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1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 THERMAL-HYDRAULIC PHENOMENA SUBCOMMITTEE MEETING

6 + + + + +

7 THURSDAY

8 MARCH 20, 2003

9 + + + + +

10 ROCKVILLE, MARYLAND

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12 The Subcommittee was convened in closed
13 session at the Nuclear Regulatory Commission, Two
14 White Flint North, Room T2B3, 11545 Rockville Pike, at
15 1:06 p.m., Dr. Graham Wallis, Chairman, presiding.

16 COMMITTEE MEMBERS PRESENT:

17 DR. GRAHAM WALLIS, Chairman

18 DR. SANJOY BANERJEE, ACRS Consultant

19 DR. THOMAS S. KRESS, Member

20 DR. DANA A. POWERS, Member

21 DR. VICTOR H. RANSON, Member

22 DR. JOHN SIEBER, Member

23
24 ACRS STAFF PRESENT:

25 MICHAEL R. SNODDERLY, ACRS Staff Engineer

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

2 (1:06 p.m.)

3 CHAIRMAN WALLIS: Okay. We will come back
4 into session. We will now have an open session, and
5 we will hear from Westinghouse again, and try to wind
6 up some things.

7 MR. CORLETTI: The next discussion is that
8 I think we are going to first go over some of the
9 comparison plots from NOTRUMP that we discussed
10 yesterday. We put at least one comparison plot, and
11 we have some additional plots that we can show you.
12 I think we have handed out the packet. Do you all
13 have the handouts?

14 CHAIRMAN WALLIS: I don't think any of us
15 the handouts.

16 MEMBER SIEBER: No, we don't.

17 MR. CORLETTI: Then I will turn it over to
18 Andy Gagnon to go through some of these comparison
19 plots.

20 MR. GAGNON: Okay. One of the requests
21 that we had yesterday was to provide a comparison plot
22 of the core collapsed level and some void fractions.
23 We have a comparison of the core collapsed level for
24 the DVI line break.

25 As you can see the RELAP is about a foot

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1 lower than the NOTRUMP at its minimum, and trending in
2 the same direction. NOTRUMPS and IRWST injection time
3 for this simulation is approximately 2,076 seconds,
4 and so we are not starting to really start injecting
5 IRWST here.

6 One of the other plots presented yesterday
7 was the core void fraction. One of the things to note
8 is that the NOTRUMP core contains 14 axial segments,
9 and NOTRUMP was also validated against the G2 14 foot
10 course facility, as well as Achilles.

11 G2 was run in a pressure range from 700
12 down to near atmospheric conditions. One of the
13 things that you will note here is that I think that we
14 are lower than the predicted value at mid-plane for
15 RELAP-5 for Walt's presentation yesterday, and we are
16 at near the similar values for near the top of the
17 core.

18 One of the things to note is that we have
19 a 14 foot axial core power shape that we are utilizing
20 in this simulation, which the top core nod is at
21 substantially lower power than the previous core nods.
22 So the peak power NOTRUMP is core node 13.

23 DR. BANERJEE: Core node 13 is the
24 highest?

25 MR. GAGNON: Yes. It is also the peak

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1 power.

2 DR. BANERJEE: Is it also the highest core
3 average void fraction?

4 MR. GAGNON: Yes. This is the core
5 average void fraction for this case. You can see
6 where the core average is roughly between 50 and 60
7 percent.

8 MEMBER KRESS: What causes the
9 periodicity? It looks like it is fixed --

10 MR. WRIGHT: We are getting pressure
11 oscillations as to when we start slugging flow out of
12 ADS-4. We have periodic discharges out of four, and
13 at that point --

14 MEMBER KRESS: And is that calculated in
15 the NOTRUMP?

16 MR. GAGNON: Yes.

17 DR. BANERJEE: This is increased
18 resistance in the ASD-4 line?

19 MR. GAGNON: Yes.

20 CHAIRMAN WALLIS: This is the build up of
21 liquid in the riser part of the line; is that what it
22 is?

23 MR. GAGNON: Yes, we get liquid into
24 contact and we suck it out, and we pressurize.

25 MEMBER SIEBER: And push it.

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1 MR. GAGNON: And then it turns itself back
2 off.

3 CHAIRMAN WALLIS: And when it gets to the
4 valve, it increases the pressure and drops the flow a
5 bit?

6 MR. GAGNON: Yes.

7 DR. BANERJEE: And what is keeping the
8 level up? Is it the CMT flows then for the first
9 slide that you showed?

10 MR. GAGNON: The CMT for NOTRUMP, if you
11 go back to the slide presentation that we had
12 yesterday, Slide 65, which is some of the slides that
13 we skipped over, the CMT continues to inject until
14 2006, the impact CMT.

15 DR. BANERJEE: So that is what is keeping
16 up the level then?

17 MR. GAGNON: Yes, that is what is keeping
18 the level up. There is a slight injection gap for the
19 14.7 psi containment of approximately 70 seconds for
20 AP-1000.

21 DR. BANERJEE: Slide 65 you said?

22 MR. GAGNON: Slide 65, yes.

23 DR. BANERJEE: Slide 65 is the integrated
24 flow, right?

25 MR. GAGNON: This the sequence of events.

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1 CHAIRMAN WALLIS: It is the timing.

2 MR. GAGNON: It is the first presentation
3 from yesterday.

4 CHAIRMAN WALLIS: That is the wrong one.
5 The covers look the same on these presentations?

6 MR. CORLETTI: One of them is proprietary.

7 CHAIRMAN WALLIS: One is proprietary and
8 one isn't, and you have to look for that.

9 DR. BANERJEE: So it is CMT around 2005,
10 right?

11 MR. GAGNON: Yes. And the IRWST.

12 CHAIRMAN WALLIS: So what is keeping it up
13 after 2000?

14 MR. GAGNON: Well, it is only 70 seconds.
15 The void fraction is increasing after 2000 and --

16 CHAIRMAN WALLIS: Well, the liquid level
17 is going up after 2000. I was looking at the
18 collapsed liquid level.

19 DR. BANERJEE: Is it 70 seconds later that
20 the IRWST comes on, right?

21 MR. GAGNON: Yes.

22 CHAIRMAN WALLIS: No, it is 700 seconds.

23 MR. GAGNON: No, 70.

24 DR. BANERJEE: 76 seconds.

25 MR. GAGNON: 76 seconds.

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1 CHAIRMAN WALLIS: Where did you have that
2 coming in again?

3 MR. GAGNON: 2076.

4 CHAIRMAN WALLIS: Oh, okay.

5 MR. GAGNON: Now, if we look at a more
6 realistic containment back pressure, IRWST injection
7 comes on at roughly 1,400 seconds, which is
8 considerably earlier. So we have an injection from
9 both paths at the same time, which we believe to be
10 the more realistic case for DEDVI.

11 This just happens to represent for the
12 DEDVI case.

13 CHAIRMAN WALLIS: And going back to the
14 presentation yesterday, when you did it with
15 COBRA/TRAC, it had a very different picture of
16 integrated mass flow, and it must have been at
17 COBRA/TRAC that the IRWST came on much earlier.

18 MR. GAGNON: Yes, very shortly after, and
19 approximately -- what was it, Bob, about a hundred
20 seconds after ADS-4?

21 MR. KEMPER: 110.

22 MR. GAGNON: 110 seconds after ADS-4.
23 Whereas, NOTRUMP would delay that up to about 1,400
24 seconds. I believe that is the case.

25 MEMBER SIEBER: It really doesn't make a

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1 difference in the outcome though what the timing is,
2 right?

3 MR. GAGNON: No. It has a slight impact
4 on core void fractions.

5 CHAIRMAN WALLIS: It just depressurizes
6 quite dramatically.

7 MEMBER SIEBER: In the grand scheme of
8 things.

9 MR. GAGNON: In the grand scheme of
10 things, it has essentially none.

11 DR. BANERJEE: Because you have CMT.

12 MEMBER SIEBER: Right.

13 MR. GAGNON: This is the DVI line
14 pressure, compared to our IRWST injection flow, and as
15 you can see when we slip down to about 25, I believe,
16 psi in order to get our IRWST injection flow. You can
17 see the kind of behavior that we are getting as we
18 plug the ADS-4, and vent it, and with the
19 pressurization we get a blip, and it comes in and
20 plugs it again.

21 And once we can get it clear sufficiently,
22 we start getting more stable IRWST flow. This is the
23 10 inch break, and we don't have the RELAP curve on
24 here, but --

25 CHAIRMAN WALLIS: This is the purple

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1 curve?

2 MR. GAGNON: That was the purple curve
3 from yesterday, and they were predicting approximately
4 a 30 percent core level as their minimum. And you can
5 see with NOTRUMP that the collapse level is down
6 around -- oh, half a foot. This is in the active
7 shield area, and so it is very highly voided, and that
8 is why we did the adiabatic to heat up the
9 calculation.

10 And while it didn't predict the
11 traditional mixture level uncover, we said these void
12 fractions are just too high to say that it is not going
13 to be a brief blowdown. I mean, this is a high
14 pressure type uncover.

15 DR. BANERJEE: And five foot is the
16 minimum roughly?

17 MR. CORLETTI: In the long term, yes.

18 CHAIRMAN WALLIS: And so 30 percent is
19 something like 4 foot? It is about the same when you
20 get out further. The RELAP calculation would be about
21 the same or the minimum.

22 MR. GAGNON: The void fraction for that
23 case -- this is core average void fraction. And you
24 can see the initial blowdown was very high, and then
25 it settled pretty quickly, and we --

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1 CHAIRMAN WALLIS: And all these
2 oscillations are -- do you think they are real or
3 numerical?

4 MR. GAGNON: I think that in a combination
5 that some are real and I would say a good chunk of
6 them of fairly numerical.

7 CHAIRMAN WALLIS: Is this for RELAP, and
8 does this play the same kind of fluctuations? The
9 purpose code?

10 DR. BANERJEE: They seem to.

11 MR. SNODDERLY: I'm sorry, Walt, but can
12 you come to the microphone?

13 CHAIRMAN WALLIS: Maybe you could show us
14 the purple. While we are waiting for Walt, is there
15 something else?

16 MR. GAGNON: Not really. This is what I
17 was talking about when you were looking at that
18 pressure, the pressure oscillation. You can see that
19 this is one of the ADS-4 paths, and here is the other
20 ADS-4 path and how it pressurizes and you start
21 getting -- I believe this is -- and I can't remember
22 which one, but I believe that this is probably the
23 single failure path. I don't remember off the top of
24 my head without the nodding diagram, and which one is
25 50 percent and which one is the 100 percent path.

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1 DR. BANERJEE: This is with the three ADS-
2 4?

3 MR. GAGNON: This is with 3 ADS-4 paths.
4 And you have a single failure.

5 CHAIRMAN WALLIS: We are going back to
6 look at the purple curve

7 DR. JENSEN: The purple curve.

8 CHAIRMAN WALLIS: Upside down.

9 DR. JENSEN: It looks better that way.

10 CHAIRMAN WALLIS: So the purple curve is
11 qualitatively -- it does show that initial big dip,
12 but it is nowhere near as big?

13 MR. GAGNON: Not as deep, no.

14 CHAIRMAN WALLIS: And then it goes way up
15 to high value, and then after a thousand it has a
16 second dip. Qualitatively it is different.

17 DR. BANERJEE: And the second dip in
18 NOTRUMP is about 1,500, right?

19 MR. GAGNON: I can't see that too well.
20 Wrong one, I'm sorry.

21 DR. BANERJEE: One over the other.

22 CHAIRMAN WALLIS: And so the qualities,
23 there is a significant difference there.

24 DR. BANERJEE: Not that much.

25 CHAIRMAN WALLIS: RELAP goes up much more

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1 and then has a second evacuation to about half, and
2 then it goes back up to 60. Whereas --

3 MR. GAGNON: This is actually the same
4 time period, this evacuation, and is roughly the same
5 time period as --

6 DR. BANERJEE: And you are filling this up
7 to 14 feet, which is a hundred percent, right?

8 CHAIRMAN WALLIS: And maybe it is also a
9 different scale?

10 MR. GAGNON: Yes, the time scales are
11 different.

12 CHAIRMAN WALLIS: So I guess what we have
13 is a kind of general uneasiness about three codes
14 predicting things that look to be quite different.
15 Now, maybe this can be resolved in some way that is
16 pleasing to everybody.

17 DR. BANERJEE: By putting the relap points
18 on the other one.

19 MR. GAGNON: On the 10 inch?

20 CHAIRMAN WALLIS: No, I mean in the
21 future. This just raises a question in my mind is
22 what do we do with something when you see these
23 different things, and maybe the staff and Westinghouse
24 can put together an answer which makes --

25 DR. JENSEN: Well, the staff was

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1 (inaudible) could understand some of the phenomena
2 that were going on, and give you insights to ask the
3 proper questions to Westinghouse on what was going on
4 in the process in very small break LOCAs.

5 And what our goal is to license the plant
6 based on Westinghouse's calculations, and based on
7 their comparison of their codes to experimental data.
8 And they have done some comparisons, of course, to the
9 AP-600, and potentially the 14 foot level swell test.

10 But then we think that they need some more
11 data as to the core containment. So we are hoping
12 that Westinghouse will do a good job and benchmark the
13 codes against the (inaudible) data, and that is how we
14 perceive --

15 CHAIRMAN WALLIS: You license based on
16 their predictions. but there has to be a probability
17 of their predictions, which is enhanced tremendously
18 if you can do independent calculations giving the same
19 prediction.

20 MEMBER KRESS: Or to explain why they
21 didn't.

22 DR. JENSEN: Yes, that would be very
23 helpful. It could be that the difference is the way
24 that we perceive the input. We might have put
25 different numbers.

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1 CHAIRMAN WALLIS: I guess I might say, and
2 I don't know if my colleagues agree, but I think it is
3 sort of essential that we don't license entirely based
4 on curves shown by Westinghouse, but that you have
5 some independent assessment of what the curve should
6 be. That is why you run your code, or their code, or
7 both codes, in order to get this independent
8 assessment of what the curve should be.

9 DR. JENSEN: But I ran that code.

10 CHAIRMAN WALLIS: Or run your code, or
11 something, but we just don't believe a figure entirely
12 coming from Westinghouse. If all the evidence comes
13 from Westinghouse, there is no independent check of
14 it.

15 DR. JENSEN: If our code showed core
16 (inaudible), we would have looked at or tried to find
17 the cause a lot more carefully, and our codes showed
18 that everything was fine, except for some differences,
19 but if we had Westinghouse's code, we could have put
20 them side by side and looked for perhaps differences
21 in the input.

22 CHAIRMAN WALLIS: So you have got two
23 different plays. You have got Romeo and Juliet, and
24 Hamlet, and the hero dies in both, or doesn't die in
25 both, and the same conclusion, and therefore it is

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1 okay, There ought to be some comparison of what goes
2 along the way as well, and what happens along the way.

3 DR. JENSEN: I think we have some
4 similarity.

5 CHAIRMAN WALLIS: Well, is the fundamental
6 reason that you are getting these differences that we
7 have here a passive system design? If you had an
8 injection which was forced by a pump, or an
9 accumulator, or something, it would be much crisper
10 and deterministic wouldn't they than this passive
11 design?

12 DR. JENSEN: You are correct. We are
13 dealing with very small pressure drops.

14 CHAIRMAN WALLIS: That's right. So it can
15 go this way or that way, and in a way or in the
16 traditional active safety system design. Isn't that
17 why we are getting these differences at the times that
18 things happen, but the overall conclusion is the same.

19 DR. JENSEN: I suspect that could be the
20 cause of some of the differences, but some models are
21 different than what you would expect the models to
22 predict.

23 CHAIRMAN WALLIS: Well, what is the
24 reality is the question isn't it?

25 DR. JENSEN: That is the question. I hope

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1 that the OSU test will give us something closer to
2 reality. We don't have plans to benchmark RELAP
3 against the OSU test. I don't believe the Office of
4 Research plans to do that.

5 DR. JENSEN: Well, Research might run the
6 TRAC-M code though in the way that you have here, or
7 in some other way, to give us an independent
8 assessment.

9 DR. JENSEN: I would hope that they would.
10 That would be helpful.

11 CHAIRMAN WALLIS: Okay.

12 MR. CUMMINS: If I could make a comment.
13 We have subcontractors in Italy that run RELAP and
14 does some of the same analysis that we do, and we find
15 that there is general agreement between the results of
16 our codes and the results of their RELAP analysis,
17 though I think where you evolve as you evaluate this
18 kind of question is what does that mean.

19 What is general, and it is sort of like
20 how do you know that scaling within .5 and 2 is okay.
21 And I am not sure that there is a clear answer to
22 that, but I think that you are seeing in this
23 particular instance an aberration between the codes
24 that is more than typical, and I would expect that the
25 staff, if they saw a continual aberration, would have

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1 a source of our RAIs that they would have asked us
2 about the cause of that.

3 MR. CORLETTI: I am not sure that we have
4 concluded anything here, and I guess --

5 MR. CUMMINS: And we also don't have the
6 staff's results. So maybe we could ask the staff to -
7 - they have our results, and we don't have the staff
8 analysis results, and I am not sure that we are
9 supposed to have them. I don't think we are. I think
10 that it is for their independent assessment.

11 So maybe we could ask that in the future
12 that they make a plot of our results and their results
13 together.

14 CHAIRMAN WALLIS: Maybe it is up to the
15 staff in their safety evaluation report to explain to
16 us and to the public how they reached their
17 conclusions in the light of these differences and in
18 the details predicted in the codes, which if you
19 picked the right place looked to be fairly large,
20 though the outcome is the same.

21 And maybe they would explain why this
22 happens, and why it is okay if it is okay, and maybe
23 that is where it should be. But then you have two
24 codes predicting different results, too. So you have
25 to fill that obligation of explaining.

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1 MR. CUMMINS: Yes, I think we have the
2 obligation to explain the differences between our
3 codes.

4 CHAIRMAN WALLIS: Right.

5 DR. BAJOREK: Dr. Wallis --

6 CHAIRMAN WALLIS: Yes.

7 DR. BAJOREK: Just to kind of go on, I
8 think this is one of the reasons that the staff feels
9 that a well-scaled experimental test is a necessity
10 here for the AP-1000.

11 We do see differences between these 3
12 codes, and if we were to run TRAC-M at this point, we
13 would probably see differences in four codes. Maybe
14 we should just average them all together. But I am
15 not sure that would help.

16 But that is why we think there is enough
17 uncertainty here, and the big difference in these
18 passive plans is the uncertainty is not due to the
19 functioning of the equipment, whether you lose a
20 diesel generator, and we can make an assumption on an
21 ADS-4 valve failing.

22 But the big uncertainty comes in these
23 thermal hydraulic codes, and how they handle these
24 very, very small pressure drops and very small deltas
25 on the calculations, and those get magnified from code

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1 to code.

2 CHAIRMAN WALLIS: And which we have said
3 I think three times in our research report, in three
4 separate places.

5 MR. CORLETTI: I guess if I could make a
6 comment. If you just look back at AP-600, we ran
7 properly scaled experiments, and we developed NOTRUMP
8 and validated NOTRUMP to those tests.

9 The staff did the same for those tests,
10 and we did the same with COBRA/TRAC for those tests.
11 And I bet if you take similar transients for AP-600,
12 I don't know if they are laid on top of each other, or
13 that there was these similar differences, but in all,
14 we always had a large margin to core cooling, and I
15 don't know what the criteria is for code to code
16 similarities.

17 We tend to validate each of these codes
18 separately against test data that we hope is suitable,
19 and I don't know. Walt, if you can comment on -- are
20 these differences in our code comparisons for AP-1000
21 any more or less different than they were for 600?

22 DR. JENSEN: I didn't do the analysis for
23 AP-600, but I think that for the most part the staff's
24 calculations for AP-600 were best estimate
25 calculations; and that we ran the same models that we

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1 ran the test data for, which is also best estimate.

2 Whereas, Westinghouse, I suspect, ran
3 conservative Appendix K calculations for small break
4 LOCA. So for that reason, I don't think that those
5 results could be compared directly.

6 MR. CORLETTI: Okay. But that is not what
7 you did here, and here you did it in more of an
8 Appendix K approach.

9 DR. JENSEN: I tried to make the RELAP
10 model on the first cut to Westinghouse's NOTRUMP
11 calculations with the same failure, with 20 percent
12 AMS, and atmospheric containment, and so, yes. The
13 noding is different. The input, we derived that from
14 (inaudible) independently, and if I am sure that we
15 had the same numbers in our codes, then I would be
16 looking for more of a code problem, but I think there
17 may be differences, but likely there is not.

18 Maybe Westinghouse was using a
19 conservative or more conservative levels in some of
20 their tanks, and in IRWST perhaps, and we probably
21 used more best estimate in a lot of the plant
22 features. I don't know.

23 MEMBER RANSOM: Walt, can I ask you a
24 question about the AP-1000 RELAP model?

25 DR. JENSEN: Sure.

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1 MEMBER RANSOM: Was it just a direct
2 conversion of the AP-600 model? And the reason that
3 I ask that is that I know that from what of the AP-600
4 model, it was sort of an overzealous attempt to put in
5 some 3-D effects and everything, and the model was
6 very complex.

7 DR. JENSEN: You are correct, Dr. Ransom.
8 The AP-1000 model is a derivative of the AP-600 model.
9 There were several AP-600 models, but the first one
10 was extremely complex, and it had a split core, I
11 believe.

12 MEMBER RANSOM: Right.

13 DR. JENSEN: And that introduced
14 artificial circulations within the core. A later
15 model that was produced was simpler, and it only had
16 a single flow path to the core to avoid the
17 circulation problem.

18 But the downcomer is still split into
19 eight radial segments. And the AP-1000 model is the
20 same as or was based on the second AP-600 model.

21 MEMBER RANSOM: Did they turn off momentum
22 flux in the downcomer then?

23 DR. JENSEN: I believe they did.

24 MEMBER RANSOM: That is one fix of the
25 recirculation that I know that I have heard.

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1 DR. JENSEN: So it doesn't circulate in
2 the downcomer, and I know that I did check that.

3 MEMBER RANSOM: Thanks.

4 MR. CORLETTI: At this point in time, we
5 would discuss maybe potential -- whether actions are
6 coming out of this meeting, and one of the ones that
7 I had on my list was this code to code comparison, and
8 maybe looking for advice. What are your expectations
9 from either Westinghouse or the staff for our next
10 following meeting, or have we satisfied -- has this
11 discussion satisfied it, or --

12 CHAIRMAN WALLIS: Well, I don't think it
13 will go away. I think that you should address it in
14 whatever the next meeting is. I am not sure whether
15 it is going to be a thermal hydraulics meeting or
16 whatever, or the other advanced reactor subcommittee.

17 MEMBER KRESS: The easy answer to the code
18 to code comparison is to try to explain why they are
19 different. The hard answer is -- and that I know that
20 you can't get to, is that these codes should have
21 uncertainties associated with the results, and if the
22 uncertainties more or less overlap, then you have a
23 pretty good feeling that you can deal with the
24 differences, in terms of uncertainties.

25 But you are not going to be able to do

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1 that, and so just explain the differences to some
2 extent.

3 CHAIRMAN WALLIS: Don't get into problems
4 where you tell us that you got the same steam flow,
5 but you got more water flow, and yet the pressure
6 drops less.

7 MEMBER SIEBER: Won't a lot of this be
8 answered when the APEX data, the new data, becomes
9 available, and is benchmarked?

10 MEMBER KRESS: Well, we always have the
11 question that Sanjoy was going to bring up, is how
12 good is that scale to the full AP-1000, and we have to
13 look at that, I guess.

14 MEMBER SIEBER: Well, it would be better
15 than what they have now.

16 DR. BANERJEE: Well, after that, in spite
17 of the fact that at some point AP-600 was blessed, I
18 hope that it was blessed with scaling, because there
19 was a whole lot of other facilities available,
20 including ROSA.

21 MEMBER SIEBER: Yes.

22 DR. BANERJEE: What we found wrong with
23 the APEX for the AP-600 was that the CMT flows were
24 wrongly scaled, and as you see, CMT flow is vital in
25 some of these breaks between the time that the ADS-4

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1 goes on and IRWST comes on.

2 MEMBER SIEBER: Both in timing and in flow
3 rate.

4 DR. BANERJEE: Yes. It is very, very
5 important, and what happened in APEX was the flow was
6 about three times too high, and so it gave you the
7 wrong resistances in those lines, and I am just
8 speaking from memory here, and it ended up giving you
9 less core uncovering, or much less of a level depression
10 than you would find in a properly scaled case, such as
11 ROSA.

12 So one has to look at that aspect fairly
13 carefully and not just say that this is properly
14 scaled, because it wasn't properly scaled. Now, I
15 hear that we said it was okay for some reason, but I
16 was on the other side. I wasn't on the NRC side at
17 that time, and we identified that very clearly.

18 MEMBER RANSOM: Well, the way you would
19 answer some of these problems it would seem is that if
20 these codes really embody all of the physics of the
21 access process, is to model the facility directly, and
22 compare the results of the calculation to the
23 facility, and then of course use the code to model the
24 plant and then compare it to that.

25 As opposed to saying to directly compare

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1 the data to the said plant behavior.

2 DR. BANERJEE: Well, that --

3 MEMBER RANSOM: I mean, that helps explain
4 some of those differences.

5 DR. BANERJEE: And in fact when we looked
6 at the adequacy of the database for the AP-600, we
7 came to the conclusion that the database was adequate
8 for scaling, and in fact the RELAP-5 version that was
9 used in the ISL presented it extensively for the PTS,
10 and it came out fine.

11 I mean, there was nothing wrong with it.
12 So that's why we said it was okay.

13 MEMBER RANSOM: Well, Oregon State does
14 quite a bit of modeling, and Professor Reyes, could
15 you comment on that?

16 DR. REYES: Well, we found that -- and
17 again we were using the RELAP-5 version that was used
18 for the AP-600 work to perform some calculations for
19 the pressurized thermal shock study that we did, and
20 simulating the Palisades Nuclear Plant.

21 And what we found was that we got very
22 good comparisons with a wide range of transients.

23 MEMBER RANSOM: For your data.

24 DR. REYES: For our data, right. For
25 comparisons to our data, and so it seemed to predict

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1 our data very well. Part of it that we noticed was
2 that our modeler was right there at the site. So he
3 could look at the volume, and he could see exactly
4 what we had modeled in the experiment.

5 He had access to the initial conditions
6 and the boundary conditions. So, there was a lot of
7 information that was available to him because he was
8 right there.

9 And that did seem to make a difference
10 between our calculations and even some of the ISL
11 calculations. Later on we went back and showed them
12 where some things were different than what they had
13 modeled, and so we did get good comparisons. On the
14 ADS-4, or the CMT, I am a little vague on exactly what
15 the scaling problem was on that one, but I know that
16 we did model for a single phase, but I thought we were
17 within the range.

18 MR. CORLETTI: Dr. Banerjee, our scaling
19 studies that we performed for AP-1000 in WCAP-15613
20 was docketed last year, and I think that concluded
21 that we were not poorly scaled for CMT flow, and for
22 the tests or for the sum total of the available
23 information for AP-1000.

24 And therefore our codes have been
25 validated against SPES and OSU, or were validated

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1 against SPES and OSU, and that we had at least one of
2 the scaled facilities that were properly scaled for
3 CMT flow.

4 MR. CUMMINS: And we further checked the
5 scaling against ROSA, which indicated that the ROSA
6 tests were applicable to the AP-1000.

7 DR. BANERJEE: I am not saying that the
8 AP-1000 is not properly scaled, because I don't know
9 that. I am just saying that the AP-600, there was a
10 potential issue.

11 Now, also the sort of thing about ROSA was
12 that it was -- that ROSA was well-scaled for AP-600,
13 and now I don't know if it was well-scaled for AP-
14 1000, and if you had gone through that analysis and
15 found that it was, that's fine.

16 The differences are, of course, related to
17 your core power being higher and relative resistance
18 to out flow from the core through the hot leg and so
19 on, because those have been tighter now compared to,
20 say, AP-600. So is the back pressure going to be
21 more, and those are the two main issues in my mind.

22 MR. CORLETTI: Well, I don't know if you
23 are saying the same thing that Steve has been saying,
24 is that the one area was upper plenum and hot leg
25 entrainment, was the one issue that was found to be

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1 not --

2 DR. BANERJEE: Maybe I am saying it in a
3 different way. I am saying what is of interest to me
4 is the pressure drop.

5 MR. CORLETTI: The pressure drop.

6 DR. BANERJEE: But maybe it is the same
7 thing, in the sense that between the outlet of the
8 ADS-4 and the top of the core, because everything is
9 a bit tighter, I would expect a higher pressure drop.

10 MR. CORLETTI: You have to look at it that
11 it is not really. In ADS-4 to the hot leg is
12 significantly larger core power, but from the hot leg
13 to the upper plenum and in that area, you are right.
14 We have higher velocity.

15 However, if you look at the contribution
16 to pressure drop, I think you will find that you are
17 either choking in the ADS-4, or you have your line
18 losses in your ADS-4 piping.

19 I don't think that your significant line
20 losses from a subcritical pressure drop point of view
21 is going to be in the hot leg piping.

22 DR. BANERJEE: Well, if that is true and
23 the scaling shows that, then that is less of an issue
24 to me. But if the core power density had been higher,
25 to me at least I expect more entrainment from the core

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1 itself.

2 DR. BAJOREK: Dr. Banerjee, I guess I
3 would like to compare notes with you on the CMT flow
4 for APEX, because we did use your analysis method in
5 taking a look at that, and we did not come to the
6 conclusion that APEX was poorly scaled out for long
7 term cooling in those periods after the ADS-4 and
8 IRWST transition.

9 However, I think I would agree with you
10 that in general leading up to or just after ADS-4 to
11 IRWST transition, ROSA actually, looking at all of the
12 parameters, may have been a more suitable choice in
13 looking at all of the different periods.

14 DR. BANERJEE: Well, I am only talking of
15 the period between ADS-4 being opened, and IRWST
16 coming on, which is sort of a critical period. For
17 the long term cooling, I completely agree with you.
18 There is no problem.

19 MR. CORLETTI: Well, if I may continue.
20 I am not sure -- that discussion is that, Steve, you
21 and Dr. Banerjee are going to compare notes on that,
22 and whether we have an issue on CMT flow scaling or
23 not, and maybe that can resolve that.

24 The other notes that I had, unless you
25 want to go down your notes, Dr. Wallis.

1 CHAIRMAN WALLIS: Well, you have the
2 floor. Maybe we should go through what you have.

3 MR. CORLETTI: My notes? Okay. We heard
4 a question about the long term cooling analysis that
5 we did, and that we performed with COBRA/TRAC and with
6 a two-node core, and I think that the ACRS had -- I
7 think that you questioned that, whether that was a
8 suitable model.

9 And I think that it was also recognized
10 that you probably had large margins, because I think
11 that is what we did say. And I think that you also
12 recognized that it is probably a pretty easy hand
13 calculation to perform, or along those lines.

14 I am not sure that I could do it, but it
15 is easy for some people, like Steve, to do, or Bill
16 Brown, or our people. But I am sure that we could do
17 it.

18 So I think we would like an opportunity to
19 do an assessment of -- do a calculation to --

20 CHAIRMAN WALLIS: I think it would be
21 appropriate to just pick some window or a couple of
22 windows, and do a more thorough nodalization of the
23 core.

24 MR. CORLETTI: And do some sort of a
25 calculation at that point.

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1 CHAIRMAN WALLIS: And as you point out,
2 you probably skipped a lot of flow regimes by having
3 two nodes, and it is not particularly representative
4 of what happens in the middle, and where it may get
5 most of the pool swell.

6 MR. CORLETTI: And that leaves me with --
7 I only have one other thing on my list, and that is in
8 the entrainment issue that we heard so much about, and
9 I think what the recommendation or the perception was
10 that perhaps the detailed modeling code that we used
11 for COBRA/TRAC was going to -- that some day we might
12 be able to demonstrate that we had everything
13 absolutely correct there, but that was going to be a
14 rather long path.

15 And that also that we recognized that
16 probably a bounding approach, some sort of a bounding
17 approach, where we demonstrated large margins in this
18 area, would be maybe a way to try to show in reality
19 how bad the problem could be in that regard.

20 And I think that we will take that under
21 advisement. Also, I think that leads us to the use of
22 the test data that we saw in the first test, the APEX-
23 1000 facility, and I think that there we can provide
24 more presentation in the future as far as some of the
25 results that those tests are showing, and try to put

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1 that into context of what we believe that tells us
2 about plant safety for AP-1000.

3 MEMBER KRESS: I think we also suggested
4 that you look at the 14 foot test data.

5 MR. CORLETTI: Yes.

6 MEMBER KRESS: And if there was an action
7 there or not.

8 MR. CORLETTI: Yes. The action on the 14
9 foot, and I think maybe we could follow up with Dr.
10 Banerjee, but we provided an REWIRE response that at
11 least outlined our validation of NOTRUMP against the
12 14 foot G2 test data that we were speaking of.

13 I think maybe we can follow up if there
14 are more questions next time from that, but I think
15 there are other WCAPs, NOTRUMP validation WCAPs, that
16 probably speak to that in more detail. Andy, is that
17 true? Is there even more detail in -- and maybe we
18 can get the list of those topical reports.

19 MR. GAGNON: Yes, WCAP-14807, Revision 5,
20 and I believe it is either Section 5 or 6, has the
21 notes on the two-phase

22 MEMBER KRESS: Again?

23 DR. REYES: WCAP-14807, Revision 5.

24 MR. CORLETTI: And I believe our RAI
25 response references that; is that right, Andy?

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1 MR. GAGNON: I believe that's correct.
2 What is in the RAI response is specifically void
3 fractions. The remainder of the information,
4 including the background and the modeling techniques,
5 are described in the final validation report.

6 DR. BANERJEE: Now, with these
7 experiments, do you have a write-up on the experiments
8 in terms of data where you can interpret given this
9 inlet flow rate, or whatever the situation is with a
10 temperature at this level, apart from, let's say,
11 NOTRUMP? But just data to look at to get a feel for
12 whether you get dryout, or you don't get dryout, and
13 things like that?

14 For example, there must be some conditions
15 under which get dryout in the experiments?

16 MR. GAGNON: These were like boil out type
17 experiments.

18 DR. BANERJEE: Right, but at some point --

19 MR. GAGNON: The heater rod should
20 increase in temperature, yes. I have not looked at
21 them in a long time.

22 DR. BANERJEE: So more or less what I am
23 trying to understand is what is the margins to this,
24 and what core level do you start to get dryout and
25 temperature excursions, and things like that.

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1 MR. GAGNON: In terms of collapse level?

2 DR. BANERJEE: Yes, collapse levels or
3 whatever. So I can see that this is trying to make
4 NOTRUMP -- compare NOTRUMP with some of the
5 experiments done here. But leaving aside NOTRUMP,
6 just the physical feel at what point somebody runs
7 into trouble. Is it 20 percent, or 30 percent, 40
8 percent?

9 That is the source thing that would make
10 me feel comfortable that your 40 percent level is the
11 correct level, or even if you made a mistake and it
12 was down to 30 percent, it wasn't going to get you
13 into trouble.

14 MR. GAGNON: Yes, we should be able to
15 look at that.

16 DR. BANERJEE: I think that is more of a
17 comfortable factor that would increase strongly.

18 CHAIRMAN WALLIS: Any other member want to
19 raise any matter at this time?

20 MEMBER RANSOM: One issue that I have
21 heard about is these 14 foot tests I guess are -- and
22 I am just guessing, but they are bundle tests which
23 are more heat transfer tests. Do they have the tip of
24 the upper plenums? Is there any data from the
25 entrainment point of view that would be valuable

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1 there, or is there nothing there?

2 DR. BANERJEE: They have collapsed liquid
3 levels, and so you know what is being entrained there.

4 CHAIRMAN WALLIS: If it is coming out of
5 the bundle, you wouldn't know.

6 DR. BANERJEE: But it is not flow
7 resistance you are saying.

8 MEMBER RANSOM: Well, the upper plenum,
9 and configuration, is it more or less typical of the
10 AP-1000, or --

11 DR. BANERJEE: I don't know.

12 MR. GAGNON: I don't remember the back
13 pressure of these.

14 DR. BANERJEE: The outlet wouldn't be, but
15 there would be a back pressure I think.

16 MR. GAGNON: I don't remember off the top
17 of my head, but there is a description of the
18 facility, including drawings of the facility, and the
19 NOTRUMP validation report, but I don't think it is
20 prototypic in the upper plenum.

21 DR. BAJOREK: Andy, one of the problems
22 with the G2, and what it was like up there, it was
23 actually originally designed for looking at upper head
24 injection tests, and up at the top there were a set of
25 thimbles to mimic this upper head injection.

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1 And the other aspect of that, where the
2 upper plenum area becomes very confusing and maybe not
3 very useful. That is where they brought all the
4 thermal coupled cables out.

5 And if you take a look at some of the
6 photos that are available from that, it is a little
7 bit of a spaghetti pot appearance from that. So I
8 think it is useful for level swell and heat transfer
9 from the core, but probably not for de-entrainment and
10 for things that are going on up at the very top.

11 DR. BANERJEE: Well, there are two
12 separate problems. I mean, unless you believe there
13 is a lot of back flow from the upper plenum into the
14 core, it is a one-way street that it is going in. So
15 the upper plenum is seeing the flow resistance by the
16 core, and then of course the details of the de-
17 entrainment or whatever happens in the upper plenum is
18 a separate issue.

19 But from the core point of view, as long
20 as there was some resistance to it, that would
21 probably be quite educational to see that. A coupling
22 backwards is not through the flow back. I don't think
23 there is a lot of liquid coming back.

24 CHAIRMAN WALLIS: So let me go over what
25 we did yesterday. We had some general introductions

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1 which were helpful, and then we go into the safety
2 analysis results, which I think we actually came here
3 mostly expecting to talk about the entrainment issues,
4 and that seemed to be the one outstanding issue.

5 And then we got these other things put on
6 the program, of the large break LOCA, and small break
7 LOCA, and containment. That is where I think it was
8 a little bit surprising.

9 We thought it was going to be a breeze,
10 and you guys had worked it all out, and the large
11 break LOCA was okay. It looked like a large break
12 LOCA in any PWR. There didn't seem to be issues
13 there.

14 But it was a bit surprising that we had
15 issues with the long term cooling, and the two-nodal
16 model did seem -- I think struck us as being too crude
17 to be relied upon completely.

18 And you agreed to sort that one out. The
19 small break LOCA again was surprising, because when
20 you fixed the momentum flux, it wasn't quite clear why
21 it went out and came back again. We never saw any
22 equations, and so maybe somebody should look at the
23 equations that you used for this momentum flux.

24 Presumably they are around somewhere where
25 you fixed this momentum flux terms in the ADS-4 line.

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1 Do we have that written up somewhere?

2 MR. CORLETTI: Well, we have. We wrote it
3 up on AP-600, and submitted that. We could also find
4 you -- is this committee interested in that, as far as
5 providing you a copy of that?

6 CHAIRMAN WALLIS: Well, it had quite a big
7 difference to get quite a big difference in the
8 answers, and that's why I was kind of curious as to
9 how that could be.

10 MR. GAGNON: That is also documented in
11 the NOTRUMP final validation report, and all the RAIs
12 are included as the appendix.

13 CHAIRMAN WALLIS: So we can find that in
14 the RAIs?

15 MR. GAGNON: That's correct.

16 MR. CORLETTI: Instead of having them go
17 through this mountain of pages, do we know which one?

18 MR. GAGNON: It is really the AP-600 RAI,
19 which is maybe a little bit of a confusing thing here.
20 It is RAI 440796F, Part A, I believe.

21 MR. CORLETTI: And the NOTRUMP report,
22 what is the WCAP, 14807, Revision 5?

23 MR. GAGNON: The same one.

24 MR. CORLETTI: Okay.

25 CHAIRMAN WALLIS: Well --

1 DR. BANERJEE: Is it documented in that
2 WCAP?

3 MR. CORLETTI: Yes, it is documented
4 actually in several places.

5 CHAIRMAN WALLIS: Mike would you like to
6 pull out the pages that are relevant so that we don't
7 have to look through a mountain of paper and see if
8 there is anything that I ought to look at there.

9 MR. SNODDERLY: Okay.

10 CHAIRMAN WALLIS: So I guess we were
11 surprised because this went off on quite a discussion
12 about how these codes all gave different answers, and
13 you agreed to address that in the future.

14 MR. CUMMINS: Could we clarify how we
15 agreed to do that? I am not -- I guess my point
16 before was that the staff is the only organization
17 with all of these data, and it would seem to me that
18 the staff would have the lead to --

19 CHAIRMAN WALLIS: Well, you had two codes.
20 You had NOTRUMP and WCAP, and they were predicting
21 very different flows at the break, and there are very
22 different depressurization curves, and refiling codes,
23 and the rate at which REFRAN was occurring, and it was
24 very much more rough with one than the other.

25 And so I think that this gives or raises

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1 questions as to the believability of the codes,
2 although the bottom line is the same, and I think that
3 has to be addressed at some time.

4 You have got two codes, and they have got
5 another one, and so they have three to compare with,
6 and then they even have four if they run their -- and
7 so I think you and the staff have to -- well, the
8 thing that surprised me was that we ran into this.

9 We didn't expect to have issues with these
10 things which weren't the entrainment issue, which was
11 the big issue. So it was a little disconcerting
12 perhaps that issues arose, or so many questions arose
13 about what looked like being a more routine
14 presentation that we could just be pleased with.

15 The containment analysis, and I think that
16 Sanjoy agreed to review the heat master transfer and
17 the falling film, which looked like a pretty
18 straightforward problem. It doesn't look like it is
19 bedeviled with a phase flow and so on. So that should
20 be very straightforward.

21 DR. BANERJEE: But somebody has to provide
22 me with that.

23 CHAIRMAN WALLIS: And he needs to get
24 whatever.

25 MR. SNODDERLY: Let's clarify then what it

1 was. I had it in my notes, but I would like to go
2 over it. It was WCAP15806. We have that WCAP, the
3 one that Dana Powers has, but --

4 MR. CORLETTI: Dana has actually all the
5 WCAPs related to WGOthic, and so that ought to be in
6 this.

7 MR. SNODDERLY: But again if you could
8 help us. What was the specific RAI or chapter?

9 MR. CORLETTI: Rick, do you know?

10 MR. WRIGHT: I don't know offhand, but we
11 can check it out. I was talking about the WGOthic
12 applicability report.

13 MR. CORLETTI: Well, there is the main
14 WGOthic WCAP.

15 MR. WRIGHT: Right.

16 CHAIRMAN WALLIS: So describing the
17 equations for the heat mass transfer.

18 MR. CORLETTI: So it is the main WGOthic
19 submittal.

20 DR. BANERJEE: There was interest from the
21 outside.

22 CHAIRMAN WALLIS: From the outside of it.

23 MR. THROM: Ed Throm with the staff.
24 WCAP15846, I believe, is the one. It is rather
25 large, and it is three volumes. Well, this is what

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1 you want, and as I remember, it is Chapter 2 which
2 discussed what Westinghouse refers to as the CLIME
3 model, and that is basically taking you from the
4 containment atmosphere inside through the condensate
5 on the shell, and through the shell, and into the PCS
6 water on the outside of the shell, and into the riser
7 downcomer section of the PCS system.

8 So that is pretty much the definition of
9 the heat transfer package that deals with both sides
10 of the containment. It is 10 or 11, but it is in one
11 of these specific sections.

12 DR. BANERJEE: The area that I am
13 specifically interested in, or the one that I have
14 been charged to look at is for the liquid film falling
15 along the outside of the containment and --

16 MR. THROM: I am pretty sure that is in
17 Section 10.

18 CHAIRMAN WALLIS: The mass temperature in
19 the liquid film and so on.

20 MR. SNODDERLY: Now, we have Rev. Zero.
21 Is that --

22 MR. THROM: That is the current revision.

23 CHAIRMAN WALLIS: Well, the next technical
24 issue that I had was --

25 MR. SNODDERLY: I'm sorry, Graham, but

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1 before we leave containment, we forwarded some
2 comments and some information that Dr. Powers wanted,
3 and I think yesterday off the record you had said that
4 you were going to provide some information for that.

5 MR. CORLETTI: Yes, and I think I said
6 that all of that information is in the WCAP, but what
7 I think I said was that I would provide -- that
8 instead of making him hunt through the three volumes,
9 we will try to pull it out and provide that.

10 It is all docketed information, and so I
11 don't think there is an issue of public information,
12 but maybe I will work with either yourself, Mike, or
13 John, on how we get that information to Dana.

14 MR. SNODDERLY: That would be great.
15 Thank you.

16 CHAIRMAN WALLIS: Then there is the matter
17 of boron precipitation, and this was raised I think by
18 the staff. It seemed to be a key issue that needed to
19 be resolved, and there is no RAI on the boron
20 precipitation issue? So this is something which is
21 being resolved and I guess we will hear about how you
22 resolved that.

23 So then we got into the liquid entrainment
24 issues, which are sort of the main reason why we are
25 here. You were working on them, and you are working

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1 to resolve them with the staff. And I think we will
2 probably get involved when you have reached hopefully
3 that resolution.

4 So I don't think it is our job to give
5 consulting advice on how to do modeling and things
6 like that.

7 MR. CORLETTI: If I just could interject.
8 I believe the APEX-1000 test are very well scale tests
9 for the AP-1000. I think we would look to see a
10 scaling report provided. I think we want to look at
11 the overall system performance, because that is what
12 has really been our contention all along, is that the
13 overall system performance is really the most
14 important aspect of this issue.

15 And look at how it does in that regard,
16 and whether we are going to be able to predict and
17 define everything that we examined going on between
18 the core and the upper plenum, and to that level, I am
19 not sure it is the right --

20 CHAIRMAN WALLIS: Well, you don't want to
21 hang your hat on that, because that is where you might
22 get in a lot of trouble because it might be easy to
23 shoot down parts of that structure, and destroy parts
24 of that structure, and then you wonder what you have
25 for the whole, unless you have the whole perspective.

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1 MR. CORLETTI: Yes, that is the approach
2 that I believe that we will be pursuing.

3 MR. GAGNON: Yes, and I think that what
4 was discussed yesterday is that there is a possibility
5 that you could resolve this even without tests if you
6 did some sort of bounding calculations, and in fact
7 that was the first approach taken by Westinghouse, and
8 we are halfway there or whatever.

9 I don't believe that we have satisfied the
10 staff, and I am not sure that we quite understand the
11 part that we have not satisfied, but I don't think we
12 need the ACRS to help there. I think we can deal with
13 the staff.

14 So that is one way of resolving it, and
15 the next way if that doesn't quite get worked out is
16 by showing and reaffirming that the integrated safety
17 predictions of the codes are similar to the test
18 results.

19 CHAIRMAN WALLIS: So maybe we ought to
20 think about where we go from here, in terms of
21 schedule and meetings, and so on. You presented a
22 schedule suggesting that it would be two meetings of
23 the AP-1000 subcommittee in May and June; is that what
24 I saw?

25 MR. CORLETTI: Med, is that consistent

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1 with your thinking? That is what I put there. That
2 was my understanding.

3 MR. EL-ZEFTWAY: That is what it was based
4 on, was the fact that this thermal hydraulic
5 subcommittee would actually conclude all the issues
6 that we are talking about now, and the May
7 subcommittee is the future planned design subcommittee
8 meeting on the other issues.

9 CHAIRMAN WALLIS: Do we need to have a
10 meeting in April to wrap up some of this?

11 MR. EL-ZEFTWAY: Well, that is probably
12 what you have to do right now.

13 CHAIRMAN WALLIS: Can we attach it to some
14 other meetings that we have in April and in other
15 subcommittee meetings that we are going to be
16 attending?

17 MR. SNODDERLY: We could try, but as I
18 remember, April was pretty heavy, and May was not.

19 CHAIRMAN WALLIS: So we might have a
20 meeting of the thermal hydraulics committee say the
21 day before the AP-1000 subcommittee?

22 MR. SNODDERLY: Or joint.

23 CHAIRMAN WALLIS: Or joint.

24 MEMBER KRESS: Well, when do you plan on
25 meeting?

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1 CHAIRMAN WALLIS: Spend half-a-day on
2 thermal hydraulics and go on?

3 MR. CORLETTI: That sounds like a good
4 idea.

5 MR. EL-ZEFTWAY: We can have two meetings,
6 one after the other.

7 CHAIRMAN WALLIS: So we will do that. So
8 maybe half a day is what I think we need.

9 MR. EL-ZEFTWAY: I think the time frame
10 was we were thinking about the week of May 19th. I
11 mean, that is for the future plan design.

12 MR. CORLETTI: And you see the list of
13 items that I have on that slide? I think that is
14 generally from feedback that I have received from the
15 ACRS in general on some of the issues. Reliability of
16 ADS-4 squib valves, which we talked about quite a bit
17 at the PRA meeting.

18 And the containment structural design. I
19 guess I am a little bit -- I think we can go over what
20 our containment structural design is. I don't know of
21 any issues with it, but I know that there was interest
22 from this committee, and I believe it is taller, and
23 how did you design it. I could see a short --

24 CHAIRMAN WALLIS: The thing with the
25 seismic thing, and --

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1 MR. CORLETTI: Yes, and we could present
2 you with our seismic analysis results that we
3 performed.

4 MEMBER KRESS: Now, this was raised by
5 Peter Ford, and I am not sure that is what he had in
6 mind, but I would certainly be interested in that part
7 of it.

8 MR. CORLETTI: Okay. We can check back
9 with Peter, too, to see what his concern was as well.

10 MEMBER KRESS: Yes, and I think we should.
11 I don't really recall what he had in mind.

12 MR. CORLETTI: Okay.

13 MR. SNODDERLY: I believe that Dr. Bonaca
14 has the lead for that review, but we should check with
15 both, and I think Peter might have had the materials.

16 But the point is that we need to make sure
17 that the agenda addresses the needs of the committee.

18 CHAIRMAN WALLIS: And the experience
19 yesterday might indicate that in discussing these that
20 other things might appear.

21 MR. CUMMINS: We hope not. In Pittsburgh,
22 at least we have the experts.

23 CHAIRMAN WALLIS: We expect to go to
24 Pittsburgh in May.

25 MR. CORLETTI: The materials is on there

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1 was one, and --

2 CHAIRMAN WALLIS: And shutdown maintenance
3 is one.

4 MR. CORLETTI: Shutdown maintenance, and
5 I think I would like some feedback, and maybe not
6 right now, Mike, but maybe we can work between you, I,
7 and Med, as far as what the issue on materials might
8 be.

9 Shutdown maintenance, I think I understand
10 what some of the issues were that they might want to
11 hear.

12 CHAIRMAN WALLIS: Well, I presume that May
13 is going to be to resolve some issues that have been
14 raised. Is June going to be where you put together
15 our final picture of how it all fits together?

16 MR. CORLETTI: Actually, Dr. Wallis, I
17 thought that May was to be to discuss these issues,
18 and June was going to be on open items, and --

19 CHAIRMAN WALLIS: Well, what concerns me
20 is that we have over 2 or 3 years now gone over this
21 AP-1000, and it goes back to the AP-600, too. And we
22 have talked about various things along the way, and I
23 would like to see the whole picture again, and not
24 with a lot of unnecessary detail, but the whole
25 picture.

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1 And how does all this stuff that we have
2 talked about over 2 years fit together. And when we
3 say we discussed that 2 years ago, and so we don't
4 need to do that again, well, I think you do, because
5 we have lost how it all fits together. So that is my
6 comment and I don't know what my colleagues want to
7 say on that.

8 MR. CORLETTI: Is that for the May meeting
9 or the June meeting?

10 MEMBER RANSOM: That would be good.

11 MEMBER KRESS: For the June meeting.

12 CHAIRMAN WALLIS: And put it all together
13 as a kind of dress rehearsal for the full committee
14 meeting.

15 MR. EL-ZEFTWAY: We still have to get also
16 a lot of draft sections from the staff on the DSER,
17 and I think we have to look at all of them at the same
18 time.

19 CHAIRMAN WALLIS: Look at all the issues
20 and how they were resolved, and so on. I mean, the
21 whole story, beginning to end, on why should this be -
22 - why should we accept the design of this device.

23 And then there is a question of when the
24 SERs is available to us.

25 MR. SEGALA: This is John Segala.

1 CHAIRMAN WALLIS: If we are finished with
2 Mike, we should put you up, John, and you do your
3 summary.

4 MR. SEGALA: Well, I handed out a slide on
5 yesterday, and the last slide, Number 10, and I don't
6 know if you have that in front of you, was sort of my
7 wrap-up. We were looking at right now to get
8 Westinghouse the comments on our unresolved issues to
9 try to see if we can come to a conclusion on those.

10 We have an internal due date to get our
11 DSER input from the technical reviewers by April 21st.
12 And then as project managers, we have to put that
13 together into one concise document, and get it through
14 the lawyers, and then issue that by June 16th.

15 And then I guess some of this on the ACRS
16 interactions might change a little bit based on the
17 discussions that we just had, but we I guess the
18 future plant design subcommittee in May will include
19 half thermal hydraulics and half of some of these
20 other issues that we discussed, and we had scheduled
21 a full committee meeting in probably the July time
22 frame, and we were going to present the DSER open
23 items, and try to give you a view of what were the
24 items that were classified as open in our DSER.

25 And welcome any feedback that you have at

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1 that time. And then we would have --

2 CHAIRMAN WALLIS: Well, we have a letter
3 to the full-committee in July.

4 MR. SEGALA: Well, our schedule as of
5 right now, I think that Westinghouse wants a more
6 aggressive schedule. Our schedule as it is right now
7 is that that would just be a conclusion of the DSER,
8 and then we would -- our schedule right now has
9 another full committee in July and August of 2004 time
10 frame.

11 And then the final safety evaluation
12 report would be issued in September of '04.

13 CHAIRMAN WALLIS: So we have another year?

14 MR. SEGALA: Hold on. We have talked with
15 Westinghouse and we have agreed that when the DSER
16 goes out that we are going to reassess our schedule
17 and look at, okay, how many open items do we have, and
18 how significant they are, and try to get a feel from
19 the staff on how much effort it is going to take to
20 review that.

21 So we are going to reassess our schedule.
22 But as of right now, this is our schedule, and we are
23 not going to change it unless there is something
24 obvious that would --

25 CHAIRMAN WALLIS: So any results from OSU

1 would be available long before the final SER.

2 MR. SEGALA: Yes, and we have another
3 issue, and that is security, and it is kind of like we
4 have not issued any RAIs on that yet. So that is a
5 whole another unknown right now, and that I don't
6 think we want to change the schedule until we have a
7 handle on that.

8 CHAIRMAN WALLIS: Is that something that
9 we get involved with?

10 MR. EL-ZEFTWAY: I think that is going to
11 be handled differently or separately.

12 MR. SEGALA: We have that on a whole
13 separate schedule, but it affects the issuance of the
14 final safety evaluation report.

15 MR. SNODDERLY: But, John, I want to go
16 back and clarify that right now the expectation is
17 that in the middle of June, June 16th, that we would
18 receive a DSER with perhaps open items.

19 MR. SEGALA: Yes.

20 MR. SNODDERLY: And that in July a full
21 committee meeting, and you are asking for a letter
22 from the committee --

23 MR. SEGALA: No.

24 MR. CORLETTI: John, I think that even at
25 the DSER stage, I think that they will be asking for

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1 a letter.

2 MR. SEGALA: I looked back on what we did
3 for the AP-600, and we did not require a letter from
4 the ACRS. You may have sent one, but --

5 MR. EL-ZEFTWAY: Well, normally at the
6 draft SER level, we write an interim letter.

7 MR. SEGALA: Okay.

8 MR. EL-ZEFTWAY: So that is what we
9 thought we were going to have to do, and at the July
10 meeting we are going to write an interim letter on the
11 draft SER.

12 CHAIRMAN WALLIS: I would think that you
13 would need a letter.

14 MR. CORLETTI: Yes.

15 CHAIRMAN WALLIS: And to let you know if
16 we have major concerns, or any additional issues, or
17 whether we think that everything is fine.

18 MR. SEGALA: Well, we welcome your
19 comments. I don't think that we have a requirement in
20 our schedule right now, but we welcome any feedback.

21 CHAIRMAN WALLIS: Well, you won't get any
22 ACRS position until you get a committee letter. You
23 can get all kinds of comments from committee members,
24 and even read the transcript and all of that, but you
25 won't get an ACRS position on anything until you get

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1 a letter from them.

2 MR. SEGALA: Okay.

3 MR. CORLETTI: I would agree, John, that
4 Westinghouse does have a more aggressive schedule,
5 too.

6 MR. SEGALA: And I think we have to go
7 back and reassess our schedule, and we will have to
8 take it from there, but right now our schedule is
9 fixed. We are working to our schedule.

10 CHAIRMAN WALLIS: And can we review with
11 Steve where we stand?

12 DR. BAJOREK: I have a handout. Our plans
13 at this point are to continue supporting NRR and the
14 review. We have been asked at this point to be
15 involved in the liquid entrainment issues. So we will
16 continue to follow those, and if it means evaluating
17 test data, or new analysis methods, we will do that,
18 but we are going to have to wait and see how
19 Westinghouse responds to some of the issues that were
20 raised here today.

21 Above and kind of beyond the review, we
22 are doing some confirmatory work. We have been
23 running some TRAC-M calculations, primarily in large
24 break. It is premature to discuss those results and
25 at this point we don't see any new issues being raised

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1 from them.

2 We do plan and intend to run a series of
3 tests of APEX, and these tests would be designed to
4 look at beyond design basis accident conditions.
5 Things that would really stress the plant APEX, and
6 provide some rather severe conditions for a thermal
7 hydraulic code to help you assess the models that are
8 in there, and possibly in this case to help in TRAC-M
9 for the same problem that we see in RELAP, NOTRUMP,
10 and COBRA/TRAC, and how do we model these processes in
11 the upper plenum.

12 So we would hope to try to gain some of
13 that from these tests. That is all that I have as far
14 as our follow-up. Dr. Kress, I do have a brief
15 handout to talk about this scaling idea and the .5 to
16 2, and if you would like to hear some of that now, I
17 can take about 5 minutes to do that.

18 MEMBER KRESS: I think that would be good.

19 CHAIRMAN WALLIS: That would be fine.

20 DR. BAJOREK: There is a one page handout
21 coming around, and it has three overheads on it, but
22 again I think I can just handle this from here. The
23 topic here are is the range of acceptability for these
24 pi groups.

25 As has been pointed out at a previous

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1 meeting, well, why is it .5 to 2. Why is it something
2 else; .3 to 3, or something more restrictive than
3 that. We have tried to start some work on this area,
4 and at this point we have not made a whole lot of
5 progress, but I just wanted to try to report our
6 thinking on this, and where we think this may go.

7 First, and this was the first overhead,
8 one thing that we would do is to rephrase the question
9 slightly. And rather than looking at an acceptability
10 range, it ought to be, well, how large can a
11 distortion become before it starts to invalidate the
12 test results.

13 CHAIRMAN WALLIS: Well, another question
14 is what is the uncertainty introduced by having this
15 distortion. Is it a quantitative measure, and how
16 long you can be.

17 DR. BAJOREK: Yes.

18 MEMBER KRESS: And on what.

19 DR. BAJOREK: And on what and it is not
20 simple. And by the way, we look at this as a generic
21 problem in scaling, and not something that is AP-1000
22 specific in this case.

23 MEMBER KRESS: And another thing that
24 worried me was if there are cliff effects, where you
25 might change flow regimes within the high range, and

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1 then that could --

2 DR. BAJOREK: Yes.

3 CHAIRMAN WALLIS: And something like AP-
4 600, and as I remember, there was a condition where
5 the CMT might drain, and just throw up a number, like
6 X minutes. And then if you don't quite reach that
7 condition, they don't drain until 10 X minutes.

8 Well, that is a big change in the scenario
9 for a little balance between some others, and it well
10 could be the difference between 1 and 2 in a pipe and
11 it changes the scenario.

12 DR. BAJOREK: And is there a bifurcation
13 in here.

14 MEMBER KRESS: Well, what we were looking
15 for with respect to your comment is that what would be
16 a generic fundamental approach to determining
17 appropriate pi groups for any scaling? And you might
18 be faced with this later on and with other things.

19 DR. BAJOREK: Well, we have to do scaling
20 evaluations for ACR-700 and SBWR.

21 MEMBER KRESS: We would like to see some
22 fundamental technical basis for choosing those ranges.

23 CHAIRMAN WALLIS: Well, I don't think
24 there is. I think it is very system specific.

25 MEMBER KRESS: It may be system specific,

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1 but that may be the answer that you come up with.

2 CHAIRMAN WALLIS: Then you have to look at
3 the system and do sensitivity tests or something in
4 order to evaluate how important it is.

5 DR. BAJOREK: We would like of like to
6 formalize our thoughts in there, but we think that the
7 bottom upscaling approach is important, because this
8 is where you look for changes in flow patterns. Is it
9 annular, where before you thought it was stratified.

10 Now the difficulty that we have had is
11 that the correlations that you would like to use to
12 address those aren't always appropriate for these new
13 sets of conditions.

14 However, it is in that approach where we
15 think it is prone to introduce a bifurcation, or all
16 of a sudden the drag changes. Now, we think that
17 perhaps the answer of this is to ask the next
18 question, is that if you do have a problem in the
19 scaling group, a distortion, how does it propagate
20 through that transient?

21 There is two approaches that we have seen
22 in the past that have been able to at least address
23 this. One was by Dr. Banerjee in his scaling for the
24 AP-600, where after he got the scaling groups, went
25 back to the simplified conservation equations, and

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1 looked at the experiments in non-dimensional terms,
2 and saw if the plant adhered to what was going on in
3 the experiment.

4 I mean, that kind of focuses just on the
5 main parameters in the scaling evaluation. Well, once
6 you get it in those terms, you can look at the
7 relative effect of changing one term against the three
8 or four others that may balance it.

9 A similar one was by Marino Demarzo, where
10 he said, well, let's take a look at a specific period,
11 and develop a simplified model, and if we have a
12 question on a distortion like we did for this
13 entrainment, what is its impact down the stream.

14 And that is how we identified the flow
15 quality. So the answer may be after you do the spread
16 sheet work with the scaling analysis, go back and look
17 at the scaling equations, and see how those
18 distortions may propagate in a simplified model with
19 time.

20 Now on a grander scale, I think the
21 question basically asks, well, what happens in the
22 plant analysis, and as we start to think that out, it
23 starts to become CSAU again. Now we have a code, as
24 opposed to a simplified model, and we arrange those
25 terms which are thought to be important.

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1 If you have models in the code, and you
2 are confident that they are predicting something close
3 to reality, that has a lot of merit. An example may
4 have been in the Westinghouse large break methodology,
5 where the PIRT experts had ranked -- I think it was
6 gap conductance as being very large, and they had a
7 decent model for that, and when that was ranged within
8 its experimental uncertainty in a plant calculation,
9 the delta PCT, the effect on the transient was
10 significantly smaller.

11 And that is good, because that basically
12 means that the developers of the PIRT were being
13 overly sensitive at that point, and it was an issue
14 that they need not be concerned about.

15 But the problem then is when you go to the
16 full CSAU evaluation, you have got to be able to say
17 that those models were applicable, or very realistic,
18 for the process.

19 CHAIRMAN WALLIS: And that you could do
20 something to range the uncertainty. One thing that I
21 think came up in discussion with another applicant was
22 the question of how do you range the uncertainties in
23 the room on momentum equations.

24 Really, there ought to be fudge factors in
25 there or something which say that you really don't

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1 know the momentum flux that well, and there is an
2 uncertainty with a factor of two on it, and let's
3 range it in some way.

4 And at that fundamental level, rather than
5 ranging just some heat transfer coefficient which
6 affects a tiny little bit of the whole scenario over
7 a big range, range the fundamental things that affect
8 how the whole code behaves, which you know are not
9 exact either. And maybe you can work towards that,
10 too, in your work.

11 DR. BAJOREK: Okay. I think what we would
12 like to do is -- I have been talking with Marino
13 Demarzo on this, and maybe the thing to do is we will
14 try to set up a couple of simple test cases, and see
15 how this works, and write down what we think is some
16 of the appropriate steps to protect against these
17 distortions.

18 MEMBER KRESS: I think the approach sounds
19 really good to me, Steve.

20 DR. BAJOREK: Thanks.

21 MEMBER KRESS: Good luck on it.

22 CHAIRMAN WALLIS: Yes, I think I should
23 also say that I appreciated your presentation on the
24 entrainment issues. That was very helpful.

25 DR. BAJOREK: Thank you.

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1 MEMBER KRESS: I think that this would be
2 a significant contribution to the whole process here
3 with coming up with something.

4 MR. SNODDERLY: Graham, if it is all right
5 with you, I would like to try to take another shot at
6 summarizing the last two days of meetings, because I
7 think that there is three -- well, as I see it, the
8 most important issue that was identified coming into
9 the meeting was as you said the entrainment issue.

10 And I think that we heard from
11 Westinghouse and also from the staff about why there
12 may be more need for an assessment of the APEX test
13 data. And the staff has documented in their letter of
14 March 18th why that is.

15 I think that perhaps we could maybe
16 provide some feedback in an hour or in the future, but
17 I think the impression that I got was that they seemed
18 to be heading in the right direction, or that is an
19 important -- it is a good summary of the entrainment
20 issue, and one possible success path.

21 I think as part of this meeting we also
22 accomplished our other major objective, which was to
23 identify possibly thermal hydraulic issues that may
24 turn into possible open items if not resolved between
25 now and the time of the DSER when we are asked to

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1 review it.

2 Those two issues as I saw them were the
3 issue of the two node modeling for long term cooling,
4 and the treatment of the momentum flux, and I think
5 that Westinghouse has a good understanding of those
6 issues, and that I think the staff is aware of those
7 issues that have been brought up, and they will either
8 have to address those in the DSER or at the time of
9 the writing of the letter on the DSER, those two
10 issues would then again be brought up, if not
11 resolved, between now and then, either through another
12 subcommittee meeting perhaps in May, or at the time
13 that we review the DSER.

14 And as you mentioned there was the boron
15 precipitation issue that was brought up, and then the
16 other one that I had on my list that had not been
17 brought up was the future presentation possibly on the
18 sump strainer issue.

19 And as Westinghouse had portrayed it, it
20 was that they had made a submittal, and they feel that
21 their design is adequate, but they have not heard back
22 from the staff. And the staff is in the process of
23 evaluating that.

24 But that is another issue that perhaps
25 when we review the DSER that that is another area that

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1 we may focus on, and I think the staff is aware of
2 that.

3 So all I was trying to do here was
4 summarize what I saw were the three major issues,
5 which was entrainment, long term cooling, the two node
6 and long term cooling, and the treatment of momentum.

7 And it appears that the two parties are
8 aware of those issues, and will resolve those either
9 in the DSER or at a future thermal hydraulics
10 subcommittee.

11 CHAIRMAN WALLIS: I want to put this in
12 perspective though, the two issues of momentum and the
13 codes predicting different things. Sometimes it is
14 not quite there physically and why, and the business
15 of the two nodes long term cooling. These were issues
16 that came up just by chance because Westinghouse made
17 a presentation.

18 And it seems to me that this is a lesson.
19 I mean, if we looked at it and it said that we had
20 four presentations and on two of them we had
21 surprisingly new questions, that is not a very good
22 thing to happen.

23 So I think what I would like to see
24 personally is in June when you come before this
25 committee to make your case that it is an absolutely

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1 clear case, and that when we ask questions that you
2 have the answers.

3 Because if you make a presentation and at
4 random we hear about four things and we have major
5 questions, that does not give a very good feeling that
6 you are really on top of everything.

7 So when you come back in June, you are
8 going to be on top of everything, and there won't be
9 things that rise out of your presentation which
10 require a lot of discussion or whatever, and you give
11 us a feeling that something is not or has not really
12 been thought out, or resolved, or maybe there is
13 something there that needs to be investigated.

14 MR. CORLETTI: That's fine.

15 DR. BANERJEE: Nice bounding calculation.

16 MR. CORLETTI: Mike, the one issue that
17 you mentioned on the sump issue, and I don't know that
18 it will be an issue, but the May meeting would be a
19 good opportunity to have our expert on the issue make
20 a short presentation, if nothing else.

21 CHAIRMAN WALLIS: And it may be at the May
22 meeting.

23 MR. CORLETTI: Yes, that would be a good
24 time.

25 CHAIRMAN WALLIS: And when Brian McIntyre

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1 was here, we had this business about the particles of
2 paint, and what was their trajectory when they landed
3 in the pool, and we looked to the maple leafs falling
4 in the air, and how they wobbled around and when off.

5 MR. CORLETTI: You have to do that in the
6 fall for the maple leafs.

7 CHAIRMAN WALLIS: Well, you are going to
8 revisit that and have a platform to prevent the debris
9 from falling down, but it doesn't always follow a
10 straight line trajectory. I think that would be
11 appropriate to bring that up in May.

12 MR. CUMMINS: This is Ed Cummins. I would
13 like to maybe clarify a sense of the ACRS, because I
14 think that it helps us in resolving the big issue,
15 which is the entrainment issue.

16 And I am going to say that as a straw man
17 comment, and you can agree with it, or disagree with
18 it. I believe after we went through the whole thing
19 that there was a general consensus that trying to be
20 exact on the entrainment and the de-entrainment, and
21 all the phenomena on each tiny place of the plant is
22 less than productive.

23 And the key is whether you can predict the
24 integrated system performance of the entire safety
25 systems. And if I could get a sense from the ACRS

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1 that would help guide our resolution with the staff,
2 I believe.

3 CHAIRMAN WALLIS: Who wants to start with
4 that?

5 DR. BANERJEE: Physics is good, or good
6 calculations.

7 MEMBER KRESS: I will give you what my
8 thought on it was. I think the key is what comes off
9 at the interface between the liquid and the pool, as
10 Ishii gets below the hot leg, and so you do need some
11 sort of a physical model or an empirical correlation,
12 or something that tells you what gets entrained as a
13 function of the steam rates or the gastral rates that
14 comes off of there.

15 And then to get a bounding issue, and just
16 forget about de-entrainment. Now, I say forget about
17 it, but it may be possible to use that Ishii -- and I
18 can't pronounce the other name, but where you have a
19 function of height in there, and where it is the
20 entrainment, because that is physically very real,
21 because it is just fall back mostly.

22 So being able to use that as a variable
23 amount that goes into the hot leg line as a function
24 of the position of the collapsed liquid level. But
25 other than entrainment, other than that, I would just

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1 forget about and say that all that stuff that goes
2 into the hot leg also goes out your ADS-4 line.

3 Now you may have to treat the pressure
4 drop differently, and I don't know how to deal with
5 that, but you also will need as a function of the
6 collapsed liquid level this thing that Sanjoy asked
7 for, and that was if it gets too low, what does it
8 give you in terms of margins to dry out.

9 And what affect does it have on the
10 thermal properties. We have not really seen that
11 exactly what the margins are. And before I quit on
12 this question of how to model the entrainment, I think
13 you still need to think about as the collapsed liquid
14 level gets lower and lower that you do leave a film.

15 And I would say that is part of the
16 entrainment liquid that goes out, and I don't know how
17 you calculate a film thickness that is left on the
18 fuel elements, but there are models for that. So that
19 to me would be a bounding approach, assuming that you
20 had a good technical basis for this model for what
21 comes off at the collapsed level as a function of the
22 steam rate.

23 Does that fit with anybody else's thinking
24 on this?

25 MEMBER RANSOM: Yes, I think I would like

1 to add to that a little bit, in terms of some guidance
2 as far as what things to try to refine and what not
3 to. And that is that when you start trying to model
4 things at a level that is below your ability to
5 describe them in the physical system, such as say 1D
6 models in pipes, or even finite volume models within
7 a core, you can't refine those ad infinitum in spite
8 of the fact that we have very powerful computational
9 tools today. We are pretty much stuck with that.

10 When you start trying to build ad hoc
11 models for processes that lie below the level of that
12 description, you are going to cause a lot of problems.
13 And I am not sure that you can improve the uncertainty
14 in a calculation.

15 And so my attitude is that it is important
16 to recognize right from the start that there is
17 uncertainty in these models and in the calculation.
18 And so there are limits to how much refinement that
19 can be made on an ad hoc basis in any given phenomena.

20 And I am not ready to say that like the
21 entrainment phenomena is at that point. I mean, you
22 do need a model of entrainment, but it can be refined
23 to the point where you see the wiggles in the curves
24 and they interact with a model that you put in there,
25 and you are not sure it is believable, because a lot

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1 of these oscillations are caused by the numerical
2 process to actually integrate the equations.

3 And often times it seems like there is a
4 tendency to go overboard in one area, and maybe the
5 AP-600 model that was originally produced was an
6 example of that, where they were trying to make this
7 thing do multi-dimensional calculations, and dividing
8 up the downcomer, and it was a very complex model.

9 And probably not -- and I can say
10 definitely not what the codes that they were using
11 were intended for. It was more a -- it is not exactly
12 an integral balance model. I mean, that is another
13 level of crudeness you might say which may be useful
14 at times.

15 So I believe that it is important to keep
16 that in mind and I know that this drift towards the
17 use of probabilistic uncertainty methods in licensing
18 is an area where in these codes we are going to have
19 to address the uncertainty in all of the different
20 models in some way, and if you incorporate that, then
21 the output from those things becomes a band, and it
22 does not become a curve.

23 And now you can compare, say, one band
24 with another and, and if they substantially overlap,
25 maybe draw the conclusion that they are similar. But

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1 I believe there is an issue there.

2 DR. BANERJEE: Let me say something.

3 CHAIRMAN WALLIS: And let's hear from Jack
4 after that.

5 DR. BANERJEE: I was going to say that
6 having been involved with scaling that I am very
7 skeptical about scaling. Therefore, wherever you can
8 use full-scale data to anchor your case, that to me
9 makes a lot of sense.

10 And that is why I like the UPTF
11 experiments, and I like the G2 experiments. If you
12 could use those experiments to get a feel for what is
13 going to be the entrainment rate from the core, and
14 the carryover, which I think is the key there, and
15 maybe what capacities the upper plenum might give you
16 in storing a little bit of liquid if that is
17 necessary, and as Tom or Dr. Kress suggested, that if
18 you don't have to appeal to storing liquid in the
19 upper plenum, but can just say that whatever comes out
20 of the core goes out of the ADS-4, then that is even
21 more convincing.

22 But anchoring the case on full-scale
23 experiments, where you have got at least components
24 that are full-scale, to me would be much more
25 convincing. So that we don't have to go through some

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1 of these very convoluted arguments regarding the
2 scaling.

3 MEMBER SIEBER: I guess my approach to a
4 lot of this is pretty simple. I liked the plants that
5 had active safety systems and (inaudible) came along
6 and closed the switch and the pump started, and you
7 had pressure in the flow, and you could test for that,
8 and you knew from your modeling, and from the
9 installation that you had that the safety systems
10 would work.

11 It is not clear to me that with these very
12 low pressures in driving heads that you can actually
13 model this with sufficient accuracy to be able to tell
14 what goes on. And the only approach I think that you
15 can use is to take a look at collapsed level or void
16 fracture, or what have you, and calculate how bad can
17 it get when core damage begins to occur.

18 And then from APEX data and all of your
19 modeling, say I will never get to that condition, and
20 to me that would be good enough, except that you
21 really have not improved the usefulness of the models
22 at all. You have not said too much about uncertainty
23 at all.

24 But that is sort of a way out of where we
25 are right now to my view point. And it is a different

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1 kind of an approach, and it is not a very satisfying
2 approach, but it does give some regulatory assurance
3 that you are still on solid ground. I don't know what
4 anybody else thinks of that, but that's it.

5 CHAIRMAN WALLIS: Well, to answer your
6 question there, I agree with Dr. Banerjee that physics
7 is good. I think that full-scale data is better,
8 because even if you don't understand the physics, you
9 sort of have much more confidence in what happens.

10 In the case of what we are talking about
11 here with entrainment, there are some parts of the
12 system where you need to get it right. I think you
13 need to get right what comes out of the core. You
14 can't really take bounding assumptions like homogenous
15 equilibrium flow or something, and that gives
16 ridiculous answers.

17 So you have got to get that right, or
18 right enough --

19 DR. BANERJEE: Out of the core.

20 CHAIRMAN WALLIS: Out of the core, yes.
21 And now there are other parts where, say, let's take
22 the other extreme, where we are talking about the hot
23 leg entrainment from the ADS-4 line, and where the
24 amount of water that you can store there is not very
25 much, and this is the changes that you make from one

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1 extreme to the other, and changes that you have or the
2 effect that you have on the level in the core is not
3 very much.

4 And where bounding analyses makes a lot of
5 sense, because it is difficult to get it right. If
6 you can get it right, then it is best that you do
7 that, but it is difficult to get it right. And the
8 worst thing you can do is to try to get the physics
9 right, and to bring in Teitel-Duckler or something,
10 which to a knowledgeable reviewer doesn't seem to be
11 appropriate to the problem.

12 If you are relying on importing
13 correlations, and then Kataoka-Ishii is a little bit
14 like that, and you are importing something from
15 another context, and where it doesn't really cover the
16 range of variables and parameters, and the geometries.

17 And you can't rely on it very much. So
18 you are liable to have it become unconvincing, and
19 there is nothing so convincing as a really good
20 bounding analysis, which says that by the first law of
21 thermal dynamics, or by some continuity of mass, or
22 something, the worst it could be is X.

23 And if that is what you need to rely on,
24 then that is a very strong thing to rely on. If you
25 can't rely on that, then you have to do more physics.

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1 And you can't rely on that at every stage,
2 and so I think for some of these phenomena that we
3 have been talking about, it may be appropriate for you
4 to show that whenever your physical model lies between
5 this limit and that limit, and everything is okay over
6 the whole range, that is a good argument for you to
7 use when it is appropriate, yes.

8 MEMBER KRESS: But I came away with a
9 feeling that the Kataoka-Ishii model might be
10 appropriate for what comes off of the core, and one
11 way to judge that would be to use the 14 foot
12 databases and see how it compares.

13 CHAIRMAN WALLIS: If it helps to explain
14 the full-scale data, but if you don't have any data at
15 all to invoke it, it is a very weak thing to rely on.

16 MEMBER KRESS: That would be the
17 connection that I would like to see.

18 CHAIRMAN WALLIS: Absolutely. The more
19 legs you have to stand on the better. I mean, if you
20 have full-scale data and an understanding of the
21 physics, and a theory to explain those physics, then
22 that is wonderful, and then you really have them all.

23 MEMBER KRESS: Well, there is no theory
24 for the Ishii thing. It is strictly --

25 CHAIRMAN WALLIS: But the --

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1 DR. BANERJEE: Then you get the heat
2 transfer and --

3 CHAIRMAN WALLIS: And the danger from this
4 upper plenum modeling is that you have to patch
5 together so many things which you are not too sure
6 about that it is not a convincing story and good data.

7 Now, maybe you would be convinced by OSU
8 data. I don't know. It depends on how well we
9 believe the scaling. Does that help?

10 MR. CORLETTI: Yes, it does.

11 CHAIRMAN WALLIS: And you can look at the
12 transcripts, too. Do you read transcripts of these
13 meetings afterwards?

14 MR. CORLETTI: Yes. Yes, we do.

15 CHAIRMAN WALLIS: Do you go cold and
16 sweaty and say I can't believe I said that or
17 something?

18 (Laughter.)

19 MR. SNODDERLY: While Dr. Banerjee was
20 speaking it reminded me that Slide 25 from your
21 proprietary material provided two data points for the
22 UPTF tests, and then the presenter showed six, and I
23 think that you guys had committed to providing those
24 six.

25 MR. CORLETTI: I will provide that.

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1 MR. SNODDERLY: Thank you.

2 CHAIRMAN WALLIS: That is very good to
3 follow up on all those things.

4 MR. SNODDERLY: Yes.

5 CHAIRMAN WALLIS: Is there anything else,
6 or can we close this session?

7 MR. CORLETTI: I would just like to say on
8 behalf of Westinghouse our thanks to the members for
9 the past two days, and it has been a challenging
10 review and challenging questions, and for your
11 patience.

12 Also, I wanted to thank Mike Snodderly and
13 Med for all your help with helping us, and thanks to
14 the staff and the Office of Research, and Jose, Dr.
15 Reyes, for trucking out from Oregon to be with us
16 today. That was very helpful. Thank you.

17 CHAIRMAN WALLIS: So you have made my
18 closing speech, and I would just endorse what you just
19 said.

20 MEMBER SIEBER: I will second that.

21 CHAIRMAN WALLIS: Well, I declare this
22 meeting closed.

23 (Whereupon, at 2:46 p.m., the meeting was
24 concluded.)

25

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CERTIFICATE

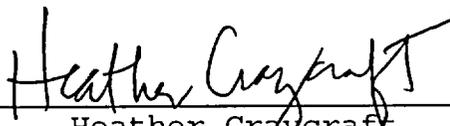
This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Reactor Safeguards
Thermal-Hydraulic Phenomena Subcommittee
OPEN SESSION

Docket Number: n/a

Location: Rockville, MD

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

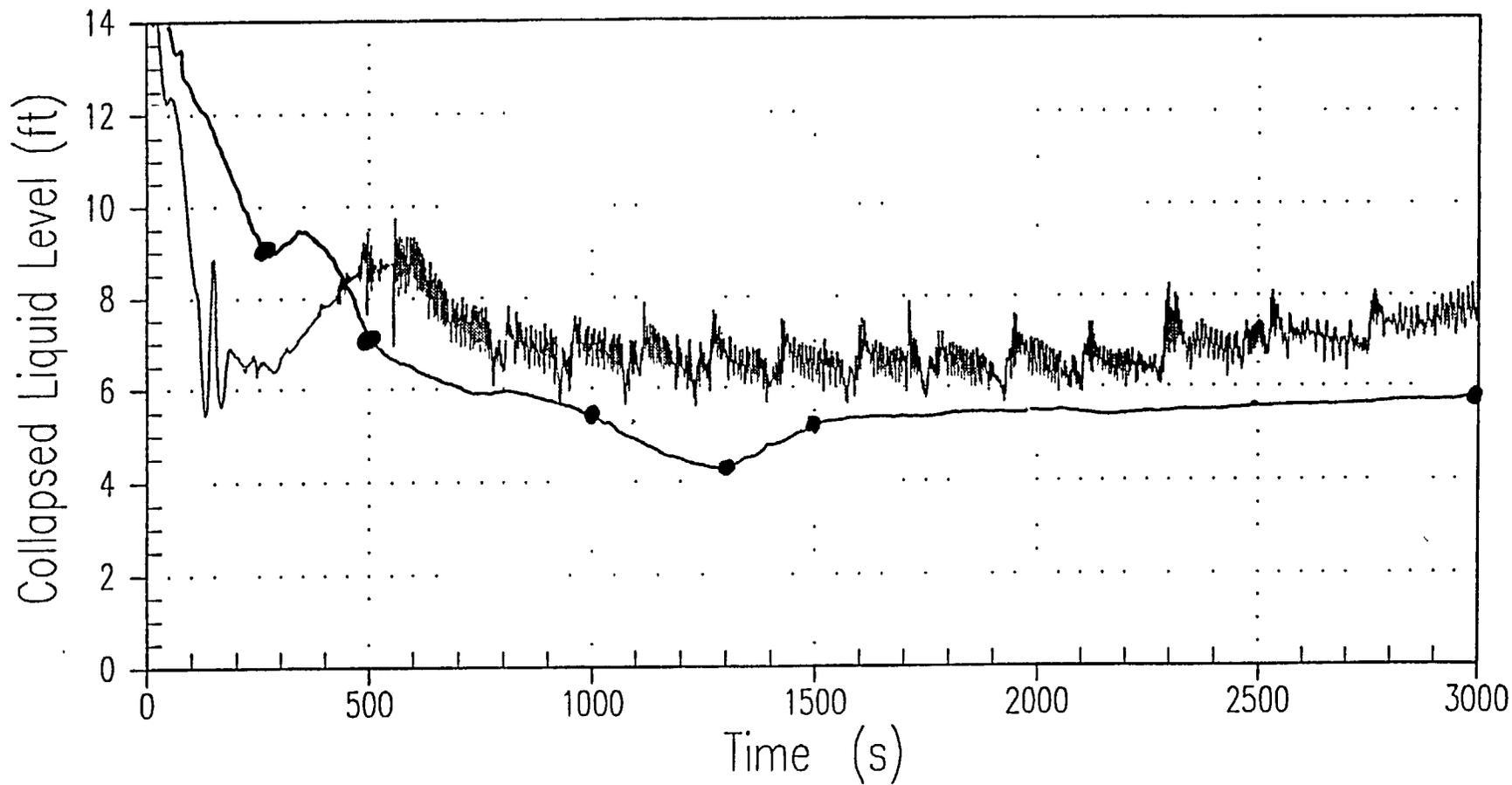

Heather Craycraft
Official Reporter
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Summary of RES Future Actions

- ❑ RES plans to support NRR in resolution of liquid entrainment issues.
- ❑ RES is sponsoring confirmatory research at APEX that is applicable to AP1000. Integral and separate effect experimental tests in the APEX-AP1000 test facility to investigate BDB scenarios and develop improved models for upper plenum processes for TRAC-M.

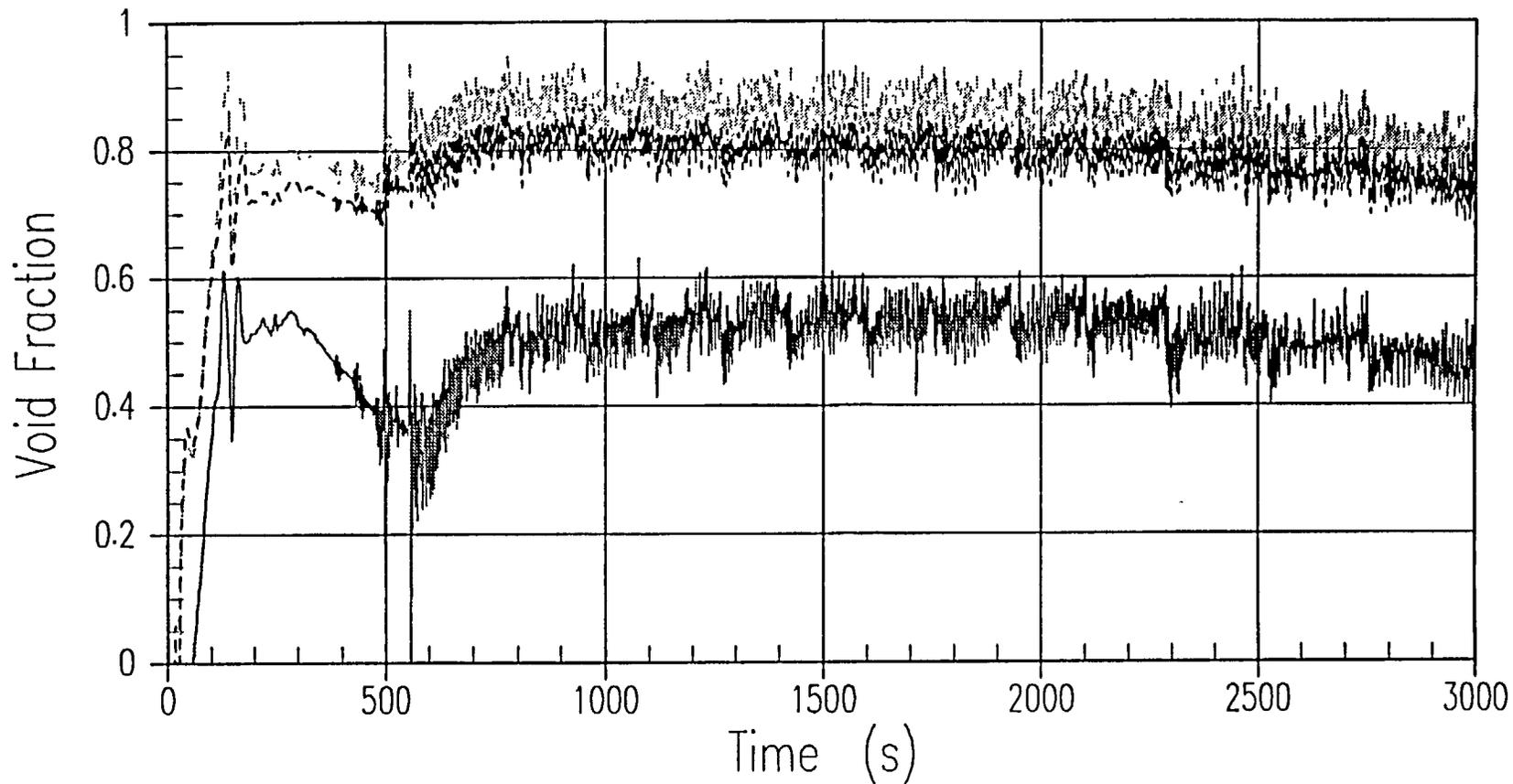
AP1000 DVI Line Break

— Core Collapsed Liquid Level (NOTRUMP)
—●— ~ RELAP



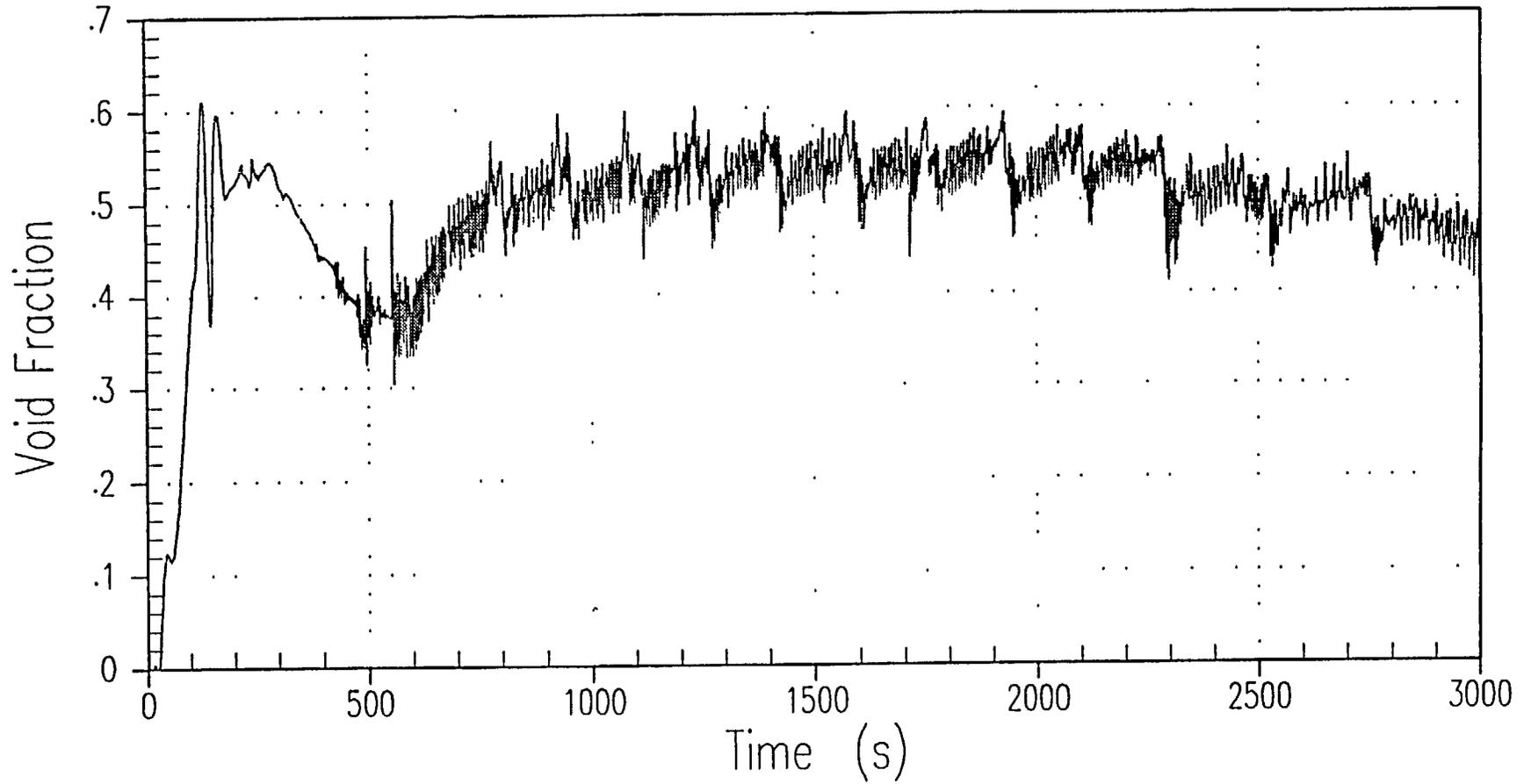
AP1000 DVI 14.7 (Half PRHR), ADS-4 K Increase by 70%.

————	VFMFN	165	0	0	Core Node-7
- - - -	VFMFN	171	0	0	Core Node-13
- - - - -	VFMFN	172	0	0	Core Node-14



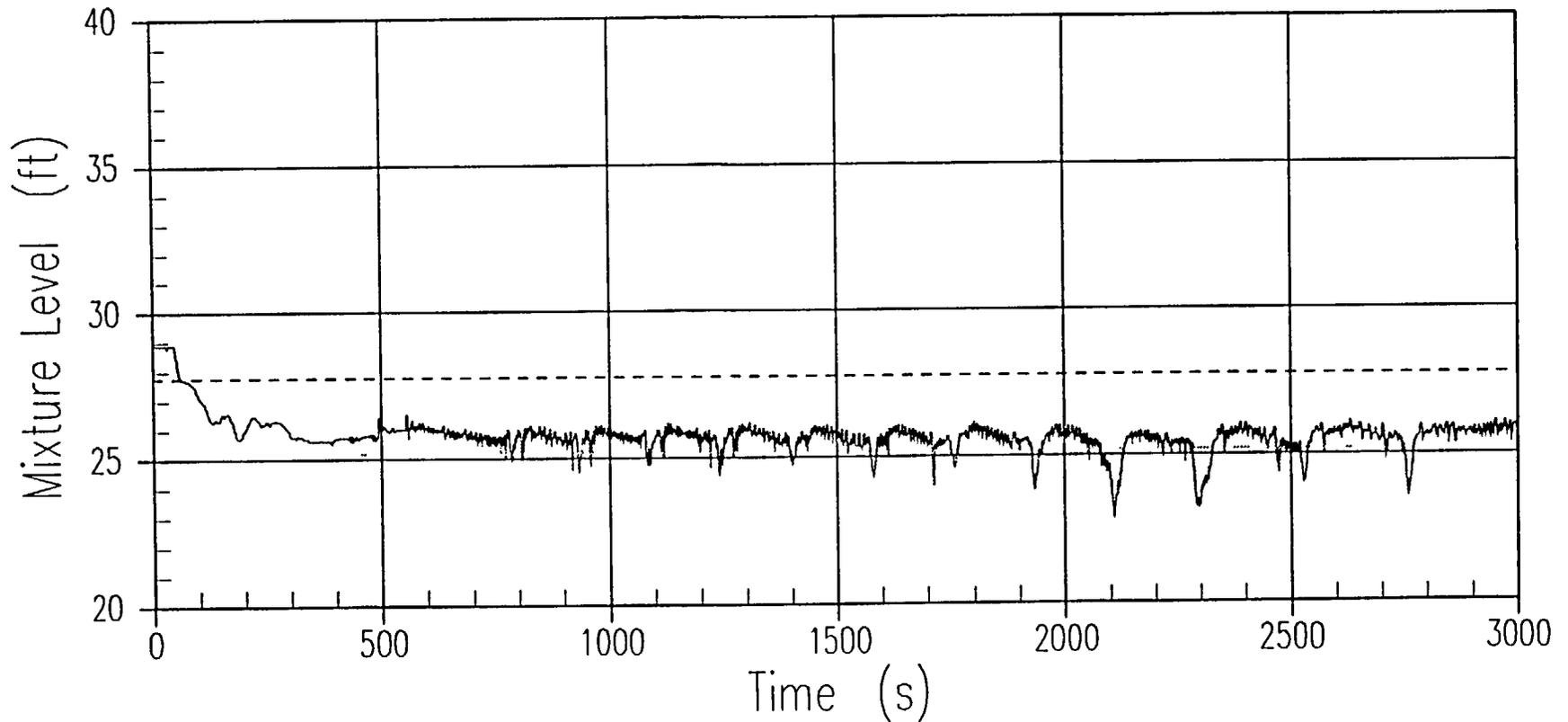
AP1000 DVI Line Break

— Core Average Void Fraction



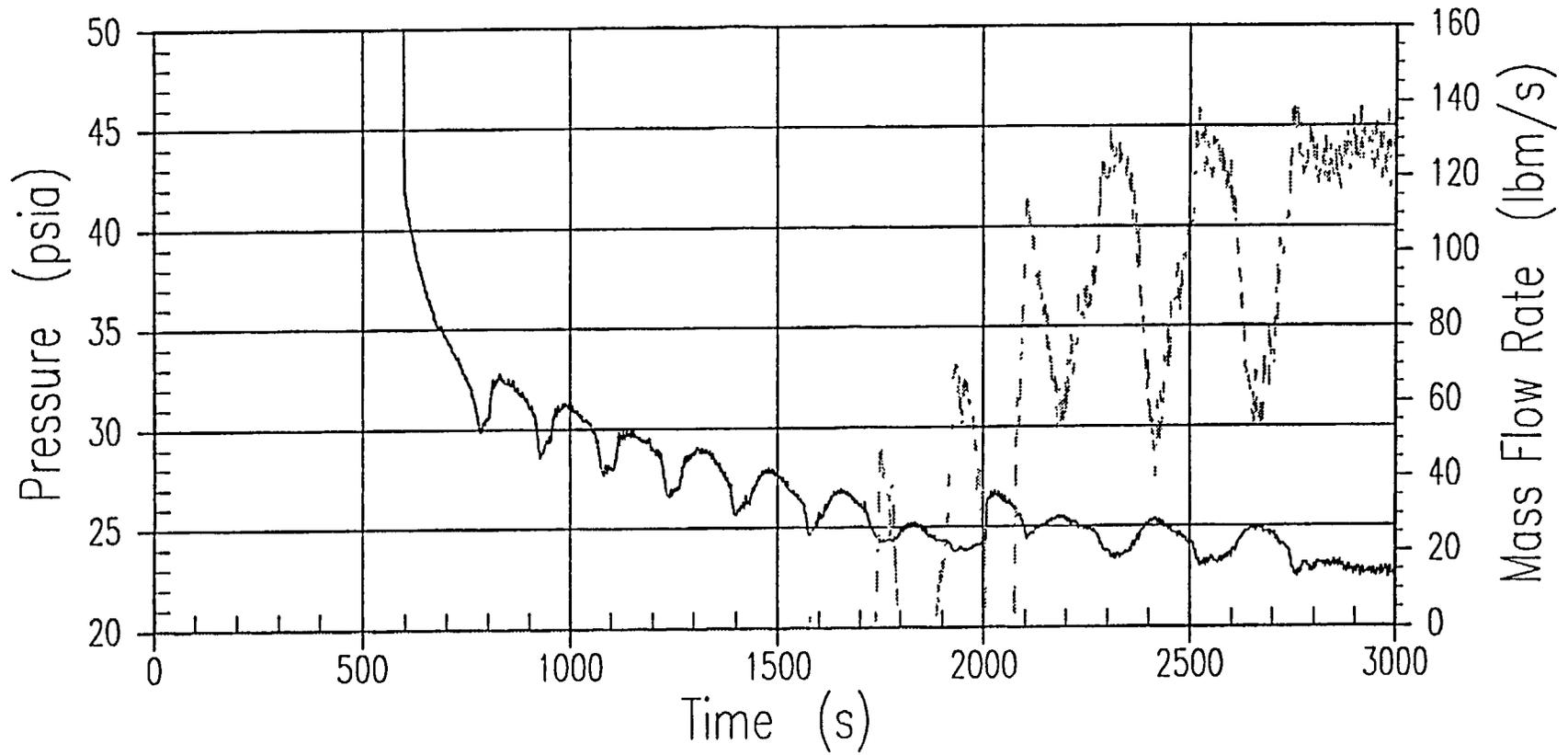
AP1000 DVI Line Break (14.7 psi Pcont)

— EMIXSFN 7 0 0 CORE
· Bottom of Hot Leg
- - - Top of Hot Leg



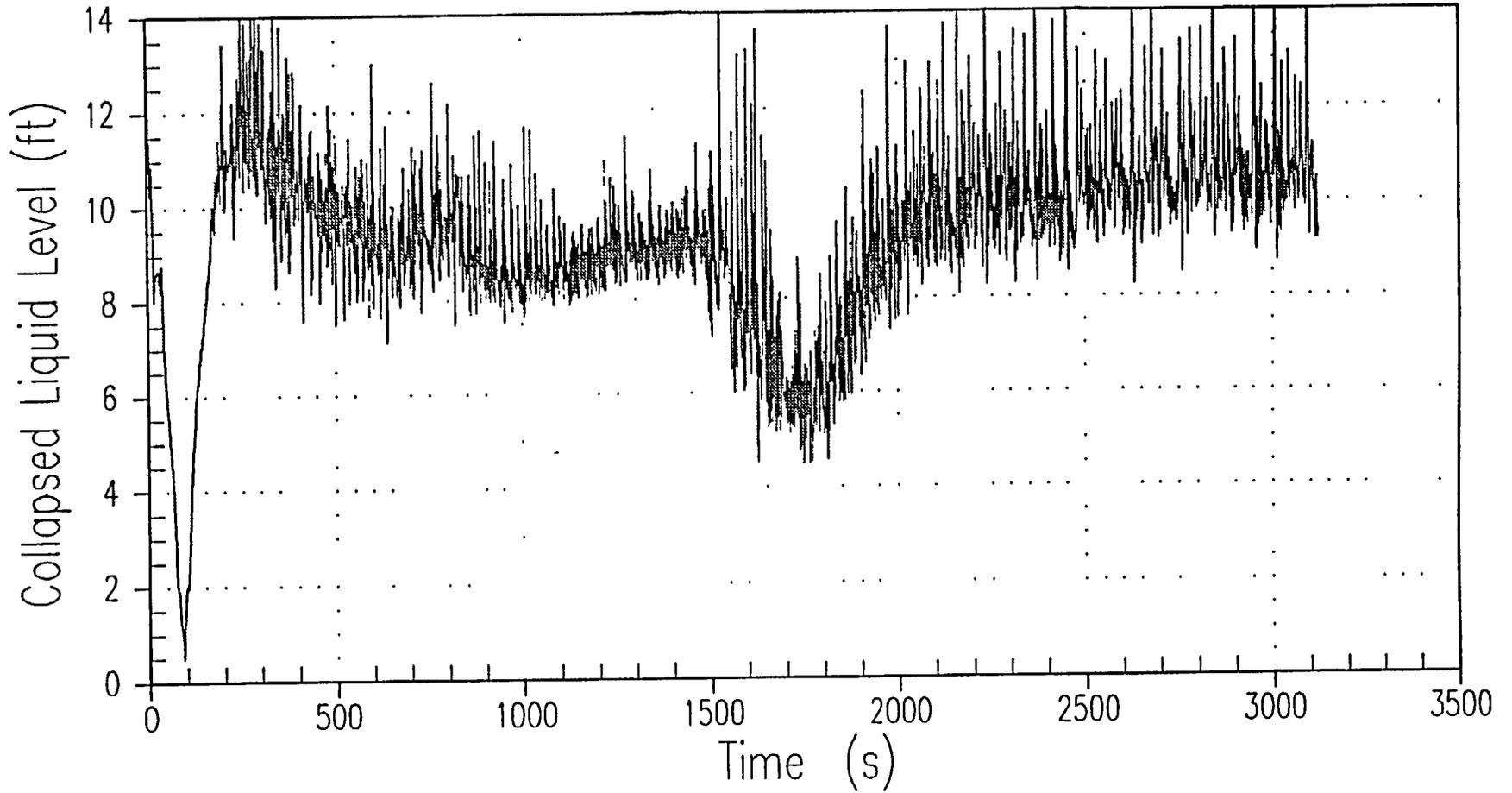
AP1000 DVI 14.7 (Half PRHR), ADS-4 K Increase by 70%.

Pressure (psia)				
—— PFN	62	0	0	DVI-2
Mass Flow Rate (lbm/s)				
- - - - WFL	66	0	0	IRWST-2



AP1000 10 Inch Break in Fluid Node 49 (Cold Leg)

— Core Collapsed Liquid Level



AP1000 10 Inch Break in Fluid Node 49 (Cold Leg)

— Core Average Void Fraction

