

NUCLEAR REGULATORY COMMISSION

Title: **Advisory Committee on Reactor Safeguards
Thermal-Hydraulic Phenomena Subcommittee**

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

Docket Number: (not applicable)

Location: **Rockville, Maryland**

Date: **Wednesday, July 17, 2002**

ORIGINAL

Work Order No.: **NRC-473**

Pages 1-403

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

SUBCOMMITTEE ON THERMAL-HYDRAULIC PHENOMENA

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WEDNESDAY

JULY 17, 2002

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Graham B. Wallis, Chairman, presiding.

Subcommittee Members:

GRAHAM B. WALLIS, Chairman

THOMAS S. KRESS, Member

VICTOR H. RANSOM, Member

ACRS Staff:

SANJOY BANERJEE, Consultant

FREDERICK MOODY, Consultant

VIRGIL E. SCHROCK, Consultant

PAUL A. BOEHNERT

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Also Present:

STEVE BAHIREJM RES

NORM LAUBEN, RES

JACK ROSENTHAL, RES

JOSEPH STAUDENMEIER, RES

AKIRA TOKUHIRO, RES

RALPH CARUSO, NRR

V. J. DHIR, UCLA

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A-G-E-N-D-A

Welcome, Graham Wallis, Subcommittee Chair . . . 4

Review of the NRC Office of Nuclear Regulatory
 Research Draft Regulatory Guide DG-1120, Transient and
 Nuclear Accident Analysis Methods, Joseph
 Staudenmeier, RES 6

Review the RES Thermal-Hydraulic Research Program
 Dealing with Subcooled Flow Boiling Phenomena

Steve Bajorek 195

V. J. Dhir 225

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

(8:30 a.m.)

CHAIRMAN WALLIS: Please come to order.

This is a meeting of the ACRS Subcommittee on Thermal-Hydraulic Phenomena. I'm Graham Wallis, chairman of the subcommittee. The other ACRS members in attendance are Tom Kress and Victor Ransom. ACRS consultants in attendance are Sanjoy Banerjee and Virgil Schrock. We expect Dr. Fred Moody any moment.

For today's meeting the subcommittee will continue its review of the NRC Office of Nuclear Regulatory Research, draft Regulatory Guide DG-1120, Transient and Nuclear Accident Analysis Methods. And associated NRC standard review plan Section 15.0.2. That's the first of our tasks.

The second one is to review the RES thermal-hydraulic research program dealing with subcooled flow boiling phenomenon. The subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the full committee.

Mr. Paul Boehnert is the cognizant ACRS staff engineer for this meeting. I am very happy to notice that Dr. Fred Moody has managed to make it through the badging procedure and is up here.

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1 Welcome, Fred.

2 DR. MOODY: Good morning.

3 CHAIRMAN WALLIS: The rules for
4 participation in today's meeting have been announced
5 as part of the notices of this meeting previously
6 published in the Federal Register on July 2 and July
7 15, 2002.

8 A transcript of this meeting is being kept
9 and the transcript will be made available as stated in
10 the Federal Register notice. It is requested that
11 speakers first identify themselves and speak with
12 sufficient clarity and volume so that they can be
13 readily heard. We have received no written comments
14 nor request for time to make oral statement from
15 members of the public.

16 Now, this regulatory guide was being
17 worked on when I joined the ACRS four years ago.
18 We've had a couple of meetings on it. Again, they
19 were a long time in the past.

20 It's become evident that the gestation
21 time for regulatory guide is somewhat longer by not an
22 insignificant factor than the gestation time of an
23 elephant. We are hoping that this regulatory guide
24 will be born in the near future. That's what I hope
25 we will find out today. I'm very happy to welcome Joe

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1 Staudenmeier to be the midwife.

2 Joe, you have a formidable array of
3 consultants and committee members this morning.

4 MR. KRESS: We're ganging up on you.

5 DR. STAUDENMEIER: I think you outnumber
6 the rest of us here.

7 Today I'm just going to go over the
8 Regulatory Guide. The SRP is property of NRR and they
9 didn't want that presented today although the changes
10 made to it were less than what was made to the
11 Regulatory Guide.

12 CHAIRMAN WALLIS: They are not going to
13 present it ever?

14 DR. STAUDENMEIER: They've made the
15 decision that it will be issued without anymore public
16 comments so it will come to you before final issue.
17 I believe the process is it has to go back through the
18 ACRS before it's issued as final. Even though they
19 didn't want it issued for public comment, they wanted
20 to wait until the Regulatory Guide was ready for final
21 issue before they issued the SRC.

22 CHAIRMAN WALLIS: So it's going to be
23 twins then that will be born.

24 DR. STAUDENMEIER: Yes.

25 CHAIRMAN WALLIS: Thank you.

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1 DR. STAUDENMEIER: On the title slide, the
2 draft guide used to be 1096 but when it goes out for
3 public comment again it gets a new number. That's why
4 it's now 1120.

5 CHAIRMAN WALLIS: This will be its final
6 number?

7 DR. STAUDENMEIER: Hopefully it's the
8 final draft number. Hopefully this is the final draft
9 that will go out for public comment and after this
10 round of public comments it will be issued.

11 CHAIRMAN WALLIS: It will be 1.120?

12 DR. STAUDENMEIER: I don't know what the
13 official -- I don't think it's been assigned an
14 official Reg. Guide number yet.

15 In this presentation I just want to
16 present the background in common of the Reg. Guide.
17 I know there are some new faces here that haven't been
18 through the presentations for this Reg. Guide before.
19 Feel free to ask any questions for clarification.

20 The point of this talk is to go over more
21 of the changes that have been made to the Reg. Guide
22 as a result of public comments. Feel free to ask any
23 information about the background.

24 CHAIRMAN WALLIS: I think you might give
25 some of the background information.

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1 DR. STAUDENMEIER: Okay. I have a little
2 overview of it here.

3 CHAIRMAN WALLIS: Three or four people
4 haven't seen it before.

5 DR. STAUDENMEIER: Okay. Mainly this Reg.
6 Guide is to be used for analyzing events that are put
7 in standard safety analyses for operating plants which
8 most of the events are in Chapter 15, the so-called
9 Chapter 15 events, but there are some other events
10 that are in different parts of the standard review
11 plan that also would be covered by this Reg. Guide.

12 CHAIRMAN WALLIS: Can you give us a few
13 examples of what is in Chapter 15?

14 DR. STAUDENMEIER: Sure. Chapter 15 is
15 just about any type of transient that would be
16 analyzed for a plant like loss of feed water, pump
17 trips, turbine trips, things of that nature. Events
18 that wouldn't be in Chapter 15. There's a low-
19 temperature over-pressure transients like station
20 blackout which is something that may be analyzed with
21 codes. That isn't really a classical Chapter 15
22 accident.

23 ATWS. LOCA is something that would be
24 covered by this, although there is a specific Reg.
25 Guide for best estimate LOCA. The development process

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1 of a code for LOCA would also come under this Reg.
2 Guide.

3 MR. KRESS: Just about all of them.

4 DR. STAUDENMEIER: Yeah. Reactivity
5 transients.

6 CHAIRMAN WALLIS: These are the
7 anticipated operational occurrences? They are in
8 there, too?

9 DR. STAUDENMEIER: Right. Any anticipated
10 operational occurrences in there.

11 MR. BANERJEE: So everything which is the
12 design basis like severe accidents are off site and
13 everything else is on site?

14 DR. STAUDENMEIER: Yeah. Severe accidents
15 aren't analyzed for safety analysis.

16 CHAIRMAN WALLIS: It seems sort of
17 illogical. The only thing you really worry about is
18 the severe accidents. They don't analyze it.

19 MR. KRESS: That's because the DBAs take
20 care of everything else.

21 DR. STAUDENMEIER: By definition there's
22 no risk in design basis accidents.

23 CHAIRMAN WALLIS: You weren't here last
24 week but there was some discussion about whether we
25 really needed a focus on design basis or whether we

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1 should focus on things that really matter like
2 accidents which could actually harm somebody. Anyway,
3 that's beyond today's conversation.

4 DR. STAUDENMEIER: I guess one thing that
5 comes out of design basis accidents is the only reason
6 the plants are so robust in severe accident situations
7 is because they were designed for LOCA.

8 CHAIRMAN WALLIS: That's the whole -- yes,
9 if you chose your design basis accidents wisely.

10 DR. STAUDENMEIER: Okay. I'm going to go
11 over as part of this talk the background and need for
12 the Reg. Guide, the contents of the original Reg.
13 Guide, the response and public comments that we've
14 gotten in response to public comments, new content and
15 status and summary of where we go from here.

16 CHAIRMAN WALLIS: When you say public
17 comment, do you mean anything other than industrial
18 comment?

19 DR. STAUDENMEIER: There was one person
20 that wasn't part of an industrial organization but he
21 had recently retired from an industrial organization.
22 There were no comments from the public at large, I
23 guess.

24 CHAIRMAN WALLIS: That's too bad because
25 we put out the draft Reg. Guide and it's supposed to

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1 protect the public. Yet, the only public who will
2 respond to it are the people who want us to cut back
3 on what they are being asked to do, not the other
4 side. Maybe you could stimulate attention on the
5 other side and get more of a balance.

6 DR. STAUDENMEIER: Yeah. I guess most of
7 the people that would be interested in thermal-
8 hydraulic codes don't follow Federal Register notices
9 or come to NRC meetings. Else they thought it was
10 good and they didn't need to comment on it.

11 CHAIRMAN WALLIS: Very exciting, yes.

12 DR. STAUDENMEIER: Okay. The background
13 in need. This all arose out of findings or
14 allegations at Maine Yankee about their safety
15 analysis and findings made by some investigation teams
16 that went up to look at this. As a result of that,
17 one of the conclusions was that the NRC needed to
18 provide guidance on code development for accidents and
19 transient analysis.

20 And also guidance on reviewing methods for
21 accidents and transient analysis because the review
22 methods weren't documented in one place. It was more
23 tribal knowledge that went along. People picked it up
24 from the reviewers before them but it wasn't clearly
25 documented.

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1 CHAIRMAN WALLIS: When was that?

2 DR. STAUDENMEIER: Oh, '96. It was a long
3 time ago. I can remember right after this happened
4 sitting in a meeting with Dr. Ransom. I think he was
5 a consultant for the State of Maine on this talking
6 about safety analysis at Maine Yankee.

7 Okay. What we hope to come out of the
8 Reg. Guide is to ensure sufficiency and consistency in
9 the level of documentation and validation. That was
10 to try to correct the fact that if you looked at
11 different codes that had been developed and reviewed
12 for essentially the same type of accident, there was
13 a wide range of level and quality of documentation and
14 a wide range of safety analysis reports written by the
15 staff.

16 There just wasn't consistent quality or
17 consistent standards set in the code development
18 process or the code review process. As part of this
19 have a documented process in place that could be
20 followed by the industry that would give a standard
21 set of content that they would be submitting for a
22 certain type of analysis.

23 MR. BANERJEE: Were there some specific
24 areas in this safety assessment team report that was
25 cause for concern?

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1 DR. STAUDENMEIER: I guess it depends on
2 what you mean by concern.

3 MR. BANERJEE: Their statement is very
4 broad so it's hard to get any meat out of it. What
5 were the types of problems?

6 DR. STAUDENMEIER: For instance, the
7 safety analysis at Maine Yankee. I know the transient
8 analysis there's a main steamline break in particular.
9 I think there was no real code assessment done to show
10 that code was good for calculating what it was doing
11 during the safety analysis.

12 The LOCA methods that they had were based
13 on an early version of RELAP-5 and they had some
14 numerical stability problems and behaved erratically
15 when applied and weren't even able to run through all
16 the whole break spectrum like they are supposed to
17 and, as a result of that, Maine Yankee went through
18 some contortions to try to justify what they did but
19 it didn't follow what they said they were going to do
20 when the LOCA methodology was submitted or what was
21 written in the safety analysis report.

22 They didn't follow the procedure that was
23 required of them for LOCA analysis. Part of it was
24 because they are having lots of code problems. It
25 just couldn't perform the way that they had

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1 represented that it would.

2 CHAIRMAN WALLIS: Actually, a lot happened
3 since then because in '98 or something we started
4 reviewing these codes. ACRS got involved and got
5 dissatisfied with some elements of the codes. We
6 tried to have an -- we did have an influence on the
7 way in which this Reg. Guide was put together.

8 It was our recent experience with the
9 codes that we had to review, particularly for best
10 estimate codes which really are more demanding than
11 the old type of codes. You have to be clear on what
12 you mean by best estimate. Is it a good estimate or
13 is it not, how good is it, and so on.

14 I think it's not just the Maine Yankee
15 lessons learned. It's the codes of the future and are
16 they going to have to meet the same standards as the
17 codes of the past or are we going to specify something
18 that is more stringent or more appropriate.

19 DR. STAUDENMEIER: Another driving, I
20 guess, event outside of the Maine Yankee experience is
21 the AP600 review for all of this. There was a wide
22 criticism by the ACRS at the time about the
23 documentation, Westinghouse's documentation of their
24 safety analysis methods for AP600 and their assessment
25 against experiments at the time.

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1 CHAIRMAN WALLIS: We had a very long
2 letter to the Commission on this issue a couple of
3 years ago now.

4 MR. SCHROCK: Well, one of the things that
5 has impressed me in these reviews is how we get to a
6 certain point where some problems have been
7 identified. At the end the approval of a code goes
8 through but there are things left that presumably by
9 agreement between staff and the industry are going to
10 get resolved some place down the road. The
11 documentation never seems to follow through on that.
12 That kind of thing gets lost.

13 I can think of some examples in connection
14 with AP600, for example. This is kind of a general
15 point but I think it is an area that you've got to
16 look at a little harder to see how you get the
17 documentation into the right shape after a review is
18 finished. What are the principles that are followed
19 in declaring it really a final product.

20 CHAIRMAN WALLIS: Some of these are
21 trivial matters. I remember AP600, just to take an
22 example, but with other codes we got the same thing.
23 We would ask for details of the code and we get some
24 handouts and we look at them and it turned out that
25 some of the equations were garbled. There was no

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1 assurance that they were ever fixed up. We were
2 assured, "Oh, we'll fix that up," but we never saw a
3 proper equation.

4 We have no knowledge aye or nay about
5 whether the equation was fixed up or was not fixed up.
6 Then there is always the question about if the
7 equation was garbled, what was in the code. That we
8 never even got a chance to look at. We don't really
9 want to look at codes but somebody has to look at
10 them. Those are minor points in a way but they may be
11 symptomatic of something.

12 DR. STAUDENMEIER: Yeah, I agree. I know
13 the AP600 thing. I don't know if it was a specific
14 case you were talking about for their large break LOCA
15 cobra track. I remember going back through their
16 final documentation and auditing some of the
17 implementations that they said they were going to do.

18 Obviously we didn't go through the whole
19 list of REIs at the time because it was enormous. We
20 did some auditing of their final implementation and
21 the documentation.

22 That may not have been the code you were
23 talking about but I think we try to some extent to
24 make sure the final -- at least when I was in NRR we
25 tried to some extent to make sure the final

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1 documentation was what it was represented that it was
2 going to be.

3 MR. LAUBEN: Joe, Norm Lauben. I think
4 all these things that are said are exactly correct.
5 It started with Sanjoy's question, what prompted what
6 we did. I think Jack and I were on the non-LOCA part
7 of the team that investigated at Main Yankee and Joe
8 was on the LOCA part of the team that investigated
9 what went on at Maine Yankee.

10 As far as we were concerned when we were
11 looking at non-LOCA things, the principle issue was
12 assessment. We were concerned that the assessment
13 base was rather small so the thing we looked at and
14 saw that something like CSAU had developed a process
15 by which you could do assessments. That was a strong
16 part of assessment.

17 Then I think, Graham, your comments on
18 some of the other codes indicated that there really
19 wasn't a strong basis for the development part. Do
20 you have the right things in the code to start with.
21 That prompted us to put in the hierarchical
22 methodology from SASM that Novak had developed.
23 Novak's hand is in this a lot with both the assess and
24 process and the CSAU.

25 I think that the fact that we could,

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1 therefore, relate the development and the assessment
2 through a logical process was something that we
3 finally came up with in large measure because of the
4 comments we received from a lot of people.

5 CHAIRMAN WALLIS: You mentioned
6 assessment. I think that is the key part. I remember
7 one of the reviews we made when the applicant had
8 compared the code with two, I think, LOFT tests. We
9 said, "Why is two enough? Why choose those particular
10 ones? Shouldn't one probe more to see if the code is
11 doing its job and be satisfied with comparison with
12 two LOFT tests that look sort of okay.

13 MR. LAUBEN: This is exactly what -- when
14 Jack and I were up at Maine Yankee we saw that -- we
15 were looking at non-LOCA transients. It appeared to
16 us that the assessment base for steamline break, as
17 Joe pointed out, was seriously lacking. It was for a
18 BNW plant and Maine Yankee is not a BNW plant.

19 You can hardly draw any relationship
20 between the behavior of a BNW steamline break and CE.
21 That was a focus that we had. We thought there was no
22 process here. There's no standards for saying this is
23 an adequate assessment base. That's a good bit of
24 what our comments were.

25 CHAIRMAN WALLIS: It would perhaps help --

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1 it's a bit late in the day -- if we had made a
2 separate document in which we said, "These are the
3 things we need to fix up. This is the problem we are
4 addressing." Then you could see whether your document
5 actually addresses the problems. Solves, resolves, or
6 whatever the problems that you identified.

7 MR. LAUBEN: Right. But the thing you
8 really need to do when you do a Reg. Guide, though, is
9 make sure that it's not just addressing some narrow
10 problems that you may have focused on in some
11 investigation, but rather does it cover the entire
12 subject you are trying to address in the Reg. Guide.
13 That's really why this turns out to be a bit broader
14 than what some of the problems were that we discovered
15 at Maine Yankee that we felt we were addressing.

16 MR. BANERJEE: What were they using for
17 the steamline break? Was it RELAP?

18 MR. LAUBEN: No, RETRAN.

19 MR. BANERJEE: A large steamline break?

20 MR. LAUBEN: Well, yeah. The spectrum of
21 steamline breaks, right. You know, because a code has
22 a name that doesn't necessarily mean it's bad for
23 doing it. It's just that their assessment base we
24 felt was pretty inadequate. Also depending on what
25 the problems were, Len Ward was the other member of

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1 our team and he looked very carefully at the equations
2 appropriate for what they were really trying to
3 address.

4 MR. SCHROCK: This mention of RETRAN is
5 something that I've been wondering about. You've got
6 RETRAN mentioned throughout the draft guide. RETRAN
7 is in kind of limbo, isn't it? Is it ever going to
8 get out of it?

9 DR. STAUDENMEIER: What do you mean by
10 kind of limbo?

11 CHAIRMAN WALLIS: Well, there's an
12 original RETRAN which was approved. There was a
13 RETRAN and then there was a new RETRAN that we had
14 some problems with.

15 MR. SCHROCK: Right.

16 CHAIRMAN WALLIS: I think there is an old
17 RETRAN which is approved.

18 MR. SCHROCK: The old one is better than
19 the new one?

20 DR. STAUDENMEIER: No, I don't think it's
21 better.

22 MR. SCHROCK: The old one just never got
23 the same level of review as the new one I think is the
24 truth.

25 MR. RANSOM: Well, taking a look at this

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1 I think, Graham, you were talking about assessment.
2 I think that to me in reviewing this Reg. Guide it
3 tries to address a lot of the documentation and the
4 history of the code which is very good and must be
5 done and has in the past always led to a lot of
6 problems.

7 One of the biggest ones, I think, is that
8 the NRC through their development often times
9 neglected funding of the documentation right from day
10 one which should happen. That led to poor quality
11 documentation in many of these code developments.
12 Catching up later is always more difficult than, I
13 think, doing it right at the time.

14 A lot of those things are helped by this
15 Red. Guide, but the word that I have the biggest
16 problem with is assessment. I think assessment, and
17 everybody talks as if we know what that means, has
18 addressed qualitative aspects of agreement with, say,
19 physical phenomena but still falls far short of, say,
20 quantitative assessment in the sense that you can
21 actually say how well this does fit a certain
22 situation, plus what are the uncertainties associated
23 with that.

24 As near as I can tell by reading the CSAU
25 documents, I can't see that it sheds a whole lot of

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1 light on that subject. I think that in the end they
2 come off as biased to account for, say, phenomena that
3 are not modeled or modeled incorrectly in codes.

4 Plus, you know, some uncertainty
5 associated with the things that we do are in the code
6 and should fit and know to combine those together to
7 use in a licensing sense to me is still an open issue.
8 I don't know but I hope maybe these meetings can help
9 clarify some of that, for me at least. I see that as
10 still a major problem.

11 MR. LAUBEN: Vic, I think you're right.
12 I think CSAU -- there's two focuses on CSAU as I see
13 it. One was to outline a process, and the second was
14 to show that you could apply the process in terms of
15 uncertainty. It did not go into a great deal of
16 detail on how you do assessment because it was assumed
17 that the assessment base was already complete when the
18 CSAU was done. We ran into the same problems that you
19 are talking about in AP600.

20 People, I think, struggle with standards
21 for assessment all the time. I don't know if we can
22 put into words always what we all can competently
23 agree is the right things to say about assessment. We
24 tried to do a little bit of that in the Reg. Guide and
25 do a lot more by reference.

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1 I think you end up having to do a good bit
2 by reference. What we tried to reference was some of
3 our struggles we had with AP600. I'm not sure that's
4 the best and it probably takes people a lot smarter
5 than me to figure out how to do it in the best way
6 possible.

7 CHAIRMAN WALLIS: Well, I think --

8 MR. RANSOM: I'm not trying to be
9 critical. I'm just saying that I think this is still
10 an open issue and I know people have struggled with it
11 since 1973 with what do we mean by assessment and what
12 are the measures for assessment.

13 CSAU did go a long ways towards a process
14 -- putting in place a process for assuring that you
15 have addressed the significant phenomena in an
16 accident and that the code generally is capable, say,
17 of modeling those.

18 The last loop or step in that, though, in
19 which you come up with how do you use the code in the
20 best estimate plus uncertainty in a licensing
21 framework, I think, is still gray and somehow needs to
22 be further closed, I believe.

23 One example is in the CSAU examples. They
24 will have biases that are plus and minus and in the
25 end you allow the lack of one to compensate for

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1 another. I just can't understand how that's a good
2 philosophy.

3 CHAIRMAN WALLIS: I should point out to
4 the new members of this group that Norm Lauben was the
5 original drafter of this guide, I believe, and he was
6 the one who presented it to us some time ago. One of
7 the things we said is, "We don't like the way you're
8 doing assessment," because it was done in an even more
9 qualitative way at that time.

10 What I think the committee would like to
11 see eventually is some more rigorous ways of saying
12 now you've got these data points. What information do
13 they tell you about the code in a qualitative way,
14 which not sort of just looking at some graphs which
15 present something that looks reasonably okay, but is
16 more in a sort of Bayesian form. What does this new
17 information tell you about what you thought you knew
18 before?

19 This guide which still looks much like the
20 last one that Norm put together, I don't know quite
21 what's happened. Maybe he'll tell us what happened
22 since then. Still doesn't face that question of
23 whether the more formal rigorous ways of doing
24 assessment and evaluating uncertainties.

25 I would welcome sometime down the road

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1 both the academic community developing these methods
2 or the research community whoever can do it. Maybe we
3 need a supplement to that guide of something down the
4 road which says now we know how to evaluate and assess
5 more rigorously and these are the methods which we
6 will accept.

7 DR. STAUDENMEIER: Yeah, I agree.

8 CHAIRMAN WALLIS: But this is developing
9 because even the applicant's are doing it with order
10 statistic or something. They are actually applying
11 methods which have some logical basis.

12 MR. LAUBEN: Graham, it ends up requiring
13 that somebody do something like the CSAU application
14 part again using different methods. That's not a
15 cheap process.

16 CHAIRMAN WALLIS: No, it's not.

17 MR. SCHROCK: That's the comment I was
18 going to make is that the major difficulty with the
19 use of CSAU in the regulatory process is that the
20 demonstration of it was very expensive. As I
21 remember, it was on the order of a \$6 million effort.

22 Extensive documentation and then, I think,
23 even the code that was being assessed on that basis
24 was found not to be in existence in a workable form in
25 a very short period of time after that.

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1 All of the follow-up uses of CSAU that
2 have been reviewed in my experience with ACRS have
3 been very shortened-up versions of CSAU and there are
4 always arguments as to why the shortened versions are
5 sufficient and give satisfactory results.

6 The Reg. Guide, I think, if you're going
7 to protect yourself against this kind of use of CSAU
8 methodology, you're going to have to be very specific
9 about the requirements that you're going to impose
10 here.

11 DR. STAUDENMEIER: We do have some
12 guidance about what constitutes uncertainty analysis,
13 I guess, but we don't have a specific answer that says
14 if you do this, this, and this you'll get the right
15 answer. I guess as you know there's been quite a few
16 different methods for determining uncertainty
17 throughout the nuclear safety world. I don't think
18 there's any consensus that one stands up and above all
19 the rest that everybody is going to be flocking to.

20 We did write the Reg. Guide so that things
21 can be plugged in later as appendices when we have
22 better answers for things and more specific guidance.
23 We had planned on that in the future like specific
24 guidance for different accident classes to go on in
25 uncertainty. If we can get more done on uncertainty,

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1 that would be another good place to do that.

2 As part of the code assessment for the
3 consolidated code and research we are going to be
4 looking at more quantitative methods for assessment
5 instead of the qualitative thing, the code looks close
6 to the experiment and it's pretty good. We're going
7 to try and get quantitative measures of the assessment
8 and maybe that will lead us to some answers on giving
9 better guidance in the future.

10 As you said, it's only -- the CSAU method
11 has only been applied -- best estimate with
12 uncertainty has been applied in two cases so far that
13 have been licensed, Westinghouse with COBRA TRAC and
14 GE for transient analysis with TRAC-G. I guess you
15 could call them abbreviated in some sense.

16 I think there is justification for their
17 abbreviations where they said, "We looked at this and
18 we don't think this needs to be applied." They had
19 reasons for why specific parts didn't need to be
20 applied backed up by calculations or experimental
21 assessment.

22 Even with their abbreviated method I think
23 both of those were multi-million dollar efforts. The
24 Framatone method, which is formerly the Seamans
25 method, I think that is probably also a multi-million

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1 dollar method. I don't know what the status of that
2 is. That will be the --

3 CHAIRMAN WALLIS: They're a lot cheaper
4 because they just have to run RELAP a lot of times and
5 you can do that much cheaper now than you used to be
6 able to do it.

7 DR. STAUDENMEIER: That's true. You can
8 do a lot more. Once you standardize your method and
9 set up automated runs, you can certainly do
10 uncertainty analysis a lot quicker now. Things that
11 would take a day or so with very expensive craton back
12 in the '80s you can get done relatively quickly on PCs
13 now.

14 That's one thing that will maybe bring the
15 use of best estimate plus uncertainty up to the
16 forefront because you are no longer computation power
17 limited in applying these things.

18 CHAIRMAN WALLIS: While we're on this
19 background and need, it think it's appropriate we talk
20 about some of the other ACRS concerns which constitute
21 a need for you. We talked about assessment here and
22 it's a very broad topic. We'll probably come back to
23 it.

24 We were concerned about the cavalier way
25 that sometimes basic equations were derived with the

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1 use of handwaving with Stokes or something. But the
2 equation is actually used so that the most trivial
3 equation that comes from first course and fluids for
4 a very idealized situation so just decreed this will
5 now be used for everything.

6 There's no discussion about why a method
7 derived for simple geometry applies to the actual
8 geometry of a reactor, for instance. It's just
9 decreed we're now going to use it.

10 The other area where we had some problems
11 was in the sort of scaling and range of applicability
12 of correlation to equations or constitutive laws or
13 whatever you call them. Someone derives an equation
14 for nitrogen water experiment in an university for a
15 Ph.D. thesis and then it gets used for steam water,
16 high pressure, and bigger dimensions of a reactor.

17 How should the staff view this? Should it
18 be thrown out? It's probably unreasonable to expect
19 everyone to do all the experiments in full scale so
20 how do you make the choice of whether or not to accept
21 something when it seems to be used -- a recipe that
22 seems to be being used beyond its range for which it
23 was developed. I think those are two other key issues
24 that we have with these codes.

25 DR. STAUDENMEIER: I thought the Reg.

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1 Guide did address something like that where if you're
2 going to use a correlation it has to be for the range
3 of conditions you're using it in. Or if it wasn't
4 originally developed in that way, you have to do some
5 sort of assessment to show that it will be okay to use
6 it in those conditions.

7 CHAIRMAN WALLIS: I think on the
8 correlation the guy is quite good. I think we still
9 might have a way to go if the ACRS applied the guide
10 in terms of thoroughness with which the approach is
11 laid out of the code rather than just saying this is
12 the only way we can think of to model this so we'll do
13 it and then going ahead and doing all this
14 tremendously complicated correlation stuff.

15 Maybe if we wrote the guide we would say,
16 "Well, you should really go back and say what was the
17 influence of the assumption we made right up front on
18 the answers that we got."

19 DR. STAUDENMEIER: I agree with you. I do
20 think that type of stuff should be dealt with when you
21 come up with your mathematical model that you're going
22 to solve that you really have to have justification
23 for why your mathematical model is adequate to model
24 the situation.

25 That involves looking at all simplifying

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1 assumptions that you've made going from a detailed
2 model to your simplified mathematical model and make
3 sure that these assumptions still hold or to some good
4 approximation and estimate of what the error is in
5 dropping out these other terms that you left out when
6 you've come up with your simplified model.

7 CHAIRMAN WALLIS: The approach of the
8 applicant usually is to push all this over to the
9 assessment process. I mean, they either do not
10 present or they present very quickly as a basic
11 approach and then they go ahead and say, "Look, here's
12 a curve and here's some data points for LOFT or
13 something or other. Therefore, it works. Everything
14 gets presented in terms of the assessment process,
15 whereas ACRS starting at the beginning of the document
16 may have questions about the first page.

17 DR. STAUDENMEIER: I agree with that. A
18 lot of people do push it out for assessment like
19 someone may say, "Oh, we're going to assume
20 incompressible fluid." Instead of going out and
21 showing why it's okay to assume an incompressible
22 fluid in this stage, they say, "We'll just show that
23 it's okay with our assessment against test data."

24 That test data may not cover the whole
25 range of conditions that it may end up getting used

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1 in. It can get carried on and used in situation where
2 it shouldn't. I know one example where that happened
3 with Westinghouse using MAP calculations for AP600 for
4 PRA studies doing LOCA calculations.

5 Once you got over a break size of about
6 four inches, the map results just were totally bad.
7 It really had to do with incompressible fluids. You
8 get depressurization rates too fast and MAP couldn't
9 really handle it, along with some of its other two-
10 phase models couldn't handle the situation. You're
11 right. That type of situation really does need to be
12 addressed up front.

13 CHAIRMAN WALLIS: That's why we used to be
14 always encouraged the party assessment process should
15 be the staff running the applicant's code and their
16 own code and experimenting with it. If they have some
17 query about whether or not something which is not
18 modeled very well matters, then try it.

19 Test with your own code and the
20 applicant's code and see if it matters. If it doesn't
21 matter, there's no sense in trying to make it perfect
22 because it's not appropriate. There are some things
23 that matter.

24 MR. ROSENTHAL: This is Jack Rosenthal.
25 Let me say to your last comment, we totally agree and

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1 that's what NRR is trying to do. Joe Staudenmeier and
2 I were looking at his slides yesterday late and we
3 thought that like slides 11, 12, 13 would spur a fair
4 amount of discussion.

5 It may just pay to let Joe get on with
6 some of his presentation so that we're all sort of
7 thinking about the same thing at the same time. Much
8 of this discussion will come up again. Then we can
9 focus on the key issues of how much do you have to do
10 in the assessment.

11 CHAIRMAN WALLIS: Fred had a point but,
12 first of all, I think it's appropriate that we have
13 this discussion now because Sanjoy asked the question
14 of what's the need. What needs does this address.
15 That's what we're talking about. I think if we have
16 that in mind it will help us to assess whether or not
17 it's okay.

18 My feeling is it's been through so much it
19 would be very difficult to turn around now and say a
20 major revision is necessary. I think it has been
21 good. You're very patient, Joe, to stand up there.
22 You can sit down. I think it would be good to talk
23 about some of the reasons why we need a Reg. Guide.

24 DR. MOODY: This is just mostly to put
25 things in perspective for me, but it sounds like all

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1 this discussion has roots in what has gone before. Is
2 it not the purpose of this Reg. Guide to fix a lot of
3 these problems? This is the main reason this is done.

4 CHAIRMAN WALLIS: That's right. That's
5 why we wanted to identify some of the problems so we
6 can look and see does it fix them or does it half fix
7 them and do we need to go further.

8 DR. STAUDENMEIER: Okay. And to end with
9 Maine Yankee lessons learned, what was decided is we
10 needed a standard review plan in our Regulatory Guide.

11 CHAIRMAN WALLIS: It's very helpful to
12 have something happen, and then learn lessons from it,
13 isn't it?

14 DR. STAUDENMEIER: Yes. Okay. We first
15 came to the ACRS in 1998, I think, with the first
16 presentation of the Reg. Guide even though it had been
17 put in motion before that. What we proposed is we
18 wanted to address analytical methods for all events on
19 a generic basis as much as possible, and address
20 verification, validation, documentation, and quality
21 assurance. There had been problems identified in all
22 of those areas in past code reviews.

23 As part of this what was done was to
24 generalize the evaluation model concept that was
25 originally in place for LOCAs and extend it to

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1 encompass any type of transient or safety analysis.
2 What we really wanted to do is lay down in this Reg.
3 Guide a description of what constitutes an acceptable
4 evaluation method or a development process that would
5 lead you to an acceptable evaluation model for the
6 transient or accident that you were working on.

7 MR. RANSOM: Joe, could you define
8 evaluation model? In the old days we used to use that
9 to mean Appendix K as far as LOCA-type analysis is
10 concerned. Does it have a broader meaning?

11 DR. STAUDENMEIER: Evaluation model, yeah.
12 It's really any model. I mean, it goes beyond just
13 LOCA. People use their evaluation model definition
14 for their transient analysis methods or things like
15 that. What it encompasses is not only the code itself
16 but the input assumptions of how you generate your
17 input for going into the code.

18 MR. RANSOM: In particular we used to use
19 best estimate versus evaluation model. I think the
20 way it's being used here it includes the best estimate
21 method.

22 DR. STAUDENMEIER: Yes, it would include
23 a best estimate method. As I said, it goes just
24 beyond the code. It goes beyond the way -- it goes
25 into the way you apply the code so the methodology

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1 that you use in applying the code.

2 MR. LAUBEN: That's right. Vic, I think
3 there was a mis -- well, when the ECCS rule was
4 modified in 1988 the only evaluation model for LOCA
5 was Appendix K. But in the revision in '88 you could
6 do best estimate but the definition of evaluation
7 model included both a best estimate evaluation model
8 and the Appendix K evaluation model.

9 Even LOCA does not distinguish between
10 best estimate and Appendix K, at least the rule. It's
11 just that the idea sort of carried over in a lot of
12 people's minds that evaluation model only applied to
13 Appendix K. For this purpose we decided we are going
14 to generalize the evaluation model concept which is
15 simply, as Joe said, it includes all the things that
16 go into your analysis.

17 In the old days in particular, there may
18 be a lot of codes that go into one analysis because it
19 was cheaper in the old days with computer time and so
20 forth. You may have had to run a string of six or
21 eight codes or six or eight little subcodes separately
22 to get the answer that you wanted, whereas today we
23 lump them all into one big code more often than not.

24 MR. BANERJEE: I have a question. Does
25 the evaluation model include how you nodalize the

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1 system, for example, because the impression I get is
2 that this is not sort of -- there's no conventional
3 convergence testing done so you model the steam
4 generator in this way, the pipes in that way, the core
5 in that way. All this is some sort of folklore that
6 has grown up around use of these codes. Am I right on
7 that?

8 DR. STAUDENMEIER: There is supposed to be
9 convergent studies that the vendors do when they put
10 together their nodalization. The evaluation model
11 does include the nodalization. We consider a change
12 to the nodalization to be a change to the evaluation
13 model.

14 If you look at Appendix K it specifically
15 says that. 50.46 in Appendix K specifically includes
16 the nodalization as part of the evaluation model
17 because essentially you are really solving a different
18 set of mathematical equations. When you change the
19 nodalization you've added for each equation -- for
20 each node you have equations you're solving so you've
21 changed the number of equations you're solving.

22 There are supposed to be nodalization.
23 They may not be as rigorous as formal convergent
24 studies but they are supposed to be sensitivity
25 studies applied to make sure that you are converged in

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1 space and in your time integration when you do those.

2 MR. RANSOM: So your results, are they
3 supposed to be independent of nodalization?

4 DR. STAUDENMEIER: I think with two-phase
5 codes I don't think you can get independent of
6 nodalization. I think if you took TRAC or RELAP and
7 went towards large number of nodes, I think you will
8 run into Calvin Helmholtz two-phase instabilities that
9 aren't damped out because you don't have discus trends
10 and other things in there.

11 Specifically you cannot mean convergence
12 in the classifical sense. Numerical convergence is
13 you take the limit as you go to zero and see. CSAU,
14 for example, addresses this problem. Admittedly in
15 the old days you were probably driven somewhat by the
16 limitations of the computer and the expense of the
17 time that you could spend actually in solving a
18 transient by how many nodes you might actually use.

19 The allocation of nodes between, say,
20 steam generator core, and things like this, some
21 sensitivities were done to find a nodalization which
22 gave satisfactory results in comparison with LOFT or
23 one of these experiments.

24 What CSAU says is that whatever you use in
25 the way of nodalization for that assessment, you must

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1 use those same nodalization guidelines when you apply
2 this to a nuclear power plant so there is a constant
3 more or less. Admittedly there may not be a one-to-
4 one mapping in all cases between these two. Generally
5 the nodalization guidelines should be the same for the
6 application as they are for the assessment process.

7 MR. BANERJEE: But why? The scale is
8 different.

9 MR. RANSOM: The scale is different but
10 the geometric scale presumably there should be some
11 similarity.

12 MR. BANERJEE: But is that proven in some
13 formal way that the scaling is correct?

14 MR. RANSOM: I don't think so.

15 MR. BANERJEE: Otherwise why have a set of
16 differential equations you're solving? If you want to
17 make a model and say this is a physical model for the
18 steam generator or this and that throughout the
19 differential equations, it makes no difference. I
20 don't see the logic of having results which are at all
21 dependent on nodalization.

22 MR. RANSOM: For example, it may be
23 important to track levels in some cases like a small
24 break in the steam generator where the boil-down level
25 may be important. Nodalization is about the only way

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1 you can refine that level in the computer code
2 calculations so you must find at least a satisfactory
3 one.

4 Another good example I could give, and
5 this is one you could take some issue with, but
6 Marviekin critical flow experiments. If you do a
7 course nodalization of the vessel much like you might
8 use in the core of a reactor, you're going to get a
9 terrible result because of numerical diffusion in both
10 the energy and the mass. Rather fine nodalizations
11 are used in those cases.

12 It's still a subjective matter of
13 judgement. This is why assessment is still a
14 qualitative sort of science as opposed to real
15 quantitative in my mind. As much as I would like to
16 see it tightened up, it's a difficult problem.

17 Another thing would be, for example, does
18 it make any sense to have nodalizations that are finer
19 than, say, one pipe diameter when you have ignored all
20 the transverse gradience in the pipe to start out
21 with. It's the averaging process you've used to drive
22 the equations you use. You're going beyond the limits
23 of those. Does that make any sense?

24 So there are these kinds of limits to
25 which you can actually apply these models, I believe.

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1 Some of that I would like to see addressed in time in
2 something like a Reg. Guide but it's somewhat of a
3 debatable issue.

4 If you talk to the French, they have
5 another opinion in terms of, say, what well posiness
6 of the equations and presumably you could then carry
7 out, say, a refinement of the nodalization ad
8 infinitum if you wanted to. I don't think that's
9 necessary. It's not my opinion but these are issues
10 which are not really settled.

11 MR. BANERJEE: So the evaluation model
12 includes in some way a definition of what is an
13 acceptable nodalization, however it's arrived at?

14 MR. RANSOM: Yes. And typically in the
15 past the way this has been done is like the last time
16 I reviewed Appendix K LOCA model upgrade the main
17 problem they were having was in the core of their DMB
18 correlation and their disperse flow heat transfer from
19 boiling heat transfer correlation.

20 What they would do is specifically for the
21 core nodalization they looked at 12 nodes, 18 nodes,
22 24 nodes and compared it to experimental data that was
23 applicable for that case which in that case, I think,
24 was THTF dispersed low-film boiling heat transfer, and
25 came up with a nodalization that was adequate to

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1 predict the temperature profiles and dry-out profiles
2 for that experiment.

3 For different parts of your model like the
4 steam generator it may be based on having an adequate
5 number of levels to track when you break natural
6 circulation in the loop, or there may be various other
7 constraints in other parts and nodalization studies
8 will be done to make sure that you are adequately
9 resolving the phenomena in those locations in the
10 plant for the transient that you're looking at,
11 transient or accident that you're looking at.

12 The same with time step studies. All the
13 codes have some time step. They are not really smart
14 enough to control time step automatically and make
15 sure everything is resolved.

16 They don't look at truncation and do a
17 truncation error analysis of the equations that they
18 are solving. They look at rates of change of various
19 things and some error measures for global iteration
20 conversations but they don't really do classical
21 convergence in terms of their time step control.

22 Part of this study would be making sure
23 you have a small enough time step to resolve your time
24 history and looking at time step sensitivity studies
25 to determine what an adequate time step to calculate

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1 the accident that you are looking at.

2 MR. BANERJEE: So if I understand what
3 you're saying correctly, the way I get it is that you
4 are trying to capture certain types of physical
5 phenomena which you think are important which is fine.
6 And your evaluation model then would have appropriate
7 nodalization so that it would allow you to capture
8 those phenomena.

9 But you are not trying necessarily to
10 solve the mathematical set of equations that you posed
11 to begin with with their boundary conditions, initial
12 conditions, and so on. You are simply trying to solve
13 some integral representation which conserves mask
14 momentum or whatever for a lump parameter almost
15 description of the system with adequate nodalization
16 to capture certain phenomena.

17 DR. STAUDENMEIER: Yes, I would agree with
18 that statement.

19 MR. BANERJEE: Is that the philosophical
20 basis? I'm having trouble with the philosophy
21 actually.

22 DR. STAUDENMEIER: I think that's the
23 philosophical basis because, as you know, the
24 equations in these codes aren't really a well-posed
25 set of differential equations. I mean, you look at

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1 the correlations and they are kind of like subgrid
2 models and have discontinuities in them and things
3 like that. It would really be hard to do formal
4 convergence analysis I think.

5 MR. BANERJEE: Katarah uses bellpost
6 equations with proper transition because they have to
7 calculate a Jacobian.

8 DR. STAUDENMEIER: It depends on what you
9 mean by proper transition. Proper transition may be
10 the functional fit that made the code run faster in
11 that case.

12 MR. BANERJEE: It could well be.

13 DR. MOODY: I'm reading on page 19 of this
14 masterpiece here. This is the second paragraph. I
15 thought it kind of addressed that.

16 MR. BANERJEE: Maybe it does.

17 DR. MOODY: In the middle of that
18 paragraph under the heading, "Prepare Input and
19 Perform Calculations to Assess Model Fidelity or
20 Accuracy." In the middle of the second paragraph it
21 says, "In particular nodalization and option selection
22 should be consistent between the experimental facility
23 and similar components in the nuclear power plant."
24 I guess that's true. I guess it's just how you get
25 from here to there.

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1 MR. BANERJEE: That's really the problem,
2 yeah. I don't see how you scale it. It's embraced by
3 this structure.

4 MR. ROSENTHAL: Let me try this. Bear in
5 mind that the Reg. Guide pertains to physics analysis
6 and fuels analysis as well as thermal-hydraulic
7 analysis to all analysis in chapter 15, anticipate
8 operational occurrences and transients that Joe
9 Staudenmeier talked about.

10 Let's take a physics example. Clearly in
11 all cases you are solving Boltzmann equations. If you
12 use a final mesh treatment, then you'll convert the
13 Boltzmann equations into finite difference equations
14 that are reasonably simple.

15 If you go to a coarse mesh treatment where
16 there is one or maybe four nodes per assembly
17 radially, then you tend to have -- you use different
18 numerical approximations to the differential
19 equations. You tend to do more arithmetic at each
20 node and fewer nodes.

21 Now, in my own mind when we talk about the
22 evaluation model, you have written Boltzmann equation
23 of course. You've written down whether it's coarse
24 mesh or fine mesh and what the numerical
25 approximations are in those cases. Then the

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1 evaluation model consist of both numerical methods
2 that you're using and the nodalization because that
3 clearly coupled.

4 MR. BANERJEE: There's a formal process
5 that we use in turbulence called coarse screening. It
6 uses certain types of renormalizations to go coarser
7 and coarser. That's a formal process and I don't see
8 any such formal process here.

9 I mean, you may stop with a very fine-
10 grained description of the system. You say this is
11 not very useful to me because one extreme there are
12 intermolecular forces, but now I want something which
13 I can microscopically observe.

14 At that moment you don't make a leap of
15 faith. You go through a formal process of coarse
16 graining and there's no such coarse graining process
17 that I see going on here. We do that all the time in
18 turbulence. That's how you get eddie viscosity at the
19 end. You renormalize the molecular viscosity but
20 there is nothing like that being done here.

21 CHAIRMAN WALLIS: But what you're
22 addressing is I remember a few years ago I tried to
23 write out my own sort of summary of what should be in
24 these codes. What I would really like to see is an
25 opening chapter which says this is what we're asking

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1 the code to do. These are the kind of geometries and
2 flow regime or whatever. It's got a handle.

3 This is the approach we're using and this
4 is the philosophical way. This is missing completely
5 and it's not even there hidden because I find a great
6 difficulty in going from a statement, "We are going to
7 use this momentum equation," to how it's applied to
8 the actual system. If I look at the nodalization, I
9 see a box, a square box which is supposed to describe
10 a piece of the reactor.

11 Well, if I look at the lower plenum, what
12 is this box? It's either in a gross way something
13 like looking down on half a grapefruit that you are
14 going to eat. How do you represent that as a box? No
15 one tells me. If you're going to break it up, they
16 are going to take each little segment and scoop out
17 with a spoon and they will model that in some way.

18 It never tells me how the picture which
19 was drawn for a little square box to derive a momentum
20 equation has any relationship to what goes on in that
21 little segment of a grapefruit which is not a square
22 box. That never gets addressed.

23 I would like to see an approach that says
24 we have to model these kinds of geometries. We have
25 to model these kinds of situations. We are going to

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1 formally develop some reasonable approximation or
2 something to represent them showing that we understand
3 what we're doing in a way which I think no code ever
4 does.

5 No code documentation ever does. They
6 just launch into writing down some vector equations or
7 something and then say, "We can't handle that so we're
8 going to use something very much simpler," and then
9 going ahead.

10 DR. STAUDENMEIER: Yeah, I agree with
11 that. I thought the Reg. Guide had some sections to
12 address that you really need to start out with your
13 specific scenario and the equipment that you're
14 modeling and start from there to see what is adequate
15 to model in your situation.

16 CHAIRMAN WALLIS: I think the words may be
17 there.

18 MR. RANSOM: Use some reason in the
19 application of these methods to things like reactor
20 systems. It doesn't matter whether you're talking
21 about chemical systems or whatever. They are, in a
22 sense, more integral type models that worry about mass
23 and energy hopefully and a conservation within major
24 components. We have gone steps further and subdivide
25 these.

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1 Invariably we replace the heat transfer
2 with a heat transfer coefficient using Neuton's
3 cooling law or a Darcy-type friction factor and ignore
4 all the transverse gradients. It doesn't matter if
5 you're talking about modal dimensional formulations of
6 these codes. They do the same thing.

7 You simply don't have enough detail, or
8 can't afford it at the current time, to actually model
9 the physical transport process as they go on is the
10 result of these transverse gradients.

11 CFD, I think, is getting closer to that
12 kind of thing where they can do some modeling of
13 turbulent phenomena from a fundamental point of view.
14 Some day we may do that in reactors but, as far as I
15 can see, probably beyond my lifetime.

16 CHAIRMAN WALLIS: Take the lower plenum.
17 It's not a grapefruit now. It's a ball you put in the
18 sink. You force it down, it squirts around, and comes
19 up again. It's like a turbine bucket. Treating that
20 as if there were no transverse gradients seems to me
21 inappropriate. Show me that the model that you're
22 using applies to that kind of geometry.

23 MR. RANSOM: Well, that's why I think the
24 mass and the limitations of these models, some care
25 needs to go to that because I'm not sure there's

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1 anything better you can do at the current time.

2 CHAIRMAN WALLIS: Because you don't know
3 how to do anything better means that you ought to
4 admit it rather than just writing it down as if it has
5 some authority. Everyone is going to believe that
6 this equation is the only way to do it.

7 MR. SCHROCK: To add to the confusion if
8 you look at this TRAC-M documentation you find that,
9 in fact, you can do three dimensional calculations in
10 your plenum and also in your downcomer. I mean, TRAC-
11 M does that. It does that because TRAC did it before
12 and there it is in the documentation. It says it's
13 able to do that. I've never been able to fathom what
14 the basis for that claim is.

15 DR. STAUDENMEIER: Well, limited 3-D
16 capability.

17 MR. SCHROCK: Let's talk about the basis
18 of an argument that you're doing a 3-D computation in
19 either the plenum or the downcomer.

20 DR. STAUDENMEIER: I think the assumptions
21 and what you mean by that should be spelled out in
22 documentation. I agree with that. Like modeling
23 downcomers, I mean, you have an open space. You have
24 structures on both sides, water coming in during
25 reflood.

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1 How do you tell if the water is touching
2 the inside wall or the outside wall? We throw in
3 these constitutive relations that hopefully do
4 something reasonable. You know you're not modeling it
5 entirely correctly but hopefully it's doing something
6 reasonable for the situation.

7 Largely we are held together by our code
8 assessment both in terms of the correlations
9 themselves at the separate effects test and in terms
10 of how it holds together in a situation like a
11 downcomer big integral test.

12 In that case we have UPTF data which is
13 full-scale reactor downcomer. We really are largely
14 held together in this analysis field by our
15 experimental database.

16 CHAIRMAN WALLIS: Dr. Kress.

17 MR. KRESS: I just wanted to throw in a
18 contrary thought. That is, in terms of the
19 description of what the geometry is supposed to be, I
20 think everybody assumes that we know what it is.
21 There's not that many geometries out there. Do
22 describe each geometry every time in a general sense
23 is probably not worthwhile.

24 From the standpoint of the crudeness or
25 the lack of sophistication of the model, I think you

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1 have to ask yourself how good do we want the answer to
2 be? How good of an answer do we need? Sometimes that
3 allows one to have some pretty crude models.

4 For example, a lot of the BWR results is
5 just a pot boiling away. You can be pretty crude with
6 the pot boiling out. Some places you need better
7 nodalization than others. I agree that if you're
8 trying TRAC level or TRAC two-face flow entrainment
9 and things of that nature, you need to look at how to
10 refine your models.

11 It all boils down to how well your
12 nodalizations and your model describes the data in
13 relatively large-scale experiments and then the
14 question of how can you be sure that is the case for
15 the full scale, I think, is real valuable.

16 I've never really -- you know, there's
17 these scaling equations to show you that at least the
18 phenomena ranges are about the same, but that doesn't
19 really tell me much about whether if you use the same
20 nodalization in a sense of similarity nodalization,
21 that is the appropriate way to do it. It would be
22 nice to see that somewhere.

23 CHAIRMAN WALLIS: I think what concerns us
24 is, it's true, certain accidents are just a pot
25 boiling. In probably a two-node system or something

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1 we work fine. Then if you say, "Ah ha, therefore,
2 anything we assume about our momentum equation is
3 going to work because it's just a pot boiling.
4 Therefore, this validates the momentum equation,"
5 that's not true.

6 It may be that in something like AP600
7 where it's more delegate to the balance between
8 whether the flow goes from this reservoir to that one
9 or to some other one because there's a balance so the
10 pressure drops and so on. Maybe you need to know
11 these pressure drops much more precisely.

12 MR. KRESS: I think that's exactly the
13 case where you need to have better and more
14 sophisticated modeling because the small pressure
15 drops make a big difference.

16 CHAIRMAN WALLIS: Another peeve of the
17 ACRS is that something gets approved in 1965 or
18 something and never examined ever again.

19 MR. KRESS: It can apply to AP1000.

20 CHAIRMAN WALLIS: Even if Vic Ransom wrote
21 it.

22 MR. KRESS: That's an automatic approval.

23 MR. BANERJEE: Well, I guess coming back
24 to the evaluation model, the philosophy is probably
25 defensible in the sense that you've got to take your

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1 best guess at some expert's perk or something and then
2 resolve the phenomena that you can.

3 I think the last step on how you go from
4 relatively small-scale facilities to the full scale
5 and sort of defend your position in terms of whatever
6 nodalization you have chosen and whatever model is not
7 clear.

8 I was involved with the scaling study for
9 the AP600 and it was relatively easier for that case
10 because most of the things you could describe with a
11 locked parameters set of ordinary differential
12 equations tracking levels here and there and you could
13 get some scaling groups that were useful.

14 Actually, you could get analytical
15 solution to the equations which almost gave you what
16 you were looking for. You didn't even need to use a
17 code really. But that was a unique situation. It was
18 sort of a situation dominated by this ADS-4 and levels
19 up and down.

20 In general I don't see how you can derive
21 this way to bridge from the nodalization that you are
22 choosing for your experiment to the full scale.
23 That's why people have gone to saying, "Well, if you
24 refine the nodalization and your answers are not
25 dependent on the small scale, then they are not likely

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1 to be dependent on the full scale.

2 As soon as you get into the trap of
3 saying, "This is the nodalization that works for this
4 small-scale system. Now I have to find how it works
5 for the full-scale system because my results are very
6 nodalization dependent, then I think it's a difficult
7 position to defend.

8 If it's nodalization independent, then you
9 can defend it because you can say, "Well, it doesn't
10 really matter how I nodalize it."

11 DR. STAUDENMEIER: Well, in most cases you
12 can say there are some cases where you get fooled by
13 even that because you are not modeling something. If
14 you were really modeling it they wouldn't depend on
15 nodalization.

16 Most of the cases we look at are fairly
17 well behaved in terms of nodalization and do converge
18 fairly well as you add nodes. In most transients I
19 think you can boil down into some simple phenomena
20 that are driving the whole thing just like AP600.
21 Like a pump trip in a plant is driven basically by the
22 frictional losses in the system in the pump.

23 In PWR it will be in single-phase flow
24 during the pump trip. You have plant data that
25 measures the coast down to the pump and coast down to

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1 the flow in the plant that you can compare your code
2 results against it to show that you are doing
3 something reasonable in that case.

4 I think a large majority of cases we're
5 looking at are like that. I mean, there are some
6 cases you get into like severe accidents, but before
7 severe accidents like ATWS and BWR, you get into these
8 super large full oscillations coupled with power
9 oscillations.

10 We obviously don't have plant data to
11 compare when we get into that range. We have some
12 plant data at small oscillation amplitudes when some
13 BWRs went into instabilities. For the full analysis
14 you do for ATWS you don't have plant data that covers
15 that whole range of conditions.

16 You have some heated channel data that
17 shows where the onset of flow oscillations is. Your
18 data probably doesn't cover the full amount in your
19 amplitude that you get into in some of these beyond-
20 design basis situations like ATWS.

21 When you are in a situation like that, you
22 have to recognize that beyond a certain point there
23 are just large amounts of uncertainty in my prediction
24 and take compensations for the fact that you really
25 are going out into some place you don't know a lot

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1 about and don't take confidence in what those
2 calculation results are giving you out in that range.

3 You don't make decisions pretending that
4 you know with fine details of accuracy that this is
5 how the plant is going to behave in that place. I
6 think the regulation in here has taken that attitude
7 where you get into regions where you are in the
8 unknown you apply conservatism or apply some sort of
9 resolution to the problem that we don't really know
10 what's going on out there so you work around it.

11 You don't have to know what's going on out
12 there. Your solution to the problem would be taking
13 measures that keep you from going out there or if it
14 did go out there, if you are beyond design basis like
15 in PRAs, you count that up in the failure bin for when
16 you are doing core damage assessments or things like
17 that.

18 CHAIRMAN WALLIS: What you're showing is
19 that it's not just the paper, it's the people. In
20 order to do a proper review using this guide, the
21 staff has to have the kind of awareness and knowledge
22 of all these things that you've been revealing and the
23 things you've been saying.

24 A new trainee coming in here would have
25 difficulty getting your experience and reviewing code

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1 using this guide. There have to be other things that
2 have to happen in order for it to be a good review.

3 DR. STAUDENMEIER: Yeah, I agree with
4 that. There has to be knowledgeable people here and
5 you just can't -- you couldn't just get rid of all the
6 knowledgeable people in the NRC and bring in a whole
7 new crop of people out of college.

8 CHAIRMAN WALLIS: It requires a commitment
9 in terms of funding and personnel over a long period
10 of time.

11 DR. STAUDENMEIER: I think so. I think
12 that is actually one weakness of the NRC in that area.
13 They should really come up with some sort of
14 formalized training program or process where people
15 learn all this stuff in a more formal manner.

16 Right now the way it works you have a
17 junior level reviewer working with a senior level
18 reviewer and he might go and ask a few other people
19 who had written SERs on this process, but there's no
20 real formal training program.

21 CHAIRMAN WALLIS: Then you put them in
22 front of the ACRS and that's a learning experience.

23 DR. STAUDENMEIER: You can call it that,
24 I guess. It depends what you think you'll learn.

25 MR. RANSOM: Discussing this Reg. Guide it

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1 would be interesting for maybe the NRC to put together
2 on all of these issues that have been discussed around
3 this table what is known about these issues and what
4 is the accepted approach and get some agreement on
5 that and get some specificity into a document like
6 this.

7 Whereas right now it's very qualitative,
8 you know. It specifies what you must do in sort of
9 general terms but it doesn't say you need a 1,000 page
10 document to do this and I'm not suggesting that kind
11 of thing. Somewhere in the assessment of how good is
12 good enough there does need to be some more detail
13 actually.

14 We have argued and talked about these
15 issues and it would be very helpful if some of this
16 would simply attack some of these problems and get
17 them down and get agreement on them that this is the
18 approach and accepted approach. Then maybe we could
19 not have to redo this so often.

20 CHAIRMAN WALLIS: Maybe this committee
21 could contribute to that. Maybe not today but in the
22 next few years.

23 DR. MOODY: If you hire all your NRC
24 employees from either Berkeley or Purdue or Dartmouth
25 or U.C. Santa Barbara you ought to be okay.

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1 CHAIRMAN WALLIS: No, the way to do it is
2 to hire them from General Electric and Westinghouse.
3 Then we know what's really going on there.

4 MR. CARUSO: Dr. Ransom, this is Ralph
5 Caruso from the staff of NRR. I've just been sitting
6 here listening to this discussion and I would make the
7 observation that right now all three vendors have been
8 through this process. G has been through it, Seamans
9 has been through it. They've been through this
10 process using this methodology. There is ongoing
11 dialogue with them continuously about how much is
12 enough.

13 I agree strongly with Joe's comment and
14 Dr. Wallis' comment about the people. It's nice to
15 write it down. It's nice to write down what we've
16 done that is acceptable. We have written it down when
17 we write our SERs but a lot of this is going to be
18 tribal knowledge.

19 There was an ACRS member last week who
20 talked about the dark side of certain things. If you
21 write things down in too much detail, there's a dark
22 side to that and that is you get people that do
23 reviews who think they are doing the review right but
24 if they don't understand what they're doing, they give
25 you an answer which is incorrect.

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1 There's a balancing that has to go on
2 here. I'm under a lot of pressure from my management
3 right now to write down more stuff so it can be done
4 by less experienced people. I'm not sure I entirely
5 agree with that.

6 I'm going on the transcript. I've said
7 this to my management and I'll say it to you. I don't
8 think that's necessarily the right way to go. I would
9 much rather depend on smart people like Dr.
10 Staudenmeier here to do the review done on somebody
11 who has never done it before.

12 CHAIRMAN WALLIS: We need to develop a way
13 in which someone like Norm can never retire.

14 MR. CARUSO: He'll become an ACRS
15 consultant and sit up here with you guys.

16 MR. LAUBEN: The economy has done that for
17 me.

18 MR. RANSOM: And I agree that a lot of
19 this reactor safety analysis work isn't that hard.
20 It's dependent on good judgement on the part of
21 engineering people or engineering judgement if you
22 want to call it that, and a lot of the design in
23 safety analysis. It is very difficult to tighten some
24 of those up.

25 In that sense, a popular phrase today, "It

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1 ain't rocket science," but a lot of this is rocket
2 science.

3 MR. CARUSO: Yes.

4 CHAIRMAN WALLIS: Vic, I think you have to
5 speak into your microphone. I'm sorry. You have to
6 speak in the microphone.

7 MR. RANSOM: Okay. I was just saying that
8 it is rocket science. That's where a lot of this came
9 from, as a matter of fact. You could say the same
10 methods are used in those cases, the model transient
11 and rocket engines. Again, it depends a lot on
12 engineering judgement and I think we will a long time.

13 There does have to be some balance and I
14 understand probably the vendors would like loop holes
15 because that means it's easier to get the thing
16 through than if there is more specific algorithm for
17 that. I understand that's the balance you fight.

18 MR. CARUSO: Everybody wants, you know, a
19 certain amount of flexibility but everyone also wants
20 predictability and there's a tension between
21 flexibility and predictability. You can't have it all
22 one way.

23 The example I give people about
24 difficulties in coming up with analytical methods is
25 numerical methods. We had Westinghouse come in with

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1 W-COBRA TRAC and they had one numerical method to
2 assess code uncertainty. Then Seamans and Framatone
3 came in with another method. Westinghouse seeing the
4 method that Seamans came in with are thinking about
5 revising their method to something else. NGE has yet
6 a fourth method and I'm sure there must be a fifth and
7 a sixth method out there to do statistical
8 uncertainties.

9 MR. ROSENTHAL: GRS.

10 MR. CARUSO: GRS. GRS method. Okay.
11 There are other methods out there and I'm constantly
12 being asked why don't you figure out a way to tell
13 people how to produce predictable results when they
14 review these codes.

15 I don't know how I can do that if I can't
16 predict in advance how creative they are going to be
17 to develop new methods. I mean, it's like asking me
18 to come up with a review standard for a starship
19 drive. I don't know how to do that.

20 MR. RANSOM: Well, one way, of course, is
21 that you have to focus on the end result that you
22 want. Not necessarily the method for getting there.

23 MR. CARUSO: Well, then you end up with
24 the common complaint that you treat these things like
25 black boxes and you don't understand what's in them.

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1 MR. RANSOM: All the documentation and the
2 standards you put forth for that allow it to be
3 reviewed so that is part of the check and balance
4 system I think, to make sure that it doesn't just
5 float through.

6 CHAIRMAN WALLIS: One of the checks which
7 would be very useful and a little bit difficult with
8 proprietary codes and methods is if the audience were
9 not just a few NRC reviewers in ACRS but the public
10 and if these things were actually presented at
11 professional meetings.

12 This is the new way of evaluating
13 uncertainty that has been developed by X company.
14 It's actually out in the open. That gives you a lot
15 more assurance that people would find errors if there
16 were some.

17 MR. CARUSO: Well, it would be a good
18 thing except that companies treat this stuff as
19 proprietary.

20 CHAIRMAN WALLIS: They are using a
21 statistical approach which has been used in many other
22 fields and it has credibility.

23 MR. CARUSO: I agree. I would like it to
24 be publicly available. Unfortunately a lot of times
25 it isn't.

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1 CHAIRMAN WALLIS: Sometimes it's the
2 things which are not public that give us the most
3 trouble.

4 MR. CARUSO: I understand. I understand.

5 CHAIRMAN WALLIS: Well, Joe, we're taking
6 time because you've got all morning. I think we may
7 have addressed a lot of things that we would otherwise
8 address later. Perhaps we should let you get on to
9 your track.

10 MR. BANERJEE: In more ways than one.

11 MR. STAUDENMEIER: Okay. The basis for
12 all this lies in the regulation 10 C.F.R. 50.34 which
13 says that you have to base technical specifications
14 and plans on safety analyses. That's the whole
15 driving regulation behind all of this is that you have
16 set points and various other tech. specs. at plants
17 that have to be based on analysis.

18 As guiding principles for developing this,
19 Norm started with CSAU. I think Novak informed them
20 he had gone beyond that with SASM, Severe Accident
21 Scaling Methodology. The principles from that were
22 also incorporated into the Reg. Guide.

23 CHAIRMAN WALLIS: That's what was
24 mentioned. I thought someone said assassin.

25 MR. STAUDENMEIER: SASM, S-A-S-M.

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1 CHAIRMAN WALLIS: I was wondering what's
2 the difference between assessing and assassin. SASM
3 is another word. Okay.

4 MR. RANSOM: Joe, could you give me an
5 example of what this hierarchial system decomposition
6 principles does for you?

7 MR. STAUDENMEIER: Really it's a top-down
8 scaling method is how I would describe it. You look
9 first at the system you are describing and try to
10 divide it up into different parts where different
11 phenomena are going on and then down at more detailed
12 levels.

13 You say for this component model these
14 physical processes are going on underneath there and
15 do I have adequate models to model these physical
16 processes going on within these components. Then the
17 top level would be integrating these components into
18 a couple systems and doing the calculations.

19 MR. RANSOM: It sounds like a PIRT.

20 MR. STAUDENMEIER: It's similar to the
21 PIRT.

22 MR. BANERJEE: It eventually ends up as a
23 PIRT.

24 MR. RANSOM: But I guess you try to give
25 a quantitative figures of merit or something to the

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1 different things.

2 MR. BANERJEE: It's qualitative.

3 MR. RANSOM: Qualitative?

4 MR. BANERJEE: I think it's qualitative.

5 MR. STAUDENMEIER: It's a structure -- I
6 mean, somewhat quantitative and somewhat qualitative
7 but it's just a structured method of decomposing it
8 into parts that you can understand and generate models
9 for is how I view it.

10 MR. BANERJEE: It gets down to phenomena.
11 It should be getting down to phenomena.

12 MR. RANSOM: That's what they do in the
13 PIRT, too, isn't it? It's phenomena identification.

14 MR. BANERJEE: It's a more formalized way
15 of arriving at that. I don't know. There may be more
16 to it. I'm not sure.

17 MR. RANSOM: I was wondering what it does
18 for you in the end.

19 MR. LAUBEN: Well, there are about seven
20 levels. I'm not an expert in it by any means but the
21 idea is that it's more simplified at the top. If you
22 are missing something at a high level, you're not
23 going to be compensated for it at a lower level.

24 You have to make sure at each level as you
25 go down through it that you have what you need to

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1 solve your problem. It includes things like do you
2 have enough phases, do you have appropriate
3 conservation equations, do you have all these things.
4 I can't even remember what each level is.

5 MR. BANERJEE: It's somewhere in the Reg.
6 Guide.

7 MR. STAUDENMEIER: Yeah, there's a fairly
8 large new reg. describing the whole thing if you're
9 interested.

10 MR. RANSOM: I'll try to get it.

11 MR. STAUDENMEIER: I think it's maybe
12 about this thick or something.

13 MR. LAUBEN: The principle purpose of it
14 when it was being developed for SASM was actually to
15 look at assessment but it applies very well to code
16 development principles. Are you putting the right
17 things into code.

18 MR. STAUDENMEIER: Yeah, I would call it
19 kind of almost like a PRA type structure only applied
20 to analysis where you are dividing things up and you
21 have different contributions and it gives you a
22 formalized way to take what is the most important
23 thing that you have to invest your time and money into
24 getting better models.

25 CHAIRMAN WALLIS: You have your equations

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1 and you have to have your principles. You have to
2 have the equations based on them and you have to have
3 the coefficients and the equations and so on.

4 MR. STAUDENMEIER: Okay. This is what
5 Norm came up with, that it's an organization in DG1096
6 introduction discussion. It's very similar to 1120.
7 I'll put up the table of contents for that later.
8 Then Norm wasn't satisfied with CSAU or SASM so he had
9 to come up with his own acronym and came up with
10 EMDAP, Evaluation Model Development and Assessment
11 Process.

12 That's the main piece of the Reg. Guide is
13 describing this evaluation model development and
14 assessment process covers quality assurance,
15 documentation, and the section on general purpose
16 computer programs was added really as a result of the
17 RETRAN review experience. Also there's an appendix on
18 additional considerations for using this for ECCS
19 analysis.

20 The principles of this EMDAP process is
21 that up front you have to determine the requirements
22 for what your evaluation model has to do. You decide
23 on a power plant type and accident scenario.

24 Once you've picked that out, you look at
25 the components you have to model, the processes that

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1 are going on that you have to model, and assure that
2 you've come up with a well structured system in
3 analyzing these requirements up front before you go on
4 deciding what sort of code or equations you need to
5 solve to do this.

6 After you develop all these requirements
7 you develop an evaluation model that meets the
8 requirements. Developing a model doesn't mean that
9 you may not be writing some code from scratch.

10 You may be picking up some code like
11 RELAP. After you've done this analysis up front you
12 may determine that RELAP has all the required models
13 in there and physical processes in there to be part of
14 your evaluation model.

15 After you've made that choice, developed
16 it, you do a specific assessment base that is
17 appropriate to the requirements of your evaluation
18 model which depends on the accident scenario in the
19 plant you are looking at for this model.

20 You come up with all the physical
21 phenomena that are important in that case which is the
22 PIRT like process. Come up with experiments to assess
23 your important models against those physical phenomena
24 and hopefully some integral experiments which in the
25 case of transients could be actual plant data.

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1 So you go and assess your model. During
2 the process you have to be following quality assurance
3 protocols to make sure that you have a paper trail
4 documenting that your model is actually good to do
5 what you're going to do so that it's traceable back to
6 all your assessment and showing that it's adequate to
7 use it for what you're doing.

8 MR. RANSOM: Joe, right here you're
9 talking about here is a road map for developing an
10 evaluation model and things that I had difficulty
11 with. This is in response to Ralph's comments, too.
12 It says "specified figures of merit." Then down below
13 it defines those as, "Figures of merit are those
14 quantitative standards of acceptance that are used to
15 define acceptable answers for safety analysis."

16 MR. BANERJEE: BCT.

17 MR. RANSOM: Well, these should be
18 defined. Is there a table or something that says what
19 they are for different accidents?

20 MR. CARUSO: It depends on how the
21 licensee or the vendor or the person who is using the
22 code what they are using it for.

23 MR. STAUDENMEIER: But that's where this
24 appendices would come in later. This was going to be
25 a top level framework and then there would be an

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1 appendix for a specific type of accident or transient
2 where you would have that actual success criteria or
3 safety criteria that you are examining. But there are
4 very -- I mean, DMBR ratios, CPR ratios.

5 MR. RANSOM: You read on down further and
6 it says, "Determine evaluation model biases and
7 uncertainties." Again, that's about as much as it has
8 to say about it.

9 CHAIRMAN WALLIS: This is much more
10 difficult. in the case of 2200 you have a criterion
11 but what is the criterion for uncertainty?

12 MR. RANSOM: And finally in the last block
13 it says "inadequacy standard." What is it? I mean,
14 these are the problems that give me real grief.

15 CHAIRMAN WALLIS: Even with uncertainty we
16 get things thrown around like 95 percent confidence in
17 the 95th percentile of the predictions or something.
18 That may help you when you protocol efficiencies in the
19 code. It doesn't help you when you're addressing the
20 scaling. How can you be 95 percent sure that you are
21 within this 95th percentile of some scaling situation.
22 I don't know how to do that.

23 CHAIRMAN WALLIS: If your tests have only
24 been validated at half scale, what's your assurance
25 that they apply to full scale?

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1 MR. LAUBEN: Usually these things are
2 found some place else. Not in this Reg. Guide but
3 some place else. They may be found in a regulation or
4 they may be found in a different part of the standard
5 review. It may say that --

6 MR. RANSOM: 95 percent certainty that no
7 more than 1 percent of the rods were experienced below
8 transition.

9 MR. LAUBEN: I think it's in the SRP.

10 MR. RANSOM: It's in the SRP with GEC.

11 CHAIRMAN WALLIS: Vic, you have to talk in
12 the mic.

13 MR. RANSOM: Why wouldn't you incorporate
14 these by reference at least. They are all over the
15 place.

16 MR. LAUBEN: Because in the SRP which
17 section is a companion to this, it will relate that to
18 a section in the SRP that is right next to it.

19 MR. RANSOM: Well, could you put that in
20 this Reg. Guide and say just those words? If I were
21 a guy coming in here and I wanted to do this and I
22 wanted to pick this up and go through this process, I
23 mean, every one of these you have to go find out what
24 it means, I guess.

25 MR. BANERJEE: Are you saying that for

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1 each accident in Chapter 15, or whatever, you would
2 like to see a reference to --

3 MR. RANSOM: Either that or just describe
4 how --

5 MR. BANERJEE: -- merit or --

6 MR. RANSOM: -- you establish those. How
7 are those established.

8 MR. LAUBEN: I think when I first
9 presented this to the ACRS in '98 I had a chart
10 because you had to have a chart showing that this
11 regulation pointed to this Reg. Guide pointed to this
12 SRP section and so forth.

13 It's true, you almost -- it's a road map.
14 Everyone is always talking about road maps. It's true
15 that you sort of do need a road map. Maybe the Reg.
16 Guide isn't the right -- maybe there's a higher level
17 that has to have a road map.

18 MR. BANERJEE: You probably have it in
19 your head but there can't be too many people who do.

20 MR. LAUBEN: Well, that's a bad place for
21 it.

22 MR. RANSOM: The people doing these
23 calculations know where everything is.

24 MR. STAUDENMEIER: Yeah, I guess we just
25 assume that the people who would be using this knew

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1 what those appropriate criteria were. We could add a
2 reference to the SRP right there saying that many of
3 the success criteria are defined in the SRP or in
4 various parts of the Reg.

5 MR. ROSENTHAL: It might make a very nice
6 summary paper to product this road map to show some
7 place. Let me remind you again that the Reg. Guide
8 was meant for broad application, not only in the
9 thermal-hydraulic area but in one case it's going to
10 be a fuel rod internal pressure and some other
11 applications going to be how well do you know the
12 moderate temperature coefficient. I think by the time
13 you draw the full map, it will look like a street map
14 of the United States.

15 CHAIRMAN WALLIS: We wrote a letter last
16 week on PRAs and many of the paragraphs there would
17 apply to thermal-hydraulics. I was just saying that
18 if you make assumptions they should be justified and
19 if you make simplifications, there are reasonable
20 representations of a more complex approach and so on.
21 All these things which would apply to almost any
22 analysis you do of anything.

23 MR. STAUDENMEIER: Okay. The last
24 principle here would be the accurate up-to-date
25 documentation would be part of this process because

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1 that's been I guess a problem point that's been
2 happening in many reviews of codes at the NRC by both
3 the staff and the ACRS is that there wasn't a good up-
4 to-date documentation.

5 MR. SCHROCK: On the assessment we have
6 often complained that assessment that is presented is
7 so frequently extremely limited and I don't see how
8 you are going to improve that situation through this
9 Reg. Guide.

10 MR. STAUDENMEIER: No. I mean, I think
11 the approach that most vendors take is throw in what
12 they think will be the minimally acceptable amount of
13 work that they have to do and if the staff tells them
14 they have to do more work, they will add some more
15 work.

16 MR. SCHROCK: You don't have standards
17 really.

18 MR. STAUDENMEIER: There are some cases
19 where they are proactive and come in with lots of
20 assessment up front. Those cases don't happen too
21 often.

22 CHAIRMAN WALLIS: You see, if you had a
23 formal method, something like order statistics or
24 something, you could actually show from some
25 mathematical way that you had enough data points to

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1 have your 95 percent confidence of some criteria.

2 You actually show it mathematically and
3 you could say we need at least four LOFT tests or
4 something in order to have enough data points to
5 satisfy this mathematical criterion. You don't have
6 anything like that now so it's a question of
7 negotiation and judgement.

8 MR. STAUDENMEIER: Yeah. The only place
9 that really formal criteria comes in is DMB or CPR
10 correlations where they do have a fixed uncertainty
11 that they are trying to get at and they really do need
12 a certain number of data points and different ranges
13 or conditions to get their uncertainty down to that
14 level. Other than that you're right, there is no good
15 solid way of putting those numerical criteria on
16 there.

17 CHAIRMAN WALLIS: But if it only comes
18 from one side, we just see curves from an applicant
19 which show a curve and the data point is close to the
20 curve for this LOFT test. One wonders what happened
21 to the other comparisons with LOFT tests that they
22 didn't show us? Were there any other ones? That's
23 where, again, the staff if they do independent
24 assessment can do this. They can say, "Ah ha, we're
25 going to take a different LOFT test and see how it

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1 works."

2 MR. STAUDENMEIER: The reason they only
3 had a few tests is probably that they picked these
4 tests back when computer time was very expensive and
5 they could only run on a limited number of tests and
6 they had just been carried through for historical
7 purposes since then.

8 CHAIRMAN WALLIS: But they have a choice
9 on what they show you.

10 MR. STAUDENMEIER: Yeah, they do.

11 CHAIRMAN WALLIS: It's usually that the
12 criterion has to be that it makes the code look good
13 I would think.

14 MR. STAUDENMEIER: Not always. Like lots
15 of LOFT tests like in the large-break LOCA case there
16 are certain LOFT tests that really -- I mean, you may
17 say that maybe they should run them all but you look
18 at some of them and you come to the conclusion that
19 it's not going to do you any good for approving that
20 your code is good in some case.

21 Like there's actually one that the NRC
22 runs that is good for low-down type phenomena but you
23 look at reflood stage and the accumulator dumps all
24 the nitrogen in and it pushes the water up and
25 refloods the core.

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1 Because that LOFT has a short core it
2 really isn't prototypical for nuclear plants for the
3 reflood stage so it really isn't adding any support
4 that your code is good for reflooding a 12-foot core.
5 In many cases I think it's examining the data and
6 coming up with conclusions like that that they don't
7 run the whole break LOFT series of tests.

8 Okay. We sent out draft Reg. Guide out
9 for public comment in December of 2000. We received
10 13 sets of public comments. Twelve were from industry
11 organizations. One was from an individual who was a
12 former employee of an industry organization.

13 There were comments on both the SRP and
14 the draft Reg. Guide but most were directed at the
15 draft Reg. Guide because that was what most impacted
16 the industry and also had a lot more information in
17 it.

18 Most of the comments, I would say the
19 majority of the comments, were that applying this
20 methodology would be expensive. It wasn't justified
21 based on the risk involved in these accidents and
22 various things like that. It would stifle innovation
23 that you put all these requirements on.

24 I think one thing was the utilities
25 thought this was going to be a large onerous process

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1 that they've broken themselves away from the field
2 vendors and doing some types of analyses but this
3 would be so burdensome that they didn't have the
4 manpower to keep on doing that and they would have to
5 revert back to using field vendors.

6 CHAIRMAN WALLIS: We heard this litany of
7 excuses when we complained about quality documentation
8 I remember. "It's too expensive and we don't have the
9 people." So on and so on.

10 MR. STAUDENMEIER: There were actually, I
11 guess, some disturbing comments, minor comments like
12 there's not adequate data for assessment under all
13 ranges or conditions that are important.

14 CHAIRMAN WALLIS: So what are you supposed
15 to do?

16 MR. STAUDENMEIER: Well, how are you
17 justifying your code right now if there isn't adequate
18 data for assessment. There were all different sorts
19 of comments but the biggest concern was a burden that
20 would be placed on this. Especially they had concerns
21 that this would try to be back-fit on to their
22 existing evaluation models they had been running for
23 long periods of time that were approved in the past.

24 MR. BANERJEE: They're grandfathered,
25 aren't they?

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1 MR. STAUDENMEIER: Yes, they are
2 grandfathered but what they are concerned about is
3 making small changes or error corrections to these
4 approved models and that would suddenly throw them
5 into the bin where before they had this small amount
6 of documentation and testing and it would throw them
7 in that to improve one model and a small amount they
8 had to suddenly bring in this whole new volume of
9 work. That was the main concern.

10 CHAIRMAN WALLIS: The real extra work is
11 if you are going to use a realistic model rather than
12 a conservative one. If you're not going to use
13 Appendix K it will ask for some relief then you've got
14 a pretty good case for it. That's where I think the
15 work comes in when you use a realistic model and
16 somehow show that it's a good estimate. We don't like
17 the term best estimate because it doesn't mean much.

18 MR. STAUDENMEIER: Yeah, realistic is a
19 better word than best estimate I think.

20 Since the comments that we received
21 indicated that this Reg. Guide was fairly
22 controversial and there were a lot of concerns, Norm
23 organized a public workshop to bring in the concerned
24 parties to discuss resolution of their concerns and
25 resolving their public comments in a way that would be

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1 acceptable to all parties.

2 We had a one-day workshop where everybody
3 gave their presentations on what they thought was
4 wrong with the Reg. Guide or what could be done to
5 improve it. We had some roundtable discussions, took
6 notes, and went back to revising the Reg. Guide.

7 MR. KRESS: You don't feel constrained to
8 act upon these public comments, do you? I mean --

9 MR. STAUDENMEIER: Constrained?

10 MR. KRESS: Do you feel like it's in your
11 best interest as a regulator to keep it like it is,
12 you'll keep it like it is.

13 MR. STAUDENMEIER: Oh, yes. There are
14 public comments that we just said to make a decision.
15 You can't accommodate this public comment.

16 MR. CARUSO: What if the vendors fully
17 supported this and they wrote in and said, "This is
18 good. We'd buy into this."

19 MR. STAUDENMEIER: Yeah, that was --

20 CHAIRMAN WALLIS: If we're looking for
21 positive feedback.

22 MR. STAUDENMEIER: They had one negative
23 comment, that we are too biased towards CSAU as an
24 uncertainty.

25 CHAIRMAN WALLIS: That's a good comment.

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1 MR. STAUDENMEIER: That was a good
2 comment. There was one vendor that said, "We think
3 this is great and everybody should do it this way."
4 I think partly because they were doing it that way and
5 they wanted everybody else to have to go through the
6 work data.

7 CHAIRMAN WALLIS: That's fair.

8 MR. STAUDENMEIER: Completed revisions to
9 draft Guide 1096 in February were provided to NRR for
10 comment and we received NRR comments back in June of
11 this year.

12 CHAIRMAN WALLIS: NRR didn't seem to have
13 all that much to say.

14 MR. STAUDENMEIER: Their comments require
15 some revisions of the SRP more than the Reg. Guide.
16 There were no real revisions of the Reg. Guide that
17 were required by the NRR comments but there will be a
18 needed revision of the SRP.

19 I have a page of what I consider to be
20 some significant revisions. The main revision was
21 adding a section on a graded approach to the EMDAP so
22 that people with their legacy models out there that if
23 they made small changes to it that they didn't have to
24 go through the whole EMDAP process. They would be
25 able to go through a more limited process for review

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1 and approval. That was to resolve the main concern of
2 everybody.

3 CHAIRMAN WALLIS: Section 5.

4 MR. STAUDENMEIER: Yeah, we added a new
5 Section 5 to accommodate that. The other changes you
6 can see there are a lot of rewordings and making some
7 clarifications like some people don't use FORTRAN
8 codes. They do calculations. They have models they
9 developed in MathCAD or Mathematica and we believe
10 something like that is covered the same way as a
11 FORTRAN code would be. It's just a different program.

12 CHAIRMAN WALLIS: They don't change the
13 structure of the Guide at all but they are just more
14 inclusive, let's say.

15 MR. STAUDENMEIER: Right.

16 CHAIRMAN WALLIS: The big change is the
17 first one which might provide an out for some
18 applicants to do less work than they might otherwise
19 feel they had to do. But it might actually work the
20 other way. It might work that someone said, "Now,
21 look, because of the complexity of this event you've
22 got to do more work."

23 MR. STAUDENMEIER: Yeah, it may turn out
24 that way.

25 CHAIRMAN WALLIS: It's not clear that it's

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1 all just relief that is being offered in Section 5.

2 MR. STAUDENMEIER: The things in
3 parentheses after the various changes are the
4 organization it came from. NRC is us; GNF is Global
5 Nuclear Fuel; CEOG is Combustion Engineering Owners
6 Group.

7 MR. BANERJEE: What is GNF?

8 MR. STAUDENMEIER: Global Nuclear fuel.
9 It used to be GE and Ge split off their fuels division
10 to have a combination with some Japanese companies so
11 their fuels is now called Global Nuclear Fuels and
12 that is a separate entity than General Electric which
13 is still based out in San Jose. The fuels group is
14 down in Wilmington.

15 MR. BANERJEE: What is CEOG?

16 MR. STAUDENMEIER: Combustion Engineering
17 Owners Group. The next page there are other
18 definitions. BWROG is BWR owners group. WOG is
19 Westinghouse Owners Group.

20 The number of comments was far greater
21 than the number of changes that were made. I tried to
22 accommodate all the changes made.

23 CHAIRMAN WALLIS: This reminds me a bit of
24 student evaluations of a course. The professor goes
25 back and changes a bit about how it's done next year.

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1 MR. STAUDENMEIER: That was distilled from
2 about this much set of comments so it was quite a
3 distilling process going on. So the revised Reg.
4 Guide essentially had the same structure. There was
5 some more material added in various sections to either
6 clarify, make corrections, or more detailed
7 explanations.

8 This new section was added which is this
9 graded approach to applying the EMDAP process which
10 was to alleviate the industry concerns that as soon as
11 they made a change to an existing model, that they
12 would suddenly jump into this super amount of
13 documentation and testing.

14 CHAIRMAN WALLIS: I wonder if this is a
15 good time to take a break since you're on all morning
16 and you've got to the point where you've told us the
17 history and how this thing got created and what the
18 changes were. Now we've got to what it is. We can
19 break and come back and discuss how we like what it
20 is.

21 MR. STAUDENMEIER: Sure.

22 CHAIRMAN WALLIS: Then you won't have to
23 stand up.

24 MR. STAUDENMEIER: I could use a drink,
25 too. My throat is getting a little dry.

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1 CHAIRMAN WALLIS: Why don't you sit down
2 at any time.

3 MR. BOEHNERT: Kind of early to be
4 drinking.

5 (Whereupon, at 10:23 a.m. off the record
6 until 10:37 a.m.)

7 CHAIRMAN WALLIS: We'll now come back into
8 session. Joe, are you ready?

9 MR. STAUDENMEIER: Yeah.

10 CHAIRMAN WALLIS: I think we'll probably
11 finish early. Don't count on that now.

12 MR. STAUDENMEIER: These are the slides
13 that I thought would take longer.

14 CHAIRMAN WALLIS: Come back into session
15 and Joe will finish up the presentation that he
16 started earlier this morning.

17 MR. STAUDENMEIER: Okay. So the new
18 section in the 1120, the biggest revision is this
19 graded approach to applying the EMDAP process. It's
20 to alleviate the concern by vendors. "We have this
21 model we've been using for years and we want to make
22 a small change to it. Why do we have to suddenly
23 apply this 30-page document and go through all these
24 additional steps?"

25 CHAIRMAN WALLIS: One reason is that some

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1 of the things you've been doing for 30 years don't
2 apply anymore. They applied when we were being
3 conservative and now we're being realistic and it's
4 got to be examined.

5 MR. STAUDENMEIER: In some cases that is
6 true and they do need to go and apply the whole
7 process or a substantial amount of the process. In
8 other cases we agree with them that they may not have
9 to go do a full-scope uncertainty study and large-
10 scale assessment for small changes for a simple model.

11 Although I guess our argument at the
12 public workshop to them was if they have simple models
13 to start out with with a small number of parameters,
14 then it doesn't really take a lot of effort to apply
15 an uncertainty analysis to that type of model.

16 CHAIRMAN WALLIS: So in the case of a new
17 design of reactor with different features, that would
18 be covered by the last one.

19 MR. STAUDENMEIER: Yes.

20 MR. KRESS: I'm not sure I know what you
21 mean by novelty.

22 MR. STAUDENMEIER: Okay.

23 MR. KRESS: Newness or neatness? There
24 are a lot of meanings to the word novelty. I'm not
25 sure what you mean here.

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1 MR. STAUDENMEIER: By novelty we meant
2 something totally different than what they were doing
3 like if they had an HEM model or something and they
4 changed over to a full two fluid model, then there
5 would be a lot bigger requirements on showing that
6 this new model was adequate and good for what they
7 were doing and would require a lot of assessment that
8 wasn't required for their old model compared to, say,
9 just changing a heat transfer coefficient in the old
10 model.

11 What we meant by novelty is something much
12 different than what they had been doing. The change
13 introduces some sort of new physics or new
14 mathematical model or something that is qualitatively
15 different from what they had been doing.

16 MR. BOEHNERT: Doesn't this really come
17 down to the staff's engineering judgment on what the
18 extent of the change is?

19 MR. STAUDENMEIER: Yeah, I think a lot of
20 it does come down to that.

21 CHAIRMAN WALLIS: It gives you a basis for
22 argument, though. They will come back and say,
23 "There's nothing new or very little new. Therefore,
24 we don't have to do so much." And you'll say, "Ah,
25 but this is new and that's new and something else is

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1 new and this influences something else." It gives you
2 a basis for negotiating.

3 MR. STAUDENMEIER: Yeah, I think that is
4 the case because a lot of times the way things work is
5 the staff may feel one way. They get overruled by
6 their management. It isn't written down anywhere and
7 there's nothing that says that it shouldn't be the way
8 the manager is. He says, "I've had more experience in
9 this than you and overrule you."

10 MR. KRESS: In the forth bullet what do
11 you mean by the event? Is that when you're talking
12 about the model will be used to evaluate various
13 transient events?

14 MR. STAUDENMEIER: Yes.

15 MR. KRESS: It's usually more than one of
16 them if you change something in the model but the
17 model is used to evaluate a number of events.

18 MR. STAUDENMEIER: Right. I guess our
19 concept of it is that the model is really your
20 analysis for evaluating a specific event. If it
21 covers more than one, I mean, you have to consider all
22 the events that you are analyzing with that computer
23 code when you make that change. If it was used for
24 multiple --

25 MR. KRESS: Do the words "safety

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1 importance" imply something different than risk
2 significance?

3 MR. STAUDENMEIER: I think it could be
4 considered the same as risk significance, although you
5 may be able to extend it beyond something that would
6 be pure risk. I mean, there are some things that we
7 may consider that have safety importance but in terms
8 of overall risk to the public, it may --

9 MR. KRESS: I would almost interpret that
10 to mean if it has to do with ATWS, then it's
11 important. If it's not ATWS, then it's not. That's
12 the only one I can think of with real risk
13 significance.

14 MR. STAUDENMEIER: They are sort of
15 interchangeable and there are some small cases I can
16 think of where we think like protecting the fuel in
17 terms of DMB margin. We think that's of safety
18 importance but it doesn't really contribute to risk to
19 the public.

20 CHAIRMAN WALLIS: The text only talks
21 about risk significance. It doesn't use the word
22 safety importance. If it's just risk significance,
23 then it goes back to a conversation we had a couple of
24 hours ago. All these design basis accidents don't
25 really affect risk.

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1 MR. KRESS: Except ATWS.

2 CHAIRMAN WALLIS: So it's a different
3 world. Yet it's the risk world we're probably most
4 interested in in terms of affects on public safety and
5 so on. How is it supposed to fit into this?

6 MR. STAUDENMEIER: Well, I guess the way
7 we saw it as fitting in is if for each accident you're
8 looking at you have a safety parameter that you're
9 looking at that you're trying not to exceed like
10 overpressure, peak pressure during a pressurization
11 event or something like that.

12 I guess the risk significance would come
13 in by what are the consequences. Obviously you've
14 analyzed this. It's the design basis. By that
15 definition you don't have to worry about it because
16 your plant is going to stay under this safety criteria
17 in the worse case.

18 I guess we are thinking of it and there
19 maybe is some uncertainty or finite probability that
20 the plant in this situation may really exceed the
21 safety parameter and what are the consequences of
22 exceeding a safety parameter.

23 Maybe in some cases it's not real high
24 consequences in exceeding it. Something fails but
25 it's not going to cause some propagating consequences

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1 that go down stream and lead you into a severe
2 accident.

3 CHAIRMAN WALLIS: I think you may need to
4 rewrite this section because if you're looking at,
5 say, 2,200 degrees, if you're using realistic code
6 with uncertainties, there's going to be a probability
7 of getting more than 2,200 degrees. Bound to be.

8 And you're going to use some criterion
9 like 95 percent assurance or in 95 percent of the
10 cases you won't exceed 2,200. What happens if you do?
11 If you have a long tail, you might get up to 3,000.
12 We don't know until you estimate it.

13 I think this is a very vague requirement
14 that they look at consequences exceeding a safety
15 limit because I don't think the staff ever does in the
16 case of something like 2,200. You don't say, "What
17 happens if it's 2,201 or 2,210." You don't have a way
18 of evaluating the importance of that.

19 MR. STAUDENMEIER: Not in the way you're
20 talking about but events that if you are reviewing
21 something for an event that had more safety, say, if
22 you did exceed whatever safety criteria it had. You
23 might review that analysis more closely than something
24 that doesn't really have any severe consequences if
25 you didn't really meet the safety criteria.

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1 CHAIRMAN WALLIS: What is going to be --

2 MR. STAUDENMEIER: So there is in some
3 cases a disconnect between the safety criteria or
4 tech. specs and what is actual risk to the plant.

5 CHAIRMAN WALLIS: We're talking about
6 performance-based regulation where instead of saying
7 2,200 degrees you simply say you've got to assure the
8 integrity of the cladding or something. Then it's
9 going to be even vaguer how you are going to assess
10 whether or not they meet the regulations.

11 MR. STAUDENMEIER: That issue is currently
12 under consideration.

13 CHAIRMAN WALLIS: You might need to
14 rewrite the section 54, risk significance, in a way
15 that helps anticipate some of these things. It's a
16 very short section with two sentences. I don't think
17 it helps the reader. It doesn't help me. I'm not
18 sure that the present regulations for use of these
19 codes for design basic accident risk is relevant at
20 all.

21 MR. BANERJEE: It also allows to do very
22 little if they wanted to because risk is usually
23 small, right?

24 MR. STAUDENMEIER: Yes.

25 MR. BANERJEE: Not very significant in any

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1 case.

2 CHAIRMAN WALLIS: PRA shows the large-
3 break LOCAs unimportant so we want to analyze it.

4 MR. STAUDENMEIER: And that is the
5 industry position. They really want to get away
6 without analyzing just about any of these events or
7 taking them out of the regulatory arena.

8 MR. SCHROCK: I have some difficulty with
9 the degree of conservatism aspect of this. I guess
10 it's somewhat related to Vic's question earlier about
11 meaning of evaluation model. It used to be those
12 words applied to the Appendix K and along came the
13 concept of a realistic analysis or best estimate
14 analysis.

15 I think for many people, certainly in my
16 mind at the time the realistic analysis was being
17 introduced it was an either/or proposition. I think
18 you gradually move towards a situation where you're
19 going to be confronted with analyses that span the
20 whole spectrum between.

21 This wording in this seems to me to be
22 opening the door for that where you want to do
23 something less costly than a full CSAU so you
24 introduce a little more conservatism here and there
25 and then you can have a less costly process for the

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1 industry.

2 I may not be making myself clear on where
3 I see the pitfall but I think there is one here. It
4 also came out in our last discussion about risk-
5 informed considerations and the conservative models
6 that are involved in that context.

7 It isn't very clear what one would do in
8 evaluating the degree of conservatism in the
9 evaluation model in deciding how detailed this model
10 development has to be.

11 MR. STAUDENMEIER: Actually this was more
12 to accommodate existing models than for developing any
13 new models, I guess. I understand where you see the
14 pit falls.

15 MR. SCHROCK: It says the extent to which
16 the full model development process may be reduced for
17 a specific application.

18 MR. STAUDENMEIER: Right. Yeah. I mean,
19 we hadn't thought of -- I guess you could apply that
20 to developing a new model from scratch. If it was
21 extremely conservative and if it was defensible, then
22 I think you would have to accept something like that.

23 When you are developing a model, I mean,
24 you just wouldn't say that it's conservative without
25 supporting information to back it up. I think you

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1 have to have technical defensibility in your model.

2 I think you have to also consider that if
3 there's no -- if you're not gaining any additional
4 benefit from going through this whole process that you
5 would have a technically defensible model with less
6 elaborate development or less costly development
7 process, then I think that would have to be
8 acceptable.

9 I think we have to be sure that we're not
10 putting additional burden on the industry for no
11 reason when they could have an acceptable or
12 technically defensible model with less effort or cost.

13 MR. SCHROCK: You put yourself into a
14 corner sometimes like on the determination of an
15 overall conservatism. The idea that the old Appendix
16 K had compensations which you understand somehow, but
17 on the basis of what do you understand these
18 compensations?

19 You kind of end up with a scheme which
20 seems to me to be basically unsound where you are
21 trying to weigh one thing against another thing and
22 then judge overall the result of the computer
23 calculation as a suitable basis for making a
24 determination that you meet this criteria.

25 I can't see there is any way you can

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1 relate what one inaccuracy does to what another
2 inaccuracy. It has no relationship to that in the
3 calculation as it does to the bottom line
4 determination of, say, peak-life temperature.

5 MR. STAUDENMEIER: I guess another type of
6 example I would use is if you had -- I guess part of
7 this you'll see later on that part of this degree of
8 conservatism in the evaluation model is that you
9 actually in order to apply this justification for
10 going through the reduced effort you couldn't just
11 say, "I have a conservative model."

12 You have to put forth some effort in
13 quantifying that you really do have a conservative
14 model and have a fairly good estimate on the degree of
15 conservatism in your model before you use this as a
16 justification. You couldn't just say, "I have an
17 Appendix K model. It's extremely conservative and,
18 therefore, I'm not doing assessment on my new reflood
19 E-transfer correlation," or something like that.
20 That's a case that would not be acceptable, I don't
21 think. I can see how you see that these worse cases
22 may slip by because they probably have in the past.

23 CHAIRMAN WALLIS: You've got to be careful
24 by what you mean by conservative. What is
25 conservative? Heat transfer coefficient for reflood

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1 is not conservative if it's used for something like
2 pressurized thermal shock.

3 Even so if you just took a brief flood it
4 may be that the heat transfer at sometime produces
5 more steam which changes the scenario so having it
6 lower later still isn't conservative because of the
7 interaction between what happens earlier and what
8 happens later. It's not obvious that particular
9 assumption is conservative unless you look at the
10 consequences of making some other assumption.

11 MR. STAUDENMEIER: Yeah, I agree with
12 that. I guess the ultimate goal is that we would
13 really like people to move towards realistic
14 calculations with true uncertainty evaluation. We're
15 just trying to make some attempt to culminate some
16 older methods that are still going to remain with us
17 on this transition process.

18 MR. SCHROCK: I guess my concern is that
19 I am completely convinced that it takes a lot of
20 nudging to move them in that direction and that you
21 have a lot of pressure on you to accommodate them in
22 other ways. You are doing things which are not
23 consistent with the idea of nudging them in that
24 direction.

25 MR. ROSENTHAL: If I could, instead of

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1 thinking about LOCA and steamline break which we all
2 acknowledge are thermal dynamically challenging to
3 analyze and the staff puts a lot of effort into it,
4 let's go to the full other end of the spectrum.

5 There's a pressurized water reactor rod
6 drop accident analyzed in Chapter 15 of the FSAR in
7 which having dropped the rod in the core of the
8 reactor saves power and the pressure and temperatures
9 hardly change at all.

10 The consequence of the drop rod is that
11 you may on the other side of the core from where you
12 dropped the rod experience DMB in some limited number
13 of fuel pins. I think we would all agree there is
14 life after DMB.

15 Here we have a reasonably benign scenario.
16 We would like it not to happen and, of course, we'd
17 like not to challenge the fuel, and it has happened so
18 the probability is reasonably high. You can say just
19 how much analysis do we want them to do.

20 Now, you compound that by saying that for
21 a large-break LOCA analysis it may be years before you
22 have to redo it. Conditions have changed in your
23 reactor. You do fuel shuffles every cycle and you may
24 well find yourself reanalyzing this reasonably benign
25 drop rod scenario which puts you into this mode. It

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1 just seems that the graded approach ad not requiring
2 all the qualification was appropriate for that sort of
3 event.

4 MR. KRESS: The problem I have with that
5 is once you have a change in your model and you give
6 it some sort of stamp of approval, then it may have
7 originally been intended to be used for this rod drop
8 problem, but then it's proved in the code for any use
9 that they want to put it to and they want to come back
10 later for a power upgrade. This model may have a
11 significant affect on the peak clad temperature or
12 something whereas that wasn't the original application
13 change.

14 I worry about not having -- for example,
15 the risk significance or safety importance, I worry
16 about that one particularly because what I think is
17 needy is, two things, how good is my code that I've
18 gotten now, the one that has been approved, how good
19 is it with respect to reality. I don't know how in
20 the hell you know that.

21 My guess is you have your best guess at
22 reality by using some realistic code like TRAC-M that
23 you developed. You could say this is my best guess at
24 reality, but that's going to be specific for a
25 specific plant.

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1 I would love to see some sort of a system
2 where here is my best guess at reality for this plant
3 and then here is how close this particular approve
4 models or set of models for this plant come to my best
5 guess at reality and why is that acceptable to me.
6 There is some criteria need there.

7 Then they will come in and say, "I want to
8 make a change." What you've got is now a new set of
9 models or new set of code. Then you ask yourself how
10 did that affect my assessment of how close this comes
11 to reality and how does it relate to my acceptance
12 criteria.

13 I don't really see any of that. That's
14 the process that makes rational sense to me. This is
15 to me what you have here is a reasonable process
16 except I think it's too judgmental and it's going to
17 lead to a lot of negotiation and discussion. I'm sure
18 you guys know how to do that and you'll come down on
19 the right end of it. What worries me is from the
20 standpoint of how an outside might view it.

21 MR. STAUDENMEIER: Yeah, I think that's a
22 valid comment. This is the comment seeking period so
23 I invite you to express that. I mean, maybe it isn't
24 the proper thing to do what we have proposed here. We
25 may have not thought through all the nuances of these

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1 various things and we would like to hear possible
2 pitfalls that we haven't thought of.

3 MR. RANSOM: I'd like to comment just a
4 little bit more following on what Professor Schrock
5 has indicated, the need for conservatism. Appendix K
6 was an attempt to provide an overarching conservatism
7 to a calculation by doing a worse case type scenario
8 in all cases. A lot of conservatism is maybe not so
9 good because you weren't assured of safety.

10 I still think there's a need for some
11 overarching layer of conservatism in a calculation.
12 The one example that I'm going to give, and this is
13 something that maybe would be something the NRC really
14 should almost legislate, would be the effect of the
15 user of one of these codes.

16 In the calculations that I've seen where
17 there were blind calculations using the same code but
18 different users to model the phenomena. The largest
19 variation was due to user. My question would be how
20 do you account for that?

21 This is not an unmodeled piece of physics
22 necessarily but simply a looseness in the user
23 guidelines or whatever that allows different users to
24 get different results. Some of them might even be due
25 to human error. Human error also needs to be

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1 considered in these kinds of calculations.

2 MR. KRESS: I think the only way to deal
3 with that is to have their own assessment model that
4 they believe and know the user affect and to compile
5 the results.

6 MR. RANSOM: How do you know their user
7 effect isn't wrong?

8 MR. KRESS: They have to have that one
9 studied and down.

10 MR. RANSOM: This I believe is their role.

11 MR. CARUSO: Dr. Ransom, I'll give you an
12 observation on this. I've seen this myself. I think
13 I've made some comments about this in the past. In
14 the case of the vendors with things like the LOCA
15 codes there is a lot less user options than you might
16 imagine.

17 The vendors have very strict rigorous
18 processes which we've seen which we look at all the
19 time to make sure that they get the same answer every
20 time. They don't allow their individual engineers to
21 go off and model and nodalize plants differently.

22 They do production runs and they have to
23 be able to do them in a very predictable way. They
24 have books and books and books and piles of books and
25 rooms full of books that describe in exquisite detail

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1 how they do these things.

2 The calculations that we do are much less
3 predictable because we don't -- this agency doesn't
4 have as rigorous a set of guidelines as the vendors
5 do. I've seen the same sort of variation that you
6 have seen.

7 I've seen it interestingly enough in
8 comparisons among people who had nothing to gain other
9 than their pride. I mean, I have one ISP that I drag
10 up as an example all the time in which some regulators
11 and some university professors did some very creative
12 things with one of your computer codes to get the
13 answer that they thought was correct. They had
14 nothing at stake.

15 The vendors who have an enormous amount of
16 money at stake have proceduralized how they do these
17 calculations very, very carefully. Licensees, on the
18 other hand, are more creative and that's difficult to
19 police but it has to be policed, I think.

20 Remember we talked about this. They want
21 predictability but they also want flexibility. They
22 want to be able to be creative and you don't want to
23 shut down that creativeness but you don't want them to
24 go off and use RELAP-5 to do containment
25 subcompartment analyses which some of them have done.

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1 Then they file Part 21 reports with us saying the code
2 is deficient because it doesn't do it very well.

3 These sort of examples are always going to
4 show up and it's our job, it's the job of the
5 inspectors, it's the job of the people that understand
6 how the codes work and how they should be applied to
7 monitor this and correct them when they do the wrong
8 thing. I honestly believe that is the only way to fix
9 it. I don't think the guidelines are going to fix
10 this.

11 MR. RANSOM: They won't entirely but, you
12 know, good guidelines and guidelines for nodalization,
13 like I think Dr. Banerjee was talking about, those
14 things help. All of these things help. The only
15 thing I'd like to know is maybe it's only a fraction
16 of a percent or something in there in the uncertainty
17 that is associated with the human aspect of this
18 thing.

19 CHAIRMAN WALLIS: I think you have to
20 space things out.

21 MR. CARUSO: When we do the reviews of
22 these methodologies we try our damnest -- the word is
23 going to get in the transcript -- we try our damnest
24 to make sure that we nail down how they are going to
25 do the analyses. We try to write that in the SER. We

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1 try to make them define it in the topical reports.

2 That's part of this dialogue that occurs
3 back and forth between the staff and an applicant
4 about how to use these methods. We try to define it
5 well but we try not to make it so strict that they
6 can't use it in a realistic way. Once again, I think
7 this is a judgement. That's why we have smart people
8 like Dr. Staudenmeier to help us do this and Dr.
9 Lauben.

10 CHAIRMAN WALLIS: If you try your damnest,
11 I think we should talk about damnest estimate codes.

12 MR. CARUSO: Or realistic, not best
13 estimate.

14 CHAIRMAN WALLIS: Your next slide, I
15 think, shows what my colleague Dr. Kress was saying.
16 There's a huge range for maneuver in terms of what is
17 required here because you can be anywhere on this
18 scale in any code evaluation.

19 MR. STAUDENMEIER: Yeah, I agree with
20 that. You can be anywhere. Like I said, maybe it's
21 not appropriate that we allow this wide range of
22 variation. This was trying to come up with a proposal
23 for accommodating this graded process.

24 If there are deficiencies in it, which I'm
25 sure there are, then I would appreciate they wrote

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1 them down and said what they are. We're putting out
2 this proposal and I wanted to put out something -- get
3 something down on paper to comment on to get a
4 starting point in trying to, I guess, address the main
5 public concerns.

6 CHAIRMAN WALLIS: This is exactly the
7 opposite from the way that ACRS is going on PRAs and
8 the ACRS got fed up with seeing minimum PRAs and wants
9 every PRA to be good. It seems to be the line we're
10 taking now.

11 MR. STAUDENMEIER: I can see the holes in
12 this process. I guess one thing we thought is people
13 would be either close to one end or the other end and
14 that there wouldn't be this continuous spectrum in
15 between.

16 CHAIRMAN WALLIS: Where there are two
17 bosses, not a spectrum.

18 MR. STAUDENMEIER: Right. This would be
19 maybe their old conservative evaluation models here
20 and this would be the new generation of evaluation
21 models coming in like COBRA TRAC and TRAC-G and things
22 like that and that you wouldn't really be moving
23 across a continuous spectrum like that.

24 MR. KRESS: I think on the first one you
25 could be on either end but for the rest of them, you

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1 are more likely to be on the minimum end.

2 MR. STAUDENMEIER: Yeah. Well, a lot of
3 the cases while it may not be like conservatism, it
4 may not be that the code you're using is real
5 conservative. It may be that the input assumptions
6 for how you evaluate that event are conservative.

7 Like you ignore the first safety grade
8 trip or your ACCS flow that you assume is 20 percent
9 below what the high-pressure injection flow really is
10 in the plan, or something like that, where it's more
11 conservative input assumptions than the code actually
12 being conservative.

13 There are other cases on this chart that
14 I could think of that it's not really exactly. I
15 guess there are exceptions to one box or the other
16 box.

17 CHAIRMAN WALLIS: The first line any code
18 that is derived from RELAP is simply going to say
19 RELAP has been around for a long time. Ours has this
20 great heritage and everything so nothing much has
21 changed so it's a small change.

22 MR. STAUDENMEIER: Well, we haven't really
23 accepted that in the past. Actually, there have been
24 vendors that have tried that and referenced old
25 assessment that was done out at INEL on some older

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1 code version that had maybe nothing to do with their
2 code version.

3 We require them to come in with their own
4 assessment that they have performed their own version
5 of the code. That is something that we have
6 considered and hopefully that type of thing doesn't
7 slip by.

8 The cases where that maybe slipped by is
9 actually where there's lot of analyses that are done
10 without using a formally approved code that aren't
11 really safety analyses like this.

12 It may be some event analysis or some
13 special type of analysis that a licensee will come in
14 with the support of tech. spec. amendment or some
15 change in the plant and they pull out the NRC version
16 of RELAP-5 which hopefully they have done some QA to
17 make sure it works properly on their system or RETRAN.

18 They are using it for an event that isn't
19 covered under any approved transient or accident
20 methodology because it's just a special case they are
21 looking at.

22 In those cases I think that is the most
23 dangerous cases people invoke the goodness of the code
24 because it's been around so long and it's been used
25 for a wide variety of things even though maybe those

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1 things have nothing to do with what you are using now.
2 Hopefully in those cases the staff does know that
3 specific assessment may be required for that specific
4 application and what they are using it for in that
5 case.

6 I have seen a few cases like that that
7 have come across my desk and hopefully we're not
8 letting them slip through the cracks. There is a
9 possibility that may happen. Actually in one big case
10 these risk-informed amendments where it goes through
11 and part of the amendment may have something to do
12 with reactor systems branch.

13 They used the risk-informed amendment
14 process as a way to bypass reactor systems branch and
15 only the PRA people look at it and may see it done
16 with RELAP or some other code that they know the name
17 of and think this must be good and approve it on the
18 basis of PRA and maybe some of the supporting
19 calculations aren't very good.

20 CHAIRMAN WALLIS: What you're saying,
21 though, is that full application is going to be
22 required not just for a completely new evaluation
23 model but for an evaluation model which has
24 significant newness to it but not completely new.
25 That would never happen probably.

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1 Also, a new plant design, uniquely new
2 plant design that is an extraordinarily different
3 plants. There are light water plants which
4 significantly differ from old light water plants which
5 require full application.

6 They don't have to be uniquely new but the
7 difference needs to be significant so I wouldn't pick
8 some of these superlatives or adverbs over here. They
9 make it look as if you only have to do the whole job
10 when things are really tremendously new and different.

11 MR. STAUDENMEIER: Yeah, I agree with
12 that.

13 CHAIRMAN WALLIS: Maybe this is just for
14 us to see rather than being part of the Reg. Guide.
15 Is this part of the Reg. Guide, this picture here?

16 MR. STAUDENMEIER: This picture is not
17 part of the Reg. Guide. I was trying to point out the
18 spectrum of cases that you may have run into.

19 MR. BANERJEE: So extent of plant change,
20 would that include, say, a request for an uprate?

21 MR. STAUDENMEIER: Yes.

22 MR. BANERJEE: That would be significant.
23 Let's say they are using an evaluation model to look
24 at ATWS. Because we operate the plant, you might be
25 driven into different regions of instability and stuff

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1 on ATWS. Does that mean we have to requalify the tool
2 that you're using to look at it?

3 MR. STAUDENMEIER: If the new range of
4 plant operation conditions went beyond what the
5 original methods were approved for, they would have to
6 qualify the tools in that new range of operation. But
7 that is the main thing is to look at your plan
8 operation and accident conditions and see if they are
9 still in the range of what the codes were approved to
10 be used for when the SER was written on the codes.

11 MR. BANERJEE: So how would you sort of
12 address that specific issue, let's say? The stability
13 maps are going to change and things so how would you
14 quantitatively know that the code has been approved
15 for this or not? Is there sort of limits for what a
16 code is for?

17 MR. STAUDENMEIER: Yeah, usually in SERs
18 there is usually some set of limitations that the code
19 can be used under this range of parameters and with
20 this specific input or things like that, or specific
21 options so there usually are restrictions put on the
22 use of the code, that it is only applicable for this
23 range of conditions.

24 More likely there may be some linear heat
25 generation rate on the reflood data or something that

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1 you have assessed against and pushing -- if you tried
2 to push a fuel bundle up higher than that. If
3 there was an approval basis on that linear heat
4 generation rate, you would have to go out and perform
5 assessment of new data that was outside the range, or
6 else make some argument that your model is still valid
7 outside that range.

8 I think one case that has come up recently
9 is that GE Safer Jester LOCA Evaluation methodology
10 where there was an artificial temperature limit of
11 1,600 degrees put on that so it wasn't valid if you
12 were calculating temperature higher than that.

13 I don't know but GE at one time was
14 talking about coming in -- that was the result of the
15 data they had assessed against was limited to that
16 temperature range. I think GE is going to come in
17 with more assessment against some other data besides
18 that to raise that limit.

19 MR. CARUSO: They did the testing. They
20 have assessed it against the data and the limit has
21 been lifted.

22 MR. BANERJEE: And what about ATWS for the
23 E uprates? How are they analyzing that right now?
24 Fuel is more subdivided so it's faster and all sorts
25 of interactions and instability.

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1 MR. STAUDENMEIER: Well, I mean, they're
2 not -- if you look at ATWS and what are required for
3 ATWS analysis it's not as complex as going through a
4 full ATWS with all these power spikes and calculating
5 them correcting.

6 If you look at ATWS what's required for
7 BWRs is that you have a slick system that can eject a
8 certain amount of borated water into the system. Also
9 what they have to evaluate is their operating strategy
10 during the ATWS. You are going to do certain things
11 like one thing you do is based on suppression pool
12 temperature.

13 If your suppression pool temperature gets
14 up to a certain temperature, that's when you initiate
15 your slick injection. You have a level control
16 strategy during the ATWS to minimize power produced
17 and power dumped to the suppression pool.

18 You're not really evaluating to the point
19 of large-scale oscillations well beyond that design
20 basis where you see in lots of ACTW calculations
21 that's not really part of the regulatory process of
22 ACTS.

23 There's stability constraints that are put
24 in, stability maps that are derived, and they have to
25 operate within the stability limits. Those stability

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1 maps are updated at the new range of operating
2 conditions for the power uprate.

3 MR. BANERJEE: So you would just take
4 whatever is the existing methodology and, say, in this
5 case it would be okay?

6 MR. STAUDENMEIER: It may be okay or it
7 may not be okay. You have to look at the methodology
8 to see if the new application lies within the range of
9 applicability, and if it doesn't, you have to do
10 something to update your methodology so it does.

11 MR. BANERJEE: How would you judge in this
12 case? I mean, are there experiments under this?

13 MR. STAUDENMEIER: There are some
14 experiments related to ATWS in the FIST facility at
15 GE. Obviously it doesn't have the full kinetics
16 feedback. There's various parts of your -- you would
17 have to compare various parts of your evaluation model
18 to applicable experimental data if you have it.

19 Like with the onset of instability there
20 are some tests. I can't think of the name but the
21 experiment now is over in Sweden, the full-power
22 bundle experiments. The void fraction is there, too.

23 CHAIRMAN WALLIS: FRIGG.

24 MR. STAUDENMEIER: FRIGG. Yeah. They
25 have onset of stability experiments in there. GE has

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1 their own experiments on heat transfer when you get
2 into the oscillatory flow regime at, I think, the ATWS
3 facility. They have these FIST test that were done in
4 conjunction with the NRC for looking at transient
5 behavior in BWRs.

6 There is data out there and piecing it
7 together to get, I guess, a unified picture of how
8 well your evaluation model is may take some work
9 because you don't have it all in one place. There are
10 ways to determine whether your model is operating
11 within its range of applicability.

12 As far as uniquely new plant design, I
13 mean, the pebble bed would probably have been the
14 first plant where we could have maybe applied this
15 full process in all its glory and see how well it
16 works because it's way different than anything we
17 looked at before, new evaluation methods that haven't
18 been used before or licensed before in the NRC.

19 Actually I think we told the pebble bed
20 people that to look at this draft Reg. Guide as an
21 example of what their evaluation models were going to
22 have to meet when they came in with them for a
23 specific review and approval.

24 MR. RANSOM: Along that line, is there any
25 data for the pebble bed modular reactor from the

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1 German work that were transients or experienced in
2 those reactors and could be used for code validation?

3 MR. STAUDENMEIER: I think there is data.
4 I'm not familiar with it but I know people were -- I
5 thought they went over and visited Germany and some
6 Germans came over here so I think there was a project
7 there. There is also a small, I think, pebble bed
8 reactor in China that people were looking at data from
9 that reactor also.

10 MR. RANSOM: In order to apply this
11 process you would need something like that I would
12 think.

13 MR. STAUDENMEIER: Right. Yeah. I mean,
14 for the pebble bed process people coming in with that
15 would have to do field qualification testing. Since
16 they were touting risk as a big thing under severe
17 accident conditions, I think they were going to have
18 to do this field qualification testing and
19 characterization.

20 MR. RANSOM: Along these lines, has Reg.
21 considered that if somebody comes in with a radically
22 new reactor with a rather limited data base,
23 particularly in comparison with light water reactors,
24 they pretty well know how they behave and everything,
25 how would you factor in conservatism, or should there

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1 be some overarching conservatism applied to, say,
2 concept like that that presumably could be reduced
3 with time, you know, as more experience is gained with
4 the thing.

5 It would seem like that would be a
6 rational approach to licensing a brand new type of
7 reactor. Insist initially on a fair degree of
8 conservatism that could be reduced in time as this
9 process matures you might say. Has any thought been
10 given to that sort of thing?

11 MR. STAUDENMEIER: I don't know. I don't
12 think about it. People that would be thinking about
13 it are higher levels than I am. That is one thing to
14 consider. I guess that would be follow the light
15 water reactor process when they were first licensed
16 they had large amounts of conservatism in everything.
17 As more data became available, that was reduced over
18 time.

19 MR. RANSOM: I would think the risk-
20 informed regulations would have to have some kind of
21 mechanism like that where things that are less certain
22 would be -- you know, there would be a higher degree
23 of conservatism than there would be, say, in --

24 MR. KRESS: I think you are on to
25 something there. That was my concept of how you deal

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1 with defense in depth. It depends on the uncertainty.
2 Then as you gain in experience and using that
3 uncertainty, it gets smaller because of more knowledge
4 that you ought to be able to reduce some of the
5 defense in depth which is reduce some of the things.

6 I think it's a very reasonable approach.
7 It ought to be built into the risk-informed reg.
8 someday. I don't see it there in what I've seen so
9 far. That belongs maybe not here but in the risk-
10 informed reg. stuff it belongs there.

11 MR. BANERJEE: But then you would have to
12 take into account also unexpected phenomena that occur
13 as plants get older.

14 MR. KRESS: You have to keep that in mind.

15 MR. BANERJEE: It's sort of a risk.

16 MR. KRESS: It takes you the other way.

17 MR. RANSOM: They've been talking about
18 aging, you know, and how do you factor that into the
19 risk informed regulation. Some of that is possible,
20 I think, because something is known about it.

21 MR. BANERJEE: Every few months we get a
22 surprise, you know. A new sort of break occurs so I'm
23 sort of skeptical.

24 CHAIRMAN WALLIS: Every how many months?

25 MR. BANERJEE: Every few months. I mean,

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1 it's some sort of -- at least recently it seems to be.
2 There are hydrogen explosions and David Bessie.

3 CHAIRMAN WALLIS: So we are due for
4 another one now?

5 MR. BANERJEE: Possibly. A new surprise.

6 MR. BOEHNERT: Well, actually --

7 MR. KRESS: We have a new frequency of
8 surprises.

9 MR. BOEHNERT: They do have a problem at
10 Quad Cities with the uprate. Actually they've had
11 problems with a steam drier. I haven't had the
12 details yet.

13 MR. KRESS: I would be real interested to
14 hear more about that.

15 MR. BOEHNERT: Yeah. I'm going to find
16 out what it is.

17 CHAIRMAN WALLIS: As they try to operate
18 the power they found things happening.

19 MR. BOEHNERT: They had something in the
20 drier break or something.

21 MR. ROSENTHAL: But we're not sure yet
22 that is due to the power uprate. We know there is
23 higher steam flow. We know the thing was vibrating.
24 We know they analyzed it. Or is it simply something
25 that is 20 years old that broke? So let's be cautious

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1 on the leap.

2 MR. STAUDENMEIER: Okay. Conservatism in
3 evaluation models. Many of the public comments stated
4 that the current evaluation models had a large degree
5 of conservatism and they didn't want to apply this
6 full EMDAP process to something that was so obviously
7 conservative. If you do a close examination of their
8 claims of model conservatism, you see that nobody has
9 ever quantified how conservative this is and what they
10 are really referring to really isn't how conservative
11 the underlying thermal-hydraulic code is. It's how
12 conservative the scenario input is to the scenario
13 like you may not take credit for all the safety grade
14 trips or you may have less flow as you input your pump
15 output for safety injection or things of that matter.

16 CHAIRMAN WALLIS: Something like a Bubble
17 Rise Model. No way of telling whether this is
18 conservative or not. The very idea of trying to show
19 it's conservative is probably preposterous.

20 MR. STAUDENMEIER: Or like they do DMB
21 analysis on the worst pain in the core under the worst
22 starting conditions and the worst transient scenario
23 that you can think of. That is what they think of as
24 just being conservative and that the plant doesn't
25 really operate in a way that they have assumed in

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1 these safety analyses.

2 CHAIRMAN WALLIS: It's like sort of
3 assuming that the large-break LOCA is the worse that
4 can happen. It turns out actually the small-break
5 LOCA is more challenging. Just because something
6 seems to be in worse condition doesn't mean it is the
7 worse condition.

8 MR. STAUDENMEIER: So I guess the question
9 I struggled with a little bit is how can the degree of
10 conservatism in the evaluation model be demonstrated
11 without a full CSAU analysis. I came up with a
12 simplified method that may or may not work very well.
13 It hasn't been tried out in practice yet.

14 MR. SCHROCK: I don't understand. Is that
15 your question or their question?

16 MR. STAUDENMEIER: This is my question.
17 I'm questioning how -- they want to take credit for
18 all this conservatism.

19 MR. SCHROCK: I would ask you further how
20 can you demonstrate the conservatism of what was
21 formerly called an evaluation model or specifically an
22 Appendix K model by doing a full-scale CSAU. Isn't
23 that implied here? If you do a full CSAU analysis on
24 an Appendix K evaluation, that you would come to a
25 better understanding of the degree of conservatism.

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1 I don't understand that logic.

2 MR. STAUDENMEIER: Yeah, I think that is
3 the logic. I think you would come to an understanding
4 of how conservative it is unless you are saying the
5 CSAU method falls apart for conservative models.

6 MR. SCHROCK: I don't see what its
7 relevance is to the Appendix K model.

8 MR. STAUDENMEIER: Well, I guess, the
9 industry's point is it isn't relevant because we think
10 we have this largely conservative model and we're just
11 going to --

12 MR. SCHROCK: Maybe relevance isn't the
13 right word. It isn't apparent that it's possible to
14 apply a full CSAU analysis to an Appendix K
15 calculation.

16 CHAIRMAN WALLIS: And lacks all of the
17 Appendix K assumptions and see what the consequences
18 were.

19 MR. SCHROCK: They are two different
20 things. I mean, one is an assessment of realistic
21 calculation and the other one is something off in the
22 never never land of fantasy.

23 MR. STAUDENMEIER: Not in all cases. I
24 mean, like a small-break LOCA Appendix K calculations,
25 the only real difference between best estimate or

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1 realistic small-break LOCA calculation and Appendix K
2 small-break LOCA calculation is generally decay heat
3 is the ANS-73 times 1.2 and the break flow.
4 Essentially everything else in the small-break LOCS
5 calculation is the same as what you would do in a
6 realistic calculation.

7 CHAIRMAN WALLIS: And you capture the
8 break flow.

9 MR. SCHROCK: Are you saying that the
10 physics of small-break phenomena are addressed in the
11 thermal-hydraulic models in Appendix K calculations?

12 MR. STAUDENMEIER: Yes. I mean, most of
13 the vendors use something like -- I mean, a lot of the
14 vendors use something based on RELAP-5 and it's
15 essentially NRC based version of RELAP-5 with some
16 modifications to make it comply with Appendix K and
17 maybe some more enhancements in places they thought
18 the code was deficient when they picked it up. But
19 for all essential purposes, at one time except for the
20 Moody Break Flow, which I guess you are responsible
21 for, and decay heat, which I guess you are somewhat
22 responsible for.

23 MR. KRESS: You guys are to blame.

24 MR. STAUDENMEIER: Then essentially they
25 are the same calculation as a realistic calculation

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1 except they are not -- obviously they have done
2 assessment against various stuff to show that they
3 think these models are conservative but there's no
4 real difference between the models and the codes and
5 the models and a realistic code in terms of small
6 break.

7 DR. MOODY: There's a term I haven't heard
8 mentioned here and that's called the worst case. When
9 you've got a model, usually when you input or your
10 boundary conditions are picked for that model to give
11 you a so-called worst case, it doesn't necessarily
12 mean the model itself is conservative or not.

13 I guess a model is conservative based on
14 what the result of that model is. If you are
15 concerned about how fast flow comes out of a pipe, if
16 the model neglects friction, that might be
17 conservative, at least as far as pressurizing a room.

18 If you are trying to get flow to the
19 reactor, lack of friction is nonconservative because
20 it will allow more flow to get into the reactor than
21 you would expect. I guess it really does -- all these
22 things that have been discussed there has got to be a
23 human being involved here somewhere that has a
24 conscience and is accountable to somebody else.

25 As I read these guidelines, in my opinion,

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1 our guidelines but you can't take the human element
2 out of it. Somebody that does this has got to be a
3 little concerned about his reputation and somehow
4 standing up in front of a group that is going to be
5 critical and making a good story that can be defended,
6 in other words, the accountability, track record, all
7 these things, I think it's great to have good
8 guidelines.

9 We are kind of nit-picking a lot of these
10 items but I guess that has to happen, doesn't it, in
11 order to put in perspective what the eventual human
12 being is supposed to do that has to come and say,
13 "Look, we've done a reanalysis. We've changed these
14 parameters and we want to convince you that this
15 shouldn't give you gas pains. We got a conservative
16 result."

17 MR. STAUDENMEIER: Yeah, and for the most
18 part I think that is built into our regulatory
19 assumptions that the people out there are making a
20 good faith effort and are concerned with safety
21 themselves and want to get answers to send into the
22 NRC and that they are not out there looking for every
23 loophole and trying to do things that aren't on the up
24 and up.

25 DR. MOODY: That's usually happens because

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1 of some engineering manager doesn't want to spend the
2 money to go any further than he just has to and so
3 forth.

4 MR. STAUDENMEIER: The Maine Yankee case
5 is one example of that and that is exactly what
6 happened was management pressure being put down. The
7 analysts knew that everything wasn't quite right but
8 they were pressured into doing something that wasn't
9 officially correct.

10 I don't think any one of them thought they
11 were going to melt their reactor because of this
12 shortcut or anything or that they were going to cause
13 harm to the public. In terms of following through
14 what they had committed to, they didn't do that.

15 Yeah, it was a place where our process
16 broke down because we assumed they were going to be
17 following through what was written in the SER and they
18 would be applying the code like that and that just
19 didn't happen.

20 CHAIRMAN WALLIS: Maybe you need a Reg.
21 Guide for managers.

22 MR. BANERJEE: It's generally accepted as
23 accounting practices.

24 MR. STAUDENMEIER: As part of the Maine
25 Yankee thing there was a criminal investigation on

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1 that to see how it did break down. That is beyond
2 what we do with code reviews.

3 MR. ROSENTHAL: I think there was what we
4 termed a tacit understanding and no manager had to
5 tell an analyst at Yankee. This could pertain to any
6 plant. If you are short of MPSH on a plant with a
7 LPSI pump at a certain elevation and a containment
8 sump at another elevation, barring getting out the
9 jackhammers and relocating pumps, you are going to
10 change your analysis.

11 I'm only use this as an example. I think
12 there was a tacit understanding that on this plant
13 that had been built and run for years that there
14 weren't going to be expensive hardware changes to the
15 plant.

16 No manager ever had to say anything to an
17 analyst. He understand that so he was going to get
18 out his ever bigger fancier code and do more and more
19 analysis to demonstrate that it was okay.

20 MR. STAUDENMEIER: The NRC was partly at
21 fault at Maine Yankee for the RELAP-5 part anyway,
22 The code shouldn't have been approved to do LOCA
23 analysis.

24 If you look at what was written in the SER
25 you see things like the code does too much

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1 condensation so as part of your input you are going to
2 artificially raise the temperature of the safety
3 injection water by 80 degrees or something like that
4 to compensate for the fad condensation model and
5 various things like that interspersed.

6 If you read the SER, it really reads like
7 a code that should have never been approved. When it
8 was approved, they went through all kind of
9 contortions to make it work in some manner but I don't
10 think it ever worked reliably.

11 MR. KRESS: We call it intentional
12 compensating errors and we don't like them.

13 MR. STAUDENMEIER: Yeah, it was.

14 MR. KRESS: The question that I think is
15 a great one to ask, if it were an ACRS letter, we
16 would ask you to put the question mark after the word
17 "demonstrated" and mark out the rest of the question.

18 MR. STAUDENMEIER: I think that would be
19 a good choice of words.

20 CHAIRMAN WALLIS: I think today we are
21 just looking at this piece of paper but, in fact, our
22 conclusions are going to be influenced by when we
23 evaluate the four human beings who have spoken to us.
24 I'm just wondering if we had four different human
25 beings, the same piece of paper and we read the same

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1 conclusion.

2 DR. MOODY: Interpretation

3 MR. STAUDENMEIER: So, anyway, here we go
4 on to my proposed simplified method to demonstrate
5 model conservatism which is the slide I thought was
6 going to take the bulk of the time.

7 CHAIRMAN WALLIS: So we have another two
8 hours of discussion.

9 MR. STAUDENMEIER: This was to try and
10 come up with a way to demonstrate your model
11 conservatism for these conservative evaluation models
12 with their conservative input assumptions.

13 Part of it depended on using this code as
14 best you can in a realistic or best estimate mode to
15 show that your model did have some fidelity to
16 predicting reality and that would be to test your code
17 against some plant transient or scale test and show
18 that your code was actually good at predicting the
19 reality of the situation.

20 MR. KRESS: I would have chosen number one
21 to be a performed set of analyses or a set of
22 benchmark transients with a best estimate code that is
23 different than the one you have. I wouldn't say use
24 the same code in a best estimate mode. I would say
25 use a code that you consider to be a best estimate

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1 code already with uncertainty.

2 That code would be my choice in the first
3 place to help approve the code that is being the
4 evaluation model in the first place. That along with
5 its comparison with the experimental data. I would
6 have had a different view of what item one ought to
7 be.

8 MR. STAUDENMEIER: That's another possible
9 way to look at it.

10 MR. BANERJEE: But if there is already a
11 best estimate code that you can use, why not use that
12 instead of developing an evaluation model.

13 CHAIRMAN WALLIS: I don't understand. The
14 evaluation model I thought covered everything.
15 Evaluation model is simply a code plus all the things
16 you have to do to make it work.

17 MR. STAUDENMEIER: It is.

18 CHAIRMAN WALLIS: You mean using Appendix
19 K assumption?

20 MR. STAUDENMEIER: You are actually using
21 the evaluation model the way it was meant to with the
22 evaluation model assumptions.

23 CHAIRMAN WALLIS: What do you mean by
24 that? You mean Appendix K assumption?

25 MR. STAUDENMEIER: Well, it may not be

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1 Appendix K. In the case of LOCA it may be Appendix K
2 but in the case of transients it may be some other
3 assumptions.

4 CHAIRMAN WALLIS: I thought we determined
5 that when you say evaluation model you mean simply the
6 whole process of running a code.

7 MR. STAUDENMEIER: Right.

8 CHAIRMAN WALLIS: So a best estimate code
9 is an evaluation model.

10 MR. STAUDENMEIER: The code plus the way
11 you use it is I guess the evaluation model. The
12 underlying code itself, the transient or thermal-
13 hydraulic engine.

14 CHAIRMAN WALLIS: The best estimate mode
15 and then, too, you use Appendix K?

16 MR. STAUDENMEIER: Appendix K or the way
17 they would evaluate the transient in the plant.

18 CHAIRMAN WALLIS: You might find out
19 Appendix K isn't conservative.

20 MR. STAUDENMEIER: You may and that
21 certainly would be a problem for you.

22 MR. RANSOM: Well, actually the degree of
23 conservatism should be in comparison with the data.
24 I mean, I think that's what you're suggesting in step
25 one, right?

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1 MR. STAUDENMEIER: Yes.

2 MR. RANSOM: You would do it for a case
3 where there is actual data.

4 CHAIRMAN WALLIS: How good does that
5 comparison have to be?

6 MR. RANSOM: Well, I think you are trying
7 to establish a degree of conservatism.

8 CHAIRMAN WALLIS: Is this in the guide,
9 this piece of paper?

10 MR. STAUDENMEIER: It is in the revised
11 guide actually.

12 CHAIRMAN WALLIS: I don't like this at
13 all. I think this is dangerous. We've got to require
14 that they estimate uncertainties. It's comparing
15 something against something else which is artificial.
16 It's not a good comparison with reality.

17 MR. LAUBEN: I think what you're saying is
18 really sort of with or without uncertainty.

19 MR. STAUDENMEIER: Right.

20 MR. LAUBEN: Or with and without --

21 MR. STAUDENMEIER: Which the uncertainties
22 may be that --

23 MR. LAUBEN: Artificial conservatism.

24 CHAIRMAN WALLIS: I don't know why you
25 need to do this because all these applicants, the

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1 Westinghouse, Seamans, GE are developing formal ways
2 of making estimates of uncertainty and bias. Why
3 should somebody else get a shortcut like this that
4 has all kinds of pitfalls?

5 MR. LAUBEN: I think maybe, Joe, you were
6 probably thinking of other transients.

7 MR. STAUDENMEIER: I was thinking of more
8 simplified transients like a pump trip or something
9 like that where you have good planned operational
10 testing data and that the model is fairly simple and
11 only depends on wall friction and the pump
12 essentially.

13 MR. LAUBEN: And almost all conservatisms
14 are tied up in the input.

15 MR. STAUDENMEIER: Right.

16 MR. LAUBEN: If you use nominal flow
17 versus flow that you use for your transient analysis,
18 that is the way it appears. I agree that I think you
19 are going to find this stuff tied up in the process
20 for LOCA but for the transients he's trying a method
21 here that could be done possibly fairly simply.

22 CHAIRMAN WALLIS: You see, there's no such
23 thing as a best estimate mode. These are simply just
24 estimates and you put different assumptions in and you
25 get a different estimate. There's no way of telling

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1 which is best until you compare it with things. The
2 best is presumably something which when you compare it
3 with things has lower level uncertainty than all the
4 other things. Until you've done this comparison and
5 evaluated all the uncertainties, you have no figure of
6 merit in which you could judge best, good, worse, or
7 anything.

8 MR. STAUDENMEIER: Best is a bad choice of
9 words there. Realistic I guess would be better.

10 CHAIRMAN WALLIS: But then it means could
11 you assume anything in an estimate mode.

12 MR. RANSOM: Maybe I don't understand what
13 best estimate means either but I have always thought
14 it meant that if you had a set of data you would hope
15 to get a best estimate calculation that basically is
16 the mean of the data or fits the mean in some way. No
17 conservatism in that. The conservatism comes in when
18 you take best estimate plus uncertainty and that's why
19 I have always said it's very critical.

20 CHAIRMAN WALLIS: Instead of making a
21 conservative assumption, let's say that you don't
22 allow counter current flow at all. Someone comes up
23 with, "Oh, engineering. Well, this counter current
24 flow and this horizontal pipe is limited by some
25 interfacial stability and we know that is absolutely

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1 a Froude number and we know the Froude number probably
2 is somewhere around 1 so we'll say that when we get a
3 Froude number 1 we get instability which they've got
4 in the code. This is an engineer's guesstimate. Then
5 it becomes a best estimate because it's not
6 conservative. There's nothing best about it. It may
7 be a lousy estimate. Because he's not conservatory it
8 gets called best estimate.

9 MR. RANSOM: It's your best shot at it.

10 CHAIRMAN WALLIS: It's your best shot but
11 it may be a lousy shot.

12 MR. RANSOM: Sure. That's where the
13 uncertainty comes in to play.

14 CHAIRMAN WALLIS: Our view -- my view is
15 that you shouldn't use the word best ever unless
16 you've got some measure of how good it is.

17 MR. SCHROCK: Or define what it means. I
18 remember discussions about what best estimate meant
19 when the rule change was under consideration. The
20 image that I recall for it is that it's a fluid thing.

21 Best estimate means it's the best
22 engineering calculation you can do at any point in
23 time with the expectation that it's going to get
24 better as time goes by. The best estimate is
25 something that will be constantly changing, constantly

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1 getting better.

2 DR. MOODY: We would have no trouble
3 deciding what a worst estimate would be to help us
4 understand what a best estimate is, would we?

5 MR. RANSOM: Well, I think I agree.
6 That's my understanding of what was meant by best
7 estimate but it would probably be helpful if this
8 thing was clarified. I mean, at this stage if we
9 don't understand what best estimate means --

10 CHAIRMAN WALLIS: We don't use the term.
11 We call it realistic code and a realistic code, which
12 is a code where you try to do a good job, is not
13 complete without estimates of uncertainty, without
14 quantitative assessments of the uncertainty in those
15 estimates.

16 MR. RANSOM: You're saying realistic.

17 CHAIRMAN WALLIS: It is simply saying tell
18 me what you predict and tell me the uncertainties in
19 what you predict. Presumably if it's a better code
20 this uncertainty band will be smaller presumably. We
21 don't use the term best. The uncertainty rate is a
22 measure of how good the code is.

23 MR. KRESS: Which is a real nice academic
24 concept but nobody knows how to do that uncertainty.

25 MR. RANSOM: That's the problem.

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1 MR. KRESS: Graham you gave an example of
2 something where the counter current flow situation was
3 not included, but yet it was maybe your best shot at
4 the time so is that realistic? If it is realistic,
5 then I guess realistic would include some kind of
6 uncertainty to allow for that.

7 CHAIRMAN WALLIS: That's not good enough
8 because I look at this documentation and I read it as
9 the knowledge I have and I think that's a lousy
10 estimate. What am I supposed to do?

11 MR. SCHROCK: But it can be the best among
12 lousy.

13 DR. MOODY: I think best has become a
14 dirty four-letter word here in the last five minutes.
15 Shall we using things like most realistic? Is that
16 going
17 to --

18 CHAIRMAN WALLIS: It has become an excuse.
19 Giving it your best shot often means you're doing a
20 bad job because you don't know what you're doing.

21 DR. MOODY: It helps to know where the
22 target is.

23 CHAIRMAN WALLIS: But, anyway, let's get
24 back to what you are proposing. I think you make a
25 lot of discussion of this as you anticipated. I think

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1 you should be very careful what you put in for
2 simplified way to demonstrate conservatism.

3 MR. STAUDENMEIER: Yeah, I agree with
4 that. I would appreciate your comments.

5 CHAIRMAN WALLIS: I think something like
6 a CSAU or better or equivalent.

7 MR. STAUDENMEIER: There may be no way to
8 do this simplified method that I had in mind or may
9 not be defensible in all cases. If that is the case,
10 then we really can't have this and they do have to go
11 through an analysis.

12 CHAIRMAN WALLIS: I suppose you could have
13 sort of a screening thing which says look at your
14 estimate model and look at the Appendix K calculation
15 and see if yours is conservative. If it's not
16 conservative, you go to another block in your diagram
17 as sort of a screening thing. I don't think it's a
18 substitute for a better uncertainty analysis.

19 MR. STAUDENMEIER: I guess kind of what I
20 had in mind in this thing was a case like a pump trip
21 or like a turbine trip. In BWR you have turbine trip
22 data from Peach Bottom. Run your code in its
23 realistic mode and see what that is. Run your code
24 with its evaluation model assumptions that you have to
25 put in. That shows you an idea of how much

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1 conservatism there is in terms of real data.

2 Then do the same thing at your own plant
3 for the calculation that you're interested in to give
4 you an estimate of how much you are over-predicting
5 whatever parameter you're looking at for the transient
6 you're interested in. For like a turbine trip you
7 would be looking at CPR margin.

8 That sort of process applied to real data
9 and using comparison between running in the realistic
10 mode and in your evaluation model mode would give you
11 an estimate and you would really only be able to use
12 this if there was really a very large amount of
13 conservatism in your ER analysis method.

14 It's not something that if it was barely
15 conservative if it turned out that your method wasn't
16 as conservative as you thought it was, then maybe you
17 wouldn't be able to use this method at all to evaluate
18 your uncertainty.

19 You would have to come up with a better
20 method to do it. This would only apply in cases where
21 it was truly highly conservative and this would be a
22 simple method at getting at that amount of
23 conservatism.

24 CHAIRMAN WALLIS: It only covers then the
25 assumptions of the evaluation model which are rather

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1 few.

2 MR. STAUDENMEIER: Right. It would only
3 really apply to simply evaluation models.

4 CHAIRMAN WALLIS: Appendix K. If you use
5 something -- there are very few assumptions specified
6 and you can relax those but that's no measure of the
7 quality of the code itself.

8 MR. STAUDENMEIER: Now, in Appendix K --
9 like Appendix K I wouldn't consider -- I mean, your
10 realistic estimate would be transfer correlations you
11 had in there. Actually you would be surprised that
12 some of the Appendix K reflood heat transfer
13 correlations is good or better than realistic heat
14 transfer correlations.

15 I mean, you compare the data and they do
16 very well and all the conservatism in reflood is in
17 your decay heat assumptions or your reflood or your
18 calculations that you're getting what the reflood rate
19 is which it may be helpful to downcomers or something
20 like that. If you look at the reflood heat transfer
21 correlations themselves, they are as good as any you
22 can get.

23 MR. BANERJEE: During the discussion maybe
24 you should, if you would, go through the logic of
25 these five steps.

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1 MR. STAUDENMEIER: Okay.

2 MR. BANERJEE: Let's assume that instead
3 of best estimate we call it realistic estimate or
4 something. But still I'm not understanding what it is
5 you're proposing. I haven't got the sense of it
6 completely.

7 MR. STAUDENMEIER: Okay.

8 MR. BANERJEE: Just reading it.

9 MR. STAUDENMEIER: Yeah, this would --
10 well, let me go through an example like pump trip in
11 PWR. There is good data for all the plants out there
12 because they have to do those type of testings when
13 they start up the plant so you know how your pumps are
14 going to coast down and how your flow is going to
15 coast down.

16 Performing analysis of one of these
17 transients you have data for using the realistic mode
18 of your calculational tool to show that you are fairly
19 good at predicting the realistic behavior in the
20 plant. Then --

21 MR. BANERJEE: In this case what might
22 that be? What would you change in your model?

23 MR. STAUDENMEIER: You might take out like
24 conservative assumptions based on wall friction or
25 lost coefficients. They may stick in conservative

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1 methods for computing lost coefficients, for instance.
2 They stick in extra lost coefficients to make it coast
3 down faster than the plant would in reality because in
4 something like that you would be looking at DMV
5 margin. The worse case is the flow coasting down as
6 fast as possible.

7 In that case you would put in what your
8 best assessment of the lost coefficients was or any
9 other type of input assumptions like pump head curve.
10 They may have in pump head curves or something or the
11 inertia in the pump they put in conservative values
12 for lots of those things.

13 Then in the realistic mode you would try
14 to model the plant as best as you could to show how
15 good the code was predicting if you had realistic
16 values for all these things.

17 MR. KRESS: What is your figures, DMB or
18 is it flow rate?

19 MR. STAUDENMEIER: For that it would be --
20 the ultimate measure of merit is DMB so you would have
21 to relate it somehow to the safety parameter. Perform
22 the analysis of that test again with these
23 conservative assumptions that may be in your
24 evaluation model.

25 That would show using them that maybe the

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1 flow coast down much faster using the evaluation model
2 assumptions so that would make the DMB much worse.
3 But this test that you performed isn't the worse case
4 conditions in the plant that they do their safety
5 analysis for.

6 The power shape may be different or
7 various other things may be different that they
8 perform their actual safety analysis for. You would
9 perform the same sort of exercise in your safety
10 analysis calculation where you have all your trip set
11 points and other things set the way you would.

12 MR. BANERJEE: So you are still at step
13 two. You are still running the transient for which
14 you have data.

15 MR. STAUDENMEIER: Right. At step two you
16 are still running the -- okay. Then you jump to step
17 three and take the event --

18 MR. BANERJEE: What do you mean by compare
19 the key figures of merit? In this case would it be
20 the rate at which the coast down is occurring or would
21 you actually make the next step and go to the DMB
22 prediction because you may not have any DMB prediction
23 there.

24 MR. STAUDENMEIER: Right. I think you
25 would do both in that case. You would show DMB

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1 prediction, although in that case --

2 MR. BANERJEE: And you may not have data
3 for that, right?

4 MR. STAUDENMEIER: Data for the DMB? Oh,
5 you don't have plant data for the DMB but you would be
6 comparing your DMB prediction using your approved
7 correlation for your DMB model.

8 MR. KRESS: Implicit in that is that the
9 reason that's an approved correlation or approved
10 original code is somebody originally made a judgment
11 that it is conservative enough and there is margin
12 enough there. You just go ahead and say we'll accept
13 that because we wouldn't have approved it in the first
14 place otherwise.

15 MR. STAUDENMEIER: You would compare maybe
16 the pump coast-down rate or flow coast-down rate and
17 the DMB and it's ultimate affect on DMB. The DMB is
18 something there and you have taken your data for that
19 specific bundle and those specific grid spacers and
20 things like that and have this range of DMB data over
21 the whole range of conditions that it needs to be
22 applied for. That is probably the best part of the
23 model actually.

24 Then that pump trip event may not be the
25 exact event you're going to analyze in your safety

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1 analysis but you pick the pump trip because it's
2 similar to the pump trip and it has all the same
3 phenomena going on to your actual safety analysis pump
4 trip calculation.

5 Use initial conditions at the associated
6 tech. spec. limits that are the worse case for this
7 pump trip and run it again in realistic mode with the
8 realistic lost coefficients. Look at the plant
9 response and run it again with your evaluation model
10 assumptions that you have to use for the approved
11 evaluation model and show that change.

12 If it was DMB, show the ultimate result on
13 the DMB prediction to give you an idea of the amount
14 of conservatism in your calculation. Like I said, if
15 you is a large amount of conservatism in the
16 calculation which this would demonstrate.

17 And you have also demonstrated your code
18 was okay at predicting these phenomena, then maybe
19 that would allow you to put less effort in and not
20 have to evaluate uncertainty in making a small change
21 to this model. If you really didn't have much
22 conservatism at all, then you would say, no, this
23 isn't good enough.

24 CHAIRMAN WALLIS: Let's look at what we
25 see with, say, LOCA analysis. We get these LOCA

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1 analyses and they use Appendix K and they get up to
2 2,199 degrees and everything is fine. Maybe this
3 involves also a link to containment performance or
4 something. Then they say, "Well, when we do a
5 realistic analysis we only predict 1,400." There is
6 obviously a great deal of conservatism. What do you
7 do with that?

8 I mean, now they say we've got to relax it
9 so we've got this margin of 800 degrees to play with.
10 Therefore, we are going to make other assumptions and
11 change the model and so on. Because it's conservative
12 you have no way of evaluating what you can let them
13 do. They might as well use Appendix K.

14 MR. STAUDENMEIER: Well, Appendix K has
15 specific rules that they have to follow.

16 CHAIRMAN WALLIS: It doesn't help them in
17 saying we are now going to replace Appendix K with
18 this other model and now we are going to use it to
19 predict temperatures which Appendix K would predict to
20 be above 2,200. Because our models is a good estimate
21 with uncertainty, it still meets the intent of the
22 regulations.

23 MR. STAUDENMEIER: Well, that would put
24 you into the realistic LOCA calculation mode where you
25 would have to be --

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1 CHAIRMAN WALLIS: It seems to me that you
2 can compare with Appendix K and show your estimates
3 but it doesn't let you do anything because you are
4 still regulating according to Appendix K. As soon as
5 you try to regulate in accord with the realistic
6 model, you throw away Appendix K. Comparison with
7 that is absolutely irrelevant. What is the
8 uncertainty --

9 MR. STAUDENMEIER: Yeah, I wouldn't apply
10 this to LOCA calculations at all actually. This would
11 be applied more to transient calculations. If that's
12 what you believe, you should comment that way and
13 we'll consider it. Like I said, this is a proposal.

14 MR. BANERJEE: I guess the concern that I
15 would have, and maybe Graham has similar, is that if
16 you do a very limited amount of work under one there,
17 you may get the wrong idea about the realistic model.
18 Let's say for the sake of argument it was LOCA. It
19 doesn't have to be. So you decide that the realistic
20 model will not use the decay heat so you reduce it by
21 20 percent or something.

22 You decide that you will be able to rewet
23 even if the reflood rate is below one inch per second
24 or whatever. You maybe still will not allow
25 rewetting, you know. Whatever it is. In any case,

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1 your realistic model will come up with some estimate
2 like 1,400 or 1,100. It will come much lower.

3 If you just have a few tests even, let's
4 say, LOFT but only in the blow-down phase, it may give
5 you completely wrong information because you might not
6 take into account boiling and the downcomer and all
7 these other things which would be part of a realistic
8 model.

9 You may falsely think you have a big
10 margin because you've got a very limited small scale
11 set of experiments against which you have done the
12 comparison. That would be a concern.

13 MR. STAUDENMEIER: I agree that is a
14 concern. You have to be very careful about the amount
15 of phenomena going on and competing with each other
16 and making sure that you had a real good handle on
17 this.

18 That's why I guess my original intent was
19 to have this applied to more simplified scenarios or
20 events and not allow you to apply to complicated
21 events where you can't sort out everything. This
22 would be more or less where you knew there was one
23 dominant phenomena and knew we had a good handle on
24 that.

25 MR. BANERJEE: That would be fairly

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1 realistic but, in that case, how do you sequester this
2 so that people don't use it where there are multiple
3 phenomena, some of them not well understood like
4 boiling in the downcomer or whatever the hell. How do
5 you ensure that they don't do that?

6 MR. STAUDENMEIER: Well, by the review
7 process at the NRC. I guess it lies on the reviewer
8 to pick up on these things and recognize that this
9 isn't really a place where it can be applied well and
10 make sure that they've done enough assessment against
11 adequate data to show that they know what all these
12 dominant models are, that it is simple enough that you
13 could really apply those.

14 MR. ROSENTHAL: Let me back up a little
15 bit.

16 MR. STAUDENMEIER: And I think in these
17 simple events you could actually end up doing
18 something similar like in a pump trip. I mean, you're
19 only -- your main uncertainty is wall friction and
20 lost coefficients and momentum.

21 You are transporting momentum along loops
22 here. Decaying momentum around the loop and your
23 full-blown CSAU type analysis may not be very
24 complicated for that case either because there's just
25 a small number of phenomena dominating the whole thing

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1 and the code assessment is fairly simple.

2 It may be single phase pressure drop in
3 various geometries and know what uncertainty your wall
4 friction or lost coefficients may have around the base
5 value. It may be almost as simple to apply the full-
6 blown uncertainty analysis in that case also.

7 MR. ROSENTHAL: Let me try to just remind
8 everybody that no Reg. Guide ever replaced a
9 regulation and Appendix K would still be enforced.
10 Similarly, this Reg. Guide is not intended to replace
11 Reg. Guide 1.157 which is our best estimate ECCS
12 analysis.

13 Having said that, the next thing, and
14 maybe we could do a better job at it, but when you
15 review the code you are supposed to say what accidents
16 or transients do you think it's applicable for and
17 which are not.

18 With that, about a year -- actually, I
19 think 15 months ago we had a public meeting in the
20 building and the regulated community said for things
21 like LOCA we understand the large investment and
22 analysis that we have to do and I don't think we had
23 very much resistance.

24 The way you are writing this Reg. Guide
25 for all transients and anticipated operational

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1 occurrences you are asking for a fair amount of
2 analysis and that seemed disproportionate to the
3 challenge, either the reactor dynamics, the time
4 scales of what's going on in the reactor, or just how
5 many pins would go through DMB.

6 I think we were focused now on what one
7 might do for transients or AOs. The first bullet
8 says, "Well, you ought to benchmark this against some
9 operating experience or experiment." That's a leg up.
10 That's a leg up right there against stuff that is
11 maybe even more obscure. We were trying to come up
12 with some middle ground for these less severe
13 transients, not for LOCA.

14 CHAIRMAN WALLIS: I don't know that you
15 can.

16 MR. STAUDENMEIER: It wouldn't be for
17 major code changes. These would be what we would
18 consider relatively small code changes.

19 CHAIRMAN WALLIS: Suppose you say that
20 there's a Moody Break Model in this evaluation model
21 or whatever it is, No. 2. We know that is a huge
22 simplification of reality. We know that thermal
23 nonequilibrium plays an important role, probably more
24 important than some of these film mechanic things and
25 thermal nonequilibrium isn't in the Moody Model at

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1 all.

2 It's obviously more realistic to model
3 these things. We've got a two-fluid, two-temperature
4 model for break flow and we have evaluated all the
5 terms and it does a tremendously good job of modeling
6 break flows. It's obviously a much better
7 representation of the physics than this Moody Model.

8 When we use it in the code for a lot of
9 different transients, sometimes it's more conservative
10 and sometimes it's less. It's all over the place but
11 it's a darn sight better model than the Moody one. I
12 don't think you can make any evaluation of its
13 conservatism on the basis you have suggested here but
14 it's a much better estimate of what happens and we
15 ought to be better.

16 Therefore, you can justify if you compare
17 only with data. If you start comparing with some
18 figure of merit, I think it depends on which scenario
19 you pick and all kinds of things. I'm not sure that
20 it's a good way of saying is this a better estimate.
21 Do you see what I'm getting at? Maybe I'm not being
22 clear.

23 MR. BANERJEE: It's a more realistic
24 estimate

25 CHAIRMAN WALLIS: Yeah, more realistic.

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1 MR. BANERJEE: It may be sometimes
2 conservative and sometimes not.

3 CHAIRMAN WALLIS: But compared with a
4 Moody Model which really should be consigned --

5 DR. MOODY: Careful now.

6 CHAIRMAN WALLIS: -- to mythology.

7 DR. MOODY: Well, there was 15 minutes of
8 glory.

9 MR. RANSOM: The Moody Model is consistent
10 with the maximization of entropy, right?

11 CHAIRMAN WALLIS: It doesn't say anything
12 about thermal time nongrouping.

13 MR. SCHROCK: I think I heard you say that
14 this is in the Reg. Guide. I don't --

15 CHAIRMAN WALLIS: It's not.

16 MR. SCHROCK: I don't know where it's in
17 the Reg. Guide.

18 MR. STAUDENMEIER: What is in the Reg.
19 Guide?

20 MR. SCHROCK: This that you have on the
21 board now.

22 CHAIRMAN WALLIS: It's not, is it?

23 MR. STAUDENMEIER: I'm sure it is because
24 I copied it out of there to make this Reg. Guide.
25 Actually, I corrected a couple errors that were in the

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1 part in the Reg. Guide I think.

2 CHAIRMAN WALLIS: Where is that?

3 MR. BANERJEE: 27.

4 MR. RANSOM: Where is it?

5 MR. BANERJEE: Page 27.

6 CHAIRMAN WALLIS: The simplified method is
7 on page 27?

8 MR. RANSOM: Graded approach.

9 MR. BANERJEE: It's under 5.3, Degree of
10 Conservatism.

11 CHAIRMAN WALLIS: Oh, that's where it is.
12 Okay.

13 MR. STAUDENMEIER: I hid it at the end.
14 I was hoping you would stop reading by that point.

15 MR. SCHROCK: There's no qualification in
16 it as to what you had in mind it applying to. You
17 have indicated now you wouldn't think of this in terms
18 of LOCA but just plant transients.

19 MR. STAUDENMEIER: Yeah, that would -- if
20 it was deemed that it is a feasible approach, then we
21 would have to put some qualifications on that. Right
22 now it looks like there's a lot of controversy over
23 whether it's even feasible.

24 MR. RANSOM: There's even a sort of nit
25 pick. I don't know what you mean by model change in

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1 number five. I notice it's on your number five both
2 in the write up because nothing prior to that on the
3 slide, at least, talked about any change.

4 MR. STAUDENMEIER: Okay. This is a
5 process you would apply to making a model change.
6 That's what this whole section was about.

7 MR. RANSOM: You mean you reduce the model
8 to --

9 MR. STAUDENMEIER: Yeah, a graded
10 approach. This would only apply to making small model
11 changes is what we had in mind. If you were changing
12 a heat transfer coefficient or a loss coefficient or
13 some kind of correlation somewhere in the code it
14 would be evaluating the impact of changing that model
15 compared to what you thought was your degree of
16 conservatism in the model. If it was a small
17 perturbation to this estimated degree of conservatism,
18 it's okay. But if you are cutting out all your
19 perceived or estimated conservatism, then you
20 wouldn't. This was meant to be applied to small
21 changes with large amounts of conservatism in the
22 model.

23 MR. RANSOM: With the idea here, I guess,
24 and using best estimate I think in the sense that it's
25 used here you would have best estimate plus

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1 uncertainty. Now the attempt would be to get best
2 estimate plus uncertainty to equal reality I guess.
3 Right?

4 MR. STAUDENMEIER: Right.

5 MR. RANSOM: That would be your limit. So
6 you could iterate through this thing until you
7 actually changed your model enough that you finally
8 are just predicting best estimate plus uncertainty
9 equals reality. In other words, no margin left.

10 MR. BANERJEE: But there is no uncertainty
11 estimate here.

12 MR. STAUDENMEIER: We wouldn't allow this
13 method if it would be applied while down in that
14 range.

15 MR. RANSOM: It keeps saying that you
16 would -- the methodology --

17 MR. BANERJEE: The methodology, as far as
18 I can see, does not require an estimate of
19 uncertainty.

20 MR. STAUDENMEIER: The estimate of
21 uncertainty comes from this simple process here. That
22 was --

23 MR. BANERJEE: That's a different issue.

24 MR. RANSOM: So the degree of conservatism
25 is synonymous with the uncertainty, I guess. The

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1 degree of conservatism as it's used here is synonymous
2 with the uncertainty apparently.

3 MR. STAUDENMEIER: It was, I guess, meant
4 to be applied where we have it.

5 MR. BANERJEE: If you put it back into the
6 way we looked at the CSAU stuff if you want to
7 translate it into those terms.

8 MR. RANSOM: I'm really confused, I guess,
9 because this Reg. Guide talks about best estimate plus
10 applying the CSAU process which implies evaluating the
11 uncertainty. I'm not quite sure what best estimate
12 means now because of our discussion today. Then you
13 move over to the method here which seems to eliminate
14 the uncertainty and makes that synonymous with
15 conservatism.

16 But implied, I guess, in all of this is
17 the degree of conservatism is going to be limited by
18 whatever the uncertainty. The degree of conservatism
19 is going to be limited by the uncertainty associated
20 with the model and the process.

21 MR. STAUDENMEIER: Right.

22 MR. BANERJEE: That's the problem I guess.

23 MR. STAUDENMEIER: We would try to limit
24 this to things that you had well understood models
25 that had a fairly quantifiable level of uncertainty

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1 like something with simple phenomena governing the
2 whole thing.

3 MR. RANSOM: I guess my problem with this
4 whole thing is I think we know what we mean and want
5 to do but it somehow is not very tight. Certainly to
6 the uninitiated who would come in and read this
7 process would say that it's like wondering all over
8 the map.

9 I've always thought that anybody who
10 worked for the Union of Concerned Scientists if you
11 really knew what went on here he would have a lot of
12 room to attack this process.

13 CHAIRMAN WALLIS: This is also for
14 industry. If the only model which is allowed in terms
15 of a change is one which is more conservative than you
16 had before, which is what this seems to suggest,
17 that's not much advance. The only thing that is being
18 evaluated as a criterion is how conservative is it.

19 MR. STAUDENMEIER: Well, this would be --
20 if it changed the conservatism by a small amount, we
21 would allow it. If it changed it by a substantial
22 amount of your estimated conservatism, then you would
23 have to go through a much more detailed process. This
24 would only be for model changes that were a small
25 part of the amount of conservatism.

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1 MR. KRESS: Sort of like Reg. Guide 1.174
2 concept.

3 MR. RANSOM: Well, actually it permits a
4 small change increase at risk. Right?

5 MR. KRESS: This will, too.

6 MR. STAUDENMEIER: This would allow a
7 small change in the nonconservative direction.

8 DR. MOODY: Let me ask, and maybe Vic has
9 a good answer. How is this different than rocket
10 science? You mentioned rocket science a while ago.
11 People never put a person on the moon but did they go
12 for best estimate? Did they go for realistic? Did
13 they test everything full scale? Did they test
14 everything in zero or one-seventh gravity?

15 MR. RANSOM: Part of the answer to that is
16 yes, they tested in full scale. Every engine is
17 tested before it is ever put on one of those vehicles
18 and statistically tested to the point that the
19 probability of failure could be estimated to be 99999.
20 I mean, not fail for liability. That's been proven to
21 be. Well, there are other things, too, like defense
22 and depth is really to them is, I think, bail on fail
23 safe. Some philosophies like that and design and
24 redundancy and design. They will have four valves
25 where really in the real process you could have one.

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1 Parallel series so it allows for the possibility of,
2 say, at least one valve failing. That kind of thing
3 is done there and to a large extent -- well, the main
4 difficulty between that and nuclear science, I think,
5 is you cannot test this under full scale conditions
6 and worse accident type situations. You do blow up
7 engines on the test stand. That's happened. When
8 that happens, there hell to pay on down through the
9 design review process, the refits, and the amount of
10 retesting which must be done to verify that, indeed,
11 that problem has been fixed.

12 Actually, when that's been violated, you
13 saw the challenger accident where the indications of
14 problems with the o-rings on those solid rockets was
15 swept under the rug and, indeed, later led to a
16 catastrophe.

17 MR. BANERJEE: Even though there were
18 memos.

19 MR. RANSOM: There were what?

20 MR. BANERJEE: There was a memorandum from
21 the engineers.

22 MR. RANSOM: Oh, yes.

23 CHAIRMAN WALLIS: Some management
24 decisions were made.

25 MR. RANSOM: It's a safety culture

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1 problem.

2 MR. STAUDENMEIER: In Arian 5 they never
3 tested the control software on it. Range of
4 conditions had a numerical overflow and the control
5 system was no good and the rocket crashed.

6 CHAIRMAN WALLIS: I still don't understand
7 this. Suppose I come up with a better momentum
8 equation to use in my code, I do all sorts of
9 evaluations against data and is far better than the
10 one that is used now. I've run the same transient
11 using this momentum equation and making Appendix K
12 assumptions. That's what you asked me to do for step
13 2 and I come up with 2,210 degrees. Therefore, I'm
14 not allowed to do anything? I want to use my
15 realistic code and not make these assumptions. That's
16 what I'm driving at.

17 MR. STAUDENMEIER: I mean, in that case
18 where we uncover severe deficiencies in the model,
19 that's considered a model error and you have to go and
20 fix the thing.

21 CHAIRMAN WALLIS: For these assumptions
22 you are required to do an Appendix K and say nothing
23 about fidelity of your momentum equation.

24 MR. STAUDENMEIER: Appendix K says that
25 you have to access your code against applicable

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1 experimental data to the best extent possible. If you
2 have data they will assess how good your momentum
3 equation is. You are supposed to assess against that
4 data.

5 CHAIRMAN WALLIS: I'm trying to see how
6 your method here, your subsequent defined, enabled me
7 to put a different momentum equation in my coat. I
8 just can't see how they let me do that because I don't
9 really see what you're asking me to do in number two
10 provides any assessment at all of how good my momentum
11 equation is.

12 MR. LAUBEN: Could you put figure 13 back
13 in? Maybe if I were looking at Figure 13 or assessing
14 it because I think there are five properties in Figure
15 13. One of them is -- the first one is the novelty of
16 model or, if you will, the change that you are talking
17 about that you might put in your code. If it is
18 something like a new momentum equation, that's a
19 pretty significant change to a code, especially a LOCA
20 code. I think right there you are not on the minimum
21 application side. You are definitely on the full
22 application side.

23 The next one is complexity of event. It's
24 a large break LOCA that we're looking at. The event
25 is very complex. Now you are around the full

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1 application side of at least two of the properties.
2 I think what this whole thing that Joe was trying to
3 show was in cases where you're on the other side, at
4 least most if not all the time.

5 So I think in the example you cited,
6 Graham, where you are going to put in a new momentum
7 equation, by golly, that's really purchasing a
8 completely new evaluation model.

9 MR. STAUDENMEIER: Yeah, the case I ought
10 to apply this more to is changing something in the
11 momentum equation like your wall drag or something.
12 Or maybe you want to put in Reynolds number, dependent
13 WAS coefficients so you are putting a small
14 partipation to your momentum equation under the
15 conditions you're using.

16 CHAIRMAN WALLIS: Okay. How does that
17 help me with something like Appendix K? I want to
18 change the world drag somewhere.

19 MR. BANERJEE: Appendix K you are not
20 allowed because of the complexity of the event.

21 MR. STAUDENMEIER: Yeah. Appendix K they
22 would have to meet all the Appendix K requirements.
23 Appendix K they would have to go and meet all the
24 Appendix K requirements. Any change they made to that
25 they would have to assess against the proper data.

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1 Appendix K relies on these large imposed
2 assumptions to ensure that you are conservative. In
3 some cases we find maybe that is not the case like the
4 downcomer boiling issue. But then I think that gets
5 treated as more or less a code error or code
6 deficiency that you have to do something about to
7 correct.

8 MR. BANERJEE: That gets back to the decay
9 heat.

10 CHAIRMAN WALLIS: But I think this gets
11 back to the whole thing that codes have been
12 criticized for through the ages. By focusing
13 attention only on these figure of merit, you allow all
14 kinds of nonsense in the code simply because it turns
15 out that it seems to meet some figure of merit in some
16 conservative way until the nonsense is in the code
17 forever simply because at some time it was shown not
18 to have much effect on preclad temperature, let's say.

19 MR. SCHROCK: Yeah, it looks like you have
20 a disincentive to doing the calculation correctly.
21 Having a code which is based on I'll say correct
22 equations. I mean, more correct equations.

23 MR. STAUDENMEIER: Why do you say it's a
24 disincentive?

25 MR. SCHROCK: Well, because you are going

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1 to require a full-blown new justification of the so-
2 called evaluation model.

3 MR. STAUDENMEIER: Right.

4 MR. CARUSO: You mean for new codes, Mr.
5 Schrock?

6 MR. SCHROCK: I mean if you said you look
7 at the momentum equation in TRAC-M and say, "Uh oh,
8 this isn't right and here is another equation which is
9 closer to the truth," if I put this better equation in
10 there, then I am going to have to start in step 1 and
11 do the complete CSAU thing all over again.

12 MR. RANSOM: That's my understanding of
13 CSAU.

14 DR. MOODY: Just recently, Graham, you put
15 out a note using Bernauli's equation for two separate
16 streams, liquid and vapor, going into a branch for
17 something. It was apparently to make some correction
18 because there was a quibble with the way it was being
19 handled in one of the codes.

20 CHAIRMAN WALLIS: This was no quibble.
21 No, no, no. This was -- actually, this might have got
22 into a code. This was low on the branch which was a
23 research program to development them all which would
24 go into TRAC-M code.

25 DR. MOODY: Does that apply now? Is that

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1 a kind of an example where like someone comes along
2 with a better representation, more physics in the
3 problem or the right physics. Then they want to
4 incorporate that in the process here. Is that what
5 we're talking about? Where do you get on the loop
6 here and how far do you go?

7 MR. STAUDENMEIER: This was to come up
8 with a way that was simpler than going through the
9 whole process, this graded approach that small changes
10 that would be improvements or something if they were
11 a small change wouldn't need to go through the whole
12 detailed process because we don't want to put
13 constraints on people correcting known deficiencies in
14 the code.

15 DR. MOODY: I guess in that case that
16 would not have been a small change though. Is that
17 right? That was a significant issue but if it were
18 just a matter of whether you leave out the velocity in
19 the large pipe and simplify, that would be perhaps a
20 small change.

21 CHAIRMAN WALLIS: I think our criticism
22 there was that the model was not believable in its
23 form as presented to us. Here was another one which
24 was not very good but at least was somewhat more
25 believable. That was the gist of that.

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1 DR. MOODY: This process would handle
2 something like that.

3 CHAIRMAN WALLIS: I don't think it would
4 because you would have to show that one is more
5 conservative than the other.

6 MR. STAUDENMEIER: No, you don't have to
7 show that it's more conservative. What you have to
8 show is that you have conservatism in your overall
9 evaluation model, not that the new model is more
10 conservative than the old model. In fact, people
11 wouldn't be making model changes probably if the new
12 model -- they are not going to move to more
13 conservative models unless it's an actual error
14 correction.

15 CHAIRMAN WALLIS: They are trying to give
16 us conservative models.

17 MR. STAUDENMEIER: Right, unless it's an
18 error correction. That make is more conservative.
19 They are not going to be doing that.

20 CHAIRMAN WALLIS: The whole purpose I
21 understood of Berlistic models was that by
22 understanding -- by taking out the conservatives and
23 making good estimate with this model and then evaluate
24 the uncertainty, you could tell from that basis how
25 conservative your model is.

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1 You're predicting 1,400 degrees in LOCA.
2 That's plus or minus 200. In order to get 1,700 it's
3 going to be a one in a million chance or something.
4 Now we can jack up the power or do something because
5 this isn't a threat to any safety system.

6 That has nothing to do with the fact that
7 Appendix K might predict 2,500. Appendix K is
8 irrelevant when it comes to considering whether this
9 is a good code for evaluating this thing which is
10 predicting the 1,400 and the uncertainty.

11 MR. STAUDENMEIER: Right. And this
12 wouldn't be really applied to Appendix K model.

13 CHAIRMAN WALLIS: I don't see how it's
14 applied to anything because this could apply to a pump
15 transient, whatever your criterion is. You've got an
16 estimate X which is half of the conservative
17 evaluation model Y and you want to now change your
18 design or operation in order to use up that margin.

19 MR. BANERJEE: I guess the concern is
20 there's no estimate of uncertainty in even what you
21 call your best estimate or realistic estimate.

22 MR. STAUDENMEIER: Yeah, I guess in this
23 case there is an inherent assumption that the
24 uncertainty is small compared to the amount of
25 conservatism.

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1 MR. KRESS: That was my comment. Was it
2 an implicit assumption you're making and are you
3 approved in the first place.

4 MR. BANERJEE: But it needs -- that could
5 need a fairly more extensive comparison with
6 experiments certainly before you --

7 MR. STAUDENMEIER: Yeah, that's true.
8 That would be -- to make this really work there would
9 be some requirement to show that your uncertainty is
10 small compared to the margin.

11 MR. KRESS: Or comparison with another
12 code like TRAC-M which supposedly has a better base in
13 experiments already.

14 MR. STAUDENMEIER: You know when you are
15 comparing two codes at least one is wrong.

16 MR. RANSOM: Well, in response to that
17 TRAC-M is kind of a good example because I think --
18 and Professor Wallis' complaints about the momentum
19 equation and whatnot, the only way those things get
20 corrected, or could be corrected, is through peer
21 review, general acceptance of whatever models are in
22 there. You take TRAC-M as an example. I think it's
23 been five years or more since there has probably been
24 any peer review of what's gone into that code.

25 What happens is after that long a time,

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1 even if you do put it through peer review, it's very
2 hard to make the changes or make any substantial
3 changes in the code. I think it behooves whoever is
4 developing codes to make sure that this peer review
5 process is in place and it works.

6 In the old days when Tong and Fabic were
7 running the code development, they had what they
8 called blue ribbon committee. I don't know. A few of
9 these people here I think were on that committee.
10 They used to hold the developer's feet to the fire.
11 I don't know that they were told.

12 MR. BANERJEE: Not with much effect,
13 though. They did whatever the hell they wanted.

14 MR. RANSOM: Well, there was some effect.

15 MR. KRESS: But I think you'll find with
16 TRAC-M that they managed to formulate it in such a way
17 that changes will be easier to make.

18 MR. RANSOM: Being a code developer I have
19 to see that.

20 MR. KRESS: You have to see the proof of
21 that in the pudding. I think that you have.

22 MR. RANSOM: There's a good story and
23 here's how it's really done.

24 MR. STAUDENMEIER: I was going to say one
25 thing maybe we can -- there's a lot of controversy in

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1 this obviously and maybe get you to -- I guess we have
2 to decide whether it's worth even going out for public
3 comment at this stage or some additional work should
4 be done before it went and come back to you like maybe
5 showing a concrete example of how this method would be
6 applied to a small code change and have that become
7 part of the Reg. Guide, or whether we should just
8 abandon this whole thing and come up with something
9 new that has to go into the Reg. Guide. We will have
10 to decide on that and that is what I'll need to find
11 out.

12 MR. SCHROCK: This was not in what has
13 already gone out for public review?

14 MR. STAUDENMEIER: No, it wasn't. This is
15 going before you to get your comments before we go
16 back out for the second public comment period.

17 MR. BOEHNERT: This is in response to the
18 public comments they got.

19 MR. STAUDENMEIER: Yeah, these changes
20 were made in response to the public comments. We have
21 to go back out for public comment again because the
22 changes made are fairly significant.

23 MR. SCHROCK: Well, I think in the most
24 global view it seems to me you started with a highly
25 conservative set of regulations that served as the

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1 basis for licensing the plants. It came time to
2 recognize that so much of that was very antiquated and
3 you initiated a rule change. The rule change provides
4 for realistic calculations with assessment of
5 uncertainty.

6 The two things are pulled apart and what
7 you should have done was to set a time limitation,
8 time maybe associated with license expiration or
9 whatever. There should have been a phasing out of the
10 old Appendix K method and a phasing in of the new
11 method.

12 What you've been doing now in the last
13 five to 10 years is creating some kind of morass
14 between which is causing a great deal of confusion I
15 think. This would make it so much worse because what
16 you are trying to do is to provide the industry with
17 a way to maneuver more simply through these two
18 different things and get what they want at minimum
19 cost.

20 I think that their responsibility to find
21 that and I think they've shown a lot of ability to do
22 that. I think your problem is to figure out how you
23 are going to state what the ground rules are for what
24 you are going to do in reaching judgment about middle
25 ground fixes to this situation.

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1 I think you would have been so much better
2 off if you could keep the realistic assessment in
3 Appendix K assessment totally separate things and make
4 it a one or the other. If they do it one way, that's
5 fine. Here are the ground rules for that. If you do
6 it the other way, this means a CSAU or equivalent kind
7 of evaluation of the uncertainty in the calculations.

8 MR. LAUBEN: I wish we could take LOCA off
9 the table.

10 MR. SCHROCK: It not just LOCA.

11 MR. LAUBEN: But LOCA has nothing to do
12 with rule change, nothing to do with Appendix K --
13 excuse me, non-LOCA. Appendix K of 50.46 are LOCA and
14 LOCA only. These other transients and accidents have
15 nothing to do with Appendix K, nothing to do with --

16 CHAIRMAN WALLIS: We're just using it as
17 an example.

18 MR. LAUBEN: Absolutely nothing.

19 CHAIRMAN WALLIS: I'm going to break for
20 lunch. I didn't think we were going to go all this
21 time but we have managed to do it. You have a half-
22 hour after lunch to come back when we have mellowed
23 and decide what to do next.

24 MR. STAUDENMEIER: I was going to say
25 there are two options. Either we can decide that it's

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1 not even fruitful to keep talking and come back later.

2 MR. LAUBEN: There is one thought and that
3 is to take LOCA completely out of this Reg. Guide.

4 CHAIRMAN WALLIS: No, no, no.

5 MR. LAUBEN: Because the discussion always
6 seems to merge LOCA and non-LOCA. If our examples are
7 always about LOCA, then to try to talk about examples
8 are non-LOCA, then I don't know. I don't know.

9 CHAIRMAN WALLIS: I'm going to break for
10 lunch until 1:30 and then we have half an hour to pull
11 this all together and figure out what should be done
12 next.

13 MR. STAUDENMEIER: Okay.

14 CHAIRMAN WALLIS: So we will break now
15 until 1:30.

16 (Whereupon, off the record for lunch at
17 12:35 p.m. to reconvene at 1:30 p.m.)

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A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

(1:32 p.m.)

CHAIRMAN WALLIS: I'd like to give you a chance to finish your presentation, Joe, and then we should back and see where we are, where we need to go, what we need to do.

DR. STAUDENMEIER: Okay. Well, we are I guess at the much discussed simplified method of determining margin or conservatism. I don't really have much more to say about that. I guess one thing that maybe could clarify it is if we carried out an example and brought it back to you to illustrate what we had meant by that and add in some more information to narrow the scope of that of when it would be applied for things with large margin or small uncertainties that were at least inherent in the assumption as I was making about when this would be applied, or it could be that this whole thing just isn't worth implying at all or even putting out for public comment. And that's something that I guess we'll all have to think about.

CHAIRMAN WALLIS: Certainly not the whole thing. The whole thing's been out. It's just the changes which --

DR. STAUDENMEIER: That's right. Yes, the

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1 change -- what I was referring to is, yes, the
2 changes. Putting out the changes. I mean, maybe those
3 changes are worth making or maybe we don't allow a
4 little more simplified method of determining how much
5 conservatism is in the model in that they would have
6 to go through a more rigorous uncertainty analysis.
7 But I guess that's something you'll have to decide
8 when you make your recommendations.

9 MR. BANERJEE: How much more work would be
10 required for problems like this where there are two or
11 three important phenomena to actually do --

12 DR. STAUDENMEIER: Actually, I don't think
13 there would be that much more work, my personal
14 opinions.

15 MR. BANERJEE: Perhaps the thing is to try
16 to understand if you didn't do this and they had to
17 follow usual procedure --

18 DR. STAUDENMEIER: Yes.

19 MR. BANERJEE: -- would this be really a
20 great burden or is it something which the industry has
21 simply commented because they are looking for
22 something?

23 DR. STAUDENMEIER: Well, I mean, something
24 I don't think is a great burden to someone whose out
25 there trying to get out production work all the time.

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1 It does add additional burden to them and, I guess,
2 it's your point of view where you're at in the process
3 of whether it's a great process or not.

4 MR. BANERJEE: Right. But is there a way
5 to quantify that?

6 DR. STAUDENMEIER: The amount of extra
7 work --

8 MR. BANERJEE: Like I imagine --

9 DR. STAUDENMEIER: For a specific case you
10 could show how much extra work would be done.

11 MR. BANERJEE: I imagine that you're
12 suggesting this be used for relatively simple models
13 where there are a couple of phenomena which dominate,
14 or maybe a few, so the burden may not be all that
15 high. And if that can be shown quantitatively, then
16 that would be useful. But on the other hand, if the
17 burden is very high, then there might be more reason
18 to do this because you might say, okay, we don't have
19 to go through the whole rigorous CSA methodology, that
20 could really impose a large burden for very simple
21 changes. You know, so I don't know.

22 I personally sort of think if the burden
23 isn't large, then it simplifies everything to just
24 follow the usual route.

25 DR. STAUDENMEIER: Yes.

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1 MR. BANERJEE: If the burden is large,
2 then it's probably worth looking at.

3 DR. STAUDENMEIER: You know, the cases
4 I've thought of where this would be applied, I don't
5 think the burden is large but I may not be thinking of
6 the same cases the industry is thinking of. It might
7 just be maybe a matter of my tunnel vision on this of
8 how I think it's applied that I think it wouldn't be
9 large. But --

10 MR. BANERJEE: Okay.

11 DR. STAUDENMEIER: Well, this is the last
12 slide, the status and summary. We still hope that the
13 revised Reg. Guide will address the findings of the
14 Maine Yankee review panels and other review groups.

15 We'd like to get ACRS comments from this
16 current round of discussion, and revise with respect
17 to your comments as soon as we can and send this back
18 out for public comment, which we hope would be the
19 last round of public comment. After we get your
20 comments, the next step in the process would be
21 putting it through OGC and CRGR for review. Then
22 stick it out for public comment. The public comment
23 period I think is probably about 45 days or something
24 like. I think that's the minimum we can have. And we
25 would get the comments back in, process them.

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1 Hopefully, there won't be any controversial comments
2 this time. Hopefully, we've sorted through most of
3 them from the last round of public comments. And if
4 everything went smoothly, we would incorporate the
5 public comments, come back to the -- have to go
6 through the ACRS and CRGR and OGC again.

7 CHAIRMAN WALLIS: Again?

8 DR. STAUDENMEIER: Yes, before it's issued
9 for final. You have to review the final issued
10 product and it would get issued as a document, an
11 official document sometime, and I think would be on
12 the order of April next year or something if there
13 were no more delays.

14 CHAIRMAN WALLIS: Do you want the full
15 committee comment?

16 DR. STAUDENMEIER: I think the full
17 committee are the only ones that can apply.

18 CHAIRMAN WALLIS: Are we scheduling a
19 performance by you in front of the full committee in
20 September or something?

21 MR. BOEHNERT: Yes, we are.

22 CHAIRMAN WALLIS: We are?

23 MR. BOEHNERT: We are.

24 CHAIRMAN WALLIS: So this is just a
25 preliminary --

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1 MR. BOEHNERT: Subcommittee and then, you
2 know, the full Committee is going to pass on it.

3 CHAIRMAN WALLIS: Depending on what my
4 colleagues say on the subcommittee, I would think
5 since the full Committee has seen this before that we
6 ought to focus attention of your presentation on
7 what's new, and particularly the items that the
8 subcommittee had trouble with.

9 DR. STAUDENMEIER: And I'd welcome your
10 unofficial comments, I guess, before the full
11 Committee meeting.

12 CHAIRMAN WALLIS: Well, it's a long time,
13 too. It's 2 months or something before that.

14 DR. STAUDENMEIER: Yes.

15 CHAIRMAN WALLIS: Well, the first thing I
16 think we all need to do is we need to agree that
17 comments will be written and sent in within a week or
18 two, whatever. Given a good chance; say by the end of
19 the month or something. The sooner the better,
20 really. Because you remember what you're doing.

21 And I think we've got an opportunity now,
22 we've already aired some interest and concerns. And
23 we want to reenforce those now or raise some other
24 points, and we should do it now. That would be most
25 helpful to Joe.

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1 MR. SCHROCK: Well, Norm Lauben made a
2 comment about the distinction between transients and
3 LOCA just before the lunch break, and I --

4 CHAIRMAN WALLIS: Are you taking that
5 back?

6 MR. SCHROCK: Well --

7 CHAIRMAN WALLIS: So lunch had a solitary
8 effect.

9 MR. SCHROCK: I guess my comment would be
10 as you read this Reg. Guide you don't find a clear
11 delineation of those two cases. And if there that
12 kind of significant difference, it should be spelled
13 out in the Reg. Guide somehow. And I guess there is.

14 DR. STAUDENMEIER: That's a good point. It
15 was obvious to me what I meant when I was writing it,
16 but I had it in my head and that's why it's good to
17 have independent review like this to point out things
18 that we haven't thought of.

19 CHAIRMAN WALLIS: It was never my
20 impression that there was any difference between LOCA
21 and all these other things. This is how you go about
22 evaluating, trying analysis methods in general.

23 DR. STAUDENMEIER: Well, in terms of the
24 general prescriptions for doing things, I don't think
25 we made a difference. But in terms of applying these

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1 simplified or allowing these simplified methods to be
2 applied, I think that's where we would make a
3 distinction.

4 CHAIRMAN WALLIS: Well, I think you might
5 make that clear, that simplified methods only apply to
6 rather a small class of small changes or something and
7 in rather insignificant events.

8 DR. STAUDENMEIER: Yes.

9 CHAIRMAN WALLIS: Are there other points
10 that my colleagues want to raise at this time?

11 Do you have any comments on the bulk of
12 the document as opposed to the section 5 that's been
13 in most of the discussion?

14 MR. BANERJEE: Well, I already brought up
15 my thoughts about in some way diagraming what this
16 business of inputs which included nodalization and all
17 these other things, even though at some point it's
18 mentioned specifically, I mean I'm very uneasy with
19 making specific models for specific transients for
20 specific plants in fixing the nodalization. And the
21 arguments going forward from a small scale experiment
22 which uses a certain of nodalization to get the right
23 results and a plant then using similar nodalization
24 seems a big job to me, and I don't know how that's
25 treated.

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1 I mean, in a way this issue has been with
2 us forever. I mean, this is not the first time it's
3 been raised. So whether it's a problem with this Reg.
4 Guide or just a general problem that's around, I don't
5 know. But I feel very uneasy about not having some
6 sort of requirement to show that with nodalization is
7 sufficient to capture the phenomena which are of
8 importance, at least. Some words to that effect.

9 CHAIRMAN WALLIS: Nodalization is not
10 independent of the point I was making about geometry.
11 I mean, how you nodalize something like a lower
12 plenum. It's going to influence how well you capture
13 normal in there. It's not just a question of dividing
14 a pipe into pieces so you can say it's just straight
15 forward, but a number of pieces. But in something
16 like a lower plenum you have a choice of the shape of
17 these nodes and things. And it's not just numbers

18 MR. SCHROCK: Well, most of them are
19 connections of pipes. And so there's no way that the
20 geometric description you're thinking of can be
21 brought into it when it's represented as a set of
22 pipes and junctions.

23 CHAIRMAN WALLIS: There is a way, because
24 they use it. I mean there must be a way because
25 there's --

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1 MR. SCHROCK: Yes.

2 DR. STAUDENMEIER: Yes, I mean like in the
3 TRAC 3-D vessel component, there are things that are
4 dependent on cylindrical geometry or cartesian
5 geometry. The vector, like the gradient or divergence
6 operator depends on what geometry you're in in the
7 general sense and general conductivity of like RELAP
8 or a lot of the other codes that are more lump
9 perimeter based, it's more --

10 CHAIRMAN WALLIS: Yes, that sort of
11 assumes you've got a cylindrical thing or a plane
12 thing. But a thing like upper and lower plenum,
13 they're not cylindrical or plane, they're sort of a
14 mixture of things in there.

15 DR. STAUDENMEIER: Right. And instead of
16 thinking in those like differential equations in
17 geometry, it's more finite volumes with connections
18 between them and fluxes of different quantities going
19 through the connections, and that's what tends to
20 dominate these problems more than the specific
21 geometry does, I think.

22 MR. RANSOM: The problem is actually a
23 little more obscure than you'd think from, you know,
24 first examination of it. And since these codes don't
25 include any of the sheer terms and any mixing, you

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1 know, associated with sheer or turbulence just simply
2 is not included in TRAC or reapplied type calculation.
3 I believe and it's my opinion that you're better off
4 treating a lower plenum as simply a homogeneous --
5 which is any volume is and nodalization of the code.
6 I mean, it's well mixed. And if that assumption is not
7 really acceptable, then a CFD code or something should
8 be consulted to find out what really goes on there.

9 CHAIRMAN WALLIS: Even if it's homogeneous
10 volume, you can't write the momentum equation for it
11 when stuff's coming down and --

12 MR. RANSOM: Well, I believe you can, and
13 that's a subject of debate, I guess.

14 CHAIRMAN WALLIS: Okay. Let's see it.

15 MR. RANSOM: Well, we've done it.

16 CHAIRMAN WALLIS: You simply can't do it
17 from the usual --

18 MR. RANSOM: And I guess again,
19 fortunately, in the case of the lower plenum, the
20 momentum flux terms are quite unimportant because
21 velocities are quite low so that really that's not as
22 important --

23 CHAIRMAN WALLIS: What's what saves you.
24 I think that's what saves you.

25 DR. MOODY: Maybe my view is awful simple.

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1 It certainly depends, doesn't it, a lot on what really
2 you're trying to calculate. If you want a mass in a
3 lower plenum of an empty vessel that's being filled,
4 you can do it with one node if you know the inflow and
5 outflow. If you're pressurizing it, you can do it with
6 one node.

7 If you want the flow patterns then, of
8 course, you got to break it up more. If you want to
9 get the temperature distribution, then you have to
10 have many more nodes.

11 I guess there's not too much arguing with
12 that, is there.

13 CHAIRMAN WALLIS: If you have boran sled--
14 not a boran sled coming in from one side, and you want
15 to know how well it --

16 DR. MOODY: Mixes.

17 CHAIRMAN WALLIS: -- mixes. And then you
18 need to -- right.

19 MR. RANSOM: Well, it's the kind of thing
20 that I think, to give you an example, the thing that
21 people sometimes do is in a 1-D code they will divide
22 the lower plenum into several levels. But that's sort
23 of nonsense because they're connected by one junction.
24 And if you talk about incompressible flow, there will
25 be no flow through that lower --

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1 CHAIRMAN WALLIS: Well, you can't --

2 MR. RANSOM: You can only go through up
3 the upper layer and back up. And so it's kind of a
4 phony type -- probably doesn't cause any harm, but on
5 the other hand you'll see situations where hot water
6 or cold water is now sitting on top of hot water and
7 simply won't mix. And so you have to use a little
8 engineering judgment, I think, with these kinds of
9 thing not only in proximate models. Either
10 experimental data, CFD calculations, this kind of
11 thing needs to be used -- and I don't know. I guess
12 that wasn't really addressed in here either, although
13 the evaluation model could consist, I presume, of
14 dependence on a CFD type code or something like that
15 to validate certain parts of the calculation, and that
16 would be a reasonable thing to do.

17 DR. MOODY: I used to have a boss that
18 said "Bring it to me when you're willing to bet your
19 paycheck on it on how well it matches reality."

20 CHAIRMAN WALLIS: Well, the even better
21 one is when you're willing to bet your company on it.

22 DR. MOODY: Yes.

23 CHAIRMAN WALLIS: Well, we're going to
24 have comments for you. I think probably the usual way
25 will be each person write something and it get passed

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1 on. And since we've seen most of this before and had
2 an influence on it, I think there will probably two
3 kinds of comments. There will be comments sort of
4 bear in mind and using the guide but not recommending
5 changes. And then perhaps in this section 5 we'll
6 actually be recommending that you do something
7 different.

8 I think my comments might reflect that
9 intent, but I haven't yet written them down.

10 DR. STAUDENMEIER: Okay.

11 CHAIRMAN WALLIS: Because, as you know, I
12 have some concern with section 5.3 and section 5.4.

13 Well then, I think we would really like to
14 see this get out there and have an influence. Because
15 it's useless to have it in there. Unless it actually
16 influences what's done out there by the applicants and
17 the staff, nothing has been achieved.

18 DR. MOODY: This may be the wrong time to
19 even ask it, but why does all this go out to the
20 public?

21 CHAIRMAN WALLIS: Oh.

22 DR. MOODY: Do you want staff that comment
23 and go on something else? I mean, NASA didn't do it
24 when they put men on the moon, they didn't ask the
25 public.

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1 CHAIRMAN WALLIS: It's kind of --

2 MR. KRESS: It's one of NRC's strategic
3 goals.

4 CHAIRMAN WALLIS: Yes, but it's sort of
5 self-defeating. And I think the original intent was
6 to involve the public. The public is not involved.
7 It's industry comments that you get. So it's a very
8 select --

9 MR. KRESS: But the public gets an
10 opportunity.

11 CHAIRMAN WALLIS: That's right.

12 MR. SCHROCK: NASA's not that big of risk
13 to the public.

14 DR. STAUDENMEIER: And actually, in some
15 things actual members of the public do get involved in
16 it.

17 MR. BOEHNERT: Yes, sure. Depending on the
18 issue.

19 CHAIRMAN WALLIS: The industry comments
20 make a lot of sense, because they're the ones who are
21 going to have to use this. You know, they're sort of
22 the customer for this thing.

23 MR. BOEHNERT: Or be subjected to it.

24 CHAIRMAN WALLIS: So it's very important
25 that they have some input.

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1 The thing that's frustrating is how long
2 everything takes. We do something and then, if we're
3 lucky, a year and a half later then something comes
4 back. And that gets frustrating if we go around this
5 loop several times and then ACRS membership has
6 changed completely by the time it's reviewed.

7 DR. MOODY: I recall that one time, I
8 don't remember who it was back in the Phil Brady days,
9 the Director of NRC made the comment that someone from
10 the public could make a claim and have no basis, and
11 you didn't have to prove -- you had to spend all this
12 time proving they were wrong. And that was eating up
13 tons of time and money.

14 CHAIRMAN WALLIS: I don't think that
15 happens here. I mean, not with this sort of thing.

16 DR. MOODY: Okay.

17 CHAIRMAN WALLIS: So I'm about to say that
18 we move on to the next item on our agenda, unless Jack
19 or anyone has anything to -- I felt that we everything
20 went along very well and we were sort of in agreement
21 with everything until we got to section 5.

22 MR. ROSENTHAL: Yes, I think, you know, we
23 anticipated that that would be the source of
24 discussion.

25 My only frustration is that Norm and I and

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1 Ms. Lynn Ward went on a maniac -- in '96, and it's
2 2002. So --

3 CHAIRMAN WALLIS: Well, the PRA guys are
4 talking about to the Rasmussen report, you know, 30
5 years ago and we still haven't become risk informed.

6 MR. ROSENTHAL: In any case, we go to the
7 public meeting and the reason that we were going to go
8 at a second time, and it's not a requirement, was that
9 we felt that there were sufficient changes that it
10 would pay to go out. And just depending on what your
11 comments are, maybe we can work something out where we
12 make some incremental progress between now and the
13 time that we go to the full Committee, just to get
14 some momentum going.

15 But we look forward to your comments.

16 CHAIRMAN WALLIS: Yes, I think you have to
17 be very careful with this conservative thing. Code
18 isn't conservative. Show the conservatism in a
19 context.

20 MR. RANSOM: Can I ask a question. Why is
21 RES doing this as opposed to NRR? It seemed something
22 more that NRR would be concerned with.

23 MR. LAUBEN: I think in the reorganization
24 of years ago, or whatever, it was decided that
25 regulatory guides would be the principal

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1 responsibility of RES, but they always had to be
2 coordinated with the user on NRR. And the standard
3 review plan is the province of NRR. The two are
4 related. So it actually works pretty closely with --

5 CHAIRMAN WALLIS: That was one of our
6 questions I remember before. Is you got this sort of
7 review plan on this Reg. Guide and what's the sort of
8 correlation between the sections.

9 MR. LAUBEN: And in fact, sometimes they
10 have, you know, organizationally we may have be
11 assigned the responsibility, but we can actually by
12 agreement it can switch to --

13 CHAIRMAN WALLIS: Well, okay.

14 I'd ask this Committee then to give input.
15 And it occurs to me that it might be helpful if you
16 guys gave additional input. And having heard the
17 comments today about section 5.3 and 5.4, if you came
18 back and said we understand what you're saying, how
19 about doing it this way just for these small sections.
20 Then we could comment on that, wouldn't have to have
21 a full meeting here. Then you'd have an assignment to
22 come back with some feedback as well as us. Can we do
23 that? Without having to go through -- so you might
24 say that the full committee meeting in September,
25 realizing we had all these comments from the

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1 subcommittee, we rethought section 5.3 and 5.4 and
2 these are some of the things that we suggest would be
3 an improvement.

4 MR. BOEHNERT: Well, in fact, Jack had
5 suggested that.

6 CHAIRMAN WALLIS: We'll do that, and then
7 let us know. Let us know so that we can through the
8 loop before September.

9 DR. STAUDENMEIER: Okay.

10 CHAIRMAN WALLIS: I thank you very much.
11 You've been very helpful and patient and informative.

12 DR. STAUDENMEIER: And I thank you for all
13 your comments.

14 CHAIRMAN WALLIS: I don't need to use by
15 gavel. I think we can just invite the next speaker.
16 Are you going to do this all yourself?

17 MR. RANSOM: No, Steve is next.

18 CHAIRMAN WALLIS: Oh, Steve has given out
19 -- but then V.J., you're the one presenter.

20 MR. DHIR: Piece de resistance.

21 CHAIRMAN WALLIS: So Steve is going to put
22 into perspective what we're going to hear from
23 Professor Dhir?

24 MR. BAJOREK: Well, I'd like to put it in
25 perspective and also from our last meeting when we

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1 talked about ACWS, one of the items we brought up was
2 you have in TRAC-M right now. So what I'd like to do
3 is try to put the research program in perspective, and
4 while we're working on that, but also just a couple of
5 overheads to explain what's in the code right now and
6 why it essentially needs to be replaced.

7 What we'd like to present to you this
8 afternoon is the work being sponsored by the Office of
9 Research to develop the models for subcooled boiling
10 applicable for safety analysis and rod bundles.

11 Subcooled boiling is one of the two or
12 three regimes that are typically encountered in a two-
13 fluid code where you have a particular --

14 (Whereupon, microphone adjusted)

15 MR. BAJOREK: As I mentioned, what we'd
16 like to talk about is the work being sponsored by the
17 Office of Research to look into subcooled boiling.
18 It's one of those heat transfer regimes that's
19 particularly difficult to deal with in two-fluid code,
20 because you have to deal with this idea of heat-flux
21 splitting.

22 When you have these regimes with a lot of
23 thermal non-equilibrium you have to make a decision on
24 how you partition the energy either to the liquid
25 field or to the vapor field. And because of that non-

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1 equilibrium, you also have to start worrying about
2 things like the interfacial area, bubble size, droplet
3 size and the interfacial heat transfer. The whole
4 process as shown over here on the right hand side,
5 means you have to make some decision in the code on
6 how you partition things that generate vapor in the
7 case of subcooled boiling, how much of that energy
8 goes to the liquid heating regardless of how you split
9 or partition it at the wall. You also need good
10 models to transfer to account for the condensation and
11 the transfer of energy that occurs at the interface as
12 those bubbles are departing and moving into the bulk
13 fluid.

14 The difficulty is compounded in a two-
15 fluid code because you're not really able to deal with
16 the physics as you would like to. Meaning, you can't
17 really model, per se, a subcooled region and
18 immediately next to the wall. You're left with a
19 relatively large node with some amount of subcooling,
20 and a void fraction that the code, for all practical
21 purposes, wants to assume is mixed everywhere
22 throughout that cell and not necessarily at the wall.

23 Now, applications that rely or depend
24 quite heavily on getting the subcooled boiling correct
25 have been shown to be very troublesome. A couple of

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1 fairly recent examples, the AP600. They found some
2 cases where there are tremendous large oscillations in
3 the core wide void fraction seen from the collapsed
4 liquid level. They were particularly acute because
5 they were at low pressure.

6 Well, in evaluating those models what this
7 was traced to was a subcooled boiling model that had
8 a bubble pumping term that was a function of the
9 density. It had a row L over row V. Although that
10 model had made use of data and seemed to work quite
11 well at relatively high pressures, when it got down to
12 the low pressures typical for the AP600, that ramp
13 would turn on and off causing very large swings in the
14 core void fraction.

15 Another recent example was an evaluation
16 of a Peach Bottom turbine trip. Because the subcooled
17 boiling model was not able to get the axial variation
18 to void fraction correct, it was very difficult in
19 those simulations to try to predict the right
20 kinetics.

21 MR. SCHROCK: Well, isn't this 1-D channel
22 model that you're dealing with in TRAC?

23 MR. BAJOREK: Yes, in this case.

24 MR. SCHROCK: And so that vapor flow
25 perpendicular to the wall really is not a variable in

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1 TRAC notation?

2 MR. BAJOREK: No. I mean, in TRAC you just
3 have one large cell to work with. I've sort of drawn
4 this just as a way of -- if you could try to nodalize
5 that a little bit better, what you would like to try
6 to do is to break this down into a region with high
7 subcooling and a relatively large void fraction as
8 opposed to what the code is really doing out there,
9 which is distributing all of these bubbles over one
10 large cell that has some globally known subcooling.

11 MR. SCHROCK: So I guess an explanation
12 which is couched in terms of the variables that are
13 employed in the TRAC calculation would serve better to
14 tie this together with V.J.'s experiments?

15 MR. BAJOREK: Yes.

16 CHAIRMAN WALLIS: Well, that's a question
17 I had was how his experiments are related to what you
18 need to know in the TRAC code. You can study the
19 collapsible bubble, but I don't know quite how this
20 fits into what TRAC needs to know.

21 MR. BAJOREK: Well, you need to know
22 everything associated with these three Os over here on
23 the right hand side.

24 CHAIRMAN WALLIS: You just need to know.
25 So across the whole cross section what's the average

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1 void fraction, isn't that the question it's asking?

2 MR. BAJOREK: That's what the code is
3 basically -- well, the code's going to do that. Okay.
4 Unless you do make provisions in the code to tell it
5 it's in a regime where you are going to have
6 concentrations within that cell.

7 MR. BANERJEE: You can do that by thermal
8 non-equilibrium. So you can have a void --

9 MR. BAJOREK: You can look at conditions
10 that will tell you that you are in subcooled boiling
11 and that you should have a concentration on one side
12 or the other. But in order to get the amount of void
13 generation, this thing here, the net vapor generation
14 -- correct. Okay. You need to be able to know what
15 that partition is across other things like the
16 interfacial heat transfer, the condensation rate, the
17 bubble size and the bubble behavior near the wall
18 before you can --

19 CHAIRMAN WALLIS: But I think it actually
20 depends on where you draw your boundary. I mean, at
21 the wall presumably all the heat transfer is to the
22 liquid and there's some superheated liquid making
23 vapor. And then there's some vapor migrating, finding
24 itself in a subcooled liquid and condensing again.
25 And all this, presumably, fits into answering the

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1 question what's the average void fraction. The
2 partition I always thought was a kind of artificial
3 thing. Because depending on where you look there are
4 different partition.

5 At the wall all heat transfers are liquid,
6 and then somewhere out here it's mostly vapor
7 migration carrying the heat out. And out here it's
8 condensation causing the heat transfer. And then it's
9 all liquid again.

10 It depends where you draw your boundary,
11 how you partition things.

12 MR. BAJOREK: Unless you get all of those
13 correct, you're still going to be off when the net --

14 CHAIRMAN WALLIS: The pool is partitioning
15 in somewhat artificial way, isn't it?

16 MR. BAJOREK: Yes. Yes.

17 MR. SCHROCK: But that's I really think
18 you've got to have a logical starting point in terms
19 of what the TRAC variables are and how you imagine
20 what's happening in the subcooled boiling process.
21 The bubble that's growing attached to the wall has
22 evaporation on part of its surface, condensation on
23 part of its surface. It may or may not detach before
24 it reaches its maximum size. If it does, it moves to a
25 new location where there's less subcooling eventually

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1 -- or more subcooling, rather, eventually may be
2 totally quenched. Further downstream it may be only
3 partially quenched.

4 But how do you translate all of those
5 recognized phenomena into TRAC variables? I think
6 that's the key thing.

7 MR. BAJOREK: I think in looking at the
8 models that Professor Dhir is coming up with, we
9 haven't seen anything in there that prohibits us from
10 being able to put it into the code in terms of the
11 variables that are either used or could be used by
12 TRAC-M. The only thing to prohibit us from adding new
13 capabilities, adding new variables.

14 MR. KRESS: And in fact that's your job,
15 the job of V.J. is to understand what's going on --

16 MR. BAJOREK: We need to know what's the
17 basic physics that goes on here.

18 MR. KRESS: Yes. And that's what he's
19 doing.

20 MR. BAJOREK: Yes. And I think one of the
21 first things that Professor Dhir is going to show
22 that, hey, the existing database to try to get at
23 these various heat flows is lacking. And the point I
24 want to make, you know, in what we've got in TRAC-M or
25 RELAP or Cobra TRAC, these are all largely based on

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1 the same types of data. They use, for practical
2 purposes, the same types of models and have the same
3 questions.

4 We would expect TRAC-M to get those
5 similar types of problems. For the AP600 this is the
6 type of thing that was being predicted. This shows
7 the core collapsed level when much of the core was
8 predicted to have been in a subcooled heat transfer
9 regime.

10 You look at some of these oscillations
11 that were going on, this is a dimensionless height of
12 the core, from zero to 1. We're looking at values on
13 the order of .3, .35. This is 3 to 4 feet in
14 oscillations --

15 CHAIRMAN WALLIS: This is all subcooled --

16 MR. BAJOREK: Most of the core is --

17 CHAIRMAN WALLIS: This is all bubbles and
18 then subcooled boiling --

19 MR. BAJOREK: Yes. And in looking back at
20 what was causing this, you'd go into subcooled
21 boiling, you'd generate a very large void. Then this
22 would collapse. Okay. Once it got to saturation.
23 Okay. And the process would start and repeat itself.
24 This was being aggravated by basically ad hoc ramps in
25 that last figure that was trying to partition things

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1 between the liquid and the vapor. That's the type of
2 thing that indicated we needed to understand the
3 physics of this a lot better.

4 CHAIRMAN WALLIS: Well, it seems to me --

5 MR. RANSOM: Just a few comments of
6 caution. You know, when you report things on zero to
7 1000 second time scale and it's a very large scale.
8 And you call that numerical noise. So I guess it's
9 not numerical noise, it's actually if you plot those
10 oscillations, there are many time points in each
11 oscillation. So it's a mixture of modeling and, you
12 know, so maybe the numerics. I don't know.

13 MR. BANERJEE: It's modeling noise.

14 CHAIRMAN WALLIS: It's modeling noise.

15 MR. RANSOM: Well, yes, it can be. I
16 don't know that it's not physical. I mean, that's an
17 assumption that it's not physical.

18 Then also I think that Saha-Zuber
19 correlation that you showed -- or you haven't shown it
20 yet, that partitioning has only to do with the -- how
21 it's changing the overall heat-flux from the wall.

22 MR. BAJOREK: Right.

23 MR. RANSOM: Not the partitioning between
24 vapor and liquid. There's a secondary model in the
25 code that does that.

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