman Wallis and I -- we had an exchange just a
23 minute ago. It's the uncertainty. It's the unknown.
24 How do you model Davis-Besse in the PRA? How do you
25 model this sump/strainer history that you've had

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1 where, you know, you --

2 CHAIRMAN WALLIS: After it has happened,
3 you can model that.

4 MR. SHERMAN: There you go. After it has
5 happened, you have a pretty good failure rate after it
6 happens.

7 MEMBER SIEBER: Well, in general, it was
8 always in there. You know, they assumed LOCA. The
9 question is was the --

10 MR. SHERMAN: What caused it?

11 MEMBER SIEBER: The failure probability,
12 was that correct or not? You know, when the failure
13 probability approaches one, I think you have got a
14 different kind of an issue going.

15 MR. SHERMAN: So here is what we are
16 trying to say. We're trying to say that the
17 uncertainties that we have identified are real
18 uncertainties. From a deterministic point of view,
19 the uncertainties are great enough to direct that
20 over-pressure should be retained along with the other
21 conservatisms associated with deterministic methods.

22 In PRA space, we feel that the PRA doesn't
23 adequately account for the uncertainties that we have
24 described and that we feel that if they did, we feel
25 that they would direct you to retain the over-pressure

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1 conservatism, rather than give it away.

2 CHAIRMAN WALLIS: Now, when you say
3 over-pressure should be retained, you mean that there
4 should be no credit for over-pressure. Is that what
5 you mean?

6 MR. SHERMAN: That's correct.

7 CHAIRMAN WALLIS: Is this --

8 MR. SHERMAN: The system should provide
9 sufficient NPSH without having --

10 CHAIRMAN WALLIS: Without taking credit
11 for --

12 MR. SHERMAN: -- credit for the
13 containment pressure.

14 MEMBER SIEBER: And the effect of that is
15 to set a limit on how much power the reactor should
16 normally be licensed to produce.

17 MR. SHERMAN: No, not necessarily.

18 MEMBER SIEBER: Or buy new pumps.

19 MR. SHERMAN: Or buy new pumps. But we
20 think --

21 MEMBER SIEBER: If you can.

22 MR. SHERMAN: Exactly so. Exactly so, if
23 you can.

24 MEMBER SIEBER: Okay.

25 MR. SHERMAN: Now, looking at PRA space,

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1 I've provided here a fault tree for containment
2 isolation failure. I'd like to look at three things
3 in the fault tree.

4 I know it's hard to read. And the first
5 one is containment isolation failure, the top line of
6 the item. I think that it needs to be identified as
7 containment fails to hold pressure, which may be the
8 same as containment isolation failure but may not.
9 And I think that a thorough evaluation of the fault
10 tree may flush out some areas where they're not
11 exactly the same or they may not. I just don't know.

12 CHAIRMAN WALLIS: Let me try to see what
13 you're thinking about. I could see a situation --
14 maybe this isn't realistic -- where you have a LOCA
15 and you have no fuel failure. So there's no
16 radioactivity. And then your containment fails to
17 hold pressure, and the fuel fails later in this
18 scenario as a result of insufficient cooling because
19 the pumps don't work. Is that what you're looking at?

20 MR. SHERMAN: Right, right.

21 CHAIRMAN WALLIS: So you could have a
22 failure to hold pressure, which initially doesn't
23 involve any failure to contain radioactivity because
24 there isn't any.

25 MR. SHERMAN: Correct, right.

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1 CHAIRMAN WALLIS: Okay.

2 MR. SHERMAN: The next item on here, I've
3 circled the "dry well isolation failure flow path,"
4 two-inch diameter or greater. When we looked at the
5 fault tree and tried to understand this, it did not
6 look like this included MSIV or feedwater failure for
7 the reference plant.

8 We have already pointed out that the MSIV
9 failure rate at this particular reference plant is
10 high, higher such that we think that the result that
11 this fault tree is given is probably an order of
12 magnitude too low, considering the MSIV failures.

13 CHAIRMAN WALLIS: Well, this is all
14 qualitative. Has anyone calculated? Maybe they don't
15 know the leak rates of the MSIVs. But if you know the
16 leak rates, you could presumably figure out the rate
17 of --

18 MR. SHERMAN: Well, we think maybe the
19 staff will have something for us. We hope so.

20 CHAIRMAN WALLIS: The staff is going to do
21 that?

22 MR. SHERMAN: We hope.

23 MR. LOCHBAUM: I also, if I could just
24 have a minute, think that's related to Bill's comment
25 about what the criterion is. If it's containment

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1 isolation failure, then it's go/no go. If it's
2 failure to hold pressure, it's a --

3 CHAIRMAN WALLIS: Yes. That's what I was
4 getting at, too. It has two functions at least.

5 MR. SHERMAN: The last item I have circled
6 on here are the items that say "pre-existing
7 containment leakage," small opening/large opening.
8 There are probabilities on the sheet here that show
9 probabilities of E-3 for a small failure, larger for
10 a big failure.

11 Those probabilities probably need to be
12 adjusted because the leak rate test frequency is now
13 different. Those are based on testing a lot more
14 frequently. And then we don't think that they
15 adequately consider the unexpected.

16 CHAIRMAN WALLIS: Are there parts of the
17 environment through containment, which could be left
18 open as a result of human action? I mean, are there
19 valves or access ports or things that --

20 MR. SHERMAN: There are.

21 CHAIRMAN WALLIS: -- can be left open
22 inadvertently by people?

23 MR. SHERMAN: Yes, there are, although my
24 belief is that this fault tree accounts for that.
25 There are other paths.

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1 CHAIRMAN WALLIS: Well, people actions are
2 rather hard to account for.

3 MR. SHERMAN: Whether it accounts for it
4 in the human factors --

5 CHAIRMAN WALLIS: It's actually in the
6 fault tree.

7 MR. SHERMAN: Yes. But whether it's
8 adjusted to the human factors, the latest human
9 factors that you have looked at, I can't answer.
10 Looking at the fault tree relating directly to core
11 cooling, that is the low-pressure core spray system.
12 And on this fault tree, I would like to look at the
13 right-hand side of it.

14 This is the portion that says low-pressure
15 core spray loops fail to deliver flow. If you can
16 read it well enough, you'll see that they expand into
17 additional pages.

18 And I haven't given you those pages on the
19 slides, but when you get down to the bottom, the
20 element of interest is an element that is low-pressure
21 core spray pump fails to run during emission time.
22 That's what we're speaking about.

23 The probability in the fault tree is
24 almost E-3, 8 times E-4. And we don't think that that
25 probability takes into account everything that it

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1 should.

2 As a matter of fact, when we reviewed the
3 IPE, where we've taken these from, we found this
4 statement, "The low-pressure core spray pump
5 unavailability due to insufficient NPSH caused by
6 elevated suppression pool temperature is considered in
7 the applicable event tree but is not included in the
8 fault tree model."

9 CHAIRMAN WALLIS: Isn't there a problem
10 with all of these PRAs that these boxes tend to be
11 go/no go things and the pump fails to deliver flow?
12 Well, the pump is probably delivering some flow under
13 all conditions, but it doesn't deliver enough. So
14 there's some sort of an it works or it doesn't work
15 probability.

16 In reality, there is a whole continuum of
17 ways in which it is working, which isn't in the PRA.

18 MR. SHERMAN: Exactly so.

19 MEMBER SHACK: And then it's through
20 success criteria.

21 CHAIRMAN WALLIS: But there's just your
22 success criteria, right? But it may well be that they
23 are very conservative and that if the pump is
24 delivering half as much flow, it still works perfectly
25 well. But that's being erased because you now say it

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1 has failed.

2 MEMBER SHACK: I think your point is that
3 there are assumptions. Even in PRA space, there are
4 assumptions that are made.

5 CHAIRMAN WALLIS: Very much so. You're a
6 believer, I see.

7 MR. SHERMAN: Summarizing what we have
8 said, this is what we think is lacking. And this is
9 a cut at a way to look at what we are saying. We
10 think that there is a logic item that is pump fails
11 due to inadequate NPSH that hasn't been included in
12 the fault tree by the statement on the previous slide.

13 Among other things, it could include,
14 number one, the probability that NPSH-r is not
15 sufficient, that you don't know the right one from the
16 vendor because the pump is old, the probability that
17 the debris head loss is more than you expect it is
18 going to be, the probability that the NPSH margin is
19 insufficient, the probability that the containment is
20 going to hold pressure. And you've got an event tree
21 that shows that, but it's probably non-trivial to
22 figure out how you fold that back into this place in
23 the PRA space. I'm not saying this is easy to do.

24 Then the two things that David spoke
25 about, probability that insufficient pressure is

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1 developed or the temperature is higher than you
2 expected it to be --

3 CHAIRMAN WALLIS: I'm not a PRA expert,
4 but it seems to me all of this flow forward stuff
5 doesn't indicate the fact that something which happens
6 downstream could affect something upstream. I don't
7 know how they do that. There must be --

8 MR. SHERMAN: Well, neither do I.

9 CHAIRMAN WALLIS: -- feedback type loops
10 in PRAs. And all of this is flowing forward. And
11 this fails, and that fails and so on. There is no way
12 in which something downstream can go back and loop and
13 affect something by some --

14 MR. SHERMAN: Well, actually, we think
15 that there is some looping here, but --

16 CHAIRMAN WALLIS: I don't know, but --

17 MR. SHERMAN: But we are not PRA --

18 CHAIRMAN WALLIS: I'm just thinking about
19 it. Everything is so interdependent here.

20 MR. SHERMAN: Exactly so. And the last
21 item that I have in the box is operator fails to
22 retain. These are the uncertainties that we discussed
23 that I --

24 CHAIRMAN WALLIS: You're redesigning the
25 PRA.

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1 MR. SHERMAN: Well, I'm only identifying
2 what I think is not taken into account and that when
3 you do take it into account, I think you conclude that
4 you should retain the over-pressure as a conservatism,
5 rather than give it away.

6 I've been going a long time. If you'd
7 like me to terminate here, I can because the next
8 items talk about specific flaws in the reg guide as
9 given. If you want to give me another ten minutes, I
10 can run through this. It depends on how your timing
11 is.

12 VICE CHAIRMAN RANSOM: I think there is
13 some time later in the day for feedback.

14 MR. SHERMAN: That would be fine.

15 VICE CHAIRMAN RANSOM: Maybe that would be
16 the appropriate place to do that.

17 MR. SHERMAN: That would be fine.

18 CHAIRMAN WALLIS: Maybe we could get a
19 debate going between you and the staff.

20 MR. SHERMAN: That would be good. We
21 would like that.

22 VICE CHAIRMAN RANSOM: I think if that is
23 okay, I will call for a break for 15 minutes.

24 MR. SHERMAN: From the State of Vermont's
25 perspective, we would like to thank you very much for

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1 the opportunity to come and present our concerns.

2 MEMBER SIEBER: Thank you for coming here.

3 VICE CHAIRMAN RANSOM: Be back at 10 'til.

4 (Whereupon, the foregoing matter went off
5 the record at 10:33 a.m. and went back on the record
6 at 10:55 a.m.)

7 VICE CHAIR RANSOM: Can we proceed?

8 MR. LOBEL: We talked about the NRC
9 position.

10 VICE CHAIR RANSOM: The new position.

11 MR. LOBEL: The new position, the new/old
12 position. In order to understand the position a
13 little and where we are, it would be helpful to
14 consider the evolution of the position and a little of
15 the history. Let me say first because this has been
16 brought up before that there is no regulation that
17 prohibits credit and containment accident pressure for
18 available NPSH. We're talking about staff guidance
19 and not GDC or any other regulation.

20 MEMBER SIEBER: What's the status of the
21 old safety guides? Are they like regulatory guides
22 like 1.1 for instance?

23 MR. LOBEL: Do you mean Safety Guide 1?

24 MEMBER SIEBER: Yeah.

25 MR. LOBEL: Safety Guide 1 is also called

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1 Regulatory Guide 1 and that's part of this package to
2 revise.

3 MEMBER SIEBER: Yeah, I read it. It's a
4 one page deal.

5 MR. LOBEL: Yeah.

6 MEMBER SIEBER: But all the safety guides
7 are gone now. Right?

8 MR. LOBEL: I don't know. I don't know
9 about the others. Okay. We issued Regulatory Guide
10 1.1 or Safety Guide 1 in November 1970 and it dealt
11 exclusively with calculating available NPSH.

12 CHAIRMAN WALLIS: So it's only regulatory
13 guide?

14 MR. LOBEL: Right.

15 CHAIRMAN WALLIS: There's no regulation.
16 The regulations were silent.

17 MR. LOBEL: The regulations speak to -- I
18 think it's GDC 35 speaks to abundant ECCS flow and GDC
19 38 speaks to adequate containment cooling but not
20 specifically NPSH. I've stated the position in the
21 Reg Guide that you should assume the maximum expected
22 temperature of the pump fluids and no increase in
23 containment pressure from that present prior to the
24 postulated loss of coolant accident. The NRC allowed
25 credit for containment accident pressure for some

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1 reactors licensed before the issuance of the Reg Guide
2 but reactors licensed after issuance of the Reg Guide
3 generally complied with the guidance.

4 On December 3, 1985, the NRC issued
5 Generic Letter 85-22 which discussed the findings of
6 USI A-43 on containment emergency sump performance.
7 The issue concerned the blockage of emergency core
8 cooling systems, sump screens and PWRs and to a lesser
9 extent potential for blockage in BWRs section
10 strainers. The generic letter discussed the findings
11 which included the fact that the blockage of the sump
12 screens by LOCA-generated debris required a plant-
13 specific resolution.

14 Remember before this, it was the 50
15 percent assumption for all plants, and a revised
16 screen blockage model should be applied to the
17 emergency sump screens. But the NRC regulatory
18 analysis didn't support a back-fit of this guidance.
19 So the guidance was if, Mr. Licensee, you change out
20 your insulation and containment you should use this
21 new guidance, but it was never a requirement. As part
22 of the resolution, Reg Guide 1.82 was revised to
23 Revision 1 to consider blockage and effects in a more
24 physical way. I'm getting confused here with the
25 slides.

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1 Standard Review Plan Section 6.22 was also
2 revised to include the following guidance that the
3 NPSH analyses would be acceptable if it was done in
4 accordance with the guidelines of NUREG 0897 which
5 contain the technical findings of the USI and if it
6 was done in accordance with Reg Guide 1.1. So even
7 after the first examination of the effects of LOCA-
8 generated debris on available NPSH and the proposal of
9 uniform coverage, the guidance for NPSH was still Reg
10 Guide 1.1.

11 Then in July of 1992, there was the
12 Barsebäck, a Swedish boiling water reactor experienced
13 spurious opening of a pilot operator relief valve at
14 435 PSIG and that resulted in dislodging some mineral
15 wool insulation which blocked some emergency suction
16 strainers. This led after several blockage events in
17 this country and an extensive research and development
18 to the NRC issuing Bulletin 96.03. All BWRs complied
19 with the recommendations of 96.03 by installing
20 larger, better designed ECCS suction strainers.

21 The design of these strainers took into
22 account plant-specific debris loading of several types
23 of materials and in general these loadings were
24 predicted to be much higher than anticipated prior to
25 the research which followed the Barsebäck event. This

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1 resulted in an increase in the predicted flow
2 resistance across even these larger strainers which
3 resulted in a decrease in calculated available NPSH.
4 In some of these cases, this led to the necessity for
5 containment accident pressure.

6 VICE CHAIR RANSOM: That was to meet the
7 NPSH requirements?

8 MR. LOBEL: Right.

9 VICE CHAIR RANSOM: Where is the NPSH
10 requirement more or less legislated that you must meet
11 it?

12 MR. LOBEL: Well, like I was saying, there
13 is nothing in the regulations. There are these reg
14 guides that we're talking about. Other than that,
15 it's just good engineering practice that centrifugal
16 pumps need adequate available NPSH. They would just
17 be part of the design basis of the plant when you pick
18 a pump that that pump has to have a adequate NPSH.

19 VICE CHAIR RANSOM: So the hurdle is a reg
20 guide and good engineering practice that you must --

21 MR. LOBEL: There are industry standards
22 that deal with NPSH and calculating NPSH that I'll
23 talk about a little later, but the NRC hasn't endorsed
24 those in general. There is an industry standard on
25 doing reactor-transient analysis which the NRC hasn't

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1 endorsed that tells you how to do containment analyses
2 for different types of vents. But it doesn't talk
3 about NPSH, doing containment analysis for NPSH. So
4 really all there is is the closest thing in regulatory
5 space are the reg guides.

6 MEMBER SIEBER: Well, and they aren't
7 regulations.

8 MR. LOBEL: And they aren't regulations.
9 Right.

10 MEMBER SIEBER: The regulations that one
11 relies on are the general design criteria which says
12 you have to cool the core and you have to cool
13 containment to keep it from failure.

14 MR. LOBEL: Right.

15 MEMBER SIEBER: Everything beyond that
16 comes from codes and standards and they get
17 incorporated in the technical specifications and also
18 LCOs and surveillances. So that's really where the
19 stuff comes from.

20 VICE CHAIR RANSOM: What I'm hearing,
21 normal pump operation like in a rocket or in an
22 irrigation pump or something like that, of course,
23 it's pump damage that you worry about from cavitation
24 point of view. But here apparently, it's not so much
25 damage as inadequate coolant flow.

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1 MR. LOBEL: Well, I'd say both. You can
2 maybe damage the pump to a certain point where you're
3 not interfering with its safety function but it's
4 really both. You don't want to damage at the pump and
5 you obviously have to deliver the flow that you're
6 assuming in your safety analysis.

7 VICE CHAIR RANSOM: My experience with
8 cavitation is it's a fatigue-damage phenomena having
9 to do with collapse on the surface and a fairly large
10 number of cycles before you really begin to erode the
11 material -

12 MR. LOBEL: That's one of these that --

13 VICE CHAIR RANSOM: -- as opposed to gross
14 damage with a - going through the pump.

15 MR. LOBEL: Right, that's one of the
16 effects, but you can also damage bearings and seals
17 and other things if you have enough vapor that you
18 start to get radial forces or axial forces that you
19 haven't considered in designing the pump.

20 MEMBER SIEBER: And that's the area of
21 concern. You're not worried about impingement pitting
22 for a pump that's only going to run for 30 or 60 days.
23 It's not long enough for you to change the flow
24 characteristics of the pump. But constant vibration,
25 high vibration, can destroy seals, destroy bearings

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1 and that's a problem.

2 MR. LOBEL: And when people have taken
3 some credit for cavitation and licensees have, I'm
4 going to get into this later, but it's usually that
5 they've run a test with that pump or a similar design
6 pump. They've run it in cavitation at the expected
7 conditions and then they disassemble the pump and they
8 look at shafts and bearings and impeller surfaces and
9 things and they see that there's no damage for the
10 length of time that they've run that pump.

11 In some cases, pump vendors make
12 statements. Licensees will submit statements made by
13 the pump vendor that says that we'll endorse that the
14 pump can operate under these conditions for this
15 length of time.

16 MEMBER SIEBER: And those are generally
17 based on tests that the manufacturers run.

18 MR. LOBEL: Right, which may not be on
19 that particular pump but on a similar pump.

20 VICE CHAIR RANSOM: What we've heard
21 recently I think is that the likelihood of damage was
22 much greater from debris, calcium silica and some of
23 the other things that plugged some of the passages and
24 erode the bearings. Those are not addressed, I guess,
25 by this. Right?

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1 MR. LOBEL: No, like I've said, I'm just
2 talking about NPSH and I know the staff is working on
3 downstream effects it's called but I'm not the person
4 to discuss that. So I guess the point of all this
5 with the Barsebäck event was that the Reg Guide was
6 revised again to include the BWR guidance in May 1996.

7 As a related issue in '96 and '97 as a
8 result of the NRC inspections and licensee event
9 reports, the NRC became aware that available NPSH for
10 ECCS and containment heat removal pumps may not have
11 been adequate in all cases. This applied to both PWRs
12 and BWRs. In order to understand the extent of the
13 problem, the NRC issued Generic Letter 97.04 which
14 requested licensees to provide current information
15 regarding their NPSH analyses for the ECCS and
16 containment heat removal pumps.

17 Again, there have been statements about
18 not following the guidance in the Generic Letter
19 97.04. The Generic Letter didn't contain any
20 requirements or request any actions other than a
21 response to questions on NPSH calculations which
22 included credit for containment accident pressure.

23 There were no review criteria in Generic
24 Letter 97.04 itself. In some cases in response to
25 97.04, licensees had to revise their NPSH analyses and

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1 in some of these cases, licensees proposed credit for
2 containment accident pressure. This was necessitated
3 by things like finding that they had incorrectly
4 considered flow losses and the BWRs, like I said, when
5 they put in the larger suction strainers when they
6 accounted for more debris they found some of them that
7 they needed credit for containment over-pressure.

8 CHAIRMAN WALLIS: And this GED was
9 satisfied by granting credit.

10 MR. LOBEL: Yes.

11 CHAIRMAN WALLIS: Was some criterion, the
12 criteria, that you indicated at the beginning were
13 used in deciding whether to --

14 MR. LOBEL: What we did was we went
15 through the letters that were submitted from the
16 licensees and reviewed them. As we did the reviews,
17 we came up with positions on what was acceptable and
18 not acceptable. We didn't publish those positions any
19 place and they were only included in individual SERs
20 as they applied to that plant review.

21 So leading into the next view graph, since
22 the criteria weren't published before, we felt that in
23 order to make them available they should be available
24 to stakeholders and we included them in Reg Guide 1.82
25 Revision 3. The reason for doing that was that now

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1 Reg Guide 1.82 Revision 3 contains all the regulatory
2 positions in one reg guide related to all pump suction
3 issues, vortexing, air entrainment, debris, blockage
4 as well as NPSH.

5 So a stakeholder who wants to look at what
6 the NRC position is on any issue that deals with pump
7 suction can go to this one reg guide and find whatever
8 guidance there is. It may not be all that complete in
9 some cases. But the regulatory guidance we have would
10 be in one place.

11 To bring up your predecessors again, we
12 briefed the ACRS twice on NPSH credit for accident
13 pressure. The last briefing was in December 1997 and
14 particularly concerned the effect of the staff's
15 position on beyond-design basis accidents and we, the
16 Commission, received a letter from, to Chairman
17 Shirley Ann Jackson, which concurred in it the NRC
18 staff position but urged that all accident sequences
19 should be examined as I quoted before. You'll see
20 we've tried to include this in the reassessment that
21 we're going to talk about today.

22 The reg guide allows credit for
23 containment accident pressure and determining
24 available NPSH but Reg Guide 1.1 and Standard Review
25 Plan Section 6.22 do not. So that's the inconsistency

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1 that we're going to fix now. That's why all of these
2 documents were included together.

3 Reg Guide 1.82 Revision 3 states that
4 "Containment accident pressure should only be credited
5 when the design cannot be practicably altered." It
6 goes on to state that "No additional containment
7 pressure should be included in the determination of
8 available NPSH then is necessary to preclude pump
9 cavitation." We propose to change these positions to
10 the position I stated earlier which emphasizes safety
11 and is more consistent with the staff reviews.

12 Essentially, we decided internally that
13 there was really no practicable alternative that
14 replacing RHR in core spray pumps in these older
15 plants, and you'll see later I'll talk about the
16 plants that this is applicable to, really wasn't a
17 very practicable alternative and that we've always
18 granted the pressure that was asked for when
19 calculated with a conservative assumption. So
20 essentially, we ended up with the position that we're
21 at now and hadn't followed the positions of the
22 regulatory guide.

23 VICE CHAIR RANSOM: What is the
24 alternative? If you don't accept this, do you shut
25 the plant down?

1 MR. LOBEL: If you don't accept it,
2 usually the argument is about, the discussion is
3 about, assumptions in the analysis. If there were
4 some reason why we couldn't accept it, then the plant
5 wouldn't be able to do whatever it was asking to do,
6 the power upgrade for instance or operate with the
7 larger --

8 VICE CHAIR RANSOM: Like the older plants,
9 it couldn't satisfy it even under the current
10 licensing basis. You didn't change the safety at all.
11 You would simply allow them to continue to operate I
12 guess.

13 MR. LOBEL: They could power down and
14 maybe that would help with the flow they needed for
15 the pumps.

16 VICE CHAIR RANSOM: But you don't require
17 it.

18 MR. LOVEJOY: Or changing out -- Well, we
19 don't require it. If there was something wrong with
20 the analysis, something we wouldn't accept, then we'd
21 look for alternatives. If there wasn't any good
22 alternative, then the plant wouldn't be able to do
23 whatever it was asking to do. We haven't gotten to
24 that situation with anybody.

25 The analyses for the BWRs are fairly

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1 standardized and very conservative like -- I'll talk
2 about before. If there were a problem with blockage
3 of the suction strainers in the BWRs, even in the PWRs
4 I suppose too, they could change out insulation and go
5 to some insulation that would be -- Get rid of the
6 Calsil or whatever and go to an insulation that would
7 give them better, more favorable, characteristics. It
8 hasn't been a case of go or no-go yet. It's been more
9 a case of discussing assumptions and modeling.

10 MEMBER SIEBER: I think one way to look at
11 it is that for every plant regardless of the type or
12 design as you increase power you will reach some limit
13 someplace.

14 MR. LOBEL: Right.

15 MEMBER SIEBER: And this cooling of
16 containment and core cooling could involve one of
17 those limits.

18 MR. LOBEL: Yeah. In this case, the flow
19 rates of the pumps we're talking about aren't
20 increasing. The analyses are showing that they're
21 still acceptable at the higher power conditions or
22 with the increased blockage or whatever.

23 CHAIRMAN WALLIS: So on this slide, you're
24 going to get rid of these two statements.

25 MR. LOBEL: Yes.

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1 CHAIRMAN WALLIS: Because precluding pumps
2 -- is a bit awkward. Since we've heard that NPSH-r
3 corresponds to operating with the pump with quite a
4 bit of cavitation. So you have to have a different
5 definition of NPSH in order to preclude pump
6 cavitation all together.

7 MR. LOBEL: I've tried to use the two
8 terms that are technically used "available NPSH" and
9 --

10 CHAIRMAN WALLIS: But they're not the
11 same. I don't think we have -- I don't think pump
12 manufacturers give you a number for the onset of the
13 very, very first cavitation.

14 MR. LOBEL: Oh no.

15 CHAIRMAN WALLIS: That would be precluding
16 cavitation, wouldn't it?

17 MR. LOBEL: That would be precluding
18 cavitation. That's right.

19 CHAIRMAN WALLIS: So it's not a very good
20 definition.

21 MR. LOBEL: And it's not a very good --
22 That's right. It's not a very good technical
23 statement. The onset of cavitation is at some much
24 higher -- That was the factor of two or twenty that
25 was quoted before.

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1 CHAIRMAN WALLIS: There are certain points
2 in the pump which are particularly susceptible to
3 cavitation and you might get a little bubble there
4 pretty early on.

5 MR. LOBEL: Right. The standard pretty
6 much has been a three percent drop in head. Some
7 people have proposed a five percent drop or head or
8 even more, but the required NPSH typically is the
9 three percent. The reasons for that are that three
10 percent when you're doing the test is easy to notice.
11 You can see a three percent drop in head when you're
12 doing these tests.

13 The other reason is that to throw in
14 another term for low suction energy pump -- That's a
15 term that's used by the hydraulic institute and in
16 other papers for characterizing the tendency of pumps
17 to cavitate and to cause damage to the pump. For low
18 suction energy pumps, the three percent doesn't result
19 in any damage to the pump. The pump can operate for
20 a very long time with a three percent head drop for
21 those types of pumps. I won't quote the staff
22 position again. It hasn't changed between earlier and
23 --

24 MEMBER KRESS: What does the guidance go
25 on to say, going back to your slide, what is meant by

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1 sufficient pressure? Is there still guidance on
2 keeping a certain margin between it?

3 MR. LOBEL: Yeah, that's a little
4 complicated. It's kind of a complicated subject but
5 what the staff has always accepted is that the
6 available NPSH could be equal to the require NPSH.
7 That would be acceptable. When the containment --

8 MEMBER KRESS: Without any additional
9 margin.

10 MR. LOBEL: Without any additional margin.

11 MEMBER KRESS: I thought that margin is in
12 there because it's calculated conservatively.

13 MR. LOBEL: Yeah. Without any additional
14 margin in that particular aspect, but as I'm going to
15 get to in a few minutes, there's a lot of margin in
16 the containment analysis and the other analyses.

17 MEMBER KRESS: So it's just not in the
18 calculations.

19 MR. LOBEL: It's not in the required
20 equally the available NPSH. We're not putting margin
21 in that. The reason is it really gets behind what we
22 know what's been tested about these pumps. We know
23 that at a margin ration of one, NPSH/NPSH-r at a
24 margin ratio of one, the cavitation damage really
25 isn't that bad that tests have been done, have shown

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1 that when you have a margin slightly above one,
2 whatever slightly is and it varies with the pump
3 design, you're more likely to have cavitation damage
4 than at a ratio of one. Until you get to a point
5 where you have so much available NPSH that you don't
6 have a cavitation problem anymore.

7 So it's hard to define where, if you're
8 not going to pick that point, you're going to be,
9 where you should be, and then also this is a design-
10 basis calculation and there's a lot of conservatism.
11 So you don't really know truly where you are. You
12 know you're bounding. I'm going to talk about the
13 conservatism. You know you're bounding. You put
14 enough conservatism in that you know you're bounding,
15 but you don't know really truly where you are at any
16 time.

17 MEMBER KRESS: That's troublesome how you
18 know you're not right on that peak damage point.

19 MR. LOBEL: I'm going to talk about
20 conservatism a little more.

21 VICE CHAIR RANSOM: That's an issue that,
22 I think, needs to be clarified because according to
23 some of the pump articles, the peak damage point is
24 between zero and three percent drop in head as opposed
25 to being beyond three percent which would imply that

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1 from a damage point of view operating at less than one
2 for the NPSH-r would be okay from a damage point of
3 view but maybe not from a core cooling supply point of
4 view.

5 MR. LOBEL: That's true. You would have
6 to know what the change in flow rate would be. But
7 again, you have to go back to the fact that these
8 analyses are done conservatively and like I was going
9 to talk about a little later, the flow that you assume
10 in the NPSH analyses is greater than the flow you
11 assume in the ECCS analyses, in the LOCA analyses. So
12 you have some conservatism in that as well as the
13 conservatism and the temperatures and the pressures in
14 everything else.

15 VICE CHAIR RANSOM: Where did that
16 conservatism come from? You reduce arbitrarily the
17 flow that the pump will produce?

18 MR. LOBEL: No, you increase the flow.

19 VICE CHAIR RANSOM: I thought you said
20 that --

21 MR. LOBEL: When I do my LOCA analysis,
22 peak clad temperature calculations, I'm assuming a
23 certain pump flow or a certain pump curve. When I do
24 the NPSH calculations, I assume a flow that's higher
25 than that flow and the reason I do that is because

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1 that increases the required NPSH. The required NPSH
2 goes up as I increase the pump flow. So by assuming
3 a higher flow for the NPSH calculation, I'm reducing
4 the margin between available and required.

5 MEMBER SIEBER: Since we're talking about
6 margin, you indicated that the calculations for the
7 containment response gave margin.

8 MR. LOBEL: Right.

9 MEMBER SIEBER: In other words to me that
10 means that the pressure that actually will be achieved
11 is higher than the calculation would predict.

12 MR. LOBEL: Right.

13 MEMBER SIEBER: Is this the same
14 calculation that one would use for containment leakage
15 to look at Part 100 or is it a different calculation
16 or do you play with the margins somehow? Because if
17 it's conservative for the pump, it's nonconservative
18 for leakage.

19 MR. LOBEL: There are two calculations
20 that are done. There's one that's done for NPSH and
21 another one is done for peak containment pressure when
22 you're comparing with the design pressure of the
23 containment. So there are two separate calculations
24 with separate assumptions and in a lot of cases with
25 just the opposite assumptions.

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1 In one case for example, you're trying to
2 maximize the amount of air in containment because that
3 gives you a high pressure. In the other case, you
4 minimize the amount of air in containment because that
5 gives you a minimum pressure. So I pick my initial
6 conditions for the containment calculation in a way
7 that does that.

8 MEMBER SIEBER: Okay.

9 MR. LOBEL: So there are actually two
10 separate calculations.

11 MEMBER SIEBER: Actually, two different
12 calculations because they're incompatible if you were
13 to use the same calculation.

14 MR. LOBEL: Now for PWRs, you already have
15 two calculations. For LOCA analysis, you have one
16 that's done for the peak containment pressure.

17 MEMBER SIEBER: Right.

18 MR. LOBEL: And then for the LOCA
19 calculations for the peak clad temperature
20 calculations, you minimize the containment pressure
21 and there's a Standard Review Plan Section. I'm going
22 to talk about that a little later too. So PWRs
23 already do that. They do a peak pressure calculation
24 and a minimum pressure calculation with different
25 assumptions.

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1 MEMBER SIEBER: But neither one of those
2 has a specific purpose to see that you had actually
3 ruptured containment. To me that's not -

4 MR. LOBEL: The peak pressure does.

5 MEMBER SIEBER: Yeah, but you have a
6 margin of like three.

7 MR. LOBEL: You compare with the design
8 pressure.

9 MEMBER SIEBER: Yeah.

10 MR. LOBEL: You have to stay below the
11 containment design pressure.

12 MEMBER SIEBER: But the breaking pressure
13 is three times the size of that. What's important of
14 it is leakage. If you are running pretty close to
15 Part 100 limitations, you have to really pay attention
16 to the leakage.

17 MR. LOBEL: Right.

18 MEMBER SIEBER: And so these assumptions
19 become important.

20 MR. LOBEL: And that could be yet another
21 calculation to calculate the dose.

22 MEMBER SIEBER: Yeah.

23 MR. LOBEL: That's another yet calculation
24 that licensees do and they do that calculation to be
25 conservative for dose release.

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1 MEMBER SIEBER: Yeah, I think it's
2 important to keep in mind that these aren't the same
3 calculations.

4 MR. LOBEL: Right.

5 MEMBER SIEBER: And they aren't done the
6 same way and they have a built-in bias to provide
7 conservatism for the purpose for which they're used.

8 MR. LOBEL: Yeah, and I have a lot of
9 slides on conservatism because I wanted to make that
10 point to the Committee.

11 MEMBER SIEBER: You show us your best one.

12 VICE CHAIR RANSOM: Where is that margin
13 that you spoke about between that assumed for core
14 cooling as opposed to the NPSH analysis? Where is
15 that specified? I don't believe it's in the reg
16 guide.

17 MR. LOBEL: It's not. It's just in the
18 way the calculations are designed.

19 VICE CHAIR RANSOM: Is that up to the
20 vendor or the utility?

21 MR. LOBEL: Everybody pretty much does the
22 same thing and the NRC's accepted it. I've never seen
23 -

24 VICE CHAIR RANSOM: Is it like five
25 percent? Ten percent?

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1 MR. LOBEL: No, it's -- I'm not sure.

2 VICE CHAIR RANSOM: I'm wondering how you
3 qualified this margin.

4 MR. LOBEL: I was referring to saying that
5 the available NPSH is equal to the required --

6 CHAIRMAN WALLIS: No, the flow rates he's
7 talking about.

8 VICE CHAIR RANSOM: No, the flow rates.

9 MR. LOBEL: The flow rates?

10 VICE CHAIR RANSOM: You said the flow
11 rates were different that were used for, say, the core
12 cooling analysis as opposed to the NPSH analysis.

13 MR. LOBEL: Right. Where is that
14 qualified?

15 VICE CHAIR RANSOM: I'm wondering how is
16 that set.

17 MR. LOBEL: It isn't specified anywhere.
18 There's a lot of conservatisms that licensees has just
19 included in this analysis.

20 VICE CHAIR RANSOM: So it's up to the
21 licensee to set that.

22 MR. LOBEL: Yeah.

23 CHAIRMAN WALLIS: It would really help if
24 they would all do realistic calculations with
25 uncertainties. All this argument about conservatism

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1 here and conservatism there.

2 MR. LOBEL: Maybe I'm giving you the wrong
3 impression I think. What they do is they set the pump
4 flow in terms of failure that are hypothesized in a
5 BWR in the short term and by "short term," I mean for
6 the first ten minutes before you take operator action.
7 The single failure that's taken is a failure of what's
8 called LPSI loop select logic and what that does is it
9 allows the LPSI pump flow to essentially go right out
10 into the containment and so the pump is run-out
11 conditions for that first ten minutes. So it isn't so
12 much that somebody's defining the margin. It's set by
13 the single failure assumption.

14 They found the worst single failure is
15 failure of LPSI loop selection logic. That sets it
16 for the first ten minutes. Then after that time,
17 after the operator can take some action, the operator
18 would obviously throttle the pump so it's not at run-
19 out anymore but it would still be at some high flow
20 rate. But it's defined more by the single failures
21 and the conservative flow like the design pump flow or
22 rated flow or some value like that. It's not
23 arbitrary.

24 CHAIRMAN WALLIS: Now on this subject of
25 NPSH, you're assuming a margin of one and we heard

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1 this morning, earlier this morning, from Bill Sherman
2 that ANSI recommends a margin of 1.5. So that would
3 mean that this referenced plan which is spoken of here
4 with the 32 foot NPSH CHAR if you follow the standard
5 would require 48 foot NPSH. It just seems to me a
6 huge difference. You guys are not requiring any of
7 that at all.

8 MR. LOBEL: Let me discuss that standard
9 and the 1.5. As I read that standard, I wouldn't
10 apply it to these pumps. I think what the standard
11 had in mind when it was talking about nuclear pumps
12 was the recirculation pumps and the feed pumps and
13 pumps like that that are going to be in continuous
14 operation where cavitation is a concern because these
15 pumps are going to be operating for years at a time,
16 not for the situation where you have an emergency and
17 you want the pump to operate and you're not going to
18 get that kind of margin. It's just not in the designs
19 and it's probably not necessary.

20 The 1.5 is a large value anyway. Other
21 sources recommend 1.3 for continuous operation and
22 some experts I've seen say that 1.0 is okay. It
23 depends to a large extent on this thing I was talking
24 before the suction energy level of the pump. The
25 margin standard talks about three suction energy

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1 levels, low, high and very high.

2 ECCS pumps tend to be slightly above low
3 in the low/high range, just into the high range.
4 There's a formula for calculating the suction energy
5 level. It's kind of a semi-empirical value. It isn't
6 that well defined. It's not a thermodynamic
7 calculation that you do. It's a function of the speed
8 of the pump, the diameter at the eye of the impeller,
9 the specific weight of the fluid and things like that
10 that would affect the suction.

11 CHAIRMAN WALLIS: It has to do with the
12 velocity head of the fluid coming into the pump or
13 something.

14 MR. LOBEL: Right.

15 CHAIRMAN WALLIS: If you have a
16 restriction there, it's bigger.

17 MR. LOBEL: The tendency of the fluid
18 coming into the pump, the flash.

19 CHAIRMAN WALLIS: Right.

20 MR. LOBEL: So low suction energy level
21 pumps tend to not have a problem at all and they can
22 run in cavitation and not have a problem. The high
23 suction energy level pumps have more of an issue with
24 cavitation. The very high suction energy level pumps,
25 you could have severe damage from cavitation and it's

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1 related -- Well, I won't go on with it.

2 CHAIRMAN WALLIS: So you have good reason
3 for not accepting this ANSI standard and the rationale
4 is written down somewhere, is it?

5 MR. LOBEL: No, it's not written down.

6 CHAIRMAN WALLIS: So some member of the
7 public might have reasonable expectation that you
8 would abate a standard and they wouldn't know where to
9 look to see why you were not doing so.

10 MR. LOBEL: That's a fair comment. We can
11 put that as a --

12 CHAIRMAN WALLIS: I think you ought to
13 rebut this somehow if you're not going to use some
14 standard. There's a good reason for why. That needs
15 to be recorded somewhere.

16 MR. LOBEL: I'm not sure. This is a 1998
17 standard.

18 CHAIRMAN WALLIS: It's not so long. We're
19 using standards older than that.

20 MR. LOBEL: I don't believe it's even
21 endorsed by the hydraulic institute or ANSI anymore
22 because it's over five years old and I'm not sure
23 they're working on it.

24 CHAIRMAN WALLIS: We have another ANSI
25 standard, don't we, about zone of influence and stuff

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1 too, that maybe we should also treat the same way?

2 MR. LOBEL: I won't get into that.

3 VICE CHAIR RANSOM: Misunderstands
4 something of that same statement that says "or three
5 feet" which was in error.

6 MR. LOBEL: I honestly don't remember the
7 three -- It's there if they say it's there.

8 VICE CHAIR RANSOM: Right. I think I read
9 that and three feet would be almost no margin.

10 MR. LOBEL: Yeah.

11 VICE CHAIR RANSOM: So I'm wondering why
12 compared to the one and a half certainly.

13 MR. LOBEL: I don't know. I can't answer
14 that.

15 MEMBER SHACK: Let me just come back to in
16 the reg guide itself I can't find and maybe you can
17 point it to me where the beyond the design basis
18 accident consideration comes in. Is that something
19 only the staff is going to consider? You're not
20 really expecting the licensee to address it.

21 MR. LOBEL: We've been talking about that.
22 That's something that's evolving and maybe Artie wants
23 to talk about that more, but we've been talking about
24 that since this draft was sent to you.

25 MR. STUTZKE: It's my opinion although it

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1 hasn't gone outside of our branch or division or
2 whatever, but my personal opinion at this time in the
3 future the licensees that request credit for
4 containment of a pressure should do a complete --
5 analysis.

6 MEMBER SHACK: We need a Rev 5.

7 MR. STUTZKE: Of this.

8 MR. LOBEL: That would be just a comment
9 for this one.

10 CHAIRMAN WALLIS: I don't understand this
11 statement at all on 20. Are you going ahead now?
12 Credit is allowed when? First of all, say that you
13 need it. If you don't need it, why do you have to
14 analyze and conservatively demonstrate it that
15 sufficient pressure is available for design basis
16 accidents?

17 MR. LOBEL: If you don't need it, there's
18 no such analysis.

19 MEMBER SIEBER: You wouldn't ask it if you
20 didn't need it.

21 MR. LOBEL: Right.

22 CHAIRMAN WALLIS: So there's no screen
23 that says first of all you have to need it.

24 MR. LOBEL: No.

25 MEMBER SHACK: There sort of is in 1.3.11.

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1 That first paragraph is when you don't need it and
2 then you use the simplified one.

3 CHAIRMAN WALLIS: Because this kind of
4 implies that you have to always do this conservative
5 analysis whether you need it or not.

6 MR. LOBEL: The way it's done is you
7 assume a value of required NPSH for your pump and then
8 you --

9 CHAIRMAN WALLIS: You calculate what you
10 need. Right?

11 MR. LOBEL: You start with the required
12 NPSH.

13 CHAIRMAN WALLIS: And then you see if you
14 need to get any credit for containment pressures.

15 MR. LOBEL: Then you do a calculation of
16 the available NPSH without credit for containment
17 pressure.

18 CHAIRMAN WALLIS: Right.

19 MR. LOBEL: If the available is above the
20 required, you're done. If the available is below
21 required, then what's done is you take enough credit
22 in containment pressure so that the available is equal
23 to the required.

24 CHAIRMAN WALLIS: So sufficient pressure
25 is available means that you meet the NPSH-r with a

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1 margin of one.

2 MR. LOBEL: Right.

3 CHAIRMAN WALLIS: That's what you mean by
4 sufficient pressure is available.

5 MR. LOBEL: Yes.

6 CHAIRMAN WALLIS: That's going to be
7 spelled out clearly then because sufficient pressure,
8 somebody could argue that we could have a margin of
9 0.9 but we still have enough flow because the pump has
10 been shown to work.

11 MR. LOBEL: You've made all these
12 conservative assumptions when you did the containment
13 amount analysis, when you've calculated the available.

14 CHAIRMAN WALLIS: I don't mean that. You
15 could go to a pump curve and some tests and show that
16 with a margin 0.9 I still get enough flow to cool the
17 core. Is that acceptable?

18 MR. LOBEL: That's done.

19 CHAIRMAN WALLIS: That is done too.

20 MR. LOBEL: I was going to talk about
21 that.

22 CHAIRMAN WALLIS: That is also done.

23 MR. LOBEL: Yes.

24 CHAIRMAN WALLIS: So there's nothing that
25 says that you have to meet NPSH-r.

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1 MR. LOBEL: That's desirable but in some
2 cases, licensees have gone to their pump vendor or
3 done tests and shown that they can operate in
4 cavitation for a certain length of time when they're
5 below the required and not cause any damage.

6 CHAIRMAN WALLIS: So really what one
7 should say is analysis conservative to demonstrate
8 that sufficient flow is available for design basis
9 accidents. That's your real criterion is that you do
10 all this stuff and then you say with a conservative
11 estimate of all these pressures and stuff, do I have
12 enough flow. Isn't that it?

13 MR. LOBEL: But the assumption is if you
14 have sufficient available NPSH that you have enough
15 flow.

16 CHAIRMAN WALLIS: But you were selling me
17 that if you had a margin of 0.9 you could still make
18 enough flow.

19 MR. LOBEL: Right.

20 CHAIRMAN WALLIS: So sufficient NPSH isn't
21 really the criterion. It's having enough flow to cool
22 the core that's your criterion, isn't it?

23 MR. LOBEL: Yes.

24 CHAIRMAN WALLIS: It seems to me that you
25 really should say the sufficient flow is available.

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1 MEMBER SIEBER: That you won't be on pump
2 curve if you don't have enough NPSH. How much flow
3 you get is part of the pump characteristic. But to
4 get on the curve at all, you have to have sufficient
5 NPSH to define where you are.

6 CHAIRMAN WALLIS: Well, for different
7 pressures in the containment once you begin to get
8 into this region, you get progressively less flow and
9 as you decrease the pressure that's available and not
10 credit it, you get less and less flow. There's a
11 certain point where you don't have enough flow to cool
12 the core, is that the cutoff point?

13 MR. LOBEL: No, hopefully you're always
14 above that. If you're not above that, you have a
15 problem.

16 CHAIRMAN WALLIS: Well, if you're over the
17 need far enough you might not have enough flow.

18 MR. LOBEL: Sure.

19 CHAIRMAN WALLIS: But that's not what you
20 work on. You work on NPSH-r. What's your criterion
21 that you're applying? I thought --

22 MR. LOBEL: The criterion is that the
23 available is equal to the required.

24 CHAIRMAN WALLIS: Which is NPSH-r?

25 MR. LOBEL: Which is NPSH-r. Right.

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1 CHAIRMAN WALLIS: I thought we had a
2 discussion that you could be down at 0.9 HPSH-r and
3 still work.

4 MR. LOBEL: You can do that. There's a
5 position in the reg guide that says you can do that if
6 you've done testing to show that the pump will still
7 --

8 CHAIRMAN WALLIS: Provide enough flow.

9 MR. LOBEL: -- provide enough flow.
10 Right.

11 CHAIRMAN WALLIS: So flow is the ultimate
12 criterion then.

13 MEMBER SIEBER: Yeah.

14 MR. LOBEL: Yeah.

15 CHAIRMAN WALLIS: Okay.

16 MR. LOBEL: Let me point out then that
17 when PWRs do a LOCA analysis, their peak clad
18 temperature analysis, they take credit for containment
19 accident pressure in the same way that we're talking
20 about for NPSH. It's a minimum pressure calculation.
21 And the reason they do that is that when you're
22 reflooding the core, the rate that you're reflooding
23 the core depends on the containment pressure.

24 So Appendix K says minimize that pressure.
25 It doesn't say don't take credit for pressure. It

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1 says minimize that pressure and there's a Standard
2 Review Plan Section that has guidance on how to
3 minimize that pressure. So NPSH isn't the only place
4 in licensing space where credit is taken for
5 containment accident pressure. It's not unique.

6 CHAIRMAN WALLIS: But when you're
7 reflooding the large LOCA, isn't the pressure in the
8 reactor cooling system about the same as containment?

9 MR. LOBEL: Yeah, and -

10 CHAIRMAN WALLIS: So you have a loop and
11 then you're artificially saying that it's probably
12 against 50 psi but it's only sucking at 1 psi.

13 MR. LOBEL: Right.

14 CHAIRMAN WALLIS: So it's -- artificial.

15 MR. LOVEJOY: That's the conservatism.
16 And if you said I had 50 psi then you'd probably fill
17 up right away.

18 VICE CHAIR RANSOM: So you're saying you
19 take the minimum pressure for the pump suction or
20 capability but the higher pressure for what it's
21 pumping against. Is that right? The reflooding the
22 vessel.

23 MR. LOBEL: Yeah, they're two separate
24 calculations. When I'm doing the calculation for --
25 Well, it's pretty much the same. It would be

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1 different containment pressures. For the NPSH, I'm
2 minimizing the pressure that I'm going to use to
3 determine the allowable NPSH. When I'm doing the peak
4 clad temperature calculation in a BWR, I'm not really
5 sure what pressure they use for that analysis. It's
6 not the minimum.

7 When you do the calculation in a PWR, the
8 PWR calculation would use this minimum pressure. I
9 believe that's right. Is that right? Yeah.

10 VICE CHAIR RANSOM: The PWR would use the
11 minimum pressure.

12 MR. LOBEL: The PWR would use the minimum
13 pressure for both cases, for minimum NPSH and it would
14 use the minimum pressure for both the reflood and for
15 the head the pump was pumping against into the core.

16 CHAIRMAN WALLIS: But the pressure in the
17 core makes a big difference to the pool swell and all
18 that kind of stuff.

19 MR. LOBEL: Right.

20 VICE CHAIR RANSOM: But that pressure was
21 for a different purpose. That's to maximize the flow
22 out of the vessel, I think. Right? Or the
23 containment pressure?

24 MR. LOBEL: At that point, yeah.

25 VICE CHAIR RANSOM: You have the vapor

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1 flow or -- flow.

2 MR. LOBEL: Yeah, you would get more flow
3 out with lower pressure.

4 VICE CHAIR RANSOM: It has other --

5 CHAIRMAN WALLIS: This shows there are so
6 many things that are interrelated and it would be
7 really good to do a realistic calculation of the whole
8 works and then see what's the probability of something
9 going wrong. It's very hard. Something that's
10 conservative here isn't conservative for that and so
11 you get into this logical mix of stuff which is hard
12 to justify.

13 MR. LOBEL: That's the box that we put
14 ourselves into with design basis analyses. We try to
15 make them conservative and like I'm going to say in a
16 little while --

17 CHAIRMAN WALLIS: Now there's something
18 called geolistically conservative.

19 MR. LOBEL: Whatever that is.

20 CHAIRMAN WALLIS: I think realistically
21 conservative is close to what I was saying. You do
22 more realistic calculations and then you look at how
23 far away from it you could be rather than taking some
24 absolutely extreme case.

25 MR. LOBEL: Should I continue?

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1 CHAIRMAN WALLIS: Sure. I'm sorry, but
2 you have all day and all evening too.

3 MEMBER CARUSO: You want to start the new
4 section.

5 MR. LOBEL: I was thinking if we break for
6 lunch now. I was going to get into the technical
7 justification for over pressure which is a big
8 discussion.

9 CHAIRMAN WALLIS: Maybe we need to have a
10 break, do we? I'll leave it to the chairman.

11 VICE CHAIR RANSOM: Is this the
12 methodology?

13 MR. LOBEL: Yes.

14 CHAIRMAN WALLIS: How long would it take
15 to do that? Quite a while, wouldn't it?

16 MR. LOBEL: Quite a while.

17 VICE CHAIR RANSOM: Why don't we break for
18 lunch and then --

19 MR. LOBEL: It's broken up into different
20 subjects. I could do one subject and then we can
21 break if you want. I could do containment integrity
22 and then --

23 MEMBER SIEBER: Let's break now.

24 VICE CHAIR RANSOM: Want to break and be
25 back at 1:00 p.m.

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1 CHAIRMAN WALLIS: Can I ask you something
2 though? When are you going to do all this? Are you
3 just show us words or are you going to show some
4 typical numbers for things so we can put this into
5 some perspective?

6 MR. LOBEL: I have some numbers for some
7 things but I didn't include -

8 CHAIRMAN WALLIS: You talk about things
9 big or small and all that. I have no idea about how
10 big the numbers really are. Maybe when you talk about
11 conservatism and maybe there's a huge conservatism
12 because the pressure is really 20 psi and you're
13 forced to assume it's zero. Maybe there isn't. I
14 don't know. So if you could give us some numbers that
15 would help.

16 MR. LOBEL: I can give you some of those
17 numbers.

18 CHAIRMAN WALLIS: Maybe that would come up
19 in questioning.

20 MR. LOBEL: I can give you some of those
21 numbers. They're not for one plant and they won't be
22 consistent from one plant to another.

23 CHAIRMAN WALLIS: I don't know whether
24 this only comes up in large break LOCA or does it come
25 up in medium size or small break. That sort of thing

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1 would help me too because if it only comes up in large
2 break LOCA, I can know what kind of scenario I'm
3 thinking.

4 MR. LOBEL: Okay. It's typically large
5 break, but again not always and what licensees do is
6 they would do a spectrum of breaks. For instance, one
7 licensee has a PWR, has an analysis in now, where the
8 small and intermediate breaks actually give the worst
9 NPSH conditions. So they did the right thing. They
10 looked at whole spectrum of break sizes and break
11 locations because again we're talking about different
12 analyses and the break location that gives you the
13 worst peak cladding temperature may not be the break
14 location that gives you the hottest sump temperature
15 for NPSH. So you have to look --

16 MEMBER SIEBER: A small break wouldn't do
17 that.

18 MR. LOBEL: Right. There's a lot of
19 things that change. They're two different analyses.
20 Like I was saying before, the distribution of energy
21 into the containment atmosphere from the break, you
22 make one assumption for peak pressure and you make
23 another assumption for NPSH calculations. Then you
24 have more realistic codes that are in between.

25 Let me just say one more point and I'll

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1 stopped. That's why it's hard in the reg guide to be
2 too specific and too cookbookish about what should be
3 done because it's really up to a licensee for his
4 particular plant to do the calculation over a spectrum
5 of breaks and locations and size of breaks and all
6 that to find out what the limiting conditions are and
7 where is a single failure and all those types of
8 things.

9 VICE CHAIR RANSOM: All the more you think
10 the reg guides should specify that if you're going to
11 take credit for this then you should consider these
12 things.

13 MR. LOBEL: It tried to do that and I'd be
14 interested in people's comments. I really would like
15 your comments and when it goes out for public comment
16 to get people's comments on the level of detail and
17 what it says. I'm hoping for comments from pump
18 vendors and from the industry on some of the guidance
19 too. If we're doing this now, if we're trying to put
20 out guidance for people, I hope we can do it right and
21 not have to have a revision 5.

22 CHAIRMAN WALLIS: So we're going to see it
23 as a full committee in September. We're going to take
24 this up and then you're going to put out the guidance
25 and then maybe next year some time, June or something,

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1 we go through this again.

2 MR. LOBEL: Yeah.

3 MEMBER SIEBER: I think if we have any
4 great concerns about what they're proposing even
5 before public comments come in we ought to state our
6 concerns.

7 MR. LOBEL: Right.

8 MEMBER SIEBER: Otherwise it will go there
9 and then our concerns will get all mishmashed in with
10 the public comments and they're more difficult for the
11 staff to deal with in that context.

12 VICE CHAIR RANSOM: Okay. We start
13 promptly at 1:00 p.m.

14 CHAIRMAN WALLIS: One. Thank you. Off
15 the record.

16 (Whereupon, the foregoing matter went off
17 the record at 11:54 a.m. and went back on the record
18 at 1:03 p.m.)

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1 A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

2 1:04 p.m.

3 VICE CHAIR RANSOM: On the record.

4 MR. LOBEL: So far I have been discussing
5 what we're proposing to do and now I'd like to go
6 through our reassessment and I'll try to go a little
7 fast. We looked at five factors that should be
8 considered in credit in containment accident pressure,
9 that there's a high confidence in the integrity of the
10 containment, that conservative calculations are done,
11 that the ECCS and containment spray pumps are of
12 robust construction and made from cavitation, damage-
13 resistant material, the fact that the emergency
14 operating procedures aren't significantly altered by
15 dependence on containment pressure and that the risk
16 calculations show an insignificant increase in risk
17 due to reliance on containment pressure.

18 MEMBER KRESS: High confidence in
19 containment, does that relate to beyond design basis
20 accident?

21 MR. LOBEL: No. That's for design basis.
22 Yeah.

23 MEMBER DENNING: What's the reluctance to
24 change the EOPs?

25 MR. LOBEL: There's not a reluctance.

1 It's just not necessary and I'll explain. There's no
2 reluctance to change.

3 One of the rationale in Reg Guide 1.1 for
4 not crediting containment accident pressure for NPSH
5 calculations is the possibility of impaired
6 containment integrity. All design basis analysis
7 assumes containment integrity. This is acceptable
8 since the containment is subject to tests that verify
9 its integrity.

10 First, there's a structural test that's
11 performed before licensing. Then there is 10 CFR
12 50.54 (O) Appendix J that requires periodic leakage
13 rate testing of the containment structure and
14 penetrations and 10 CFR 50.55(A) that requires
15 periodic in-surface examination of inspections of the
16 containment structure in accordance with the ASME
17 code.

18 MEMBER KRESS: In our reincarnation of
19 ACRS, we talked about this required leak testing of
20 containment and the idea was how frequent should it
21 be. And they extended the frequency to ten years I
22 think.

23 MR. LOBEL: Fifteen.

24 MEMBER KRESS: Fifteen. It was five or
25 something.

1 MR. LOBEL: It was three times in ten
2 years originally. That Option B changed it to one
3 time in ten years and now we are giving extensions to
4 15 years.

5 MEMBER KRESS: As I recall the arguments
6 for that, for allowing such a thing, were all the risk
7 arguments, that it didn't increase the risk very much
8 if you did that. Now we're talking about design basis
9 space and whether or not this leakage might be -- We
10 may not know what it is and it may be too big to
11 incorporate in a containment pressure. Have I that
12 wrong?

13 MR. LOBEL: Let me try to state it. We
14 had three times in ten years. We went to one time in
15 ten years with Option B. Option B was called Risk
16 Base. It partly based on risk arguments. A lot of it
17 was based on experience. We went through the database
18 of events that challenged the integrity of the
19 containment and Option B changed the way things were
20 done from the way Option A, the old Appendix J, did
21 things.

22 In Option A, the old Appendix J,
23 containment integrity looked at leakage through valves
24 and penetrations as well as through the containment
25 structure. What Option B did was to separate the two

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1 and now the ILRT essentially looks at the containment
2 structure and the penetrations and isolation valves
3 have a different frequency.

4 So you can't fail an ILRT, a global
5 containment leakage test, because of a failure of a
6 valve. You can fail the leakage through that valve
7 but that's a different set of actions.

8 MEMBER KRESS: Those are the more likely.

9 MR. LOBEL: Those are the more likely
10 things to happen and you test those more often.
11 They're tested --

12 MEMBER KRESS: Perhaps.

13 MR. LOBEL: So you have to have two
14 successful tests and then you're allowed to go to five
15 years and you can stay on a five year interval until
16 you fail a test. Once you fail a test, you go back to
17 the every outage testing.

18 MEMBER KRESS: So they're more likely on
19 accounting on a leak test of testing more frequently.

20 MR. LOBEL: Right. When we talk about
21 extending the frequency for the ILRT, that's just for
22 the containment structure, the liner and that type of
23 thing. But the penetrations are on a much more
24 frequent schedule and that hasn't been changed.
25 There's some talk by the industry of changing that but

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1 that hasn't been changed.

2 MEMBER KRESS: This looks like a reason
3 not to change it.

4 MR. LOBEL: Yeah.

5 CHAIRMAN WALLIS: You said something about
6 design basis here. We're talking about beyond design
7 basis as well, aren't we?

8 MR. LOBEL: We'll get to that a little
9 later.

10 CHAIRMAN WALLIS: There's no risk if
11 there's no design basis, is there? Isn't it that
12 design basis acts as don't contribute to risk?

13 MR. LOBEL: The way things are laid out is
14 the accidents that licensees looked at for this or the
15 deterministic analyses are design basis accidents or
16 I don't know what you would call close to design basis
17 accidents, the Appendix R fire, the station blackout,
18 those kinds of things that we don't call design basis
19 but they're close to that. Those get looked at from
20 a deterministic point of view.

21 Licensees use conservative calculations
22 and they assume containment integrity pretty much for
23 those. Then the part that Marty will talk about
24 later, the risk part, gets into beyond design basis.

25 CHAIRMAN WALLIS: Some DBAs, beyond design

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1 basis accidents, the containment integrity is not
2 particularly good.

3 MR. LOBEL: Right.

4 MEMBER KRESS: But you only get into those
5 conditions if these things don't work. So you're
6 asking why you need to make things work.

7 MR. LOBEL: Right. So for these
8 calculations, the design basis, you're saying I'm
9 making a set of assumptions, conservative assumptions
10 hopefully, and I'm demonstrating that everything's
11 going to work, that my safety limits are protected.
12 Then I'm going to go past that and I'm going to say
13 now I'm allowing things to fail. Penetrations can
14 fail. Pumps can fail. And I'm in a new set of
15 circumstances and I look at that from what's the
16 likelihood of that and what's the consequence of that.

17 So it's different. We're looking at that
18 in two different ways. Licensees have to satisfy
19 their licensing basis which is the deterministic
20 calculations. Did I answer your question?

21 CHAIRMAN WALLIS: Well, I think we're
22 looking primarily at what you just mentioned, the
23 licensing basis type calculations.

24 MR. LOBEL: Right.

25 CHAIRMAN WALLIS: But when you get into

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1 risk, you're looking at a different space.

2 MEMBER DENNING: Can I -- I want to ask
3 how Marty related to this. I realize we're not
4 cutting into the PRA space at the moment but there's
5 PRA insight into what the frequency of failure to
6 isolate. I'm wondering what do the risk numbers now
7 say as far as the potential under a design basis
8 condition did you actually would have had failure to
9 isolate.

10 MR. STUTZKE: I don't know if I can give
11 you a direct answer. The way to look at it is the PRA
12 lays out a series of accident sequences through an
13 eventual structure. Some of those sequences are
14 successful. Those generally are design basis
15 accidents. Everything is okay, the ones that lead to
16 core damage or beyond the design basis because of
17 multiple failures and things like that.

18 MEMBER DENNING: Yes, but there is a
19 failure to isolate which one uses later on severe
20 accident space.

21 MR. STUTZKE: Right.

22 MEMBER DENNING: But the data you gain
23 relates to frequency of failing integrated leak --
24 That's where these more focused tests are now and what
25 is that now telling us that that failure rate is?

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1 MR. STUTZKE: I've have that back in my
2 presentation a bit later.

3 MEMBER DENNING: You have it some place in
4 there.

5 MR. STUTZKE: Yes, I have an estimate of
6 the probability that containment integrity has lost
7 therefore causing the loss of over-pressure. I have
8 that estimate.

9 MR. LOBEL: As I showed earlier, a
10 majority of the containments, crediting containment
11 accident pressure are BWR mark ones. The containment
12 integrity for a mark one pressure suppression
13 containment is continuously monitored during normal
14 operations since the containment is inert. All mark
15 ones are inerted except for 24 hours after start-up
16 and 24 hours prior to shutdown. That's required by
17 regulation in tech specs.

18 So any significant increase in the amount
19 of nitrogen that has to be added to the containment
20 might be assigned a degradation in the containment
21 integrity and would be observed by the operators. The
22 operators would then take the action that was
23 appropriate in accordance with the plant's abnormal
24 operating procedures.

25 Another sign of loss of integrity would be

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1 the presence of oxygen gas in containment. The tech
2 specs require oxygen monitors as part of 10 CFR 50.44
3 in the tech specs and the monitors would provide a
4 continuous insurance that there's no oxygen. So
5 again, if oxygen were detected, the operators would
6 take the appropriate action according to their
7 abnormal operating procedures.

8 MEMBER SIEBER: But the containment
9 operates at basically atmospheric pressure.

10 MR. LOBEL: Right.

11 MEMBER SIEBER: And so if it's atmospheric
12 pressure, it's an equilibrium with the outside. So
13 even if you didn't have integrity, you may not leak.

14 MEMBER KRESS: You'll get leakage. You'll
15 get little fluctuations.

16 MEMBER SIEBER: It would be very subtle.

17 MEMBER KRESS: Yeah, it's subtle but
18 you'll get it. Then there's day and night
19 differences.

20 MR. LOBEL: It's not exactly the same and
21 some containments are operated slightly below
22 atmospheric.

23 CHAIRMAN WALLIS: Atmospheric pressure
24 fluctuates by ten percent anyway.

25 MR. LOBEL: Yeah.

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1 MEMBER KRESS: That's what I was talking
2 about.

3 CHAIRMAN WALLIS: It comes in and out.

4 MR. LOBEL: The second largest group of
5 containments crediting accident pressure were the PWR
6 subatmosphere containments and the same kind of logic
7 holds that they have to maintain a vacuum. If they
8 can't maintain the vacuum, they're required by tech
9 specs to shut down within an hour.

10 Another check on containment integrity is
11 the walkdown that operators do to check valve
12 alignments and other configuration issues prior to
13 startup and during startup from an outage.

14 An assertion has also been made that
15 crediting containment accident pressure is a new
16 containment safety function and the staff disagrees
17 that containment integrity is required by regulations
18 and technical specifications. Credit for containment
19 accident pressure doesn't impose a new requirement.
20 No more credit is taken for accident pressure than is
21 conservatively calculated to be there and no new
22 equipment is added or removed.

23 CHAIRMAN WALLIS: The presentation from
24 Bill Sherman was that there were three lines of
25 defense and if you have a LOCA, you've lost one of

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1 them. Then if you lose the containment, you've
2 already lost your pumps and so you've lost two of your
3 lines of defense by losing one because you've -- Isn't
4 that the nice little argument he had?

5 MR. LOBEL: Yes, the defense.

6 CHAIRMAN WALLIS: The fuel would fail as
7 a result of the containment failing. You don't buy
8 that argument at all.

9 MR. LOBEL: I'm not talking about the
10 defense.

11 CHAIRMAN WALLIS: Well, it's sort of
12 related to that because he was saying by making the
13 containment supply this pressure to make the pumps
14 work to cool. He's fulfilling a new safety function
15 that wasn't originally intended for.

16 MR. LOBEL: But the pressure is there.
17 The containment is holding in the pressure and
18 limiting leakage. It's nothing new.

19 CHAIRMAN WALLIS: But now it's being asked
20 to supply a minimum HPSH pressure as well.

21 MR. LOBEL: Right.

22 VICE CHAIR RANSOM: How is that different
23 than the requirement to contain the fission products
24 and why not --

25 CHAIRMAN WALLIS: There's aren't any

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1 fission products yet because the fuel is still intact.
2 If you lose the containment first, then you might lose
3 the fuel later.

4 VICE CHAIR RANSOM: But the idea was it's
5 a pressure containment. Right? So it would be
6 pressurized rather than allowing whatever is leaking
7 to -- outside.

8 CHAIRMAN WALLIS: I know.

9 MR. LOBEL: Well, Mark is going to talk
10 about the defense in depth part of this later.

11 CHAIRMAN WALLIS: Okay.

12 MEMBER DENNING: What is the meaning of
13 the third bullet about nothing is done operationally
14 to enhance or decrease the pressure? Isn't there an
15 intent after the event to try to reduce the pressure
16 but not too far?

17 MR. LOBEL: My point was just whatever is
18 done is already done now. Part of the emergency
19 operating procedures is to reduce pressure. So the
20 operators are all ready. Their procedures right now
21 even if they're not taking credit for containment
22 pressure are to reduce containment pressure.

23 MEMBER DENNING: But within bounds.

24 MR. LOBEL: Yeah, I was going to talk
25 about that a little later, but the EOPs for BWRs state

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1 that the operator isn't supposed to let the pressure
2 get below a certain valve. Right now, the EPGs, the
3 emergency procedure guidelines, say zero PSIG. It
4 used to be 2 PSIG. Now it's zero PSIG. So that's
5 what the operator is told now to protect.

6 CHAIRMAN WALLIS: It's not supposed to get
7 below atmospheric?

8 MR. LOBEL: Yeah, for structural.

9 CHAIRMAN WALLIS: Then you can't get an
10 credit for pressure if there isn't any.

11 MR. LOBEL: Right. So what would happen
12 in a place that's taking credit for pressure is the
13 number would change to a number consistent with their
14 analysis. So that the operator would be told instead
15 of letting it go below a zero PSIG don't let it go
16 below 6 PSIG.

17 CHAIRMAN WALLIS: So it conflicts with
18 your third bullet then, doesn't it? Something is
19 done.

20 MR. LOBEL: But that's not enhancing or
21 decreasing pressure. Let me just say. The point I
22 was trying to make is nothing new is being done in
23 terms of those things. The operator is still reducing
24 pressure. He just has a different point at which he
25 has to stop reducing pressure. He has to make sure

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1 the pressure doesn't get below a certain value.

2 MEMBER SIEBER: That's new. As far as the
3 operator is concerned, that's new. Right?

4 MR. LOBEL: That number is new.

5 MEMBER SIEBER: Yes.

6 MR. LOBEL: Conservatism. I'd like to
7 spend a little time on conservatism. The available
8 NPSH is calculated for a design basis accident.
9 Therefore it has to be done conservatively. The
10 assumptions are done with assumptions that minimize
11 the available NPSH and other assumptions maximize the
12 required NPSH.

13 There's a concern when performing design
14 basis analyses that the results shouldn't be skewed to
15 the extent that they become misleading. And it's
16 become apparent during this reassessment that this is
17 a possibility in this case that perhaps the analyses
18 at least in some cases are done with a degree of
19 conservatism that skews the results to conclude the
20 containment accident pressures necessary and must be
21 credited when "a more realistic but still
22 conservative," those words, analysis may not reach
23 that conclusion.

24 This isn't unique. Statistical LOCA
25 analysis, statistical DNBR calculations are done

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1 defining the conservatism but they're done and the
2 reason they were done is so that the conservatism, the
3 results don't get unrealistic to too great an extent.

4 The next slides I've listed some of the
5 conservatisms that go into these analyses and I
6 thought I'd go through them for the BWRs but I also
7 listed them for the PWRs. Some of them are the usual
8 design basis things.

9 CHAIRMAN WALLIS: There's a tech spec on
10 maximum suppression pool temperatures.

11 MR. LOBEL: Usually. Right.

12 CHAIRMAN WALLIS: So if they have a
13 leaking valve or something that's heating up the pool,
14 they have to take some action to cool the pool.

15 MR. LOBEL: Right. They are not supposed
16 to let it go above 95 degrees. If it does, then they
17 have to start suppression pool cooling. If it goes
18 above 110, then they have to shut down the reactor.

19 Reactor power is 102 percent. That's a
20 guidance from Reg Guide 1.49 that people follow for
21 design basis accidents. The decay heat is at the two
22 sigma level. That's something that's usually done for
23 design basis accidents and we've required it.

24 CHAIRMAN WALLIS: Well, if we're worried
25 about two percent on reactor power, we ought to really

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1 worry about 20 percent.

2 MR. LOBEL: Yeah, this is a substantial
3 one. This is worth a good deal in terms of
4 conservatism.

5 CHAIRMAN WALLIS: It is? But with an up
6 rate to 20 percent?

7 MEMBER KRESS: I think then it would be
8 122 percent of the original power. You would still
9 add the two percent on top of that.

10 CHAIRMAN WALLIS: If you're worried two
11 percent being overly conservative then 20 percent
12 sounds like an awful lot more.

13 MR. LOBEL: No, I thought you were on the
14 next one, the two sigma.

15 CHAIRMAN WALLIS: No, I was on the two
16 percent, not the two sigma.

17 MR. LOBEL: Okay.

18 MEMBER KRESS: The two percent is not much
19 of a conservatism.

20 VICE CHAIR RANSOM: In the interpretation,
21 that would be 102 percent of a 120 if you were on an
22 upgraded system.

23 MR. LOBEL: The decay heat's based on
24 operation that bounds a specific operating cycle. So
25 you would expect to have a higher decay heat than you

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1 would for any specific cycle. Of course, you take the
2 worst single failure which is either loss of a diesel
3 or loss of an RHR heat exchanger.

4 The initial drywell/wetwell temperatures
5 and pressures and relative humidities are selected to
6 minimize the accident pressure. So you would maximize
7 the humidity, say, and that would give you for the
8 same total pressure that gives you less air which
9 gives you less accident pressure when you heat up the
10 air. All these kinds of things are determined in the
11 conservative direction.

12 The suppression pool temperature is the
13 tech spec maximum. The initial surface water
14 temperature is at the tech spec maximum. The initial
15 suppression pool water volume is the minimum allowed
16 by technical specifications and this maximizes the
17 suppression pool temperature. It also gives you less
18 positive head for the available NPSH and it also
19 lowers the containment pressure. So this is an
20 example of a conservatism that increases the
21 temperature and decreases the pressure.

22 The containment sprays are available to
23 cool the containment. They're initiated at 600
24 seconds and operate continuously with no throttling of
25 the RHR pumps below rated flow. This is conservative

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1 in the sense that you could get the same suppression
2 pool cooling in a BWR by operating the RHR pumps in
3 the suppression pool cooling mode without the sprays,
4 but you wouldn't reduce the pressure in the drywell
5 and the wetwell. So by operating the sprays, you're
6 getting the same cooling but you're reducing the
7 pressure.

8 The passive heat sinks are modeled. The
9 liner in the containment and the concrete in the
10 containment, the internal structures are modeled to
11 reduce the heat transfer to them and that reduces the
12 containment pressure. The feedwater flow in the
13 vessel --

14 MEMBER SHACK: That's not a conservatism.
15 You have to do that. Right?

16 MR. LOBEL: You don't do that for the peak
17 calculation.

18 MEMBER SHACK: Okay, but that's because
19 I'm being conservative on the other side for that one.

20 MR. LOBEL: Yeah.

21 MEMBER SHACK: But I mean for this one, I
22 certainly do need to.

23 MR. LOBEL: You do need to consider it and
24 you usually not only pick a heat transfer coefficient
25 that would model that but you usually exaggerate the

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1 heat transfer coefficient. The guidance for PWRs for
2 minimum pressure is to take the usual heat transfer
3 coefficient for heat transfer of the containment
4 atmosphere to the liner and you multiply it by a
5 factor of four. So I try to give myself more heat
6 transfer to the structure than I normally expect.

7 MEMBER SHACK: But that guidance comes out
8 of Appendix K calculations. Right?

9 MR. LOBEL: The requirement to do a
10 minimum pressure calculation is Appendix K.

11 MEMBER SHACK: Where does the factor of
12 four come from?

13 MR. LOBEL: That's from the standard
14 review plan.

15 MEMBER SHACK: Okay. Now would that apply
16 to this calculation?

17 MR. LOBEL: I'm not sure. To be honest,
18 I'm not sure off-hand. I don't remember. I was going
19 to look that up and didn't whether they use the factor
20 of four for BWRs. Maybe somebody in the audience
21 knows. I'm not sure.

22 MEMBER SIEBER: In any event, there's a
23 substantial amount of BTUs that are removed by that
24 mechanism.

25 MR. LOBEL: It's an important effect and

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1 until you turn on the sprays. Once you turn on the
2 sprays, the sprays kind of overpower this effect
3 anyway.

4 MEMBER SIEBER: Overwhelm.

5 MR. LOBEL: So it would be important for
6 the first 600 seconds.

7 MEMBER SIEBER: Okay.

8 MR. LOBEL: The feedwater flow into the
9 vessel continues after the accident until all the
10 feedwater which would increase the suppression pool
11 temperature is added and then you assume the feedwater
12 flow is terminated. So you only have feedwater flow
13 into the vessel and out into the suppression pool when
14 it's going to heat the suppression pool but not after.

15 CHAIRMAN WALLIS: This feedwater when
16 you're operating, it's presumably preheated.

17 MR. LOBEL: Right.

18 CHAIRMAN WALLIS: But when you shut down,
19 it's not longer preheated. Does it come from a tank
20 where it's already --

21 MR. LOBEL: Yes, you could probably stop
22 the heating, but I would imagine it would take a
23 little while -

24 CHAIRMAN WALLIS: And there's perhaps a
25 tank that stores hot feedwater.

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1 MR. LOBEL: You have the structures that
2 would still be warm, still be hot.

3 MEMBER SIEBER: The biggest impact though
4 is the hotwell temperature. It will go down to that
5 pretty fast.

6 MR. LOBEL: The horsepower from the core
7 spray and RHR pumps is all assumed to go into heating
8 the suppression pool so that there is some loss of
9 efficiency from the motor to the pump and you don't
10 account for that. You assume that all the energy from
11 the motor is going into heating the suppression pool.
12 The efficiency of the heat transfer between the
13 drywell air space and the liquid break flow was chosen
14 to minimize the containment pressure. So you make
15 assumptions of the efficiency of the heat transfer
16 between the break flow and the drywell atmosphere.

17 CHAIRMAN WALLIS: I should think the pump
18 is going to have -- This is suppression pool water.
19 The other inefficiency is the pumps and break
20 horsepower is presuming the power delivered to the
21 water. But there's also heat delivered to the water
22 by friction in the pump itself which doesn't show up
23 as break horsepower. It's not a very big number but
24 it's more than just break horsepower.

25 MR. LOBEL: No, it's about 15 percent of

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1 the total horsepower. Okay. A single value of the
2 suppression pool level was chosen for the available
3 NPSH calculation and the value that's chosen is less
4 than the calculated value of the suppression pool
5 level at the time of peak suppression pool
6 temperature. So not only have I done a calculation to
7 minimize the level of calculating for the suppression
8 pool but I picked a level even below that to use for
9 the NPSH calculation.

10 The pump flow. I talked about this
11 before. The pump flow used in the NPSH calculation is
12 greater than the pump flow assumed in the LOCA and
13 peak cladding temperature calculations. The other
14 assumption is that the flow is not throttled. This
15 pump flow continues for the whole accident and when
16 you consider that the peak suppression pool
17 temperature in a BWR is sometimes in the range of six
18 to eight hours, that says that the operator is going
19 to keep the pumps going at this high capacity for a
20 much longer time than they probably would.

21 MEMBER SIEBER: He's waiting for shift
22 change.

23 MR. LOBEL: Especially now because you
24 have to consider that at this point most likely the
25 core level is being maintained with a core spray pump

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1 and the RHR pump is only being used for cooling the
2 suppression pool. Although if you assume you have
3 both trains of RHR, you might be injecting with one
4 train of RHR and using the other one to cool the
5 suppression pool.

6 The debris head loss is bounding.

7 CHAIRMAN WALLIS: NPSH is measured with
8 cold water and we had this discussion with Bill
9 Sherman that apparently the way the temperatures take
10 in account of is in a term which has the vapor
11 pressure of the water in it which is on the right-hand
12 of that equation instead of the left.

13 MR. LOBEL: The required NPSH depends on
14 two things. It depends on temperature and flow. The
15 requirement NPSH increases with flow and typically the
16 value that's chosen is a maximum value.

17 CHAIRMAN WALLIS: But with temperature
18 it's more likely to cavitate with hot water.

19 MR. LOBEL: With temperature the required
20 NPSH goes down. It actually decreases with increases
21 -

22 CHAIRMAN WALLIS: It's very strange. You
23 need more over-pressure with hot water as a prevented
24 boiling.

25 MR. LOBEL: It's two thermodynamic

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1 properties. It's the specific volume -

2 CHAIRMAN WALLIS: So the vapor pressure is
3 taken account of in some other part of the equation.
4 Isn't that what this is?

5 MR. LOBEL: Yes, in his equation, he
6 combined two terms to the other. So he didn't show
7 the vapor pressure. But in the NPSH calculation,
8 there is a positive term for atmosphere and a positive
9 term for the height of water, a negative term for the
10 losses and then a negative term for the vapor
11 pressure.

12 CHAIRMAN WALLIS: If you had boiling water
13 coming in, it would have no NPSH.

14 MR. LOBEL: If you have boiling water come
15 in, the only thing you would have is the height of the
16 water. That's the PWR assumption if you assume that
17 the pressure is the saturation pressure. What that
18 does is it cancels the first and the last terms. You
19 have a positive atmospheric pressure and a negative
20 vapor pressure.

21 CHAIRMAN WALLIS: So this correction is
22 made for reduction and requires the NPSH for the
23 temperature.

24 MR. LOBEL: Yes, that's a different thing.

25 CHAIRMAN WALLIS: That means that it's,

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1 say, 32 feet for this reference plant and that's on
2 the left-hand side which you call NPSH and the effects
3 of vapor pressure are taken account of on the right-
4 hand side somehow.

5 MR. LOBEL: Yes.

6 CHAIRMAN WALLIS: But there are some other
7 effects. What's the reduction then? What's this
8 reduction?

9 MR. LOBEL: The reduction in required NPSH
10 is if I -- The tests that determine required NPSH that
11 the pump vendor does are done with cold water. When
12 these pumps are operating during an accident, they're
13 pumping hot water and the required NPSH decreases.

14 CHAIRMAN WALLIS: Just slightly because of
15 density change.

16 MR. LOBEL: No, it's two things. It's the
17 specific volume and the heat of vaporization
18 decreases. So those two effects actually give you
19 smaller bubbles and it's harder to make the bubbles.
20 So the required NPSH actually decreases as the
21 temperature goes up and there are curves --

22 CHAIRMAN WALLIS: Is this based on mass
23 flow rate or volume flow rate? Well, I guess we don't
24 want to get into this.

25 MR. LOBEL: It's just the properties.

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1 CHAIRMAN WALLIS: If you want to pump the
2 same mass, you're going to have a higher velocity at
3 lower density. You're going to have a bigger row of
4 V squares.

5 MEMBER SIEBER: Yes, like positive
6 displacement.

7 MR. LOBEL: Pumps pump volume.

8 CHAIRMAN WALLIS: But you cool with mass.
9 Anyway, forget that.

10 MR. LOBEL: Right.

11 CHAIRMAN WALLIS: This always bother me
12 this talking about gallons per minute when what you're
13 really interested in is mass flow of stuff.

14 MEMBER SIEBER: That's why you're an
15 engineer to figure that out.

16 CHAIRMAN WALLIS: You might have to
17 explain what's going on here in a bit more detail if
18 it ever gets really examined.

19 MR. LOBEL: Okay.

20 MEMBER SIEBER: A pump is a volumetric
21 device.

22 MR. LOBEL: Right. There are curves in
23 the hydraulic institute standards that provide
24 corrections to actually lower the required NPSH with
25 temperature. The reg guide has the guidance that you

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1 shouldn't do that but that should just be treated as
2 a conservatism and actually there are some papers
3 written by some pump experts. Korasic who wrote the
4 pump handbook has a paper where he recommends that
5 that be just kept in the pocket as margin and not
6 taking credit for.

7 There are also some restrictions in the
8 hydraulic institute standard on when you should take
9 this credit and how much you should take and that kind
10 of thing. So our guidances just don't use it.

11 VICE CHAIR RANSOM: This is a contrast to
12 the available NPSH which is being reduced by the
13 increase in temperature.

14 MR. LOBEL: Right. My available is going
15 down. If I let my required go down, I would be giving
16 myself more margin than I am. I'd keep the required
17 where it is. Let me see. A minimum number of ECCS
18 pumps is assumed used to inject into the reactor
19 vessel. What this does is it results in a slower
20 cooling of the reactor coolant so more heat's added to
21 the suppression pool sooner. The RHR heat exchanger's
22 effectiveness is minimized by assuming --

23 CHAIRMAN WALLIS: Okay. So you've told us
24 that you've done 15 good things here, but we have no
25 idea how important any of them are. Yeah, I do. I

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1 have some --

2 CHAIRMAN WALLIS: It would really help if
3 there were some sort of numbers on these. Because you
4 can say I'm conservative, I've done all this stuff,
5 all of these are conservative, but how much do you
6 really -- by each one of these things. We don't know,
7 do we? You probably know.

8 MR. LOBEL: I know some. I'm sure the
9 people who do these calculations do.

10 CHAIRMAN WALLIS: Some of these may have
11 almost no effect at all.

12 MR. LOBEL: Some of them don't have a lot
13 of effect. That's true. Some of them have more
14 effect some places than others.

15 CHAIRMAN WALLIS: Right, but are they
16 increasing your margin by 0.01 percent or 50 percent
17 or something? That's the sort of thing one would like
18 to know when one's being conservative, how much are
19 you really buying --

20 MR. LOBEL: Let me give you a few examples
21 that I have. These aren't all in terms of NPSH. For
22 example, a five percent degree change in initial
23 suppression pool temperature gives approximately a one
24 degree change in the peak suppression pool
25 temperature. One hundred and two percent versus 100

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1 percent power gives you about a one degree Fahrenheit
2 suppression pool temperature increase. Let me see if
3 I have some other good ones.

4 CHAIRMAN WALLIS: So the more effective
5 measures give you something a degree.

6 MR. LOBEL: For the decay heat, if I use
7 a nominal decay heat value I have a suppression pool
8 temperature 1074 degrees. If I add a ten percent
9 uncertainty to that which approximates the two sigma
10 it's 179 degrees.

11 CHAIRMAN WALLIS: That's a big effect,
12 that one.

13 MR. LOBEL: Yeah. The containment
14 leakage, if my containment leakage is 1.6 mass percent
15 per day which would be the L_a value, that's only worth
16 about a 0.1 PSIG reduction. So leakage doesn't buy
17 you a lot. The mixing of the break flow with the
18 containment atmosphere is significant. If I have a
19 mixing fraction of 20 percent, if I say that 20
20 percent of the break flow mixes with the containment
21 atmosphere, that gives me a pressure of approximately
22 2.9.

23 CHAIRMAN WALLIS: Okay. So there are some
24 nonconservatism. You're assuming that all of the main
25 steam isolation valves shut perfectly.

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1 MR. LOBEL: I'm sorry. They what?

2 CHAIRMAN WALLIS: Main steam MSIVs, main
3 steam isolation valves, you assume that they close
4 perfectly.

5 MR. LOBEL: Even if I assume, if I take a
6 single failure in one, they're redundant.

7 CHAIRMAN WALLIS: But how big? If it's
8 open wide, it's a big hole, isn't it?

9 MR. LOBEL: If one failed to close, I have
10 the other. If both failed --

11 CHAIRMAN WALLIS: You mean two in series?

12 MEMBER SIEBER: Yes.

13 MR. LOBEL: Yeah.

14 CHAIRMAN WALLIS: Then okay. I just
15 wonder but your assumption assume that they all close
16 or they assume the only one in series closes so
17 essentially the path is blocked for flow.

18 MR. LOBEL: Are you talking in terms of
19 leakage?

20 CHAIRMAN WALLIS: Yeah.

21 MR. LOBEL: Yes, you would assume that
22 would be included. The MSIV leakage is included in
23 this number.

24 CHAIRMAN WALLIS: How big is a
25 conservative leakage of MSIV?

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1 MR. LOBEL: I can't think of them in
2 consistent units.

3 CHAIRMAN WALLIS: I just bring this up
4 because it was brought up in the other presentation we
5 heard where supposedly several MSIVs were leaking in
6 this reference plant.

7 MR. LOBEL: Typically, leaking isn't going
8 to have much of an effect.

9 CHAIRMAN WALLIS: It's a very small flow
10 rate?

11 MR. LOBEL: Yeah.

12 CHAIRMAN WALLIS: I remember TMI had a
13 leaking pore and it got worse and worse from day to
14 day and it was way beyond specs and it contributed to
15 the accident.

16 MR. LOBEL: This would be leaking after
17 the accident when the pressure would be approximately
18 the containment pressure and TMI was --

19 CHAIRMAN WALLIS: I know but I was just
20 saying there was a leaking valve and it wasn't much of
21 a leak but it got worse and worse and ended up
22 contributing.

23 MR. LOBEL: Yeah. But there are two and
24 leakage like you see doesn't have a really big effect
25 and when they do these calculations, they include the

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1 tech spec value of the MSIV leakage.

2 CHAIRMAN WALLIS: Oh, that's included, is
3 it?

4 MR. LOBEL: Yeah. The tech spec value, if
5 they're leaking more than that, obviously it wouldn't
6 be.

7 VICE CHAIR RANSOM: I wonder if we could
8 get these conservatism examples that you have
9 converted to available NPSH and feet.

10 MR. LOBEL: Sure.

11 VICE CHAIR RANSOM: And that should be
12 easy to do.

13 MR. LOBEL: Well, the problem is what I
14 did was pick things I could find from different
15 analyses, different submittals, and so they're not all
16 consistent. I think the report that the State of
17 Vermont was referencing, they included some tables of
18 sensitivities. That's probably the best source of,
19 most complete source of things. Unfortunately, it's
20 not something that we get some licensees. I'm sure
21 licensees do a lot of this, but we don't have --

22 VICE CHAIR RANSOM: Where did you get the
23 temperature effects that you quoted? Are those based
24 on calculations?

25 MR. LOBEL: Different submittals.

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1 VICE CHAIR RANSOM: Oh, submittals.

2 MR. LOBEL: Yes, they're based on licensee
3 calculations from different submittals. I can give
4 you what I have but that's not in terms of NPSH.

5 CHAIRMAN WALLIS: You're going to get onto
6 debris.

7 MR. LOBEL: Well, I'm --

8 CHAIRMAN WALLIS: I'm concerned about
9 debris and you say something about ten minutes. We
10 looked at tests, several tests, and it appears that
11 the pressure drop across a strainer even when you have
12 the same stuff there increases with time.

13 MR. LOBEL: Right, and what this says is
14 -- This is kind of long but what this says is for the
15 short term, less than ten minutes, I use the value at
16 ten minutes.

17 CHAIRMAN WALLIS: At ten minutes. So
18 you're being conservative building up.

19 MR. LOBEL: Right. And then after ten
20 minutes, I'm assuming a different single failure maybe
21 and I am assuming a single different failure and I may
22 have a different number of pumps operating and they'll
23 be operating at a different flow rate. So what's done
24 is at least in one case is the debris is
25 redistributed. So any strainers that don't have flow

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1 through them for the long term, that debris is taken
2 off and it's put on the strainers --

3 CHAIRMAN WALLIS: Is there any possible
4 mechanism for that happening?

5 MR. LOBEL: No.

6 CHAIRMAN WALLIS: So someone with a
7 shovel, breaks it off the strainer that has no flow
8 through it and pumps it on the other strainer.

9 MR. LOBEL: Maxwell's demon. But there
10 are a lot of these kinds of conservatisms.

11 CHAIRMAN WALLIS: You could also say that
12 the material which is supposedly hung up in pools
13 above somewhere never gets to the sump suddenly comes
14 down and there are all kinds of things you could do be
15 conservative.

16 MR. LOBEL: There's a conservative
17 assumption that's made where I treat the power as a
18 step that's above the continuous curve just because
19 it's simpler to do the calculation that way.

20 CHAIRMAN WALLIS: This is what you do.
21 What does an applicant do? Do they all do the same
22 things you do?

23 MR. LOBEL: Well, I'm talking about what
24 they do.

25 CHAIRMAN WALLIS: You're talking about

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1 what they do.

2 MR. LOBEL: We don't do these
3 calculations.

4 CHAIRMAN WALLIS: You're talking as though
5 you were the guy doing the calculations.

6 MR. LOBEL: No, I'm sorry. I shouldn't
7 say that. No.

8 CHAIRMAN WALLIS: Now is this consistent
9 right across the industry? They all do this or is
10 there a whole mix of things that they do?

11 MR. LOBEL: There is a mix to some extent
12 but for the BWRs, it's fairly consistent.

13 CHAIRMAN WALLIS: Is that because there's
14 some sort of a guidance document that they developed
15 themselves?

16 PARTICIPANT: Yes.

17 CHAIRMAN WALLIS: Yes.

18 MR. LOBEL: Well, it's probably not they
19 might have a guidance document. It's more that
20 typically these calculations are done by one
21 organization and they have their way of doing it.

22 CHAIRMAN WALLIS: Like some of the people
23 who were sitting up at the back earlier today perhaps.

24 MR. LOBEL: Could be. They were invited.

25 CHAIRMAN WALLIS: Right.

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1 MEMBER SHACK: But you're confident, Dr.
2 Wallis, that the calculation of debris head loss is
3 bounding.

4 CHAIRMAN WALLIS: I'm not confident at all
5 about any of these calculations until I see them.

6 MR. LOBEL: When we're talking about the
7 BWRs, we're talking about the calculations that are
8 done in accordance with the URG and the staff SERs.

9 CHAIRMAN WALLIS: Right.

10 MR. LOBEL: At one time, they were
11 considered bounding.

12 MEMBER SHACK: The NC jet model.

13 MR. LOBEL: I guess they're officially
14 still considered bounding.

15 CHAIRMAN WALLIS: Okay.

16 MR. LOBEL: I'll skip the PWR
17 conservatism.

18 CHAIRMAN WALLIS: Is there anything
19 unusual here? They're just about the same.

20 MR. LOBEL: Pretty much the same. The
21 flood level.

22 CHAIRMAN WALLIS: The worst possible pipe
23 occurs, I notice you use that. That's the biggest
24 break.

25 MR. LOBEL: Yes, the biggest break in the

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1 worst location for the containment peak pressure
2 calculation the pump suction break is usually the most
3 limiting break.

4 CHAIRMAN WALLIS: Do you assume here to be
5 conservative? That the break discharges directly into
6 the sump and doesn't heat the containment at all?

7 MR. LOBEL: Essentially.

8 CHAIRMAN WALLIS: That's short of
9 remarkable.

10 MR. LOBEL: What you assume is you have a
11 break flow that's some liquid and some vapor.

12 CHAIRMAN WALLIS: You put the vapor in the
13 containment.

14 MR. LOBEL: A vapor is in the containment
15 atmosphere. A portion of the liquid flashes and stays
16 in the containment atmosphere.

17 CHAIRMAN WALLIS: And all the liquid
18 falls?

19 MR. LOBEL: And all the liquid falls
20 directly to those --

21 CHAIRMAN WALLIS: But you don't put the
22 steam in the sump too.

23 MR. LOBEL: No, not directly. There is
24 heat transfer with the atmosphere in some cases, but
25 in some cases, the sump temperature is hotter than the

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1 containment atmosphere. So that wouldn't be
2 conservatives. The flood level is calculated in a way
3 that the real level is underestimated in one calc.

4 CHAIRMAN WALLIS: And the industry is
5 happy taking all of these conservative assumptions
6 perhaps because it didn't hurt them in the past?

7 MR. LOBEL: Yeah, it didn't in the past.

8 CHAIRMAN WALLIS: When it begins to hurt,
9 then they try to figure out how to do --

10 MR. LOBEL: It didn't hurt them in the
11 past and now we're getting into debris. For the PWRs,
12 we're talking about GSI-191 now and --

13 CHAIRMAN WALLIS: Here we're not.

14 MR. LOBEL: And they're starting to look
15 at that and it may be hurting them. There have been
16 some preliminary discussions with PWR licensees about
17 crediting overflow. So I guess the message at the
18 bottom line is that not only do we have this list of
19 conservative assumptions but these analyses are done
20 in a way that all these assumptions are assume to
21 occur at the same time, that you get the most limiting
22 break, that the parameters specified in the tech specs
23 are all at their limiting values at the same time,
24 that the worst single failure, not any failure, but
25 the worst single failure occurs and that every

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1 physical process takes place in the most limiting way.

2 CHAIRMAN WALLIS: I hate to bring it up.
3 I said I wouldn't talk about 191 but are you really
4 being conservative about the debris?

5 MR. LOBEL: In 191?

6 CHAIRMAN WALLIS: No. You have all these
7 conservatisms but the debris could be a big
8 contributor to loss of NPSH and it's not clear that
9 you have said anything conservative about your
10 treatment of debris here.

11 MR. LOBEL: Well, I've been trying.

12 CHAIRMAN WALLIS: You spread it over the
13 whole area, but --

14 MR. LOBEL: I've been trying to say as
15 little as I can about debris because it's really kind
16 of outside of the scope of this meeting.

17 CHAIRMAN WALLIS: Well, maybe we could say
18 we don't quite know yet how to be conservative about
19 debris except that it's distributed over the entire
20 area.

21 MR. LOBEL: I think there are people here
22 who could answer that better than I'd rather answer
23 it.

24 CHAIRMAN WALLIS: So let's put that for
25 another day and just bear in mind.

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1 MR. LOBEL: I prefer to do that.

2 CHAIRMAN WALLIS: We're not quite clear
3 how to be conservative about debris. We agree on
4 that.

5 MR. LOBEL: I don't want to agree to that.

6 MEMBER SHACK: Certainly not up to me.

7 MR. LOBEL: Yes, it's not up to me to
8 agree or disagree. It's not my issue.

9 CHAIRMAN WALLIS: Okay. If you knew how
10 to, you'd be as conservative about debris as you've
11 been about all these other things. Right?

12 MR. LOBEL: Yes.

13 MEMBER SHACK: The intent is to be
14 conservative.

15 MR. LOBEL: Yes. The intent is to be
16 conservative.

17 CHAIRMAN WALLIS: Bounding. That's
18 bounding to you.

19 MR. LOBEL: Bounding. Yeah.

20 CHAIRMAN WALLIS: And you don't worry
21 about conservatisms which are inherently incompatible
22 with each other if there are such things.

23 MR. LOBEL: No. For instance, I was going
24 to say in the PWR in determining the level I saw one
25 calculation where the level is calculated based on a

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1 small to intermediate size break because that gives
2 you less water on the floor. But the rest of the
3 calculation is for a large break LOCA. So they're not
4 --

5 CHAIRMAN WALLIS: The level is calculated
6 assuming no water goes there and the temperature is
7 calculated assuming all the water goes there.

8 MR. LOBEL: Yeah. There are reasons for
9 this. One of the reasons that comes up every once and
10 a while is a licensee will find an error in the
11 calculation and they'll have to come in and they'll
12 say, "We found this error but it's okay for us to
13 continue to operate because look at all this other
14 margin we have." So they like to have some extra
15 margin in these calculations. I'm not sure that they
16 would want to do a realistic calculations either.

17 MEMBER SHACK: It's hard to do a half
18 conservative calculation.

19 MR. LOBEL: That's true.

20 MEMBER SHACK: Once you introduce things
21 that aren't conservative, then life really gets
22 exciting.

23 MR. LOBEL: That's right. That takes work
24 and a level of knowledge that may not be out there
25 right now.

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1 CHAIRMAN WALLIS: It's like politics.
2 There's no half conservative.

3 MR. LOBEL: Not anymore. Pump design.
4 I'm sorry. I skipped the most important. Statistical
5 method. We've been kind of talking about this.

6 CHAIRMAN WALLIS: Yes, this sounds good.

7 MR. LOBEL: One of the positions that we
8 put into the reg guide was a possible solution of
9 using a statistical method just like you've been
10 talking about, Dr. Wallis, of identifying the
11 uncertainties, quantifying the uncertainties and
12 treating them in a statistical way which has the
13 advantage of knowing what your level of conservatism
14 would be, at least better defining it than what we
15 have now. As I've said, we've had some preliminary
16 discussions but nobody's tried this yet.

17 CHAIRMAN WALLIS: If all these are really
18 conservative and bounding, then they're essentially
19 saying there's no probability of this happening.

20 MR. LOBEL: Essentially yeah.

21 CHAIRMAN WALLIS: So this would be a
22 relaxation.

23 MR. LOBEL: It would. It would be a
24 relaxation and it would have the advantage that if it
25 predicted that you needed containment pressure, you'd

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1 have a pretty good confidence that you needed it.

2 CHAIRMAN WALLIS: Has anybody done this?

3 MR. LOBEL: No.

4 CHAIRMAN WALLIS: It's interesting to see.

5 The conservative stuff may predict 30 feet, whatever,

6 pick a number. It may well be that, this method here

7 you're indicating, might predict 300 feet. It may be

8 they're so conservative now that they're way off. I

9 just have no idea.

10 MR. LOBEL: You know the ESVWR uses track

11 G to do the containment and the reactor calculations

12 in a combined fashion. So it may be possible to get

13 some sense out of that calculation when we see that

14 application at some point.

15 CHAIRMAN WALLIS: So they're going to do

16 it this way.

17 MR. LOBEL: They're going to use track G

18 and track G is set up to be able to do statistical

19 uncertainty calculations, although they haven't quite

20 done it but it's possible. So right now, this is just

21 a position that was put into the reg guide with the

22 hope that --

23 CHAIRMAN WALLIS: I don't like the word

24 "nominal calculation." What it should be is

25 "realistic calculation." But nominal to me means

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1 something pulled out of the air.

2 MR. LOBEL: Okay. Well, I was using it in
3 the sense of --

4 CHAIRMAN WALLIS: Almost pejorative.

5 MR. LOBEL: I guess it's realistic.
6 Without any uncertainty.

7 MR. CARUSO: Best estimate.

8 MR. LOBEL: Best estimate, yeah. So we
9 could take whatever you call it and then you would add
10 the uncertainties on it, some statistical and upper
11 tolerance limit that you picked.

12 MR. CARUSO: Don't you still have to look
13 at a spectrum of scenarios though?

14 MR. LOBEL: Yeah. You'd still have to do
15 that and then of course you'd have conservatism.

16 MEMBER SHACK: You really want to have the
17 margin I suspect to try this.

18 MR. LOBEL: You would. I imagine you
19 would still pick the worst break and the worst single
20 failure and then do something like this.

21 CHAIRMAN WALLIS: Ah. You're allowed to
22 look at the probability of the break size. Then you
23 could really do well.

24 MR. LOBEL: You could do that I suppose.

25 CHAIRMAN WALLIS: You would really be 99

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1 percent confident. Maybe that's what you should do.

2 MR. LOBEL: Maybe. Honestly, this hasn't
3 been given a lot of thought by the staff either. What
4 we were hoping is that somebody would be attracted
5 enough by this to try to do it and we would work with
6 that organization together and try to define a method.
7 This isn't a method. This is just a criterion.

8 VICE CHAIR RANSOM: When do you suspect
9 50.46 will appear to this if you go to this transition
10 break size?

11 MR. LOBEL: Smaller breaks probably would
12 make this pretty much, the need for over-pressure
13 would probably go away I would imagine.

14 CHAIRMAN WALLIS: It depends on what's
15 required beyond transition break size.

16 MR. LOBEL: Yeah, but if then beyond the
17 transition break size you can do a realistic
18 calculation, it may still go away.

19 VICE CHAIR RANSOM: For the mitigation
20 phase --

21 MR. LOBEL: If you can assume I have all
22 my trains of ECCS and the pumps are pumping at their
23 design rate and not at some run-out rate and the
24 temperatures are closer to what you'd really expect,
25 what you'd measure experimentally.

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1 Pump design. Let me speak a little bit
2 about pumps not that we haven't been doing that all
3 along. But the pumps that we're discussing, the ECCS
4 and containment spray pumps, all have certain
5 characteristics that are important relative to NPSH in
6 common.

7 Like I was talking about a little before,
8 the pumps are typically slightly above the low suction
9 energy level as defined by the hydraulic institute.
10 High suction energy indicates a pump more prone to
11 cavitation damage than a lower suction energy pump.
12 I don't believe any of these pumps are anywhere near
13 high suction energy level which would be very prone to
14 cavitation damage according to their definitions and
15 there are curves of this in hydraulic institute
16 standards to determine where you are and to make a
17 decision in terms of required NPSH and the speed of
18 the pump and like I said, the diameter of the eye of
19 the impeller and things like that.

20 MEMBER SIEBER: These are typically 1800
21 RPM pumps.

22 MR. LOBEL: Typically, yes. 1750.

23 MEMBER SIEBER: Yeah, whatever the slip
24 is.

25 MR. LOBEL: Some are around 3750

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1 typically.

2 MEMBER SIEBER: That would be unusual
3 though.

4 MR. LOBEL: Yeah, most of them are around
5 1750.

6 VICE CHAIR RANSOM: The energy measure
7 that you're using is kinetic energy of the inlet flow?

8 MR. LOBEL: To tell you the truth, I'm not
9 sure exactly what it is. It's described in a paper
10 that I read as the tendency of the fluid to flash.
11 But it's not defined in thermodynamic properties.
12 It's defined in terms of the speed of the pump, the
13 diameter of the eye of the impeller of the pump, the
14 specific gravity of the fluid and something called the
15 suction specific --

16 CHAIRMAN WALLIS: I think it's mostly you
17 have to get the fluid into the pump through a hole and
18 the hole is too small. You have to have too high of
19 a velocity.

20 MR. LOBEL: Right.

21 CHAIRMAN WALLIS: So you have a
22 depressurization.

23 MR. LOBEL: Right. That's what really is
24 happening anyway. That's the mechanism. That's
25 almost the definition of NPSH. You need a certain

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1 pressure, a certain head, at the suction phalange so
2 that when you go through all these pressures losses,
3 when you get to the impeller, you still have --

4 CHAIRMAN WALLIS: But some pumps don't
5 have to escalate the flow in order to get it into the
6 pump as much as other pumps do.

7 MR. LOBEL: Right.

8 VICE CHAIR RANSOM: I'm wondering if this
9 isn't equivalent to what they call the thermodynamic
10 head and pumping cryogenic type fluids.

11 CHAIRMAN WALLIS: That's a hot head.

12 VICE CHAIR RANSOM: It's more of a fluid
13 properties effect.

14 MR. LOBEL: There's a tradeoff. One of
15 the tradeoffs is since one of the factors is the
16 diameter of the eye of the impeller if I make that
17 smaller I lower the level of energy going in and so
18 that helps. But then that has other disadvantages.
19 If I make that diameter larger, I'm in --

20 VICE CHAIR RANSOM: It must not be kinetic
21 energy because the kinetic energy would increase as
22 you make it smaller.

23 CHAIRMAN WALLIS: I think you want to make
24 it big.

25 MR. LOBEL: Yeah.

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1 MEMBER SIEBER: It depends on the head and
2 the flow characteristic that you want. There's a
3 balance.

4 MR. LOBEL: There's a lot of tradeoffs in
5 this and this all gets into the design of the pump
6 which is the pump vendors.

7 VICE CHAIR RANSOM: Is this defined
8 anywhere?

9 MR. LOBEL: It's defined in some hydraulic
10 institute standards, the one on margin. I can give
11 you a copy of it.

12 MEMBER SIEBER: Basic stuff is in Mark's
13 handbook.

14 MR. LOBEL: Is it somewhere in Mark's?

15 MEMBER SIEBER: Yes, there are sections on
16 pump. I take it these are verticals, the bulk of
17 them. I know some that aren't, but they're vertical
18 shaft.

19 MR. LOBEL: The BWRs, almost all.

20 MEMBER SIEBER: The PWRs?

21 MR. LOBEL: The PWRs, I think there's more
22 of a variety but I know some of them are.

23 MEMBER SIEBER: Yeah, that's the easy way
24 to see draft because you just dig a hole in -- and
25 line it and you can go pretty deep as opposed to

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1 building a room down there.

2 MR. LOBEL: This table is just to show
3 that stainless steel is a fairly good material to use
4 for the pump impellers and pump casings that it's
5 fairly cavitation resistant.

6 MEMBER SIEBER: Right.

7 CHAIRMAN WALLIS: Two is good?

8 MR. LOBEL: It's a relative thing.

9 CHAIRMAN WALLIS: All the numbers are
10 good.

11 MR. LOBEL: It's not below list.

12 MEMBER SIEBER: Actinium is also good.
13 Plastic is not.

14 MR. LOBEL: Titanium and aluminum bronze.

15 CHAIRMAN WALLIS: But this is over a long
16 period of time, isn't it?

17 MR. LOBEL: Right.

18 CHAIRMAN WALLIS: You're not going to run
19 this thing for a year in cavitational condition.

20 MR. LOBEL: Right. That's a good point
21 and that's what I was trying to get at.

22 CHAIRMAN WALLIS: Cavitational peril
23 sounds really dramatic.

24 MEMBER SIEBER: But if you get a lot of
25 destructive cavitation, then material becomes

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1 important even in a short period of time.

2 MEMBER SHACK: Another unquantifiable
3 conservatism.

4 MR. LOBEL: The next table --

5 CHAIRMAN WALLIS: You haven't talked about
6 the particular content here. You talk about a gas
7 content is low as you're pumping stuff with finely
8 divided Calsil particles or something. Did it change
9 anything about it or not?

10 MR. LOBEL: I'm sure it --

11 CHAIRMAN WALLIS: I asked that earlier.

12 MR. LOBEL: Yeah. I'm sure it wouldn't do
13 the pump a lot of good. I don't know what the effect
14 on cavitation would be.

15 CHAIRMAN WALLIS: You might see if there's
16 any information. When you come for a full committee
17 you could answer that.

18 MEMBER SIEBER: There's an interesting
19 thing though. When you consider pumps of all types
20 even in power plant if you go to water treating,
21 you'll find that they dewater the clarifier which is
22 a big settling pond. That stuff is like mud, but they
23 pump it and the way they protect the pump is to use
24 rubberized water cooled bearings where you supply
25 fresh water to it. And so there are multiple designs

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1 of heat draft pumps that provide you with varying
2 degrees of protection from debris. You can pump
3 sludge. You can pump coal, believe it or not.

4 CHAIRMAN WALLIS: You can pump coal but
5 you have to have the right design of pump.

6 MEMBER SIEBER: I think it helps to have
7 the right design for each application.

8 MR. LOBEL: And material for the impeller.

9 MEMBER SIEBER: Right. Coal pumps don't
10 last long.

11 CHAIRMAN WALLIS: So hardness isn't
12 necessarily the right criterion for wear in this
13 context. So these rubberized pumps --

14 MEMBER SIEBER: You may recall a plant in
15 the Midwest who had a horizontal shaft pump that
16 suffered a lot of bearing damage due to sump debris.
17 That didn't have the protections that some other types
18 of pumps have and so that's unique to each individual
19 plant. It depends on the pump design, the kind of
20 pump that it is and whatever built-in protections it
21 may have.

22 MR. LOBEL: Let me go on. The next table
23 --

24 CHAIRMAN WALLIS: This is quite
25 remarkable. I mean you have two foot required for

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1 mark three and you have almost 30 foot required for
2 some of the mark ones.

3 MR. LOBEL: Well, that's the message I'm
4 trying to --

5 CHAIRMAN WALLIS: So you could just put a
6 mark three function in a mark one.

7 MEMBER SIEBER: No.

8 MR. LOBEL: You can see that the message
9 I'm trying to make that this is really mostly a
10 problem for the older BWRs that as plants evolved they
11 realized, I guess, they needed to do something about
12 this.

13 CHAIRMAN WALLIS: What happened to this
14 mark one at the bottom? It has a much lower.

15 MR. LOBEL: It's a newer mark one if you
16 look that CP issue date.

17 CHAIRMAN WALLIS: Oh, it's a '74.

18 MR. LOBEL: Yeah.

19 CHAIRMAN WALLIS: So that shows that a
20 mark one can have a pump. Does it take more space or
21 something? Can have a pump with a lower NPSH-r.

22 MR. LOBEL: Sure. That's what this shows.

23 CHAIRMAN WALLIS: So could Vermont Yankee,
24 let us say just as an example, put in a pump with a
25 lower NPSH-r like this?

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1 MR. LOBEL: I don't want to answer them.
2 I don't know.

3 CHAIRMAN WALLIS: We don't know. One
4 could ask since another mark one has it. What's the
5 CH --

6 MEMBER SIEBER: Only the licensee could
7 answer that.

8 MR. LOBEL: Yeah. I'm sorry. What?

9 CHAIRMAN WALLIS: I'm sorry. I was just
10 -- Two feet is quite an achievement, isn't it?

11 MR. LOBEL: The BWR 5 and BWR 6 product
12 lines and later BWR 4s use pumps designed to handle
13 saturated fluid. So they won't require accident
14 pressure credit. The industry was going in the right
15 direction. I guess the newer plants now don't have
16 pumps, the new designs, safety related pumps.

17 CHAIRMAN WALLIS: The new designs which
18 the flow occurs by gravity are totally dependent on
19 NPSH because it's the gravity that does all the work.

20 MR. LOBEL: They're dependent on gravity.

21 MEMBER SIEBER: You end up with other
22 issues like you have to depressurize the plant in
23 order to make gravity work.

24 MR. LOBEL: You need a suppression pool or
25 something.

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1 MEMBER SIEBER: And it has to be very
2 tall.

3 MR. LOBEL: Okay. You have approved
4 credit for operation under cavitation below the
5 required NPSH with and without credit for containment
6 accident pressure based on the pump cavitation
7 testing. The pumps are tested for a period of time
8 and then they are disassembled and the insides are
9 examined, the pump shafts, sleeves, bearings, seals.

10 CHAIRMAN WALLIS: The test also tests
11 their ability to provide the flow.

12 MR. LOBEL: Right.

13 CHAIRMAN WALLIS: It must be there
14 somewhere.

15 MR. LOBEL: That would be measured too.

16 CHAIRMAN WALLIS: And there's no falloff
17 flow rate over this period of time.

18 MR. LOBEL: There is.

19 CHAIRMAN WALLIS: There is?

20 MR. LOBEL: In some of these tests, there
21 is. The flow will decrease as you --

22 CHAIRMAN WALLIS: Now are these tests run
23 for long enough to really show what we're looking at
24 here?

25 MR. LOBEL: Some of the tests are run for

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1 periods of less than an hour, but the longest test was
2 a test run for an older BWR where they did the witness
3 test and then they took the pump apart and examined it
4 and put it back together again and then they did a
5 cavitation test. They ran the pump for an hour and
6 then took it apart, disassembled it and examined it
7 again and didn't see any damage. Then they put it
8 back together again and tested it at run-out flow at
9 more cavitation for another hour and took it apart
10 again and didn't see any damage.

11 CHAIRMAN WALLIS: But you're talking about
12 two and a half days or something, aren't you, here?
13 In our earlier discussions, you said 55 hours or
14 something like that.

15 MR. LOBEL: That's the --

16 MEMBER SIEBER: Pressure --

17 MR. LOBEL: That's the time that the
18 reference plant --

19 CHAIRMAN WALLIS: They needed to have
20 over-pressure. So we're talking about a much longer
21 time of operation than these tests.

22 MR. LOBEL: Right.

23 CHAIRMAN WALLIS: Does that concern you at
24 all?

25 MR. LOBEL: No, because they're not taking

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1 credit for operating in cavitation for all that time.

2 MEMBER SIEBER: The other issue is you
3 don't necessarily run the test until the pump destroys
4 itself. What you try to do is get all the vibration
5 signatures and shaft whip and those kinds of things
6 from which one can predict how long the pump will last
7 until it fails.

8 MR. LOBEL: There was a test done at
9 another BWR. They didn't specify the time but this
10 was actually an incentive to ask where an RHR pump was
11 operated from the suppression pool and back to the
12 suppression pool in cavitation and they didn't specify
13 a time but they did a lot of measurements of
14 throttling and reducing the flow and reducing the
15 suction flow also and seeing what the effect was and
16 determined that operation for the time they needed it
17 was okay.

18 CHAIRMAN WALLIS: Well, the slide we saw
19 earlier said that these witness tests, some of these
20 are the same thing, were only for too short a
21 duration. That was the presentation from our friends
22 this morning.

23 MR. LOBEL: Witness test is -

24 CHAIRMAN WALLIS: Is that what you're
25 referring to in this slide?

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1 MR. LOBEL: No, these wouldn't be witness
2 tests. A witness test would be a test that the pump
3 vendor runs for the customer to show to the customer
4 that the pump will do what the customer specified. It
5 would do these tests. It would go beyond that.

6 CHAIRMAN WALLIS: He probably doesn't want
7 to run it for several days on the cavitation and
8 conditions.

9 MEMBER SIEBER: The witness test is a
10 factory test as opposed to these kinds of tests which
11 are in the plant with small piping.

12 MR. LOBEL: Well, some are. Some are at
13 the pump vendors place.

14 MEMBER SIEBER: Yes.

15 MR. LOBEL: But some of them are in the
16 plant also. The 55 hours or whatever the time is for
17 these is the time that they're requesting over-
18 pressure but a lot of this time could be with not a
19 lot of over-pressure.

20 MEMBER SIEBER: Two pounds.

21 MR. LOBEL: I don't remember the exact
22 time for this reference plant, but some of that time,
23 it's like one and a half PSIGs what they're asking for
24 and with just revising one or more of these, probably
25 any one of these, well, I won't say anybody, but some

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1 of these conservative assumptions, you could get rid
2 of the one and a half PSIG need for over-pressure.

3 CHAIRMAN WALLIS: But if they were not
4 allowed to take credit for over-pressure than in
5 regulatory space they could be running for 55 hours
6 and even if never really happened, but you'd have to
7 consider them running at 55 hours with maybe severe
8 cavitation.

9 MR. LOBEL: I don't know whether that
10 would ever happen or whether like we were talking
11 earlier today about having to come up with another
12 approach. The impact on operation. The next area to
13 discuss is the impact on operation. Operators have
14 several indications of pump cavitation.

15 Actually, these would be from the control
16 room operator route near the pump. There would
17 obviously be others and there's probably others from
18 the control room that I haven't listed here, but
19 erratic or decreasing pump motor current, erratic flow
20 or flow less than expected, frequent adjustments of
21 discharge valves to maintain a constant flow would be
22 an indication to an operator that he had some kind of
23 NPSH problem or some problem with the pump. The flow
24 course from a safety-related pump is something that
25 the operator would be monitoring almost constantly.

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1 CHAIRMAN WALLIS: I think you can get
2 cavitation which can damage a pump without any of
3 these symptoms. Simply local cavitation which bangs
4 away at certain parts of the blades and doesn't change
5 the overall characteristics very much.

6 MR. LOBEL: Again, yeah. You could be in
7 cavitation but if you're not in cavitation to the
8 point where you're decreasing the flow --

9 CHAIRMAN WALLIS: Then you don't care.

10 MR. LOBEL: Then you're probably really
11 have a problem.

12 CHAIRMAN WALLIS: Right. You have to
13 separate the damaged part from the effect on operation
14 part.

15 MR. LOBEL: Right.

16 VICE CHAIR RANSOM: Is it all beyond the
17 three percent point?

18 MR. LOBEL: These are beyond it. Yeah.

19 MEMBER SIEBER: Yeah, these are out at the
20 need probably when you get these kind of symptoms.

21 MR. LOBEL: And the responses the operator
22 could take would be throttling the pump, removing the
23 pump from service.

24 CHAIRMAN WALLIS: That means switching it
25 off?

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1 MR. LOBEL: Switching it off. Utilizing
2 another water source. The next slide is a sensitivity
3 study I found that illustrates the effect of
4 throttling the pump. This is a calculation for an RHR
5 pump in a system with four RHR pumps, two in each
6 train and two course spray pumps operating. The pump
7 flow starts out at 5,000 GPM.

8 The table shows the suction loss and the
9 suction piping going to the pump, the required NPSH
10 and the NPSH margin. You can see if I throttle the
11 flow to 3750 I've greatly reduced the, or I've
12 increased the NPSH margin, but I'm still negative. I
13 still have available NPSH than required NPSH and if I
14 halved the flow from the starting flow, I have a
15 positive margin. So throttling the pump is something
16 the operator can easily do that can have a big impact.

17 CHAIRMAN WALLIS: I think if you throttle
18 it too far then you get into some other condition.

19 MR. LOBEL: Right.

20 CHAIRMAN WALLIS: Where it's not very --

21 MR. LOBEL: And the operator would have to
22 follow his EOPs and he'd have to make sure he's
23 satisfying all the other conditions he needs to
24 satisfy. But don't forget too that this is out at
25 some long time after the accident. He's not worried

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1 at this point about injection anymore. He's trying to
2 cool the suppression pool. So he'd have more latitude
3 in operations to throttle the flow.

4 CHAIRMAN WALLIS: In the days when I used
5 to have a shallow water well, this was exactly how I
6 treated cavitation in my pump in my house. I would go
7 down and throttle it and it starts to cavitate. So I
8 know it works.

9 MR. LOBEL: You can see why it works at
10 least in this case. As I lower the flow, I greatly
11 lower the suction losses since they are pretty much
12 based on the square of the flow and I also lower the
13 required NPSH.

14 Reg Guide 1.1, we talked about this a
15 little early, has two concerns, the containment
16 integrity we already discussed and the possibility of
17 cooling down the containment excessively to the point
18 where you don't have the pressure you credited. I
19 already went through most of this but the operating
20 procedures currently contain operator guidance to
21 terminate the spray flow at zero PSIG. Some BWRS, the
22 sprays are terminated automatically at a higher flow.
23 In plants, the credit accident pressure, the emergency
24 operating procedures specify a higher value at which
25 to terminate the sprays so that the credited NPSH

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1 stays available.

2 CHAIRMAN WALLIS: What does this maintain
3 containment and structural integrity?

4 MR. LOBEL: You don't want to have a
5 vacuum inside.

6 CHAIRMAN WALLIS: Oh, I see. You don't
7 want to collapse it.

8 MR. LOBEL: Right.

9 CHAIRMAN WALLIS: Ah, because it's not
10 designed for that. Now I understand.

11 MR. LOBEL: It's designed up to a certain
12 point. I don't remember what the number is for BWRs.
13 For PWRs, it's -2 PSIG, I think, is usually the design
14 number for the containment.

15 CHAIRMAN WALLIS: But if you ran a nice
16 condenser plant with no steam in it you might go down
17 to quite a big vacuum maybe.

18 MEMBER SIEBER: It depends on the plant.

19 MR. LOBEL: Yeah.

20 CHAIRMAN WALLIS: There's no vacuum
21 breaker on containment.

22 MR. LOBEL: And also the emergency
23 operating procedures for BWRs have curves of
24 suppression pool temperature and pump flow with
25 containment pressure as a parameter so the operators

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1 can keep track of any containment pressure he may need
2 for the temperature he's at in the pump flow.

3 CHAIRMAN WALLIS: Now you've made a very
4 interesting presentation, very informative. We're
5 talking about reg guide, are we? I look at it as
6 there's a lot of changes in there. So in order for us
7 to be satisfied, we have to very carefully review
8 those, wouldn't we?

9 MR. LOBEL: Most of the changes are really
10 editorial.

11 CHAIRMAN WALLIS: But they seem to be huge
12 amounts as I said before to line out and so on.

13 MR. LOBEL: Yeah. Like I was saying --

14 CHAIRMAN WALLIS: Because of duplication.

15 MR. LOBEL: Yeah, you had the same
16 discussion under BWRs and PWRs. I tried to put it all
17 in one place. So a lot of the --

18 CHAIRMAN WALLIS: So there's little that's
19 substantial.

20 MR. LOBEL: The only thing that's
21 substantial, the only thing that's really change is
22 the position. It would be the first two positions
23 under each section.

24 CHAIRMAN WALLIS: So that's where we
25 should focus.

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1 MR. LOBEL: And the other thing is the
2 statistical criterion, the statistical position.
3 That's new. A lot of information was added. I don't
4 want to give you the wrong impression. A lot of
5 information was added in things that should be
6 considered that I got from different sources that I
7 thought it would be helpful to put in for people. So
8 when they're considering the water level, say, in a
9 PWR, there's a list of things that an analyst should
10 consider or that a reviewer should look at to see that
11 they were considered.

12 MEMBER SHACK: At least in our copy, it's
13 not clear what's been added. It's clear what's gone.

14 MR. LOBEL: Is that because you can't see
15 the redlines?

16 VICE CHAIR RANSOM: Yes, it's black and
17 white.

18 MEMBER SHACK: Oh, I see. It's red.

19 CHAIRMAN WALLIS: We just have black.

20 MEMBER SHACK: Are we going to get an
21 electronic version of this?

22 MR. CARUSO: I can give you a copy. What
23 I did was I marked up.

24 MEMBER SHACK: Oh, those brackets
25 indicate.

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1 MR. LOBEL: Those brackets tell you what's
2 been added.

3 MEMBER SHACK: Those brackets are
4 additions. Okay.

5 MR. LOBEL: And you can see the strikeout.

6 MEMBER SHACK: I didn't know whether you
7 were highlighting important stuff for us. Those are
8 the additions.

9 MR. LOBEL: That's the non editorial
10 additions. If you would like, I have the Adams
11 Accessions Numbers.

12 MR. CARUSO: I can give you an electronic
13 copy so you can see the red.

14 MEMBER SHACK: Yeah, that would be help
15 me.

16 MEMBER SIEBER: That just makes our lives
17 more complicated than they need to be.

18 MEMBER SHACK: I thought you gave a fairly
19 convincing discussion of the conservatism here but
20 when we go back to the presentation this morning,
21 again you have your technical assistance contractor
22 who is an NRR contractor I think.

23 MR. LOBEL: No, it was a research
24 contractor.

25 MEMBER SHACK: Oh, tech assist.

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1 MR. LOBEL: Yes, it was a research
2 contract.

3 MEMBER SHACK: Saying that utilities --

4 MR. LOBEL: I believe that's true.

5 MEMBER SHACK: Calculations with
6 simplifying assumptions that can't be justified. Now
7 are these all reviewed or are these done by
8 inspection? Is this something that comes for review
9 before they're allowed to take this credit?

10 MR. LOBEL: Yes, when I licensee takes
11 credit for containment accident pressure, we typically
12 do a pretty careful review. I don't know what the
13 contractor was referring to. I was involved in the
14 review of Dwayne Arnold which is one of the cases that
15 was cited there.

16 For Dwayne Arnold, we did an audit
17 calculation. We did an independent contained two
18 calculation, our computer code, to compare with the
19 General Electric calculation. It was done for Dwayne
20 Arnold and got very good comparison. And as part of
21 doing the audit calculation, we had a contractor to do
22 that analysis. Typically research is done, the
23 calculations since then, for us. But as part of that
24 review, we asked the contractor the same thing we
25 asked researchers is to go through the input parameter

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1 by parameter and make a judgment that those values are
2 reasonable values to use for the analysis.

3 Like I said, this contractor wasn't
4 involved in the Dwayne Arnold review. I don't know
5 where he's getting his information. I know who made
6 that statement and I have some respect for that
7 person. So I can't explain the comment.

8 CHAIRMAN WALLIS: So what you've done with
9 the reg guide is to take all these conservative
10 assumptions and say if you made all these conservative
11 assumptions you may take credit for containment and
12 over-pressure and calculating your NPSH. Is that the
13 new position?

14 MR. LOBEL: Yes. Essentially and it's
15 really been the position. But we didn't specify the
16 concerns.

17 MEMBER SHACK: Are these conservatisms in
18 the standard review plant? Is this what the review is
19 looking for?

20 MR. LOBEL: I'm sorry. I should have made
21 this clear at the beginning. What I presented as the
22 conservatisms are conservatisms that are typically in
23 a calculation. I'm not claiming that they're all in
24 any one calculation, but typically the majority of
25 them are or some other assumption. But they're

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1 typically to that level of conservatism and we review
2 the assumptions that are made when they take --

3 CHAIRMAN WALLIS: So if they're
4 conservative enough, you allow them to take credit for
5 NMSH which is calculated using these conservative
6 methods. That's the position.

7 MR. LOBEL: Yes.

8 CHAIRMAN WALLIS: I didn't have time to
9 look into details on the reg guide as it changed. I
10 was just rather taken aback by what had looked like
11 all these changes. But I didn't have time. So that's
12 what we will find if we read it carefully.

13 MR. LOBEL: Yes, that's the position.

14 CHAIRMAN WALLIS: And essentially, this is
15 explicitly saying what you have been doing anyway.

16 MR. LOBEL: Essentially, yeah. That part
17 of it is. The other part of the position that was
18 changed was we had a position which we used for the
19 97.04 reviews that said that if you calculate at 10
20 PSI and you only needed 5 PSI for over-pressure, all
21 you got credit was the 5 PSI.

22 CHAIRMAN WALLIS: Well, it doesn't matter.

23 MR. LOBEL: And it didn't make a whole lot
24 of sense, but that was our position.

25 CHAIRMAN WALLIS: This is much better than

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1 the last time. The last time there's a transcript
2 which I've seen several times but he keeps giving it
3 back to us where we talked about this with some other
4 of your colleagues and the message seemed to be "they
5 asked for it and we give it to them." That wasn't a
6 very satisfying answer. We said, "Well, don't you use
7 criteria and so on?" We never really go down to any
8 criteria.

9 MR. LOBEL: We joke with the person who
10 told you that all the time about that. That wasn't
11 the best answer.

12 CHAIRMAN WALLIS: Well, it's in the
13 record.

14 MR. LOBEL: Oh, yeah, and it may have been
15 an honest answer up to the point and again the
16 reviewer who said that is a reviewer who did a lot of
17 the 97.04 reviewers and she did very careful
18 conservative reviews. The caveat is we approved
19 whatever was asked for as long as it was done with a
20 conservative enough analysis and we agreed with the
21 analysis.

22 VICE CHAIR RANSOM: Where are we at on
23 your presentation? We have two more presentations to
24 go.

25 MR. LOBEL: I'm done except for -- Let me

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1 just make one remark about two slides and then I'll
2 quit.

3 VICE CHAIR RANSOM: We are going to cover
4 proposed reg guide methodology 1.82 or are you more or
5 less incorporating that in?

6 MR. LOBEL: I thought I was --

7 VICE CHAIR RANSOM: And then the SRP
8 revisions.

9 MR. LOBEL: I was just going to talk about
10 -

11 MEMBER SIEBER: It's in.

12 VICE CHAIR RANSOM: It's on the agenda.
13 So we have time.

14 MR. LOBEL: I've really been going through
15 all that.

16 VICE CHAIR RANSOM: Okay.

17 MR. LOBEL: I haven't been following that
18 agenda. Ralph, I apologize. I didn't coordinate as
19 well as I could have with Ralph.

20 VICE CHAIR RANSOM: So we're doing okay
21 somewhat.

22 MR. LOBEL: So I'm done except I could
23 make just a couple fast remarks about two tables and
24 then turn it over to Marty for the rest of it on risk.
25 All I wanted to say, let's get onto the risk part and

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1 all I was going to say is ACRS has asked the question
2 a couple times about looking at other events. So I
3 made up two tables, one for BWRs and one for PWRs that
4 listed some other events and whether there was a high
5 suppression pool temperature, whether debris were
6 generated and whether accident pressure was necessary.
7 I don't need to say much about those. The asterisk
8 let me just explain since it isn't on here.

9 MEMBER SHACK: Which slide are we looking
10 at?

11 MR. LOBEL: I'm sorry.

12 MEMBER SIEBER: Sixty-three.

13 MR. LOBEL: This one.

14 MEMBER SHACK: Oh, the first one.

15 MR. LOBEL: Yes, the first one is BWRs.
16 The second one is PWRs. But they're pretty much the
17 same. The asterisk just means that for at-risk there
18 are certain BWRs where the blowdown from the safety
19 valves doesn't go to the suppression pool. It goes
20 out into the containment. So there's a potential to
21 generate some debris from that. But the limiting
22 event for both the PWRs and the BWRs with respect to
23 containment accident pressure is the LOCA.

24 CHAIRMAN WALLIS: And who big a LOCA?

25 MR. LOBEL: I'm sorry.

1 CHAIRMAN WALLIS: How big a LOCA? Small
2 LOCAs presumably we don't do this if they're small
3 enough.

4 MR. LOBEL: Well, in this one PWR
5 calculation it was a small break LOCA that was
6 limiting.

7 CHAIRMAN WALLIS: So it could be any size.

8 MR. LOBEL: And I don't understand why and
9 I've asked them the question. The review is still
10 going on and I haven't gotten an answer back yet. But
11 I think the satisfying point of that is that they did
12 do a break spectrum to find what the limiting case was
13 and for the PWRs, LOCA is really the only event that
14 gives you recirculation. There are some PWRs where
15 you need recirculation for the steam line break if the
16 containment sprays are on for a long time. But the
17 LOCA is still the limiting event.

18 MEMBER SIEBER: Now the Barsebäck plant
19 was one where safety relief valve discharges went to
20 containment atmosphere.

21 MR. LOBEL: Right.

22 MEMBER SIEBER: That's why they got all
23 the debris.

24 MR. LOBEL: Right. So I'm done unless
25 there are any more questions.

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1 MEMBER SIEBER: Okay.

2 MEMBER DENNING: I guess just some
3 comments. I'm not sure whether this is the right time
4 or later as far as summarizing what might be presented
5 to the full committee or things in the interim period,
6 but one of the things that concerns me which you
7 addressed but I'm wondering if we could have more
8 information on and that is it is possible, they are
9 allowed in a regime in which there is cavitation
10 occurring and you made arguments as to why even though
11 there's cavitation that there probably isn't
12 significant damage being done. I was wondering if you
13 could provide more evidence of that, if there's more
14 evidence we could see of that.

15 MR. LOBEL: I can provide you with, I have
16 licensee events reports, vendor reports, licensee
17 reports on the cases that I cited there and a few
18 others that I'd be glad to provide. They're all
19 publicly available and we can add the references to
20 the transcription too.

21 MEMBER DENNING: That's fine. That sounds
22 of interesting to me. The other things that we didn't
23 really get into in detail and I'm not sure whether
24 this is the right reg guide that relates to it, but it
25 is clear that the properties of the fluid can be

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1 affected by debris and I'm not talking now about the
2 pressure drops across the debris, but just this
3 question of could you really be affecting the NPSH by
4 just having added materials that could affect the NPSH
5 and I think Graham asked that question. I don't think
6 we really had an answer for it.

7 MR. LOBEL: Right. I don't know the
8 answer offhand. There may be some experience that's
9 available from people who operate pumps, paper mill
10 pumps, slurry pumps and things like that. Of course,
11 that may be too much debris in the water. But I can
12 look into that some. I didn't try to find any
13 information on that. I don't know the answer.

14 MR. ARCHITZEL: This is Ralph Architzel.
15 Good morning. I wanted to jump in one point and ask
16 a question which is on that point. I'm not going to
17 contribute much other than to say that we worked at --
18 but not that aspect of it but --

19 CHAIRMAN WALLIS: We expect it from
20 somebody.

21 MR. ARCHITZEL: That's what I wanted to
22 mention it.

23 MR. LOBEL: I will take it as an action to
24 see what I can find.

25 CHAIRMAN WALLIS: The other thing that

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1 would help would be if you weren't just qualitative. If
2 you could give examples of where you say here's a
3 realistic calculation and when you do this
4 conservatism you change things. I suspect that the
5 conservatisms, particularly one or two of them, give
6 you quite a lot of margin. I don't know until I see
7 that.

8 MR. LOBEL: Another large one was the one
9 that I didn't spend much time on but it was the number
10 of pumps injecting into the vessel to begin with.
11 That was worth a large amount --

12 CHAIRMAN WALLIS: You can talk about
13 conservatism as much as you like but if these
14 conservatisms only contribute say one or two percent
15 to the final value, they may be less than the
16 uncertainty in the value itself in which case you
17 haven't really done anything very conservative. If
18 your conservatism is a factor of four and the
19 uncertainty is at 10 percent, then I can say that's
20 very conservative. Until you put some numbers on
21 these things, you haven't told me that.

22 MR. LOBEL: My boss said pretty much the
23 same thing to me after we adjourned after the first
24 session and I'm not going to promise anything but
25 depending on money --

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1 CHAIRMAN WALLIS: But if you deliver it,
2 we'll ask you again.

3 MR. LOBEL: Maybe we'll try to get some
4 technical assistance.

5 CHAIRMAN WALLIS: I think that would help
6 me.

7 MR. LOBEL: And try and do a whole
8 analysis ourselves where we can vary all these things
9 and not just depend on what's in licensee submittals.

10 CHAIRMAN WALLIS: Maybe the reference
11 plant might be induced to do some of these things too
12 if they want to make a convincing case.

13 MR. LOBEL: Well, you'll be talking to
14 them at some point.

15 CHAIRMAN WALLIS: We haven't talked to
16 them. No.

17 MR. LOBEL: Oh, you haven't yet.

18 CHAIRMAN WALLIS: And it's been a great
19 source of silence for awhile.

20 MR. LOBEL: Well, there's been a silence
21 because the review isn't over yet. The SER hasn't
22 been written yet.

23 MEMBER KRESS: Let me ask you. My
24 impression so far is that in doing the conservatims
25 and the design basis analysis it looks like there's

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1 substantial conservatisms. We don't know how much,
2 but it doesn't matter too much because anywhere
3 between the positive suction air required and what you
4 have you will probably get enough damage so that the
5 pump is not operable and you will get increased flow
6 anywhere in there, over the flow you got at the 0.5.
7 So you don't really care where you are in this space
8 because it's not going to matter with respect to
9 performing the function. Is that the right
10 impression?

11 MR. LOBEL: That's the right impression.
12 That's honestly the impression that I have and I can't
13 quantify it like I said. The other factor I think is
14 important too that I mentioned before is it's not just
15 the individual conservatisms, but it's the fact that
16 you're saying that each of these conservatisms is
17 occurring at exactly the same time with the same
18 analysis. So everything that could go bad or be at
19 its worst value is at its worst value on this one
20 analysis.

21 CHAIRMAN WALLIS: I think what Dr. Kress
22 was saying is if you forget about all the
23 conservatisms it's still going to be okay.

24 MEMBER KRESS: No, that's not exactly what
25 I'm saying.

1 CHAIRMAN WALLIS: You didn't quite say
2 that.

3 MEMBER KRESS: I'm saying there was an
4 implication in the previous presentation that said
5 that you don't know where you are in that line between
6 incipient and that positive suction that's required
7 and it could be worse in there. But what I'm saying
8 is no, it's not likely to be worse because you're
9 going to get more flow if you're greater, if you have
10 a greater net positive suction than you had in the
11 required. You're going to have more flow than you do
12 at the point --

13 CHAIRMAN WALLIS: It's worse from the
14 point of view of where.

15 MEMBER KRESS: But the point of view of
16 where is not bad enough that you're going to, for this
17 small amount of operable time you need it, it's very
18 unlikely that's it's not going to give you the flow
19 that you need. This is the impression that I've
20 gotten so far.

21 MR. LOBEL: I don't want to leave the
22 impression too that we don't think this is important
23 or that it's not an important effect. It's very
24 important. Obviously, you're talking about the more
25 important pumps in the plant during an accident. So

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1 I don't want to give the impression that we don't
2 think this is important. It's more that we're trying
3 to put this in a perspective of what we know and --

4 CHAIRMAN WALLIS: These are important
5 pumps if you ever get to the point where you're
6 depressurized enough to use them.

7 VICE CHAIR RANSOM: I also wonder too if
8 there aren't some instabilities in all of this where
9 if you start to cavitate, for example, you reduce the
10 head that's produced, that reduces the flow, that
11 increases the temperature of the water which is being
12 in dumped into the sump and that just further causes
13 increasing cavitation. So you go to zero flow.

14 MR. LOBEL: You don't want to get to that
15 stage.

16 VICE CHAIR RANSOM: Right. Is that a
17 possibility?

18 MR. LOBEL: If things got bad enough,
19 yeah.

20 MEMBER KRESS: Certainly if you went
21 beyond this --

22 MR. LOBEL: And that's why too if we went
23 to the statistical method, I think we'd want to go
24 back and look at the margin question again. Because
25 if we're going to be using a best estimate and

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1 uncertainty and saying we have so much uncertainty and
2 we know where we are better, we would want to know
3 where we are better with respect to the margin too.

4 VICE CHAIR RANSOM: Certainly this non-
5 parametric statistical approach seems to be a very
6 powerful way to go and I don't see too many people or
7 the NRC moving in that direction very fast.

8 MR. LOBEL: It was something that just
9 came up with this reassessment and we have talked to
10 some people about it. But the industry needs an
11 incentive to go in that direction and I don't know
12 that there is one.

13 VICE CHAIR RANSOM: It would see like if
14 they can achieve some benefits from it there could be
15 large incentive.

16 MR. LOBEL: The incentive, the reason we
17 suggested it, the incentive to us is, and I don't know
18 if this has come across in what I've said, but the
19 incentive is that we don't want to have disagreements
20 with stakeholders about whether it's wise to take
21 credit for containment pressure for NPSH if there
22 really isn't a need to take credit for containment in
23 the pressure. If we're doing things in a way that
24 puts the NRC in a box where we're defending why it's
25 okay to use over-pressure when it's really not

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1 necessary, that's not a good place to be and -

2 VICE CHAIR RANSOM: That's probably an
3 easier way out. But on the other hand, the
4 statistical methods too, it's not clear that you're
5 only statistically taking credit for over-pressure.
6 In other words, there may be a few cases where you
7 would but for the majority not.

8 MR. LOBEL: That's the feeling. Yeah.

9 MEMBER SHACK: One more. The reg guide
10 also focuses on the calculation of the available NPSH.

11 MR. LOBEL: Right.

12 MEMBER SHACK: We had these discussions
13 that your required NPSH isn't necessarily NPSH-r.
14 You're willing to go below that and that's not at all
15 discussed in here. Is that handled?

16 MR. LOBEL: There is a position in there
17 that says that you could take credit for pump
18 cavitation if you do the testing and the inspections.

19 MEMBER SHACK: Okay. That's in there
20 somewhere.

21 MR. LOBEL: Yes, it's in there somewhere.
22 I can't quote exactly where it is.

23 MEMBER SHACK: I'll look for it. On the
24 electronic copy, I can search.

25 MR. LOBEL: It's one of the positions

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1 under BWR and PWR.

2 CHAIRMAN WALLIS: I have a request from
3 probably the people from this morning. We got these
4 Bingham Prop Curves that came to us as part of the
5 evidence and some of the stuff is essentially
6 illegible. Some of the more important things I can't
7 read. It would be very good to have a copy I can
8 read. Maybe it's in the reproduction here or
9 somewhere else.

10 MR. CARUSO: Actually, that was all sent
11 to me electronically. I'll give you the electronic
12 version.

13 CHAIRMAN WALLIS: Is it clearer?

14 MR. LOBEL: Yes, those are from Reference
15 -- and I have a version 2 that they're hard to see but
16 maybe not that hard to read. I could show Ralph what
17 I have and if there are better --

18 CHAIRMAN WALLIS: I think what they're
19 showing is how the pumps perform under these degraded
20 conditions when you have an NPSH which is less than
21 required and then you have this three percent and six
22 percent and so on.

23 MR. LOBEL: When you do that pump testing,
24 you measure the head and flow and then you also
25 measure required NPSH typically at the three percent.

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1 But in this case, they did other tests also.

2 CHAIRMAN WALLIS: Right. They went beyond
3 that.

4 MR. LOBEL: Yeah. So those are from the
5 vendor. It's not anything we have.

6 CHAIRMAN WALLIS: Now these are from the
7 pumps that are actually installed in this reference
8 plant.

9 MR. LOBEL: Right.

10 CHAIRMAN WALLIS: Yes, they are. It says
11 so.

12 MR. LOBEL: Yeah, they're reference plant
13 pumps.

14 CHAIRMAN WALLIS: So when you do your
15 reviews, do you look at curves like this in order to
16 decide if a situation is okay?

17 MR. LOBEL: In this case, we did because
18 they're crediting pressure --

19 CHAIRMAN WALLIS: So you can identify
20 operating points on these diagrams and all that and
21 say this is okay because the flow is bigger than they
22 need at these conditions or something.

23 MR. LOBEL: What I did was look at what
24 was assumed in the analysis and then look at those
25 curves and see whether they are consistent and

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1 reasonable and are conservative.

2 MR. CARUSO: Graham, I have a better copy
3 here. Bill Sherman has given me one.

4 CHAIRMAN WALLIS: Okay. Thank you.

5 MEMBER SIEBER: Do we have time for a
6 break?

7 CHAIRMAN WALLIS: Time for a break. Well,
8 what do we have to do now? We have to hear about
9 risk. Is that it?

10 MR. LOBEL: Yes.

11 MEMBER SHACK: We're running late.

12 CHAIRMAN WALLIS: Are we running late or
13 early? I can't --

14 MR. CARUSO: Actually, you're not running
15 very late because you have one comment from Mr.
16 Shadus. He won't take very long and then we have time
17 for discussion.

18 CHAIRMAN WALLIS: I don't think we're late
19 at all, are we?

20 MR. CARUSO: I don't think we're late at
21 all.

22 VICE CHAIR RANSOM: Okay. These are two
23 that were passed. So why don't we take a break until
24 three? Why don't we take a break until 3:05 p.m.

25 CHAIRMAN WALLIS: 3:05 p.m. okay.

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1 VICE CHAIR RANSOM: By the correct time,
2 I think 3:00 p.m. Off the record.

3 (Whereupon, the foregoing matter went off
4 the record at 2:47 p.m. and went back on the record at
5 3:07 p.m.)

6 VICE CHAIRMAN RANSOM:: Maybe we better
7 get started. We're going to hear about PRAs, I guess.

8 MR. STUTZKE: Just to remind you, I'm
9 Marty Stutzke from the Probabalistic Safety Assessment
10 Branch in NRR, and I'm here today to talk to you about
11 some risk insights concerning loss of positive suction
12 head and how it relates to containment over-pressure.

13 It's been kind of an interesting odyssey
14 of going through the literature to find out how this
15 has been treated in the past. You might notice on my
16 first slide, I'm going all the way back to the WASH-
17 1400, the original reactor safety study.

18 MEMBER KRESS: Is this in the NUREG --

19 MR. STUTZKE: Yes, it is, a little bit.
20 But I went all the way back there. Perhaps the joke
21 is I had all these books on my desk of WASH-1400, and
22 the people that I work with come by and say why are
23 you reading this? WASH-1400 was published one year
24 before I graduated at Tennessee, 1974. In fact, it
25 was a text of mine when I was in school.

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1 MEMBER KRESS: I'm glad to hear you went
2 to Tennessee.

3 MR. STUTZKE: I had to work that in some
4 how.

5 MEMBER KRESS: You know, you just raised
6 yourself in my view.

7 MEMBER SHACK: It's not going to help you.

8 CHAIRMAN WALLIS: We've got an interpreter
9 on the ACRS, too.

10 MEMBER KRESS: He doesn't speak Tennessee.
11 I don't know. He didn't come from there, he just went
12 to school there.

13 MR. STUTZKE: I've been educated.

14 MEMBER KRESS: Yes.

15 MR. STUTZKE: So the answer is I just
16 don't read from the Book of Revelation, I read from
17 the Book of Genesis, sometimes. So I had to go all
18 the way back to WASH-1400. I've looked at some of the
19 IPEs summarized in NUREG 1560, which is the EPI
20 Perspective Document put together by the Office of
21 Research. Then I looked at very recent guidance from
22 the ASME PRA Standard and the RASP Handbook, which is
23 instructions on how to draw SPAR models like that.

24 When you go back to WASH-1400, sure enough
25 the BWR event tree talked about containment leakage

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1 following LOCA. It's an event right in the event tree
2 header. And the notion was this; if you had leakage
3 greater than about 100 percent per day, then you had
4 no long-term cooling, then the ECCS pumps would
5 cavitate, and that led you directly to core damage.

6 The concern here was a balance. If the
7 leakage was too big, you didn't have enough pressure,
8 and therefore the pumps cavitated. On the other hand,
9 if the leakage was too small, you would over-
10 pressurize the containment and that would subsequently
11 fail, and all the inventory would leak out, and that
12 would also lead you to core damage, so you had -- the
13 notion was you had to have just the right amount of
14 leakage in the containment. Of course, at this time,
15 the idea of hardened containment vents hadn't been
16 created yet, so they were interested in this.

17 It goes on in that study to say 100
18 percent leakage per day is equivalent to a one inch
19 hole in the containment, which I thought was kind of
20 interesting, how small a hole it takes.

21 CHAIRMAN WALLIS: One hundred percent
22 leakage kind of is contrary to the whole purpose of
23 the containment though, isn't it?

24 MR. STUTZKE: That's right.

25 CHAIRMAN WALLIS: Leaking everything

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1 that's in there.

2 MR. STUTZKE: Well, if Rich heard 100
3 percent, he'd probably be taken to the hospital or
4 something.

5 VICE CHAIRMAN RANSOM:: Well, one thing
6 peculiar about this, though, is even if you had 100
7 percent leakage, you would still have one atmosphere
8 pressure basically inside the containment which for
9 most cases was adequate NPSH.

10 MR. STUTZKE: That's right.

11 VICE CHAIRMAN RANSOM:: So is that an
12 inconsistency in the --

13 MR. STUTZKE: It may well have been a
14 mistake in the study. So they estimated some failure
15 probabilities of having this size leakage, two times
16 ten to the minus 5 for small break LOCAs, five E minus
17 three for large LOCAs into the drywell, leakage out of
18 the drywell like this, and they were worried about
19 over-pressurizing some pipes, interfacing LOCAs for
20 the wetwell three times ten to the minus four.

21 CHAIRMAN WALLIS: One inch equivalent
22 diameter wouldn't be absurd in a main steam isolation
23 valve that didn't close properly.

24 MR. STUTZKE: Yes. Well, easily
25 detectible in my experience.

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1 MEMBER SHACK: Now what do these failure
2 probabilities mean?

3 MR. STUTZKE: The probability that you
4 have leakage greater than 100 percent per day.

5 MEMBER KRESS: This is a conditional
6 probability given these LOCA --

7 MR. STUTZKE: Given a LOCA, given these
8 break sizes of LOCAs.

9 MEMBER DENNING: I think they were pre-
10 existing, weren't they?

11 MR. STUTZKE: It's a mixture of pre-
12 existing faults, as well as some what we'll call
13 dynamic that depend on the break size.

14 MEMBER DENNING: My memory -- I actually
15 do remember back then, and I wasn't in school at the
16 time, but there were some cases of plants that had
17 operated for years with unisolated and not knowing it.
18 Now, of course, this is a BWR here, which, of course,
19 is quite different, and they were -- so my memory was
20 that we gave very small probability to the BWR because
21 of the nitrogen inerting in them.

22 MR. STUTZKE: Right.

23 MEMBER DENNING: I think we have larger to
24 PWR.

25 MR. STUTZKE: So I view this, this was

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1 interesting to see the loss of NPSH had been
2 considered in PRAs from the beginning, and it gives
3 you some feeling for probabilities, how likely people
4 thought it was at that time. But let's put the past
5 aside, and go on a little bit more.

6 Next slide entitled, "Loss of DHR". This
7 comes from NUREG 1560, which are IPE Perspectives the
8 Office of Research had compiled and compared, and
9 contrasted various IPE results. And in the
10 summarization of those, they defined a category called
11 "Loss of Decay Heat Removal in BWRs." That includes
12 things like failure of the suppression pool cooling
13 system and cavitation of the pumps due to loss of
14 NPSH. So the whole frequency here of loss of DHR is
15 a mix. We're only interested in some piece out of
16 this frequency, but I don't know how much that piece
17 is, because it wasn't broken out here.

18 I can give you an idea, if you look the
19 contribution somewhere between 5-75 percent for the
20 category BWR 1-2-3, you need to read the report
21 because they tried to group plants together that had
22 similar physical characteristics, system designs,
23 things like this. You'll notice some of the BWR-3s
24 crept over into the other category, but the report is
25 very specific. These plants belong to these

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1 categories, and you can read that.

2 Just so you know, the plant-to-plant
3 variability on the loss of DHR contribution spans two
4 orders of magnitude. Now that's not the actual
5 uncertainty distribution. That's just the variability
6 among the different results that was observed like
7 this. And so you can see in some cases BWR mark one
8 containments, the contribution was very small, 5
9 percent, in other cases was dominant. We don't use
10 the word "dominant" any more, we have significant
11 results, not dominant results.

12 MEMBER SHACK: Explain to me where the two
13 orders of magnitude comes from again.

14 MR. STUTZKE: That's just the spread of
15 the contribution from loss of DHR. For example --

16 MEMBER SHACK: So I'm looking at a mean
17 value here, a median?

18 MR. STUTZKE: You're looking at an average
19 of the point estimates. I wouldn't even call them
20 point estimates. You're looking at an average of the
21 central estimates, because some IPEs gave you mean,
22 some gave you medians. It's whatever they claim that
23 the number was.

24 CHAIRMAN WALLIS: This is one of the
25 peculiarities of PRA, that you have what look like

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1 some of the plants, and yet there's a two order of
2 magnitude spread and contribution is something which
3 is sometimes very important. It seems a little odd,
4 doesn't it?

5 MR. STUTZKE: That's why we have
6 initiatives on PRA quality.

7 MEMBER DENNING: Sometimes it's not the
8 PRA, though. Sometimes there are significant
9 differences in plants.

10 CHAIRMAN WALLIS: Physical differences or
11 something.

12 MEMBER DENNING: The sanity with which we
13 develop --

14 MR. STUTZKE: It is frustrating. You can
15 take the same plant analyzed by two PRA teams and get
16 different results and different conclusions. That's
17 possible.

18 CHAIRMAN WALLIS: That's a concern, too.
19 It's the same plant we're talking about.

20 MR. STUTZKE: Such is the state-of-the-
21 art. Okay. But that's a good segue into my next
22 slide on PRA modeling guidance. Now we have the ASME
23 PRA Standard, which has been endorsed with appropriate
24 clarifications and qualifications, and REG Guide
25 1.200. And when you read that, you find three

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1 supporting requirements that address treatment of net
2 positive suction head in PRA models, and I've listed
3 them there. So it's clear to me that current modern
4 PRA guidance is adequate to ensure that PRAs treat the
5 effect.

6 Again, use of the standard is not
7 mandatory. Nobody is required to actually have a PRA.
8 It's not part of the licensing basis, whatever like
9 that, but if they choose to follow the standard, then
10 it's well addressed inside the standard. The Staff's
11 own guidance, the RASP Handbook, which is kind of a
12 how-to handbook of methods and best practices things
13 for building SPAR models, also talks about the need to
14 model loss of NPSH in these things.

15 So what did I learn from this odyssey,
16 this walk down memory lane? First of all, you can
17 conclude that for BWRs, the loss of NPSH has been
18 addressed. There's a statement in NUREG 1560 that
19 says it's unimportant for PWRs because of the design
20 of the ECCS pumps. It's not explicit in there what is
21 meant. It's my understanding they mean the pumps are
22 capable of handling saturated liquid, so there's not
23 a cavitation concern like this.

24 When you delve into the modeling details,
25 when they talk about loss of NPSH being modeled in

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1 PRAs, the emphasis is on containment venting, not
2 containment over-pressure credit. Now let's remember
3 the sequence of interest here.

4 We have a large break LOCA, emergency core
5 cooling system is working, the heat from the core is
6 going into the suppression pool which causes it to
7 heat up. The suppression pool cooling system should
8 operate, but we'll presume that it fails, so now the
9 containment is slowly going to pressurize. And the
10 problem, in order to prevent that, is to use a
11 hardened containment vent to depressurize the
12 containment. And if you look under that fault tree
13 model, you'll find a human error, an operation action
14 event that says, "The operator fails to initiate
15 containment venting, or fails to control containment
16 venting causing loss of net positive suction head."
17 Okay.

18 CHAIRMAN WALLIS: That sort of assumes
19 that the containment is a necessary part of the NPSH
20 calculation.

21 MR. STUTZKE: That's correct.

22 CHAIRMAN WALLIS: You need to take credit
23 for it.

24 MR. STUTZKE: My third bullet here is, so
25 far, I have not identified a single PRA that considers

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1 or models the loss of net positive suction head due to
2 failure of the containment over-pressure. Okay.

3 The first step in operator error related
4 to the containment venting function. What we're
5 interested in is suppose there's a pre-existing
6 failure or flaw inside the containment, so that the
7 over-pressure is not there when we need it. Perhaps
8 the containment isolation system fails, maybe there's
9 just a hole, somebody left the door open, all of these
10 sorts of things. And I have not been able to identify
11 a single PRA that treats that. And that includes the
12 Staff's SPAR models, as well. I confirmed that one
13 with the Office of Research.

14 CHAIRMAN WALLIS: So in the second bullet
15 what happens is the containment is pressurized, and
16 it's been pressurized so much that the operator vents
17 it, and then maybe the operator leaves the vent open.

18 MR. STUTZKE: Right.

19 CHAIRMAN WALLIS: At some subsequent time
20 the pressure gets too low in the containment?

21 MR. STUTZKE: Right. Then it cavitates
22 the pumps.

23 CHAIRMAN WALLIS: And there could have
24 been no core damage until this cavitating of the
25 pumps.

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1 MR. STUTZKE: That's right. It's
2 important to understand it's the loss of containment
3 integrity happens --

4 CHAIRMAN WALLIS: First.

5 MR. STUTZKE: First.

6 CHAIRMAN WALLIS: Right.

7 MR. STUTZKE: That's what's inducing the
8 core damage. That's the dependency that Mr. Sherman
9 was talking about this morning.

10 CHAIRMAN WALLIS: Right. Right.

11 MR. STUTZKE: That's precisely the --

12 CHAIRMAN WALLIS: An unusual sequence of
13 events, where the containment failure causes the fuel
14 to fail.

15 MR. STUTZKE: Well, it's not unknown in
16 PRAs to model the sorts of sequences like that.

17 MEMBER DENNING: Well, you certainly could
18 have in this case here if you open the vent and get a
19 real blow-down of the containment, you could have
20 massive boiling in the suppression pool. I mean, that
21 would be --

22 MR. STUTZKE: Right. Flash the water.

23 CHAIRMAN WALLIS: Well, if it's boiling in
24 the suppression pool, it's likely to be boiling in the
25 pump, isn't it?

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1 MEMBER DENNING: Exactly.

2 MR. LOBEL: Well, let me just say that the
3 temperatures that they predict for these kinds of
4 events in the suppression pool are usually below 212.
5 The highest I've seen was 205, and most of them were
6 down around --

7 CHAIRMAN WALLIS: So you wouldn't boil the
8 suppression pool.

9 MEMBER DENNING: No. I think in PRA space
10 here, where you have loss of suppression pool cooling.
11 So you're getting --

12 (Simultaneous speech.)

13 MEMBER DENNING: -- where you're
14 threatening the failure of the containment, so you
15 vent it.

16 CHAIRMAN WALLIS: Okay. That's a much
17 more severe case than licensing basis.

18 MR. STUTZKE: Oh, yes, very severe. To
19 date, there have been no license amendment requests
20 for crediting containment over-pressure that were
21 risk-informed. None of them have been risk-informed,
22 so I was not able to find any PRA information from
23 these to tell me -- to give me any sort of insight at
24 all like this.

25 MEMBER SHACK: What other scenarios would

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1 lead to that loss of containment over-pressure?

2 MR. STUTZKE: Well, let me talk about
3 that. To talk about that, I wanted to remind
4 everybody, a PRA model is a mixture of event trees and
5 fault trees. Event trees describe sequences, fault
6 trees describe how functions or events in the event
7 tree fail. It's difficult to pick on a single fault
8 tree and gain a grasp of what's going on in the PRA.
9 You need to understand how it's all linked together.
10 There are various modeling techniques. Most people
11 use what's called a small event tree, small number of
12 events, and large fault trees. Some people use large
13 event trees, and small fault trees. The current trend
14 seems to be to use large event trees and large fault
15 trees. But the modeling methods are based on -- they
16 were derived out of the limitations of our
17 computational ability to solve large fault trees and
18 large event trees. That's how these things get there.

19 But the point is, it's very difficult just
20 to dive right into a model and say that's the event in
21 the fault tree that's wrong. You need to look at the
22 whole context of the sequence, and that determines how
23 human errors are determined, that determines the
24 boundary and initial conditions for some of the
25 failure events.

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1 CHAIRMAN WALLIS: You have these trees
2 I've seen this morning that flow forward, where
3 somebody leaves the vent open and this causes the pump
4 to cavitate, which causes the fuel to get into some
5 awkward condition, where it's relating reactivity.
6 Then the operator closes the vent. This business of
7 looping around where you now cancel something and it
8 goes back and affects things again in the PRA, I'm not
9 sure how you do that. PRAs always seem to be going
10 forward in a directional --

11 MR. STUTZKE: We don't go backwards too
12 well. There's nothing inherent in the event
13 tree/fault tree structure that imposes a sequential
14 timing.

15 CHAIRMAN WALLIS: Well, you change the
16 situation, you correct the error and it goes back.

17 MR. STUTZKE: That's right.
18 Traditionally, we assume we go forward, and then if we
19 produce the results of a PRA, we'll do what's called
20 a recovery analysis and say well, suppose he detects
21 his mistake and he takes some action. And we'll add
22 that probability on case-by-case situation.

23 CHAIRMAN WALLIS: You go right back to the
24 new situation again, because you're always going
25 forward with it.

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1 MR. STUTZKE: That's right. It's the
2 nature of the beast, so to speak.

3 MEMBER DENNING: There are dynamic
4 techniques that haven't really particularly caught on,
5 but there are -- I mean, there's a rigidity to event
6 tree and fault trees, the way they're done, other than
7 you have this recovery that you can do if you --

8 MR. STUTZKE: That's right.

9 MEMBER DENNING: But there are dynamic
10 techniques that are under development, that I don't
11 think --

12 MR. STUTZKE: The other thing to realize
13 is that the failure events, the fault events inside a
14 PRA logic model are brewing, and they're either yes or
15 no. It either occurs or it doesn't, so when we say a
16 pump fails, we are picking somewhere in the spectrum
17 of flow rates and say the flow rate is at this point,
18 and that's so low that we can't tolerate it.

19 CHAIRMAN WALLIS: With all these pressures
20 and temperatures going up and down, you could have the
21 pump cavitating and not cavitating, cavitating, not
22 cavitating. It wouldn't really fail.

23 MR. STUTZKE: That's right.

24 CHAIRMAN WALLIS: They might operate, and
25 not operate, might operate partially and all that.

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1 PRAs don't deal with that.

2 MEMBER SIEBER: The PRA says it failed.

3 MR. STUTZKE: The PRA will say that it's
4 failed. In other words, a typical success criteria
5 may be you need one out of two low pressure injection
6 pumps to work. We don't have success criteria that
7 says both pumps are working at 50 percent of their
8 rate of flow. We can't handle that very well, or one
9 is working at 75 percent and the other at 25 percent.
10 It's either working or it's not working.

11 MEMBER KRESS: You could add up those
12 probabilities and put those on your --

13 MR. STUTZKE: That's true.

14 MEMBER KRESS: It can't be done easily.
15 I think sometimes it's done.

16 MR. STUTZKE: There's been efforts, but
17 it's not caught on to my knowledge.

18 CHAIRMAN WALLIS: So it is a way of
19 avoiding having to do all the thermohydraulic
20 calculations all the time, and have sort of a -- you'd
21 actually model the entire sequence and what's going on
22 everywhere. You'd do it much quicker by having
23 probabilities.

24 MR. STUTZKE: Right.

25 CHAIRMAN WALLIS: You lose something when

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1 you do that.

2 MR. STUTZKE: I have to congratulate you.
3 You guys are just leading me to the next slide. It's
4 wonderful. Here was my dilemma. The Staff,
5 Management, you guys wanted to know what can risk
6 assessment say about credit for containment over-
7 pressure, and here I'm dumbfounded. I can't find a
8 single PRA that even addresses it. So what do I do?
9 What that means is Marty has to become a PRA analyst
10 again, which I had done before I came to work for the
11 staff. And in order to start PRA analysis, you need
12 to begin to define what sequences you're worried about
13 here, so the scenario is something like this.

14 Suppose that I need over-pressure. What
15 does that really mean? What it means is the pump
16 won't pump saturated liquid. The temperature of the
17 fluid going to the pump, that atmospheric pressure
18 gets high enough, that pump will cavitate, so I have
19 two choices to prevent that. One is, I apply over-
20 pressure on the pump so that I can suppress the
21 boiling. The other way is I can cool the water. So
22 the scenario that I need is a case where --

23 CHAIRMAN WALLIS: Unthrottle the pump.

24 MR. STUTZKE: Well, I can think about
25 that. We tend to look in PRAs of bounding scenarios,

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1 so I hypothesized a case where we have a LOCA
2 occurring like this, and we have no containment
3 pressure whatsoever, think of the door is open for
4 some unknown reason like this. What would happen to
5 that pump then? And the intuition said well, nothing
6 right now because the water is cold. It takes some
7 time for all that energy to come out of the core and
8 heat that water up. How much time? That's crucial
9 for the operator action. If it's a matter of minutes,
10 we'd probably have difficulty because you won't get
11 the system started in time. It won't react in time.
12 If he has days, why am I even concerned? So the
13 question is, how much time does the operator have to
14 get that water cooled off inside the suppression pool?

15 So I attacked the problem by doing a
16 freshman-level thermohydraulic calculation. All
17 right. I got a Torus. I got a bucket of water here.
18 It's at this temperature.

19 CHAIRMAN WALLIS: And you're adding so
20 much --

21 MR. STUTZKE: I need to add so much energy
22 to it. How much energy do I need? I can integrate the
23 decay heat curve, and I came up with four hours.
24 Okay? So that's telling me, well, it's not five
25 minutes, and it's not three days. It's some time.

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1 It's four hours.

2 CHAIRMAN WALLIS: You're putting all the
3 energy into the suppression pool.

4 MR. STUTZKE: Right.

5 CHAIRMAN WALLIS: You're putting all the
6 energy in, or you're not doing steam go out to --

7 MR. STUTZKE: All of the constant mass
8 plus the water.

9 CHAIRMAN WALLIS: But, in fact, there's
10 steam going out through the leaky containment.

11 VICE CHAIRMAN RANSOM:: Now is that four
12 hours to the point of pump cavitation?

13 MR. STUTZKE: To the point of pump
14 cavitation. And the way that's done is by assuming
15 the net positive suction head required equals the net
16 positive suction head actual. I know all the friction
17 losses in the system. I know the elevational head.
18 Eventually I can back-calculate what the vapor
19 pressure needs to be, and then I can look up on the
20 steam tables what the temperature of the water is.

21 CHAIRMAN WALLIS: Probably half the
22 enthalpy is going out in steam, so it takes eight
23 hours instead of four.

24 MR. STUTZKE: So you caught me, and I
25 admit, I am not a thermohydraulic --

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1 CHAIRMAN WALLIS: I didn't try to catch
2 you. I'm just trying to --

3 MR. STUTZKE: Well --

4 MEMBER KRESS: No. Most of that enthalpy
5 goes into the pool.

6 MEMBER SHACK: PR guide guys are allowed
7 to use conservative assumptions.

8 CHAIRMAN WALLIS: It's conservative. He's
9 got at least four hours. He might have eight or
10 twelve if you're more realistic.

11 MR. STUTZKE: It wasn't until the mid-
12 1990s that I actually did thermohydraulic calculations
13 to do PRA success criteria. We used to get them by
14 reading FSARs and doing back-of-the-envelope
15 calculations, and these sorts of things. But
16 anticipating your discomfort with this, we asked the
17 licensee of the reference plant to make a real
18 calculation, so they made MAAP calculations for me,
19 and that's shown on the next page.

20 CHAIRMAN WALLIS: It's time we looked at
21 MAAP again to see if it's a good code.

22 MEMBER KRESS: Well, for this, it's
23 probably okay.

24 MR. STUTZKE: This is a pretty
25 straightforward calculation like this, but it does

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1 have some of the heat sinks and things. Again, no
2 credit at all for containment pressure, over-pressure.
3 We did not start suppression pool cooling at time
4 zero, and the idea was how long until we cavitated,
5 and the result said four hours. So either we have a
6 common cause failure that MAAP this no matter than
7 Marty's freshman-level engineering calculation, or we
8 have an agreement here.

9 So let's presume that the operator has
10 about four hours to get his suppression pool cooling
11 up and running, so we can begin to form --

12 CHAIRMAN WALLIS: HEP is a Human Error --

13 MR. STUTZKE: Human Error Probability.

14 CHAIRMAN WALLIS: Only going to do it four
15 post, at ten post he's going to make a mistake?

16 MR. STUTZKE: That's the number. The way
17 of doing the HRA is this, you need to worry about
18 diagnosis problem. Does the operator realize there's
19 a LOCA happening like this, and then there's an
20 implementation part to human error. How long does it
21 take him to actually light off the system once he
22 decides he needs to do this?

23 Implementation error seems to be
24 impossible in less than one minute. We talked to some
25 shift supervisors. It's a very straightforward task.

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1 It's done in the control room, and not running
2 throughout the plant to open valves and things, like
3 I had to do when I was in the Navy. It's well-
4 proceduralized. It's well-trained upon. It's
5 simulated. This is a very straightforward sort of
6 action like this, so virtually all the four hours is
7 available for them to think about it and realize gee,
8 maybe we ought to light off suppression pool cooling.

9 So I went and used the technique for Human
10 Error Rate Prediction, NUREG CR-1278. That's one of
11 the very early Human Reliability Analysis
12 authoritative documents. There are different curves,
13 and I'm perhaps glad that George Apostolakis is not
14 here because we wouldn't get beyond this point, about
15 what's the appropriate curve like this. I used this
16 because it's well-accepted. It's accepted by the ASME
17 Standard and whatever. And what it says is that the
18 median probability that he fails to diagnosis this is
19 four times ten to the minus three over four hours.

20 Now again, that's not just an operator.
21 That's the operating staff, which would include the
22 shift supervisor, probably management by this time has
23 heard something is going on, the NRC is involved like
24 this, so this is not an unreasonable number for this
25 length of time.

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1 Realize that a lot of the Human
2 Reliability that we deal with in PRA, and especially
3 on BWRs concerns very short time frames. The operator
4 response in a BWR following ATWIS is on the order of
5 30 seconds or a minute.

6 CHAIRMAN WALLIS: We learned at TMI, if he
7 misdiagnoses the situation, he can do the wrong thing
8 for many hours.

9 MR. STUTZKE: That's right, days. But
10 that's what the number tells me. We'll talk about the
11 sensitivity to that type of number. So the next thing
12 we need in our PRA calculation is what's the
13 likelihood of loss of containment integrity to the
14 point where the containment is not pressurized at all?
15 And I went into the reference plant's IPE, I used the
16 same fault tree that you guys used, and I requantified
17 it. I put new numbers in, I looked for mistakes, I
18 cleaned it up and I generated a number of six times
19 ten to the minus three.

20 CHAIRMAN WALLIS: When you multiply all
21 these together, you're going to get something
22 impressive.

23 MR. STUTZKE: Oh, yes.

24 CHAIRMAN WALLIS: That's the next page.

25 MR. STUTZKE: That's the next page. So

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1 you pull up your paper at large LOCA frequency, and we
2 could argue about that until the cows come home.

3 CHAIRMAN WALLIS: Everyone does this and
4 they say I don't believe any numbers that are smaller
5 than a billion.

6 MR. STUTZKE: Yeah. Anyway, you multiply
7 these things together, so let's go through the
8 calculation from left to the right. Three times ten
9 to the minus five per year is the LOCA break
10 frequency. Six-E minus three is the probability of
11 loss of containment integrity. Four-E minus three is
12 the probability that the operator fails to light off
13 suppression pool cooling in four hours, and he
14 generates a number that's very small. It's certainly
15 below one-E minus six. And according to Reg Guide
16 1.174, that's classified as a very small risk
17 increase.

18 MEMBER DENNING: I missed something. In
19 the earlier discussions we had on the design-basis
20 accident, there's no credit taken for suppression pool
21 cooling?

22 MR. STUTZKE: No. They credit that.

23 MEMBER DENNING: Well, why is that then
24 required to lead to core damage here?

25 MR. STUTZKE: Because if I have a loss of

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1 containment integrity, and suppression pool cooling
2 fails, I no longer have the option of containment
3 venting to remove the heat. I've cavitated. I've
4 cavitated at this point. So this is adding a new
5 sequence into the PRA is what I'm trying to get at.

6 MEMBER DENNING: Well, isn't the sequence
7 involving a large break LOCA with the open door like
8 our analyses, isn't that core damage?

9 MR. STUTZKE: Not directly. That's what
10 I'm trying to say, is it doesn't happen
11 instantaneously. It takes at least four hours to heat
12 the water up. It takes time.

13 CHAIRMAN WALLIS: That time doesn't make
14 us very happy.

15 MEMBER DENNING: I'm still not sure what
16 you're saying is -- in the normal analysis of the
17 large break LOCA you start the suppression pool
18 cooling. Is that true?

19 MR. STUTZKE: That's correct.

20 MEMBER DENNING: And in the analysis that
21 we saw, you could, if you didn't have credit for over-
22 pressure, you would cavitate.

23 MR. STUTZKE: That's right.

24 MEMBER DENNING: Now what are you doing
25 that saves the day relative to that? I mean, why --

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1 MR. STUTZKE: Okay. In the normal --

2 MEMBER DENNING: I assume you'd be worse
3 off if you don't have suppression cooling --

4 MR. STUTZKE: Right. In the normal
5 scenario, the scenario progresses as follows. I have
6 a large LOCA. I have the integrity of the
7 containment, but I fail suppression pool cooling, and
8 I recover the core by going on and containment
9 venting. That's the traditional BWR sequence. So
10 what I'm adding here is suppose I've lost containment
11 integrity to this, I can't vent, but I can still run
12 the suppression pool cooling if I get started in time
13 with an open containment. As long as the water stays
14 cold enough, and I think it's about 175, the pump
15 won't cavitate.

16 MEMBER DENNING: I'm still confused. Let
17 me walk through it again and see if you can straighten
18 me out.

19 MR. STUTZKE: Go ahead. It took me a week
20 to figure this out.

21 MEMBER DENNING: Okay. Again, it looked
22 to me like -- I mean, in my earlier discussion, in the
23 normal design-basis accident where we take credit for
24 suppression pool cooling, if you lost your containment
25 over-pressure, you would cavitate.

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1 MR. STUTZKE: That's right, because of the
2 conservativisms placed in that calculation.

3 MEMBER DENNING: Yes.

4 MR. STUTZKE: Whereas, our's is a
5 realistic.

6 MEMBER DENNING: You're thinking this is
7 a realistic --

8 MR. STUTZKE: This is realistic. We
9 removed all the decay power conservativisms.

10 MEMBER DENNING: So you've taken away
11 conservativisms.

12 MR. STUTZKE: Right. It's an effort to
13 quantify what actually happens without the
14 conservatism.

15 MEMBER DENNING: And what your analysis
16 tells you realistically is that your suppression pool
17 temperature never gets high enough that you need the
18 containment --

19 MR. STUTZKE: If they start it in four
20 hours. In fact, part of the MAAP runs --

21 MEMBER KRESS: This kind of tells you in
22 risk space that it's not very important to maintain
23 containment over-pressure?

24 MR. STUTZKE: That's right.

25 MEMBER KRESS: In risk space.

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1 MR. STUTZKE: In risk space, yes.

2 MEMBER KRESS: But in defense-in-depth
3 space, because we haven't done any uncertainties here,
4 and don't know what the uncertainties are in these
5 numbers, it might be a good idea to do it anyway.

6 MR. STUTZKE: Well, let's talk about that,
7 because that's the next slide.

8 MEMBER DENNING: Well, there's one other,
9 and this I think is important, and that is that you're
10 saying in best estimate space you don't need it.

11 MR. STUTZKE: That's right. That's right.

12 MEMBER DENNING: And so you have to have
13 some other failure to get you to core damage.

14 MR. STUTZKE: That's right.

15 MEMBER DENNING: And not surprisingly,
16 particularly if you can find it with a large LOCA.

17 VICE CHAIRMAN RANSOM:: On best estimate
18 space, if you don't lose the containment, you don't
19 damage the core either. Right? So that one is a no-
20 nevermind. And what you've shown is if you lose the
21 containment, it's still a no-nevermind, a very small
22 increase in risk.

23 MR. STUTZKE: It's a very small increase,
24 because of the time, and there's a lot of water in a
25 suppression pool. It takes a while. Personally, I

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1 was surprised it took that long to heat it up.

2 MEMBER KRESS: That's a lot of water.

3 MR. STUTZKE: It's a lot of water.

4 MEMBER KRESS: You just integrated the
5 decay heat curve to the point --

6 MR. STUTZKE: Yeah, I actually took it out
7 of an old textbook, the old El Wakil heat transfer
8 textbook.

9 MEMBER KRESS: That's good.

10 VICE CHAIRMAN RANSOM:: Or verified it
11 with MAAP. Right?

12 MR. STUTZKE: And then we verified it with
13 MAAP. Let's talk a minute about the defense-in-depth
14 aspects. As the segue into this, I would remind you
15 Reg Guide 1.174 of the Standard Review Plan, Chapter
16 19 all contain five key principles of risk-informed
17 decision-making. And one of the principles says, "Any
18 increase in risk is small and in keeping with the
19 Commission's safety goal policy." Another principle
20 says, "Defense-in-depth is preserved." There are
21 three other ones, but not relevant to this discussion,
22 I think.

23 How do we decide the defense-in-depth? We
24 go to the Standard Review Plan, Chapter 19, and it
25 contains four questions to help us decide, and that's

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1 what I've tried to show you on the next slide like
2 this. The first question says it's the change. When
3 they talk about change, they're talking about "the
4 impact of the license amendment request does not
5 result in a significant increase in the existing
6 challenges to the integrity of the barriers."
7 Increase in the existing challenges means initiating
8 event, so creating new initiating events is something
9 unusual - well, no. All we've done is taken credit
10 for pressure. We're not adding hardware to the plant,
11 we're not changing the plant design like this.

12 The next question, "The proposed change
13 does not significantly change the failure probability
14 of any individual barrier." Now you have to read the
15 language here. It doesn't say it does not change it,
16 it does not significantly change it. Changes are
17 allowed, as long as they are not significant. So we
18 indicate, first of all, this is where the three
19 barrier concept comes in - again, the fuel cladding
20 itself, the reactor coolant system, the containment
21 itself like this. We know from the fact that there's
22 a very small change in core damage frequency, which
23 was the calculation of a couple of sheets ago, that
24 there's a very small change in the failure probability
25 of the fuel like this.

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1 We haven't actually, by granting over-
2 pressure credit, changed the failure probability of
3 the reactor coolant system. All right. That's
4 whatever the LOCA frequency is for whatever
5 mechanisms. Similarly, because we have not actually
6 physically changed the containment, we haven't changed
7 the probability that the containment fails, just by
8 granting credit for over-pressure. So what we're
9 talking about with respect to this question is the
10 first barrier, the fuel barrier, the core damage
11 frequency, and the change is small.

12 The third question, and this is the hard
13 one. This may be the heart of the problem - "Proposal
14 does not introduce new or additional failure
15 dependencies among barrier that significantly increase
16 the likelihood of failure." Again, notice the word
17 "significantly." In fact, when we credit containment
18 over-pressure, we've introduced a dependency between
19 the fuel clad and the containment. All right.
20 There's no question about that. If the containment
21 fails during a large LOCA in the design-basis, we may
22 melt down the -- we may damage the fuel. Okay. So
23 the question is, how strong is that dependency? How
24 significant is that dependency? And again, the
25 previous examples shows change in core damage

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1 frequency is very small. It's insignificant. It's
2 not a significant increase.

3 One thing I should add to this is,
4 realizing in these scenarios the change in core damage
5 frequency is equal to the change in large early
6 release frequency, because the containment is faulted,
7 is failed now. Okay. So if, in fact, you get into
8 this scenario that I described before of LOCA occurs,
9 the containment integrity is lost, and the operator
10 fails to start suppression pool cooling, not only will
11 you damage the fuel, but you'll have a release.
12 There's no question about that, but the likelihood
13 seems rather small.

14 MEMBER DENNING: You should just be
15 measuring against the LERF criterion, rather than the
16 CDF criterion.

17 MR. STUTZKE: Well, in fact, to compare
18 them against Regulatory Guide 1.174, you have to do
19 both.

20 MEMBER DENNING: Yes.

21 MR. STUTZKE: Yes, you've got to do both,
22 but the LERF driver may well be the significant one
23 here. So the last question is, "The overall
24 redundancy or diversity among the barriers is
25 sufficient to ensure compatibility with the risk

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1 acceptance guidelines." Yes, we meet the Reg Guide
2 1.174 guidelines.

3 MEMBER DENNING: Can I say that I think
4 this is interesting, but I don't think you actually
5 looked at the right risk question. I think the
6 scenario that you really should have looked at, and
7 it's difficult, is just the case that looks like the
8 design-basis accident without this compounded failure
9 of loss of suppression pool cooling, but taking into
10 account the uncertainties in the phenomenology of the
11 accident scenario, and doing a spectrum of realistic
12 accident scenarios and see what's the probability
13 when you include those phenomenological
14 uncertainties, what's the probability that you really
15 will have cavitation and core damage, without
16 compounding it with the loss of suppression pool
17 cooling. And that's a difficult analysis to do, and
18 I'm sure that that conditional probability is small
19 based upon what we believe the magnitude of these
20 conservatisms are. But I think that was the real
21 question to be addressed, not the one compounded by
22 another event, which in this case you chose the
23 failure of suppression pool cooling, but then assumed
24 that your best estimate analysis was correct for the
25 accident phenomenology.

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1 MR. STUTZKE: This is not the same as the
2 statistical treatment that Richard talked about
3 before.

4 MEMBER DENNING: Yeah. I think it's
5 really that. If you did that full statistical
6 treatment and see well, what's the probability - I
7 think that's really the question.

8 MR. STUTZKE: Right. Well, it's true
9 because the credit for containment over-pressure is
10 a design-basis consideration. It's not really a risk
11 argument. We're dealing beyond the design-basis.

12 MEMBER SHACK: Well, I mean, I think you
13 have to do both. I mean, this is one way to violate
14 it, that's another. And you're arguing that
15 intuitively you think the other one is the bigger
16 contributor.

17 MEMBER DENNING: Well, I think it's the
18 one that really addresses the design-basis space, and
19 what -- and the concerns that we heard this morning.

20 MR. STUTZKE: Yes, I don't disagree with
21 you. It would be interesting to see the results of
22 the calculation.

23 MEMBER KRESS: But it's irrelevant to a
24 risk.

25 MR. STUTZKE: But it's irrelevant to the

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1 risk that --

2 MEMBER DENNING: No, I don't think so.
3 Both of them are, perhaps, relevant to risk. I mean,
4 maybe there are a whole variety of other compounding
5 things that could lead to failure that would be
6 impacted by the failure to isolate.

7 MEMBER KRESS: I think he has to do what
8 he did for the whole spectrum of LOCAs, but what he
9 did was chose one LOCA that's probably going to
10 contribute the most to the risk and found out that
11 that one is extremely small. And in risk space, I
12 think he's covered. I don't think there's other
13 sequences he needs to add into his thing. And then
14 we can say well, what about design-basis space,
15 that's what we're actually dealing with. That's a
16 different issue.

17 MEMBER DENNING: Well, it's arguable as
18 to whether you're in design-basis space when you
19 compound a large break LOCA with an unisolated
20 containment.

21 MEMBER KRESS: I mean, design-basis
22 space, you're in some sort of stylized never-never-
23 land. It doesn't have much to do with PRA and real
24 space. It has something to do with it in the sense
25 that it renders your system design to a state that it

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1 can deal with real space, which is PRA. But I think
2 he covered the risk aspects. Now if you want to go
3 back and say well, have we done a proper design-basis
4 space analysis, and have we been able to quantify
5 what the real margins are, you don't need to do what
6 he says, the other thing.

7 MEMBER DENNING: What I was saying, Tom,
8 is there is some risk that occurs when you just have
9 loss of coolant accident and your containment fails
10 to isolate. There's some probability of core damage
11 associated with that. That's one risk-base scenario.
12 He looked at another risk-base scenario in which he
13 looked at loss of coolant accident, failure to
14 isolate, plus loss of suppression pool cooling.
15 That's another scenario that has some risk. But I
16 think that it's probably more consistent with the
17 concerns that have been raised, is how -- and when
18 you ask how adequate is the conservatism in all of
19 these compoundings of conservatisms, what we're
20 really addressing is that risk of with a loss of
21 coolant accident, and just failure to isolate, what's
22 the risk? Not compounded by another thing, but just
23 that. And there is some risk of core damage just
24 based upon that, without compounding it with another
25 failure of the loss of suppression pool cooling. And

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1 I think that's what we're trying to get a feeling
2 for, is how conservative are these conservatisms. If
3 they're not very conservative, then that risk of just
4 that event of loss of coolant accident and failure to
5 isolate may be too high for us to accept. I think
6 that's the question. These conservatisms we've
7 talked about, are they enough that they prevent the
8 scenario that I just talked about. And the only way
9 you can really address it is doing the multiple
10 scenarios, taking into account uncertainties, and see
11 how big that risk space is.

12 MEMBER KRESS: I maintain that's already
13 covered in the PRA.

14 MEMBER SHACK: Well, no. It's an
15 uncertainty analysis of your math calculation for
16 success. He hasn't done that. He's done a point
17 estimate --

18 MEMBER KRESS: But assuming your success
19 criteria is correct, it's already covered in the PRA,
20 is what I'm saying.

21 MR. STUTZKE: The issue is, is the
22 success criteria correct.

23 MEMBER KRESS: Yeah. That's --

24 MR. STUTZKE: That's what you're really
25 asking, I think.

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1 MEMBER SHACK: Yes. That needs to be
2 addressed.

3 MEMBER KRESS: Yes, but it's not that
4 it's not covered in the PRA, because it's in there.
5 It all depends on your view of whether that success
6 criteria has got a lot of conservatism in it.

7 MR. STUTZKE: I'm done.

8 CHAIRMAN WALLIS: So your conclusion is
9 that there isn't a problem, is it?

10 MR. STUTZKE: No. I guess I'm not done.
11 All right. Let's talk a little bit about where we
12 should go maybe in the use of risk calculations and
13 risk insights to try to grapple with this problem a
14 little bit. I would certainly agree with you guys,
15 it would be very, very helpful to do the whole Monte
16 Carlo runs and see how close we really are, how much
17 conservative out of Rich, what he's really done like
18 that.

19 The other thing I'll point out is that
20 what you saw here is one analysis of one plant, not
21 all the plants. Not all plants work the same way.
22 They're designed that way, and so it would be
23 probably better to look at different types of plants.
24 The other thing I'll point out is that a lot of my
25 risk calculations are hand calculations. It needs to

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1 be full logic model treatment, full treatment of
2 uncertainties, the way we normally calculate things.

3 MEMBER KRESS: If your risk numbers in
4 your calculations came out to be something that gave
5 us second thoughts, in my view, that would put a flag
6 that this might be a generic issue that we need to
7 think about for all the PRAs or all the plants. It
8 has nothing to do with a particular plant at the
9 moment, like Vermont Yankee, to say, because you're
10 dealing with design-basis space. And once you --
11 what I've been doing here is question the adequacy of
12 design-basis space to provide adequate protection, so
13 that would lead to a generic issue, I think.

14 MR. STUTZKE: Right.

15 MEMBER KRESS: Okay. I just wanted to be
16 sure I'm thinking in the right vein.

17 MR. STUTZKE: Yes, I agree with you. I'm
18 just trying to say I'm reluctant to dismiss the
19 issue, or actually reach a conclusion that we don't
20 have a problem with adequate protection on the basis
21 of a single calculation like --

22 MEMBER KRESS: I think it would be a good
23 thing to find out, because this is one of those
24 things where you're validating the design-basis space
25 to render you in a good acceptable safety, and I

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1 think it's always a good thing.

2 MR. STUTZKE: Right. And that's the
3 reason why I said this morning, I think in the future
4 when licensees request credit for over-pressure, we
5 want to see the risk calculations. We want to see
6 something, we want to see it addressed somehow. Now
7 I'm done.

8 MR. LOBEL: Dr. Wallis, there's somebody
9 here from the Staff now that I think can address your
10 question about debris --

11 CHAIRMAN WALLIS: Okay.

12 MR. LOBEL: If you want to spend a couple
13 of minutes.

14 CHAIRMAN WALLIS: Sure.

15 MR. HUGHES: Very briefly, there is some
16 public data with respect to very small, and that is
17 really part of the GSI 191 evaluation. Now the very
18 short version is for all intents and purposes, the
19 types of fluids that we're looking at right now and
20 the densities that are associated with it, it's
21 fairly close to that of water, because a couple of
22 the major factors within the NPSH calculations are
23 friction loss, friction loss and piping leading to
24 it. If I have a heavier density, more rough fluid
25 coming through, pressure drop is going to be larger

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1 coming through the inlet piping; therefore, NPSH
2 required is going to be a little higher. Same goes
3 for the internals of the pump. As the internals of
4 the pump are spinning around, because of the density
5 of the fluid, because of the additional friction
6 within the impeller and those types of things, you
7 are going to have a slightly larger NPSH --

8 CHAIRMAN WALLIS: I think the bigger
9 effect would be the nucleation and the bubble growth.

10 MR. HUGHES: The testing that's been done
11 for all intents and purposes for mixtures that we're
12 talking about - and a lot of this comes from the
13 mineral mining industry having to do with sandpipers
14 and things along that lines - as long as it's close -
15 now what's close? It's close as in you're pumping
16 dirty water out of the bottom of a sump, or out of
17 the bottom of a mining shaft - and that's, again,
18 where most of this information comes from - it's
19 close. It's close to the point where when you're
20 calculating the numbers, it's not conservative, but
21 it's reasonable.

22 CHAIRMAN WALLIS: Well, this debris has
23 maybe zinc particles from the paint, which are
24 actually producing hydrogen by interacting with the
25 material in the pool, and so you've got particles

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1 with some gas maybe attached to them, which act as
2 nucleation sites for bubble growth. It seems to me
3 much more of an effect than the effects you've been
4 talking about.

5 MR. HUGHES: Which is not a lot different
6 than methane bottom of a mine shaft.

7 CHAIRMAN WALLIS: Maybe. Yeah.

8 MR. HUGHES: Okay. Or pulling water
9 slurry out of the bottom of a wet-well.

10 CHAIRMAN WALLIS: And this doesn't affect
11 the NPSH?

12 MR. HUGHES: It does.

13 CHAIRMAN WALLIS: It does.

14 MR. HUGHES: It does, but the studies to
15 date say it's a minor -- it's something to be
16 considered, something to think about. And it really
17 becomes more of what are the friction factors and
18 what are the piping losses in-between the suction and
19 the pump itself. And it needs to be thought about.
20 Most studies say it's close.

21 Now there are some correction factors
22 that you can use and they're based upon the density
23 of the slurry, if you will, as compared to the
24 density of the water. So there are a few things --

25 CHAIRMAN WALLIS: Now for the Full

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1 Committee, would you have some quantitative
2 information where you actually have a reference and
3 some kind of numbers that you can pull?

4 MR. HUGHES: I have some references, some
5 conference proceedings of the last three or four
6 years from the Mineral Society.

7 CHAIRMAN WALLIS: And these will show the
8 curves for here's clean water, and here's dirty
9 water, and it's the same.

10 MR. HUGHES: With hard particles, that
11 sort of thing.

12 CHAIRMAN WALLIS: Okay.

13 MR. HUGHES: There are some publicly
14 available --

15 CHAIRMAN WALLIS: Sure, that will be
16 useful, I think.

17 MEMBER DENNING: I do think, though,
18 there still is the question that you're raising here,
19 and that is whether the questions of nucleation are
20 important or not. They might actually be in the
21 opposite direction, and that's superheat, and it
22 might be worse and this may prevent from getting
23 superheat. But that would be interesting to see if
24 there's anything on that, as well.

25 MR. HUGHES: I'll provide the references

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1 to Rich. But the conclusions to date have been there
2 is an effect, albeit a minor one, with the exception
3 of the --

4 CHAIRMAN WALLIS: Well, since it's a long
5 time between now and September, maybe you could get
6 the key information to Ralph in some form that we
7 could review.

8 MR. HUGHES: That's fine.

9 CHAIRMAN WALLIS: And it's best if it's
10 quantitative and based on tests or something, and not
11 qualitative and speculative. There's actually real
12 evidence, that would be very good.

13 MR. HUGHES: I will send Ralph what I
14 have.

15 CHAIRMAN WALLIS: Thank you.

16 VICE CHAIRMAN RANSOM:: One thing that
17 may be saving in the pump is that the cavitation
18 occurs in the low pressure regions, and they're
19 associated with moving surfaces, you know, the
20 blades. And consequently, the most likely place for
21 the cavitation to begin is on the surface. And there
22 are, of course, nucleation sites on the surface
23 itself. But there's a lot of evidence of that, even
24 with cavitating in tories because you don't get
25 homogeneous nucleation. It doesn't occur throughout

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1 the fluid. It occurs right on the surface where that
2 curve has led to a low pressure region and
3 vaporization occurs. And so if you kind of use that
4 argument, you expect that the particulate matter
5 probably doesn't make much difference, and that's
6 what he seems to be saying. I don't know if those
7 pumps are the same as the kinds of pumps that were
8 used in nuclear power plants or not. That would be
9 of some interest. Another data point would be
10 irrigation pumps. They pump dirty water all the time
11 with only a few feet ahead on the inlet. And they
12 run for days, and days, and days.

13 MEMBER SIEBER: I think in the
14 manufacture of pumps, the manufacturer designs a pump
15 suited to the application. And there are techniques
16 that can be used, like water flush bearings,
17 independent lubricating systems and so forth that
18 will protect the pump against the effects of abrasion
19 and wear. The question is are the pumps that are
20 applied in nuclear power plant situation designed
21 with the facts in mind that the water may not be
22 clear and pure. And I don't know the answer to that
23 question.

24 CHAIRMAN WALLIS: Now how are you going
25 to handle these sort of points that were raised from

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1 the public this morning? Are they going to appear as
2 public comments on this document when it's issued,
3 and then there's going to be some Staff response to
4 each one of them? Is that what's expected?

5 MR. LOBEL: Well, in terms of the public,
6 we made the documents available after we sent them to
7 the committee so that the public would have them to
8 be able to better participate here, but after
9 receiving your hopefully positive letter, then
10 they'll go out for public comment, and then the
11 public can comment on them then, and make whatever
12 comments they want. We specifically said in making
13 the documents available to the public that this
14 wasn't the beginning of a public document period, so
15 I guess I would say --

16 CHAIRMAN WALLIS: So this presentation
17 here doesn't get rebuttal from you until it's
18 repeated as public comments in some form. So nothing
19 much will happen for six months or something.

20 MR. LOBEL: I can address some of it, if
21 you'd like, but in terms of comments, there'll be
22 plenty of time for them to comment on the Reg Guide
23 when it's out for comment.

24 VICE CHAIRMAN RANSOM:: Are there any
25 requests for any further time for stakeholder

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1 comments?

2 MR. CARUSO: Yes. We have a request from
3 Mr. Shadis and Mr. Appleton, and Mr. Sherman would
4 like to come back for the hearings.

5 MR. LOBEL: Well, we need to move ahead
6 with that, I would say.

7 MEMBER SIEBER: Thank you.

8 MR. HUGHES: I had some conclusion
9 slides, but we've already I think stated each one of
10 them a couple of times, so I'll just leave.

11 MEMBER SIEBER: Thank you very much. I
12 can see a lot of effort has gone in --

13 CHAIRMAN WALLIS: Well, I think the
14 conclusion that you want us to reach is that the new
15 version of Reg Guide 1.82 is appropriate and responds
16 to all the shortcomings of the previous Reg Guide.
17 Isn't that the conclusion you want us to reach,
18 rather than the conclusions that you've reached here?
19 You want our letter to state that we don't see any
20 great impediment to this revision to the Reg Guide as
21 we've seen it today, or whenever we think that it --
22 we don't see anything that we need to raise as a
23 problem at this time. Is that the kind of thing you
24 want to get from us?

25 MR. LOBEL: Yes, I think so. Like we've

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1 been saying, the actual changes to the Reg Guide that
2 affect policy and the way we would do reviews are
3 really the only new changes. The other stuff is just
4 adding more information for people, technical
5 information. We, in the past, presented the issue of
6 containment pressure credit, and gotten a positive
7 response with a caveat. We tried to address --

8 CHAIRMAN WALLIS: That was six years, or
9 eight years ago or something.

10 MR. LOBEL: Well, I guess that's up to
11 you how you want to treat it. We made the effort to
12 go through the whole case again just because we
13 recognize it's been a long time, and we think this is
14 probably the most complete assessment of this issue
15 that the Committee has heard. I read the previous
16 transcripts, too, and I can't say I was all that
17 happy with some of it either, so we tried to give a
18 complete response. I guess it's up to you how much
19 you want to go back and address the issue of over-
20 pressure completely again.

21 MEMBER SIEBER: Well, this sort of takes
22 the form of an interim letter. Our final letter that
23 would say this is good or not good will come after
24 public comment.

25 MR. LOBEL: All we're asking for is to go

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1 out for public comment now.

2 MEMBER SIEBER: And basically, we would
3 write a letter if we saw some major impediment that
4 would affect the ability of the public to make
5 comments that were adequate because if we withheld a
6 major comment until after the public comment period,
7 it may alter the draft guide so much that you would
8 have to go out for additional public comment, so I
9 think the purpose of today's meeting and a Full
10 Committee meeting is to identify any show-stoppers at
11 this point in time. Or as an alternative, tell the
12 Staff it's okay to go out for public comment.

13 CHAIRMAN WALLIS: What we're really
14 saying, it's okay to come before the Full Committee
15 in September.

16 MEMBER SIEBER: Well, that would be what
17 we would say today. We wouldn't write anything until
18 September.

19 CHAIRMAN WALLIS: We don't make a
20 decision about going out for public comment.

21 MEMBER KRESS: It's hard to say what the
22 Full Committee will do. I learned that on some other
23 --

24 MEMBER SIEBER: Typically, what we say is
25 that we decided not to do the full review at this

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1 time, and so this would be considered a partial
2 review because we don't know what the public comments
3 will be. But we would like the opportunity to review
4 when the public comments are received and resolved.

5 MEMBER SHACK: I mean, the Reg Guide, or
6 at least when you send it out, you're going to have
7 to ask for some comment from the public on the
8 uniform aspects of it since it's really not addressed
9 directly in the Reg Guide. You could do that --

10 MR. LOBEL: I think the -- I don't know
11 what the procedure would be, but it seems like it
12 would be beneficial to make some changes in the Reg
13 Guide from the version we presented to you. And
14 maybe, if it's possible, I think maybe I answered a
15 little too fast about the other comments that were
16 made today. We could consider those -- rather than
17 rebutting, we could consider those before we send out
18 the version for public comment, since we've gotten
19 some -- we've heard them now.

20 The other thing is I think we wanted --
21 you didn't put anything in about risk because back
22 when this was done, the idea was that it wasn't
23 necessary. But in reconsidering that, we've decided
24 that -- Marty's decided that we should have something
25 in there so that risk is considered with every

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1 application, and so I think we want to put that in
2 before it goes out for public comment.

3 MEMBER SIEBER: I think without
4 consideration of risk, your case is not as solid as
5 it could be.

6 MR. LOBEL: Well, it wasn't --

7 MEMBER SIEBER: I think risk really helps
8 put things in perspective, to say what's important
9 and what is not important.

10 MR. LOBEL: It wasn't that we were
11 leaving it out. It was that we thought we could make
12 the case without having to make the case on every
13 single application.

14 MEMBER SIEBER: I don't know whether
15 that's true or not.

16 MR. LOBEL: We don't either, so now we're
17 going to make it part of every application.

18 CHAIRMAN WALLIS: Well, this new Reg
19 Guide says if you make all these conservative
20 assumptions and convince the Staff that they are
21 conservative, and you come up with positive suction
22 head, which meets the margin with this ratio of what
23 you get to, what you need of one, then it's
24 acceptable. And then you may even get more if you've
25 got curves you can justify. I think the trouble will

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1 come if plants find that making all these
2 conservative assumptions, they want to back-off on
3 some of those conservative assumptions for some
4 reason.

5 MR. LOBEL: I agree, yes.

6 CHAIRMAN WALLIS: Making them all seems
7 absurd, so we'll only make the first two that really
8 matter.

9 MR. LOBEL: And then the issue of margin
10 becomes more --

11 CHAIRMAN WALLIS: Then the issue is well,
12 is that good enough and so on. I think it would
13 help, as I said before, when you come before the Full
14 Committee if you could say -- you've got all these 15
15 conservative assumptions, but these are the ones that
16 really matter. And this is how much they're worth.

17 MR. LOBEL: Well, I don't know if we'll
18 be able to do that by then, but we'll try.

19 CHAIRMAN WALLIS: A perspective on what's
20 involved. There's an awful lot of loose talk about
21 conservative assumptions.

22 MR. LOBEL: Well, I think it isn't so
23 much a question of if they're in the conservative
24 direction. I think it's more of a question that you
25 were raising of what their values are and how much --

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1 CHAIRMAN WALLIS: If they're all trivial,
2 if what you get from being conservative is trivial,
3 and you're much more uncertain about something else,
4 then really it's not very convincing.

5 MEMBER SIEBER: Well, the interesting
6 thing about that, and I guess I've thought about it
7 a little bit over the years, people do make
8 conservative assumptions or bounding calculations
9 because it's difficult to do the realistic one and
10 assign an uncertainty to it. That's orders of
11 magnitude more difficult than just making a bounding
12 calculation and declaring it conservative. And the
13 problem is, without the realistic calculation and the
14 uncertainties, compared to the bounding calculation,
15 you don't know what margin you have, so when you say
16 well, I've got plenty of margin, I don't know what
17 that means. Obviously you have some margin, but
18 unless you have either experimental data or a good
19 thorough realistic calculation, including
20 uncertainties, you don't know what you're measuring.
21 And I would prefer to know what the margins really
22 are.

23 CHAIRMAN WALLIS: Now these pumps aren't
24 run very often, are they, in a nuclear plant?
25 They're only run when they're needed. Are they

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1 tested from time to time or something?

2 MR. LOBEL: They're probably tested.

3 MEMBER SIEBER: In BWRs recirculation
4 spray pumps do not --

5 CHAIRMAN WALLIS: You have to run them
6 every so often?

7 MEMBER SIEBER: Once a cycle to make sure
8 that it starts.

9 CHAIRMAN WALLIS: So there's no reason to
10 suppose that they've degraded after sitting around
11 for 30 years?

12 MR. LOBEL: Well, that's why they're
13 tested quarterly, to make sure that they're not
14 degraded.

15 CHAIRMAN WALLIS: They don't test NPSH,
16 do they?

17 MEMBER SIEBER: No.

18 MEMBER DENNING: No. As a matter of
19 fact, I think there's a little story here, and I hope
20 I get it straight. But in Surrey, when we did WASH-
21 1400, of course, the heat removal comes from the
22 spray, the long-term heat removal comes from the
23 spray system.

24 MEMBER SIEBER: Containment heat removal.

25 MEMBER DENNING: Containment heat

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1 removal. Of course, we gave it full credit for that.
2 But subsequent to WASH-1400, it was discovered there
3 was a design error in that pump, if I've got this
4 straight. And the reality was the NPSH was not
5 properly designed for that pump, and it would not
6 have worked. Subsequently fixed.

7 MEMBER SIEBER: I don't know that.

8 MR. HUGHES: Again, Steven Hughes. ASME
9 Code require testing quarterly on these types of
10 pumps. These are considered Group B-type pumps, so
11 in general, containment spray pumps, RHR pumps which
12 are not operated during normal operation are tested
13 quarterly. If they're at a point that's generally
14 picked at a well-sloped point on the curve, it needs
15 to be repeatable. They monitor in the older versions
16 of the code, DP flow and vibrations. In the newer
17 versions of the code, it's a little bit less rigorous
18 in that for these types of pumps, for every outage
19 every two years, they're required to run a
20 comprehensive pump test, which is required to be run
21 at approximately 100 percent of their design flow.
22 The actual code requirement is designed for plus or
23 minus 20 percent, so the pumps that we're talking
24 about - do they degrade over time? The answer to
25 that is they are monitored, and they are looked at.

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1 And if there is a problem, there are certain
2 requirements by the code, and by 10 CFR 50.55(a) that
3 require them to take actions. So yes, they are
4 monitored for degradation. Yes, they are looked at.
5 And in most BWRs, most BWRs have full flow test so
6 that quarterly test is generally run at design flows.
7 PWRs are a little different, but from a BWR
8 standpoint, for most of these tests, the pumps are
9 run at full flow quarterly.

10 MEMBER SIEBER: Generally speaking, based
11 on working in a plant for many years, pumps that
12 aren't ordinarily run except for quarterly testing or
13 flow testing every 18 months, you don't see wear in
14 things like wear rings, impellers, pump casings. If
15 you see degradation, it occurs in the bearings and
16 seals. And the seals, if it's a mechanical seal, it
17 may dry out. The bearing may pit, and other than
18 getting more leakage than you would like, which these
19 would be detectible during even standby conditions,
20 a pitted bearing really doesn't hamper the short-term
21 operation of the pump.

22 VICE CHAIRMAN RANSOM:: I would like to
23 move ahead to the stakeholder comments, give them
24 time.

25 MR. LOBEL: Do you have a handout?

1 MR. SHADIS: I don't.

2 MR. LOBEL: Your name, please?

3 MR. SHADIS: My name is Raymond Shadis,
4 S-H-A-D-I-S. I represent an organization called the
5 New England Coalition, which is a non-profit
6 membership group that is incorporated in the State of
7 Vermont. My position with the New England Coalition
8 requires me to track environmental and safety issues
9 at New England's nine nuclear power stations, five
10 operating stations, four in decommissioning, two of
11 those are BWR Mark-1s. That would be Pilgrim Station
12 and Vermont Yankee.

13 I do want to thank the committee for
14 entertaining our comments. We were very pleased to
15 receive a call from Mr. Caruso asking us if we would
16 like to present at this meeting. And by way of
17 preamble, I will say that I'm glad that we're
18 speaking toward the end of the meeting, because so
19 much has been said that we would have said, and it's
20 also been educational, and at times entertaining,
21 also.

22 We have some very deep concerns with this
23 proposed Reg Guide change, and they would not be
24 necessarily alleviated by refusing the change, or
25 denying the change because the history of this goes

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1 back just a little way. What in our view is
2 happening here, is that there is a problem that has
3 surfaced, and which NRC and the ACRS are being asked
4 to address. The problem goes back a very long way,
5 and it goes back to a time when there was a basic
6 design error.

7 It's hard to fathom that anybody in the
8 procurement department of an architect/engineering
9 firm building one of these BWRs, early BWRs, would
10 have ordered a pump with the intention that it should
11 be cavitating pump, able to slop just enough water
12 into the core to cool it. What we have here is a
13 design specification that call for a pump that could
14 operate at, I presume, atmospheric pressure, and
15 deliver water in excess to cool the core. And
16 there's no way that you can look at this and not say
17 that acceding to containment over-pressure in order
18 to accomplish some part of that purpose isn't a step
19 back in terms of safety. It may be small, it may be
20 incremental, and you might juggle the numbers enough
21 to actually come up even steven, but it certainly
22 isn't an advance in reactor safety for either -- both
23 for accident mitigation or recovery either way.

24 In fact, we're confused as to whether
25 this is an attempt to permit a procedure or

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1 legitimize a procedure. And if it's a case of
2 legitimizing the procedure, as I suspect it is, then
3 it's tantamount to getting a birth certificate for a
4 20-year old, to legitimize the child.

5 I have a report which I recommend to you,
6 and unfortunately I only have one copy, and I
7 grabbed it off the shelf on the way out the door
8 yesterday. But this is a -- it's titled "Vermont
9 Yankee Containment Safety Study - August, 1986." And
10 it came with a cover letter to Mr. Harold Denton, the
11 head of NRR at the time, so dated September 2nd, 1986.

12 The report --

13 CHAIRMAN WALLIS: Who is the author of
14 the report?

15 MR. SHADIS: This is from Vermont Yankee.

16 CHAIRMAN WALLIS: Oh, from the licensee?

17 MR. SHADIS: Yes, it is. "In accordance
18 with our commitment, contained in the reference
19 letter, enclosed find our completed Vermont Yankee
20 containment safety study. Represents a 60-day effort
21 on the part of Vermont Yankee and consultants to
22 compare Vermont Yankee design features to those in
23 the reference plant in WASH-1400, and calculate
24 specific containment conditional failure probability,
25 and address the five BWR containment issues raised by

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1 Mr. Benaro of NRC last June."

2 I want to point out that in this report,
3 which is, I think, a really fine little report,
4 Vermont Yankee specifically raises the question of
5 venting the containment, or of employing the
6 containment spray; and, thus, reducing containment
7 pressure and losing net positive suction head. This
8 is something that was recognized at the time. This
9 was something that the licensee and their operators
10 must have - because I've got a great deal of faith in
11 them - they must have taken cognizance of this and
12 incorporated it into their procedures.

13 In fact, it says "for anticipated
14 transient without SCRAM, Vermont Yankee" -- it
15 basically says that they have incorporated into their
16 EOPs consideration of not reducing containment
17 pressure, and I presume not down to zero. Other
18 issues that are raised in here are of significant --

19 CHAIRMAN WALLIS: I think in terms of
20 where they stand now, that is fine. And then in
21 terms of the power uprate, it might be to get credit
22 for over-pressure in the containment. But as far as
23 operating today, I think it is okay in terms of what
24 you say there.

25 MR. SHADIS: Well, it may be okay in

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1 terms of its actual effect, mechanical effect, that
2 indeed they can get away with maintaining some
3 containment pressure in order to make certain that
4 the pumps don't cavitate. But at the time this was
5 written in 1986, that was illicit. That was not part
6 of the guidance.

7 CHAIRMAN WALLIS: They didn't need over-
8 pressure.

9 MR. SHADIS: Pardon me?

10 CHAIRMAN WALLIS: I don't think they
11 needed over-pressure at the present power level.

12 MR. SHADIS: Well, this report
13 contradicts you in the sense that what they are
14 saying in the report - and I do hope you'll have NRC
15 Staff get you copies of it - but our interpretation
16 of it is that they do, indeed, need to retain some
17 containment pressure.

18 CHAIRMAN WALLIS: They actually bar over-
19 pressure in 1986?

20 MR. SHADIS: Yes, sir. And there are
21 several references to it throughout the report. The
22 other thing in here that jumped out right away is
23 that the -- we had some confusion between two
24 speakers here from the NRC. I distinctly thought I
25 heard the first speaker say earlier on that raising

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1 the water temperature would not necessarily act
2 toward inducing cavitation. That you would not have
3 vaporization and boiling of the water by raising the
4 temperature. And that was strictly counter-
5 intuitive. I was glad to hear the second speaker say
6 the opposite thing.

7 CHAIRMAN WALLIS: It depends which part
8 of the equation you put it in, I think.

9 MR. SHADIS: Quite so. And Vermont
10 Yankee makes that admission here. The concern with
11 keeping the suppression pool water temperature low in
12 order to avoid loss of net positive suction head
13 cavitation, so I recommend that to you.

14 I want to - here's a lay person talking
15 to you - and thank you for allowing me to do that.
16 I just want to make the point that with all of the
17 BWRs that have already been permitted to take credit
18 for containment over-pressure, one would presume
19 they're going to use that, that they're going to
20 employ that. And in tables provided by the State of
21 Vermont, just a quick look at it says that the over-
22 pressure typically is at 5-1/2 to 6-1/2 PSI. And
23 this is moderate and it's modest, but it needs to be
24 considered in terms of a platform from which
25 containment pressure goes up under accident

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1 conditions.

2 The Vermont Yankee's tech specs, for
3 example, talk about venting when the containment
4 pressure reaches 58 PSI. I personally think it would
5 automatically vent sometime before that, but that's
6 their estimate. So it's a non-conservatism. It has
7 a negative safety impact to presume that you're going
8 to start into that sequence with a 5-1/2 to 6-1/2
9 pound head start. And there are accident scenarios
10 where you can get a surprise.

11 This particular containment does have --
12 it is inerted. In the tech specs, the oxygen levels
13 are cut to about 4 percent with the stipulation that
14 when you get up to 5 percent, you start to move into
15 combustible space for hydrogen. That 4 percent
16 inventory of oxygen doesn't take into account the
17 addition of oxygen through zirconium hot water, or
18 zirconium steam reaction. It's not much to go that
19 extra 1 percent or even 2, to make it a situation
20 where you can get a hydrogen burn. And we're
21 reminded that the two spikes at TMI, I think the
22 larger spike at TMI was 28 pounds per square inch,
23 and in a big containment. So we looked at this, and
24 we wonder if NRC and the licensee aren't heading into
25 space where there could be some unanticipated

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1 consequences, and some unpleasant surprises.

2 I'm just trying to flip through to the
3 few remarks I wanted to say. I guess I would wind
4 this up here. I mean, there's a lot to be said about
5 the fact that you have been handed a design error and
6 asked to amend the rules and regulations, or the
7 guidance, if you will, to take care of a mistake that
8 was made many years ago, and one which does have its
9 negative safety implications. And you're now being
10 asked to legitimize a practice that has been in place
11 for 20 years or more, sometimes with NRC granting
12 exemptions, sometimes the licensee simply went ahead
13 and handled this as best they could.

14 I want to reiterate again that when we
15 look at the trend in regulatory adjustments at NRC,
16 big picture stuff, we see those regulatory
17 adjustments only moving in one direction. Either
18 they're static, or there are reductions in margin,
19 reductions in redundancy, reductions in terms of
20 defense-in-depth. There are fewer engineered
21 productions, protections, more reliance on operator
22 actions, and we don't see this as anything but a
23 retreat from early safety margins.

24 I would ask that when you consider this,
25 that you do not shy away from doing some case

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1 studies. Vermont Yankee would be a good one. It's
2 practically a poster child for this sort of thing,
3 but pick what plants you will, and look at them to
4 see if the actual physical condition of the plant is
5 reflected in its design documents.

6 We're making a lot of assumptions here
7 about how equipment is going to perform. For
8 example, how a torus is going to perform, suppression
9 chamber. The one at Vermont Yankee has been altered
10 over time. There has been welding done on it,
11 projects that were started and then recalled. I
12 couldn't begin to guess whether that suppression
13 chamber is as strong as it was the day it was built
14 or not. My guess would be not, but I don't know how
15 much those margins have been reduced. So I think on
16 the whole, we need to look at these things.

17 When it comes to leakage, someone asked
18 a question about leakage passed the MSIVs. I don't
19 know what the plan is at other BWRs, but it's
20 acknowledged that they cannot secure the MSIVs at
21 Vermont Yankee, try and try again. And so, when it
22 comes to uprate, the cure at this point is to send
23 the pressure downstream to the condenser, and then I
24 presume off to the off-gas system. I don't know.
25 But it's going to the condenser, and we don't know if

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1 that condenser can handle it. So this whole
2 proposition has got a chain of events tied to it
3 upstream and downstream, before time, during accident
4 time, and accident mitigation time, and afterward.
5 And I think it bears more of an examination before
6 anyone signs off on this new guidance. Maybe the new
7 guidance should be rewritten to be more stringent
8 than the interim guidance, but it certainly bears
9 more examination than it's been given so far. And I
10 thank you for your patience.

11 VICE CHAIRMAN RANSOM:: Thank you. Do we
12 have any questions?

13 CHAIRMAN WALLIS: I think Bill Sherman
14 wants to come up again.

15 MR. CARUSO: WE have two more, there's
16 the Applicant and Mr. Sherman.

17 CHAIRMAN WALLIS: Mr. Sherman wants to
18 come up again.

19 MR. SHERMAN: I've been conference
20 speaker at the end of conferences before. It's a
21 hard position to be in.

22 CHAIRMAN WALLIS: Get the last word.

23 MR. SHERMAN: Well, I never wanted the
24 last word, but I do appreciate the opportunity to say
25 a number of things. Actually, I wish we could have

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1 a dialogue, but that wouldn't work real well. And
2 for the record again, I'm Bill Sherman from the State
3 of Vermont, and I appreciate the opportunity to say
4 some things here at the end of the meeting.

5 First, I'd like to take another shot at
6 answering a question, Chairman Wallis, that you asked
7 me earlier in the meeting. At one point you asked,
8 this sounds like a licensee problem. Why don't you
9 just go and ask the licensee? And with thought, I
10 have a little better answer to that, and it's this;
11 when you get right down to it, why didn't the
12 licensee consider changing to more effective pumps in
13 its pinchpoint analysis? And the answer is simple;
14 the staff let's us do this. So our real concern is
15 about what the staff will let them do. And we are
16 involved in Atomic Safety and Licensing Board process
17 where administrative law judges will make decisions,
18 but we believe that this body may have the very best
19 base of expertise to judge this issue. That's why we
20 wanted to present, is because we think that you --
21 we're not nearly the experts that you are, and we
22 think that if we can sort of make our concerns
23 understood, that you will have the best tact at
24 understanding whether there's any validity of what
25 we're saying or not. So that's why we are anxious to

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1 talk with you.

2 CHAIRMAN WALLIS: Well, I would like
3 whatever comes out of this for the State of Vermont,
4 which is not an insignificant body, to be convinced
5 that the right thing is being done. I wouldn't like
6 to have a situation where one of the more responsible
7 - and I go on for a long time about describing the
8 State of Vermont - states in the union was at odds
9 with the NRC over this issue. I think it would be
10 highly desirable the NRC and the licensee to also
11 convince you that the right thing is being done,
12 whatever eventually ends up being done. I wouldn't
13 like to see a residual disagreement between a state
14 --

15 MR. SHERMAN: We're trying to signal that
16 we have high respect for this body, and appreciate
17 that opportunity.

18 In brief comments, I'd like to comment on
19 Mr. Stutzke's presentation with the slide that I have
20 up from my packet, which is --

21 CHAIRMAN WALLIS: What number is that?

22 MR. SHERMAN: This was number 31,
23 containment fails to hold pressure. The reason that
24 we have this slide up is because we had opportunity
25 to review your work, Mr. Stutzke, prior to the

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1 meeting. We had some information, and actually
2 pulled this out because we knew something about the
3 MSIV failure rate. The failure rate for us here in
4 the meeting is pretty simple to discuss without
5 having to put numbers on paper. Ten failures in 40
6 tries, that's a failure rate of 25 percent, eight
7 valves must operate when the containment wants to
8 isolate. If eight valves are operating and there's
9 a 25 percent failure rate, two of them are not going
10 to operate correctly.

11 MEMBER SIEBER: Let me interrupt a
12 second.

13 MR. SHERMAN: Okay. Good.

14 MEMBER SIEBER: I asked the question
15 before when you made the statements, and I feel
16 obligated to ask it again. When you call MSIV as a
17 failure, does that mean it leaks more than the
18 technical specification, or it never closed?

19 MR. SHERMAN: It leaks more than the
20 technical specification.

21 MEMBER SIEBER: Okay. That's a lot
22 different than it failing to close.

23 MR. SHERMAN: Yes, sir.

24 MEMBER SIEBER: When you talk about eight
25 valves, there are two valves in four lines. Right?

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1 MR. SHERMAN: Correct.

2 MEMBER SIEBER: Okay. So if one of those
3 valves failed, you still get containment isolation.

4 MR. SHERMAN: Correct, but --

5 MEMBER SIEBER: And what you have to do
6 is to have both of them in the same line fail.

7 MR. SHERMAN: Right.

8 CHAIRMAN WALLIS: It's a simple homework
9 problem.

10 MEMBER SIEBER: And a failure is leakage,
11 I'm not sure that it has any impact.

12 MR. SHERMAN: You're leading exactly to
13 my point, which is that if there are two out of the
14 eight that fail per try, then if one of them fails in
15 one line, and you're going to have another valve
16 fail, you have one out of seven chance that it's
17 going to be in the same line.

18 MEMBER SIEBER: But you're still talking
19 about leakage.

20 MR. SHERMAN: It is true that the --

21 MEMBER SIEBER: And the leakage for BWR
22 main steam isolation valves is set very low because
23 it's containment boundary, and that doesn't have an
24 impact on whether the containment pressure remains at
25 its normal value or not, the kind of leakage that

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1 you're talking about. It's very small.

2 MR. SHERMAN: Well, in some of the tests
3 --

4 MEMBER SIEBER: It's bigger because of
5 radiological considerations as opposed to -- that's
6 what sets that very small peak rate. You want to
7 have containment isolation so that the mechanical
8 parts of the system will perform as designed. And
9 that will occur even if there is a small leakage.
10 It's the radiological concern that sets the leakage
11 that low.

12 MR. SHERMAN: Okay. But working on where
13 I was going to go with this, and realizing that you
14 have to look at the specific leakage rates to see how
15 much there really was, and how much the failures were
16 - we looked at Mr. Stutzke's valuation of this and
17 found that there wasn't any accommodation for MSIV
18 leakage. And that's because -- well, I'm not sure
19 why that is, but in the fault tree that was
20 evaluated, MSIVs weren't considered. And in the
21 probability that you provided, you had in the order
22 of ten to the minus three, and I think if MSIVs were
23 included using the last five outages of data from the
24 reference plant, you'd be one or two order of
25 magnitudes higher with your probability than what you

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1 calculated. So that's our first point.

2 Here's our second point. This is Slide
3 34 out of the presentation. This is a start at a
4 fault tree for pump fails due to inadequate NPSH. We
5 stated earlier in our presentation that it is not
6 just the failure of the containment that we're
7 concerned about, but the overall failure - the
8 removal of the conservatism that containment pressure
9 gives.

10 What I think Mr. Stutzke was speaking
11 about in his presentation was just the very bottom
12 left block of this, and that is only the impact of
13 the containment failing to hold pressure as an item
14 that would affect pump fails due to inadequate NPSH.
15 But in a number of these other areas, the fact that
16 you are taking credit for containment pressure
17 changes the probability in these boxes, or at least
18 I think they do. And I think to get to the term
19 significant that was used in the defense-in-depth
20 slides, you have to do the full evaluation of the
21 uncertainties. And I think that that's what Member
22 Denning was speaking about when you mentioned the
23 fact that it's more than just the containment
24 failure. That's what I thought.

25 What we see is in the conservatism

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1 discussion that was done, we're concerned about what
2 is a double counting. First, this slide mentions the
3 margin from the standard, the 1.5 margin of actual
4 NPSH over required NPSH that we spoke about before.
5 I think Mr. Lobel mentioned that these pumps have
6 fairly low suction pressures. Actually, they're
7 considered just on the boundary of high suction
8 pressure is what you said. And the standard --

9 MEMBER SIEBER: The term is suction
10 energy.

11 MR. SHERMAN: I'm sorry. Thank you.
12 Suction energy, and the standard actually for high
13 suction energy pumps calls for a margin of 2, not
14 1.5. But we were willing to assume that --

15 CHAIRMAN WALLIS: We asked him about
16 that, and he said this margin is for pumps which are
17 being used for long time. He was satisfied that you
18 could use one for these pumps, which only run for a
19 short time.

20 MR. SHERMAN: Well, and I heard him say
21 that, and therefore, that would be subject to check
22 to see whether the standard really was there. But
23 that leads into the cavitation discussion. We
24 pointed out earlier that in order to avoid
25 cavitation, the standard mentions that you need two

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1 to twenty times the NPSHR. In both presentations
2 that we've had, both spoke as if you only got
3 cavitation if you were less than NPSHR, the required
4 NPSH. But in reality you --

5 MEMBER SIEBER: That's not true. The
6 standard fully discusses that.

7 MR. SHERMAN: The standard discusses that
8 you have cavitation --

9 MEMBER SIEBER: At NPSH --

10 MR. SHERMAN: And even higher.

11 MEMBER SIEBER: Yeah.

12 MR. SHERMAN: And so the statement that
13 was made -- what it looks like to me in the reference
14 plant evaluation is that they really do have their
15 operating in the cavitation regime for close to the
16 55 hours that they're crediting containment over-
17 pressure.

18 MEMBER SIEBER: I would say that
19 virtually every pump in every kind of power plant,
20 coal or nuclear, or gas-fired operates somewhat in
21 the cavitating regime. That's the way pumps are
22 designed.

23 MR. SHERMAN: And then my only other
24 point has to do with double counting of
25 conservatisms, and it's this. We understand the

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1 conservativisms that Mr. Lobel spoke about, and fully
2 support that that's the way that this work should be
3 and is done. But there's a reason why those
4 conservativisms are there. One reason - one type of
5 conservatism is where you either maximize or minimize
6 heat sinks in containment, and that's because you
7 don't really know quite how they're going to act.

8 Another example is the decay heat
9 correlation, where you don't really know quite how
10 the decay heat correlation is going to act. So the
11 conservatism is there because of the uncertainty in
12 the very item. Then conservativisms are provided for
13 all these things that we mentioned. I mean, we
14 mentioned paint chips, we mentioned pressure and
15 temperature calcs, we mentioned possibilities in
16 whether the NPSHR was right or not, and you have
17 conservative calcs to account for that and unexpected
18 events.

19 Finally, the single failure was listed as
20 a conservatism, and that's something that, as I
21 mentioned, cuts both ways. You do assume the worst
22 single failure, and that is a good conservatism. But
23 the fact that you only assume one failure is not
24 necessarily conservative at all, and might be non-
25 conservative, and that's why you have other

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1 conservativisms. And so conservativisms are like money,
2 and for each one of these things you've paid out a
3 little money out of your conservativisms. And then
4 rather than have margin for NPSH as the standard
5 mentioned, the draft Reg Guide says that
6 conservativisms are going to take the place of the 1.5
7 margin that may or may not be desirable. We see that
8 that's a double counting of conservatism.

9 CHAIRMAN WALLIS: So you're saying that
10 there are some other things that could affect
11 performance which are not accounted for? That's not
12 double counting, though.

13 MR. SHERMAN: We believe that there are
14 some other things that are not necessarily accounted
15 for, for which conservatism is desirable.

16 CHAIRMAN WALLIS: So it's rather an
17 omission of accounting for some of these things than
18 a double counting.

19 MR. SHERMAN: Using conservatism for the
20 NPSH margin that may be desirable, we see as a double
21 counting.

22 CHAIRMAN WALLIS: So I think you're
23 saying if you took account of all these things, you
24 get down to one because you've taken account of all
25 the things which could make it less than you thought

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1 it was. You're saying there are some other things,
2 which might essentially get you below one that you
3 haven't accounted for; therefore, you should try to
4 have these things which bring it down - not bring it
5 down below 1.5, because the 1.5 gives you this .5 to
6 account for the things that you haven't thought of.
7 Is that what you're -- am I being worse than your
8 explanation?

9 MR. SHERMAN: I think you're explaining
10 it just fine. And another way of explaining it is
11 that you had all these conservatisms, including
12 containment over-pressure. And then you're going to
13 add with extended power uprate 20 percent more energy
14 into the system, which means that it's a less
15 conservative item. So you're going to then take more
16 conservatism, and what you're taking away there is
17 you're taking away the over-pressure that you had as
18 a conservatism. Again, it's a little bit of a double
19 counting. But those are the points that I wanted to
20 make, and I really do appreciate the time that you've
21 given the State of Vermont, and we appreciate your
22 consideration of the issue.

23 MR. CARUSO: I'll take care of that.

24 MR. LOBEL: Any other stakeholder
25 comments?

1 MR. CARUSO: Mr. Atherton, if you want to
2 make a comment.

3 MR. ATHERTON: If I could, please. My
4 name is Peter James Atherton.

5 MEMBER SIEBER: Maybe you could sit at
6 the table. I have trouble hearing.

7 MR. ATHERTON: My name is Peter James
8 Atherton. A little bit of background on myself - I
9 used to work for the Atomic Energy Commission and the
10 Nuclear Regulatory Commission in the 1970s, and I --

11 CHAIRMAN WALLIS: You weren't responsible
12 for RG 1.82, though, were you?

13 MEMBER SIEBER: Safety Guide 1.1.

14 MR. ATHERTON: Well, my specialty then
15 was electrical instrumentation and controls. I went
16 to plant systems, and I ended up in fire protection.
17 So I basically have a general view of --

18 CHAIRMAN WALLIS: Out of the frying pan
19 into the fire.

20 MR. ATHERTON: Something like that. This
21 is my first involvement with the thermohydraulic
22 arena in quite a few years, so I'm going to limit my
23 comments to -- well, actually I had some questions.
24 I'm going to put them in the form of comments for
25 suggestions that I received.

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1 I'd like to start with the single failure
2 criterion. Back in the mid-70s, one of your
3 constituents, a Dr. Steven Hanauer who used to be
4 with the ACRS, later served as Technical Director or
5 Technical Advisor to the Executive Director of
6 Operations, wrote a memo to Guy Arlotto in which he
7 basically asked Arlotto to put on hold a suggestion
8 that he was trying to propose to eliminate the need
9 for single failure criteria on the basis of
10 probabilities. And Dr. Hanauer's reasoning at that
11 time was that probabilities can essentially be
12 abused. They can be used to justify anything, and
13 this was right after the Brown's Ferry fire, which he
14 was involved with in evaluating, and starting up the
15 fire protection program. And so he had a personal
16 feel for how probabilities could be used and abused
17 back in those days, and this is not intended to
18 supplant anything that Mr. Stutzke has presented
19 today. I'm just providing this as information from
20 my days with the agencies back in the 1970s.

21 Taking this to the single failure
22 criterion, well, at least in the electrical
23 department, there was a strong desire to have a
24 single failure include multiple failures if there was
25 the possibility for common mode failures. And there

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1 was -- I guess the criteria for a nuclear power plant
2 adhering to the 1967 criteria, the general design
3 criteria first proposed back then, which turned out
4 to be 10 CFR 50, Appendix A, today, had a number of
5 contentions, one of which was what the definition of
6 single failure would be. And I have not seen
7 anything other than one failure of an active
8 component would be considered a single failure in the
9 discussions here today. And not being actively
10 involved with what's happened over the years on a
11 continuing basis, I still have some concerns that by
12 not considering this, we are necessarily limiting
13 ourselves to something that is not realistic, as Mr.
14 Wallis has been pointing out during the course of the
15 day.

16 CHAIRMAN WALLIS: So you're think that
17 there are some common mode failures in this NPSH
18 scenario which have not been considered?

19 MR. ATHERTON: I'm not going to get into
20 the details of this. The only thing I'm noting for
21 comment purposes is that common mode failures were
22 not even looked at from the perspective of my point
23 of view, except possibly for Mr. Stutzke's PRA
24 analysis, which surprised me to some extent, but I am
25 also kind of curious. Back in those days I was a

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1 technical reviewer, for all practical purposes I did
2 technical reviews, and the licensees during the
3 licensing process were a bunch of plants which had
4 come in with applications for construction permits
5 and operating licenses during these days, and they
6 were required in the early 70s at least to provide a
7 failure modes and effects analysis. And I've seen no
8 mention of that at all in this meeting, and if this
9 was recognized as even somewhat of a problem back in
10 those days, a failure modes and effects analysis
11 should have addressed it to some extent. And if they
12 are now taking credit for problems created by an
13 accident, it seems to me there should be a mechanism
14 whereby that failure modes and effects analysis can
15 be looked at differently now that they're taking
16 credit for something new that they didn't take credit
17 for back during the licensing phase. So my comment
18 is why isn't the licensee being required himself to
19 provide the equivalent of a failure modes and effects
20 analysis for any changes that he's making to his
21 plant taking credit for something that he did not
22 analyze for previously.

23 And one thought that I have, which kind
24 of is important to me from my representations which
25 I get involved with today, and that is what the

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1 public is concerned with. And their primary concerns
2 are not necessarily with how the plant operates, or
3 doesn't operate. It's whether or not it's going to
4 emit radiation to the environment. And in the PRA
5 analysis there was no consideration apparently taken
6 into account from the public's perspective as to what
7 would happen if the containment were breached, and
8 radiation was released to the environment in any PRA
9 analysis. That ultimately is what NRC is here to
10 prevent from happening, and it has not addressed the
11 issue from that point of view, so that's a comment
12 that goes --

13 MEMBER SIEBER: Let me ask a question.
14 Are you asking us, or asking the Staff to go the
15 extra step to a consequence analysis from a core
16 damage and breach of containment? Or is it just good
17 enough to know that you've got core damage and a
18 breach of containment with a certain probability?

19 MR. ATHERTON: From the public's
20 perspective, and questions I get again are not how
21 the plant operates or doesn't operate, it's what
22 happens to the radiation that it releases. It would
23 seem to me that since NRC is in the position of
24 protecting public health and safety against at least
25 excessive doses of radiation, that any conclusion

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1 that they come up with should be directed toward that
2 end.

3 MEMBER SIEBER: Well, CDF and LERF are
4 surrogates for basically the health effect and so
5 you'll see those more frequently in the regulations,
6 than the ultimate consequence, since they are used as
7 surrogates.

8 MR. ATHERTON: Okay. So my comment goes
9 to the fact that there's no -- the end result, you
10 seem to have not gone that extra step to tell the
11 public as a result of whatever you're doing here,
12 radiation to the environment is going to be whatever
13 it is.

14 And one last comment is during the
15 vigorous days of reviewing nuclear power plant
16 applications, the worst case scenario was something
17 that was always looked at, and what everything was
18 reviewed to. And determining that worst case
19 scenario for whatever the safety consequences might
20 be was always problematic. I don't hear that
21 happening at all. I don't perceive the use of a
22 worst case perspective. It's all in today's
23 terrorist environment, after all this nation is
24 technically at war with terrorists wherever they are,
25 terrorism against nuclear power plants is a real-life

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1 situation we should be considering. It poses threats
2 that, at least in this meeting, we're not even
3 looking at. And I'm wondering if in the real world
4 we should be considering that from the perspective of
5 any design changes we make for other reasons. I
6 realize this has some connotation with regard to
7 security matters, so I'll leave my comments at that
8 point. And I thank you for permitting me the
9 opportunity. Are there any questions you have of me
10 at this time? Thank you.

11 MEMBER SIEBER: Thank you very much.

12 VICE CHAIRMAN RANSOM:: I think we're
13 down to the staff, or I mean the committee discussion
14 part. Do you want to do that off the record?

15 CHAIRMAN WALLIS: Can we be off the
16 record for discussion?

17 MR. CARUSO: We could do that.

18 CHAIRMAN WALLIS: Yes. Okay. We can do
19 that.

20 MR. CARUSO: Go off the record.

21 (Whereupon, the proceedings in the above-
22 entitled matter went off the record at 5:06:35 p.m.)
23
24

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