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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 THERMAL-HYDRAULIC PHENOMENA SUBCOMMITTEE MEETING

6 + + + + +

7 THURSDAY

8 JANUARY 17, 2002

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10 ROCKVILLE, MARYLAND

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12 The ACRS Thermal Phenomena Subcommittee
13 met at the Nuclear Regulatory Commission, Two White
14 Flint North, Room T2B3, 11545 Rockville Pike, at 8:33
15 a.m., Dr. Graham Wallis, Chairman, presiding.

16
17 COMMITTEE MEMBERS PRESENT:

18 DR. GRAHAM WALLIS, Chairman

19 DR. THOMAS S. KRESS, Member

20 DR. VIRGIL SCHROCK, ACRS Consultant

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1 ACRS STAFF PRESENT:

2 PAUL A. BOEHNERT, ACRS Staff Engineer

3 STEVE BAJOREK

4 RALPH CARUSO

5 HUEIMING CHOW

6 JERRY HOLM

7 GENE JENSEN

8 RALPH LANDRY

9 BOB MARTIN

10 BILL NUTT

11 LARRY O'DELL

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

(8:33 a.m.)

CHAIRMAN WALLIS: The meeting will now come to order. This is the second day of the ACRS Subcommittee meeting on Thermal-Hydraulic Phenomena. I am Graham Wallis, the Chairman of the Subcommittee.

The other ACRS Member in attendance is Dr. Thomas Kress; and the ACRS Consultant in attendance is Professor Virgil Schrock. Today, the subcommittee will begin a review of the Framatome ANP Richland S-RELAP5 Realistic Thermal Hydraulic Code Version, and its application for large break LOCA analyses.

The Subcommittee will gather information and analyze relevant issues and facts, and formulate the proposed positions and actions as appropriate for deliberation by the full-committee.

Mr. Paul Boehnert is the cognizant ACRS staff engineer for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on December 20, 2001.

Portions of the meeting will be closed to the Public, as necessary, to discuss information considered proprietary to Framatome ANP Richland,

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2 A transcript of this meeting is being
3 kept, and the open portions of this transcript will be
4 made available as stated in the Federal Register
5 notice. It is requested that speakers first identify
6 themselves and speak with sufficient clarity and
7 volume so that they can be readily heard.

8 We have received no written comments nor
9 requests for time to make oral statements from members
10 of the public.

11 Now, we will start this meeting with a
12 short presentation by Ralph Landry from the NRC Staff,
13 who will give us a brief introduction on the status of
14 the review of this code.

15 MR. LANDRY: Thank you, Dr. Wallis. My
16 name is Ralph Landry, from the NRR staff, and what I
17 would like to do is first go through a little bit of
18 the presentation.

19 We had planned to update the subcommittee
20 on where we are in the review. I would like to talk
21 a little bit about the review status, and who the
22 review team members are, and the approach that we are
23 taking to this review.

24 Tomorrow after Framatome has completed
25 their presentations, I would like to address some of

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1 the issues that were brought out in the ACRS committee
2 letter on the S-RELAP5 small break LOCA review.

3 There are a number of points that the
4 Committee made in that letter, and I would like to
5 address where we stand with regard to those points.
6 And then we will have a presentation on the approach
7 that we are taking to the statistical review, and the
8 uncertainty review.

9 That review is receiving a heavy emphasis
10 in this code review, and then some of our concluding
11 remarks. We received the code and the code
12 documentation in August of 2001, and in October we
13 accepted the code for review.

14 We determined that there was sufficient
15 material to begin a review. We held a code workshop
16 with Framatome in October of 2001, a full day in which
17 Framatome brought their staff in and led us through
18 the code, and the content of the code, and the
19 uncertainty analysis that was done, and the
20 statistical approach.

21 It was a very productive workshop in which
22 we became even more familiar with the S-RELAP5 code
23 than we had been from the small break LOCA review.

24 We are planning to have all the RAIs done
25 in April, early April of 2002. We anticipate all the

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1 responses back from Framatome in June. We are aiming
2 for a draft SER by mid-July so that we can have that
3 to the subcommittee and have a subcommittee meeting in
4 August.

5 Then we would anticipate a full committee
6 meeting at ACRS as per an ACRS letter in September,
7 and the final on the SER by the beginning of Fiscal
8 Year 2003. It is a very aggressive schedule we
9 realize.

10 CHAIRMAN WALLIS: Now, Ralph, we saw this
11 code previously, and I forget exactly when.

12 MR. LANDRY: Yes.

13 CHAIRMAN WALLIS: And we had quite a few
14 comments on the equations and formulations of things
15 at that time. And I would hope that you folks would
16 detect those things that we would detect.

17 And you would hopefully bring them up in
18 your RAIs so that we don't have to go over that ground
19 at the time when we should be seeing a finished
20 product around August or September.

21 MR. LANDRY: Yes.

22 CHAIRMAN WALLIS: And that would be most
23 unfortunate if we ever had to do anything like that.

24 MR. LANDRY: Well, that leads into a
25 little bit of who is doing the review and how we are

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1 approaching the review. Since the code was reviewed
2 for the small break LOCA, which was completed almost
3 a year ago, we have lost two of the key reviewers, and
4 we have gained a couple of people.

5 So we now have myself doing the review,
6 and Tony Attard, who you are familiar with, focusing
7 heavily in the heat transfer area, and thermal
8 hydraulics.

9 Sarah Colpo, who has joined us, and who
10 came here, and who had done a lot of experimental work
11 out at Oregon State under Jose Reyes, who is assisting
12 in looking at a great deal of the separate effects
13 assessment and testing that was done, but also is
14 working with the code itself.

15 Sarah has been looking at the internals of
16 the code, and some of the models, and subroutines
17 within the code, and is planning to continue the work
18 that was discussed on the small break LOCA of varying
19 some of the parameters within the code in determining
20 what is the effect of the --

21 CHAIRMAN WALLIS: And she is going to run
22 the code?

23 MR. LANDRY: Yes, she is going to be
24 running the code. In addition, we have Yuri Orechwa,
25 who you met on the TRACG review, and who has done the

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1 statistical review on that code, and is doing a
2 statistical review on this one, and he will have a
3 presentation tomorrow morning.

4 Shih-Liang Wu is assisting us to look at
5 the RODEX model. RODEX has been previously reviewed
6 and approved, but Shih-Liang is assisting us looking
7 at the way that model is being implemented within
8 S-RELAP5 realistic large break LOCA.

9 And we have hired Len Ward since we lost
10 a couple of key reviewers, and we have hired Len Ward
11 from ISL Laboratories to assist us in thermal
12 hydraulic review. And Len is looking at very heavily
13 the break flow models, and reflood models, and more of
14 the thermal hydraulics area.

15 Now, you will notice that we have not
16 talked about the review of the kinetics model. The
17 kinetics model is no different than what we saw on the
18 small break LOCA.

19 So it is a simple point kinetics model,
20 and there is nothing new and nothing different, and so
21 we have determined let's focus our review in some of
22 these other areas.

23 We don't have the staff available to focus
24 on every single point, and since something here has
25 not changed at all, let's let that go, and look at

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1 some of the other areas.

2 CHAIRMAN WALLIS: But these are all the
3 NRR people, and is RES going to be involved at all in
4 this?

5 MR. LANDRY: Not at this point.

6 CHAIRMAN WALLIS: Is there a possibility
7 that if you have specific questions that you might
8 turn to them for assistance for use of their
9 expertise?

10 MR. LANDRY: There is that possibility.
11 We can talk to Dr. Bajorek, and we can talk to Joe
12 Stoddemeyer, and we can talk to Tony Ulsys. One thing
13 that we would like to talk to, we can't, and that is
14 Joe Kelly, because Joe Kelly was involved in the
15 development of the code when he was working for
16 Siemens, and then Framatome. So unfortunately we
17 cannot talk to him.

18 MEMBER KRESS:: For how long? Is there a
19 timing on that?

20 MR. LANDRY: Well, he just came back this
21 fall.

22 MEMBER KRESS:: I know that, but isn't
23 there usually a year's time in that?

24 MR. LANDRY: No, I think it is usually two
25 years.

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1 MR. CARUSO: Dr. Kress, the problem is
2 that this is something that he worked on, and that
3 would involve him reviewing his own work.

4 DR. SCHROCK: You can't review your own
5 work.

6 CHAIRMAN WALLIS: It would be interesting
7 to see what effects he had.

8 MR. LANDRY: The way that we are
9 approaching this review, as I tried to allude to, is
10 that we are trying to build on what we did in the
11 S-RELAP5 small break LOCA review.

12 We are trying to emphasize work that has
13 not been reviewed previously and in particular the
14 statistical analysis, the uncertainty analysis. We
15 are looking very heavily at the experimental base, and
16 one of the things that we are looking at right now is
17 the heat transfer model.

18 Now, even though according to PIRT heat
19 transfer is not a significant player, we also realize
20 that when you talk about peak cladding temperature in
21 a large break LOCA that things like dispersed film
22 boiling become very important, even though they don't
23 appear in the PIRT.

24 We are going to look very heavily at those
25 models. One of the questions that we have already

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1 asked, and that Framatome is working very hard on, is
2 that we have asked that they take one of the large
3 breaks, and we will leave it up to them to pick which
4 one they want to look at, and identify the heat
5 transfer correlations that are called into play for
6 the entire term of that transient for each correlation
7 that comes in.

8 There is at least thee dozen correlations
9 in the code, and so we have said identify the
10 correlations that come into play throughout the
11 transient, and we want to know when they come in, and
12 what are the conditions that exist when that
13 correlation is invoked.

14 And then what are the ranges of approval
15 of that correlation, or where has that correlation
16 been shown to be valid. So that we can see how do you
17 smooth from correlation to correlation, and what
18 discontinuities exist going from a heat transfer
19 correlation to correlation, and are the correlations
20 all being used in their proper ranges of validity.

21 And to our knowledge, this has never been
22 done for one of these transients. So this is the area
23 that we are trying to focus on in this review.

24 We are trying to take the resources that
25 we have available to us, and use those resources in a

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1 productive way to look at areas that have not been
2 reviewed heavily, or areas that we feel are very
3 important for a realistic large break LOCA. So we are
4 hard at work on the review right now.

5 MEMBER KRESS:: Is there a standard
6 sensitivity analysis to find out which of these
7 correlations are most important or most sensitive with
8 respect to get an output?

9 MR. LANDRY: Some of that comes out in the
10 uncertainty analysis. Some of that comes out in
11 knowing that there are areas where a correlation is
12 very important. As I said, the dispersed room boiling
13 is very important for PCT. The correlations that come
14 into play --

15 MEMBER KRESS:: How do you know that,
16 Ralph?

17 MR. LANDRY: The correlations that come
18 into play during reflood are critical, and how the
19 quench flood moves up the fuel, and where you
20 determine T_{min} to be, and where you allow quenching to
21 come in.

22 MEMBER KRESS:: How is it that you know
23 that dispersed room boiling is very important? Is it
24 from this experience?

25 MR. LANDRY: From the experience and

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1 seeing the results of experiments, the years of
2 experiments, determining that peak clad temperature
3 can vary so much by changing flow rates, so that as
4 you change the heat transfer correlation, or the heat
5 transfer regimes during reflood.

6 So these are the areas in which we are
7 trying to focus the review. It is a tight schedule,
8 and we realize that this schedule is very aggressive,
9 and that we are trying to do everything we can to meet
10 that.

11 Now, in the past the subcommittee has made
12 a number of comments on areas that it has felt to be
13 important, and we hope to get some of those areas out
14 of this meeting today, too; and areas where you think
15 we should be looking in particular.

16 Models in the code such as we discussed
17 with the small break LOCA, where you feel this model
18 is very important, and have you looked at varying
19 parameters within such and such.

20 Any kind of feedback that we get during
21 this meeting we are going to take into account in the
22 work that we are doing, looking at the independent
23 evaluation of the code itself.

24 DR. SCHROCK: We have around four models
25 and correlations currently in the material that we are

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1 looking at. We previously reviewed MOD-2 and in
2 looking at the new one, it is difficult to identify
3 what the changes are.

4 But I think it would be helpful if you
5 could ask Framatome to mark the places where the
6 documentation has been changed, just in the interest
7 of saving time in locating it, and seeing what the
8 resources have been.

9 I see some changes, but at first I thought
10 there were no changes in one chapter at all, and as I
11 studied it further, I see in fact there are some, but
12 they are modest, but that is just a suggestion.

13 MR. LANDRY: The Framatome people are
14 taking notes.

15 DR. SCHROCK: Well, I think it is more
16 likely to happen if you ask them.

17 MR. LANDRY: Well, the documentation that
18 we have received is extensive as you have already
19 encountered. We have three CD-ROMs full of documents.

20 DR. SCHROCK: Right.

21 MR. LANDRY: We have the methodology
22 manual, and we have the models and correlations
23 manual, verification and validation manual, users
24 guide, programmers guide, RODEX manual, ICECON manual,
25 and various and sundry other supporting documents.

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1 And looking at it by rough estimate, it
2 was something like 15,000 pages of material here. So
3 that is another factor in our review; that we have to
4 say what are we going to focus on. Let's focus our
5 review on the things that are important.

6 And let's use our resources productively
7 and as efficiently as we can. So any feedback that we
8 get in the next day-and-a-half will also help us, and
9 if we can get feedback on any of your observations, I
10 think --

11 DR. SCHROCK: I find it difficult to work
12 from the Cds directly on the screen, especially when
13 figures are rotated by 90 degrees, but quite apart
14 from that, I am not skilled enough at doing that to
15 flip back and forth between text and a figure to sort
16 out ideas that I am looking for.

17 Well, there is a great deal that we have
18 printed ourselves from the screen, but this is the
19 policy of the agency to encourage electronic
20 submittals.

21 So we are dealing with it also, and as we
22 get older, some of us have to consider our vision. So
23 those are the remarks that I had planned on making
24 this morning, Mr. Chairman, and I would like to then
25 turn it over to Framatome to make their presentations.

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1 And tomorrow morning when they are
2 complete, then come back and address some of the
3 issues raised in the subcommittee and the committee's
4 letter on the small break LOCA review. And in
5 particular have Yuri Orechwa present his initial
6 thoughts on the statistical review.

7 CHAIRMAN WALLIS: Before you go, your
8 slide three essentially went through your schedule for
9 things, and I was trying to think about the ACRS
10 parallel schedule. We don't send out RAIs.

11 MR. LANDRY: Correct.

12 CHAIRMAN WALLIS: But we have all the
13 information. We have three Cds, and I think we have
14 all looked at them more or less, but we have not
15 looked in detail. Some have looked at more detail in
16 some parts and so on.

17 But as I said in my introduction, we are
18 starting this process, and it seems quite likely that
19 between now and August, and maybe even next month or
20 so, some of us may dig in pretty deeply in parts of
21 this documentation.

22 But we have no obligation to send out RAIs
23 or to say anything to anybody. We can wait until all
24 is revealed in August, or we can be part of more
25 directly part of the review process in some way. I am

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1 not quite sure how we ought to fit in.

2 MR. LANDRY: Well, that is also a part,
3 Mr. Chairman, of what I was saying earlier, that we
4 will be taking notes during this meeting, and any
5 feedback that we get, we realize that the subcommittee
6 is not the consultant to the staff.

7 And we don't want to approach using it as
8 such. But any feedback that we get, we will factor
9 in.

10 CHAIRMAN WALLIS: I think if there is
11 anything that concerns us as we do our reading, there
12 ought to be a mechanism for it to be sort of injected
13 into the process before September.

14 MR. LANDRY: Well, any feedback that you
15 provide back to Paul, and Paul can provide to us, we
16 would like to factor into our review. We want to do -
17 - we realize that this is an aggressive schedule, and
18 so we want to do as efficient and complete a review as
19 we can.

20 MR. BOEHNERT: Yes, I would say a
21 suggestion would be that you compile some notes, or
22 comments, and give them to me, and I can transfer them
23 over to the staff.

24 MEMBER KRESS:: It seems like it ought to
25 be possibly included in the RAIs.

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1 MR. BOEHNERT: Yes, it should be fairly
2 soon.

3 MEMBER KRESS:: Yes, that makes it pretty
4 soon.

5 MR. LANDRY: The procedure that we are
6 using for the RAIs is very much like we have used in
7 previous code reviews. We provide to the applicant
8 our questions in an informal manner as we develop
9 them, and then when we have -- when we determine that
10 we have all the questions together, we prepare the
11 formal questions to send them out so that they can
12 have the questions in advance, and can work on
13 responses to such questions that I just alluded to,
14 such as the heat transfer correlation mapping.

15 And that is a big problem, and it is not
16 an insignificant effort. So we are trying to provide
17 questions to them in advance so that they can develop
18 answers, and then we give them the formal responses.

19 And as we did with the Appendix K review
20 for small break LOCA, it was only a few weeks after we
21 gave them the formal questions that we received the
22 formal answers, because we have interacted with the
23 questions and responses throughout the review process.

24 We found that to be a very productive way
25 in which to transfer information back and forth. So

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1 any input that we get from you, and any insights we
2 get from you, we would be very interested in having.

3 CHAIRMAN WALLIS: We are not consultants
4 to the staff, and neither are we consultants to
5 Framatome.

6 MR. LANDRY: Right.

7 CHAIRMAN WALLIS: So it is not our job to
8 fix up something there.

9 MR. LANDRY: That's correct. But any
10 comments that you --

11 CHAIRMAN WALLIS: This is assuming that
12 maybe it is a perfect document, but we don't know that
13 yet.

14 MR. LANDRY: Are there any comments that
15 you care to make to us, we would be happy to look at.

16 CHAIRMAN WALLIS: Thank you very much.

17 MR. LANDRY: Thank you.

18 CHAIRMAN WALLIS: Well, Jerry, welcome
19 back. It has been a while since we saw you here.

20 MR. HOLM: Yes. Good morning. My name is
21 Jerry Holm, and I am primarily related to S-RELAP5
22 users manual or programmers manual, a document on
23 RODEX3A, which is the fuel rod code used in the
24 methodology, a document in ICECON, which is the
25 containment calculation, which is actually part of the

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1 S-RELAP5 code these days.

2 CHAIRMAN WALLIS: These sample columns,
3 are these reactor problems and that the nodalization
4 scheme is all set up for a real reactor system?

5 MR. HOLM: Yes. They can run the 4-loop
6 sample problem that is in the topical report, and they
7 can go in and vary it to look at other conditions if
8 they want to. But we gave them the base input decks
9 so that they could repeat our sample if they wanted
10 to.

11 Now, I end up with a schedule, which I am
12 happy to note matches very well with Ralph Landry's
13 schedule. Again, as Ralph said, we submitted a
14 topical report in August of 2001, and made a
15 presentation to the NRC in October.

16 The presentation that we made to the NRC,
17 this one that you are going to see today, is patterned
18 after that. We went back and based on the reaction to
19 the NRC staff to the presentation, made a few
20 modifications for this meeting.

21 But in general it is the same structure
22 and same topics. And it says that the first
23 presentation to the subcommittee is today and
24 tomorrow, and I think a really key date in this
25 process is for the NRC to issue the RAIs in April if

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1 we are going to respond, get a draft SER, and have
2 another ACRS meeting, and get an SER that is final in
3 September, we really need to hold to that April date.

4 I would certainly encourage the
5 subcommittee if they have got feedback to provide to
6 the NRC, that they would like the NRC to pursue if you
7 can do it prior to April, and that will facilitate the
8 process quite a bit.

9 CHAIRMAN WALLIS: This assumes that the
10 Framatome response is acceptable?

11 MR. HOLM: Yes. It assumes there is not
12 a second amount.

13 CHAIRMAN WALLIS: You don't need to
14 reiterate on anything?

15 MR. HOLM: Right. This schedule assumes
16 there is no reiteration.

17 CHAIRMAN WALLIS: That has always
18 concerned me a bit about these reviews, and it seems
19 to be stuck on a linear track; whereas, some things
20 often require a re-examination.

21 Just to have one presentation to us now
22 and then the final presentation in August may not be
23 enough. It may work out, and it may be such smooth
24 going that there is nothing to worry about.

25 MR. HOLM: We hope that we have done a

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1 good enough job on the original documentation that it
2 will be a smooth review process. If there are other
3 meetings requested, we are certainly willing to
4 support those, and we will try to support them in this
5 time frame.

6 But our goal on these topical reports is
7 that we try to identify in advance what the NRC's
8 interests are, and what their requirements are going
9 to be, and we try to make sure that the topicals have
10 that information. We don't look at this as a process
11 of submitting a topical, and then responding to
12 questions and modifying the methodology.

13 If I have to modify those topical report,
14 in terms of its functionality, then we have failed at
15 our goal here. We really want to issue this topical
16 as it is basically, with an SER that says that what we
17 submitted was acceptable.

18 And with that, I will turn it over to
19 Larry O'Dell to start the overview of the methodology.

20 CHAIRMAN WALLIS: Thank you, Jerry.

21 MR. HOLM: You are welcome.

22 MR. O'DELL: Good morning. As Jerry
23 indicated, I am Larry O'Dell, and the project manager
24 for the realistic large break LOCA project, and what
25 I am going to do this morning is provide the overview

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1 of the methodology, and what we are calling the
2 methodology road map.

3 The purpose of this is to provide an upper
4 level overview of the complete methodology, within the
5 intent of providing a perspective in support of the
6 following more detailed presentations which will be
7 following.

8 What I intend to do as indicated in
9 Jerry's presentation was go through the various steps
10 that we followed in compliance with the CSAU
11 methodology, going through the requirements and
12 capabilities of the CSAU-1, steps 1 through 6, and the
13 assessment ranging of parameters, CSAU Element-2, Step
14 7 through 10.

15 And the sensitivity uncertainty analysis,
16 CSAU Element-3, Steps 11 through 14. Moving into the
17 first element, Element 1, CSAU
18 Step-1, follows the selection of the transient. Here
19 we have selected the large break LOCA scenario for
20 analysis.

21 We selected the plant types and the
22 selection of the plant types influences the dominant
23 phenomena, and their interactions. Here we have
24 selected the Westinghouse 3 and 4-loop plants, and the
25 CE plants.

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1 All three plant types have inverted U-tube
2 steam generators, a pressurizer connected to a hot
3 lay, an ECCS injection into the cold legs, and our
4 experience with the Appendix K large break LOCA
5 analyses indicate that the three plants, plant types,
6 behave similarly in the blowdown, refill, and reflood
7 phases of a LOCA.

8 DR. SCHROCK: Excuse me, but doesn't step-
9 one require specification of a frozen code to be used?

10 MR. O'DELL: I think that is one of the
11 following steps which I will get to.

12 DR. SCHROCK: But it is not in Step-1?

13 MR. O'DELL: No. Step-1 is picking the
14 scenario that is going to be analyzed, and I don't
15 remember which one of the steps it is, but we will hit
16 that one.

17 MEMBER KRESS:: Is that one scenario, or
18 is it perhaps a series of break sizes?

19 MR. O'DELL: As we get through it, we do
20 a full break spectrum on the guillotines and splits.

21 MEMBER KRESS:: For a large break
22 spectrum?

23 MR. O'DELL: Right. And in fact we
24 phalange up with our small break LOCA methodology. We
25 go down to a break size consistent with the upper

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1 bound on our small break LOCA methodology.

2 MR. BOEHNERT: Do you have any plants to
3 do large break LOCA for BWRs?

4 MR. O'DELL: For BWRs?

5 MR. BOEHNERT: Yes.

6 MR. O'DELL: That as not necessarily been
7 decided at this point in time, and we have a follow on
8 project that has initiated this year, and in which we
9 are looking at using S-RELAP5 for BWRs.

10 However, we will start with the non-LOCA
11 transients. Okay. CSAU Step-3 has to do with the
12 development of the PIRT, and we developed the
13 identification in a ranking table, and this is
14 performed by experts who are knowledgeable of the
15 specific large break LOCA scenario.

16 The PIRT identifies and ranks the
17 important phenomena for the specified scenario and
18 plant types, and the important phases of the large
19 break LOCA are defined, and the important plant
20 components are identified, and the important phenomena
21 in each component during each phase are identified.

22 And the relative importance of each
23 phenomena during each large break LOCA phase is
24 identified.

25 CHAIRMAN WALLIS: Now, this isn't really

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1 the process, because you don't really know much about
2 the last part until you have run the code, and looking
3 at sensitivities and so on?

4 MR. O'DELL: Exactly. As I will discuss,
5 what we did here is -- well, in fact, it leads in
6 fairly well --

7 CHAIRMAN WALLIS: You have to come back to
8 the PIRT again and again.

9 MR. O'DELL: Yes.

10 CHAIRMAN WALLIS: And look around and say
11 did we make the right decision.

12 MR. O'DELL: Right. Now, what we -- the
13 process that we followed was basically to develop what
14 we call the final PIRT, and at that point in time the
15 PIRT was set.

16 Now, we did sensitivity studies, and as a
17 result of those sensitivity studies we did determined
18 which ones are the phenomena that we were going to
19 actually treat statistically without going back and
20 changing the PIRT.

21 So the final PIRT you see from this in the
22 documentation is the one that we actually developed
23 going through the process.

24 DR. SCHROCK: Are you going to identify
25 PIRT team?

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1 MR. O'DELL: I can identify the PIRT team.
2 It was basically our internal Framatome people, and we
3 brought in -- well, Joe Kelly was one of the ones that
4 came in part-way through the process, and reviewed the
5 PIRT.

6 Dr. Hochreiter participated in the review
7 of the PIRT, and we also had him come out and
8 participate in the peer review, and we used Marv
9 Thurgood as another outside source to participate in
10 the review of our PIRT, and in also the peer reviews.

11 DR. SCHROCK: I think the credibility of
12 the PIRT depends in part on insuring that you have
13 recognized people doing it, and I think also my
14 experience in PIRT has been that the degree of
15 adherence to the principles of the PIRT process has
16 varied widely in previous PIRTs.

17 So I think that they should document in
18 some way how they have been managed, and what the
19 process really is, and has it been done in accordance
20 with the defined process for PIRTs.

21 MR. O'DELL: Well, I think I have the one
22 after this slide that will go into sort of the details
23 of what we did there. The PIRT provides the basis for
24 determining the code applicability, and does the code
25 model the important phenomena in plant components.

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1 It establishes the assessment and helps
2 provide the information for establishing the
3 assessment matrix. That is, identifying the test data
4 that contain the appropriate phenomena during each
5 accident phase.

6 And finally identifying the important
7 phenomena to be quantified and ranged for evaluating
8 uncertainties. The process we followed I think -- and
9 going with Dr. Shrock's comments -- was we first
10 started with an initial PIRT, which was developed from
11 a number from both the expert, the original expert
12 evaluation, and the analytical hierarchy process.

13 And what we did is we averaged them where
14 there was no number for the experts provided for
15 there, and we went with the analytical hierarchy
16 process. We then had this initial PIRT reviewed by
17 three independent experts, and

18 CHAIRMAN WALLIS: What is the analytical
19 hierarchy process?

20 MR. O'DELL: Okay. The analytical
21 hierarchy process involves going through identifying
22 the various plant components, and the phenomena that
23 occur within those components, and then on a component
24 basis, ranking -- going through and ranking the
25 phenomena within the component, and then the --

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1 CHAIRMAN WALLIS: And that is based on
2 judgment, or is it based on something analytical? It
3 says analytical and something.

4 MR. O'DELL: Well, it is only analytical
5 from the standpoint that you first rank the phenomena
6 within the component, and you rank the components --

7 CHAIRMAN WALLIS: The ranking is done in
8 a subjective way?

9 MR. O'DELL: Exactly.

10 CHAIRMAN WALLIS: I guess, or I think, or
11 I estimate, or whatever.

12 MR. O'DELL: Right. It is trying to come
13 through and rank it, and then based on the ranking of
14 the importance of the components, combining those
15 rankings, you end up with a final overall ranking.

16 And then as I indicated, the PIRT was
17 reviewed by three independent experts, and they
18 suggested additional phenomena and ranking changes,
19 and we have outlined what the final set of changes
20 were within the documentation.

21 The final PIRT was then generated through
22 a peer review, and as I indicated, there were
23 Framatome key personnel participating in that, which
24 at that time included Joe Kelly.

25 And there was external experts, such as

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1 Dr. Hochreiter, and Marv Thurgood, and as part of this
2 peer review, we started off by first developing
3 consistent definitions for everyone to use for the
4 large break phases and phenomena.

5 DR. SCHROCK: And the purpose of my
6 question was really to see if this documented
7 someplace as to who the people are, the three
8 independent experts, for example. Is there some place
9 in the documentation where those people are
10 identified?

11 MR. O'DELL: It isn't. We didn't address
12 people's names and stuff in the documentation. One of
13 the things that we could have done, I guess, is put in
14 the acknowledgements, but we didn't do that I don't
15 believe in the document as I recall.

16 DR. SCHROCK: I think it should be, but
17 evidently not. It may be just my own opinion.

18 MR. O'DELL: I think it would have been
19 appropriate to put them in the acknowledgement
20 sections for certain, and in the attempts to get some
21 of these things out, not all of the niceties always
22 get addressed unfortunately.

23 And the large break LOCA phases that we
24 considered, is somewhat different, particularly for
25 the blow down phase and the follow on refill phase

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1 from what you normally see in Appendix K.

2 In the blowdown, we defined this as the
3 time period from the initiation of the break until
4 flow from the accumulators or safety injection tanks
5 begin. And based on the members that participated in
6 the peer review of the PIRT, they felt that there was
7 a significant change in the actual phenomena that was
8 occurring at this time, and that was a better break
9 point in a LOCA than what is normally in Appendix K.

10 And also by having it occur somewhat
11 earlier, you don't have the -- it should be acceptable
12 from the standpoint that you don't have an Appendix K
13 requirement of throwing away the water at the end of
14 the blowdown.

15 And then the refill and reflood
16 definitions pretty much fall in line with what we had
17 in Appendix K. The final PIRT, as I indicated, there
18 were numerous minor changes to the phenomena rankings,
19 and those are laid out and described in the
20 documentation, EMF-2103.

21 And just some of the major ones that I
22 listed here was the single phrase natural convection
23 was deleted from the PIRT because the experts believed
24 that this was covered in the post-CHF heat transfer
25 model.

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1 The 3-D flow, void distribution, and
2 generation were combined into a single phenomena.
3 Again, the flow and void distribution were directly
4 related, and it was felt that they were really not
5 separable.

6 Accumulator discharge was added to the
7 PIRT, and the discharge rate was felt to be a
8 significant primer in determining the refill and
9 reflood rates.

10 And a upper head component was added
11 because the initial upper head temperature was
12 expected to impact the blow down phase.

13 CHAIRMAN WALLIS: I have a question for
14 you while I have been looking through your slides
15 here. You have not really told us what S-RELAP5 is.
16 You are jumping into the process here, but I take it
17 that S-RELAP5 is something that is just something that
18 exists somewhere and then you go through this process
19 with it?

20 MR. O'DELL: Well, we viewed this meeting
21 as more of a building process on our previous meetings
22 with the ACRS. I mean, we went through this with the
23 S-RELAP5 code is something that has sort of evolved
24 through time and from wherever the previous S-RELAPs
25 were and all that.

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1 It is a long history, of 40 years of
2 evolution, and that it is a realistic code, and it
3 didn't start out being all that realistic, but there
4 is some kind of a belief that it is now realistic?

5 MR. O'DELL: Well, as I indicated, we were
6 viewing this meeting as more of a follow-on to the
7 previous presentations on S-RELAP5.

8 CHAIRMAN WALLIS: But we had a lot of
9 questions about it.

10 MR. O'DELL: And we tried to respond to
11 those questions.

12 CHAIRMAN WALLIS: And I think somewhere it
13 is up to you to say what this thing is that you are
14 taking for granted in a way.

15 MR. O'DELL: Okay. I guess I am not
16 exactly following the question. Above and beyond --

17 CHAIRMAN WALLIS: Well, you have made this
18 basic assumption, I think, that S-RELAP5 is a mature
19 code, and you don't have to question anything about
20 it, and we will just go ahead and go through the CSAU
21 process using it.

22 And it may be there that as it has evolved
23 there are some kind of bad genes that have never
24 mutated to anything better. I don't know. I am just
25 saying that you are accepting that it is now mature

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1 enough to be accepted without question.

2 MR. O'DELL: Well, I don't think we would
3 take the position that the -- with the without
4 question part, I guess. If you feel there are
5 questions from our previous discussions on S-RELAP5
6 that have not been resolved in some fashion, I think
7 it would be very appropriate that those be passed --

8 CHAIRMAN WALLIS: That is what I am kind
9 of asking. Now what I would really like to see if a
10 really authoritative document that people can look at
11 and say, yeah, they have really made the case for S-
12 RELAP5.

13 And in that case, seeing that, you really
14 have to say something about what it is, and some kind
15 of overview of what it is based on, and what it can
16 do, and what its weaknesses and strengths are, or
17 something.

18 I have not looked at that in the
19 documentation and I don't know where we can find it.

20 MR. O'DELL: I guess in part with the CSAI
21 process, I would say that actually comes in the
22 assessments of the experiments and development of the
23 uncertainties, and --

24 CHAIRMAN WALLIS: You can keep using it
25 and say, well, it is justified by what it can do?

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1 That seems to be the argument.

2 MR. O'DELL: Well, I think it is a
3 multiple phase process, all right? I mean, you go
4 through and you develop the code, and you document it
5 in the code documentation, which I believe we have
6 attempted to do, and then you assess the code against
7 experimental data to in fact demonstrate that the
8 models and correlations used in the code are in fact
9 giving you reasonable type results.

10 And that's where I am trying to say we are
11 trying to build on our previous or felt that we were
12 building on our previous presentations, where we went
13 through and presented the code, and we went through
14 and tried to respond to your questions at that point
15 in time, and when Joe Kelly went through the equations
16 and tried to lay the basis for the development of
17 those equations.

18 And so basically what you are seeing in
19 the presentations that we have laid out here are sort
20 of -- well, you have seen the code, and this is the
21 way the code is being applied, and these are the
22 results that we get from that application.

23 CHAIRMAN WALLIS: So it is not something
24 like the old caloric theory of thermal dynamics, which
25 could do a lot of things, and then got fixed up, and

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1 got fixed up, and got fixed up until eventually a sort
2 of change occurred, where people's views of thermal
3 dynamics became different, and then you had to add
4 something else to the basic theory in order to do a
5 better job.

6 So you went back and redid thermal. I
7 just wonder if some of that isn't in some of these
8 codes, where there is some old assumptions made
9 because we had to do something 40 years ago and no one
10 has really had the courage to say we really ought to
11 do something different. I just don't know if --

12 MR. O'DELL: Well, I think that at least
13 as we view codes, is that they are a continually
14 evolving system, okay? And we are going through and
15 we believe the code based on the assessments that we
16 have done, and the sensitivity studies that we have
17 done, that the code is in a condition where we can
18 demonstrate it is applicable for PWR realistic large
19 break LOCA.

20 Now, when I say it is going to evolve, the
21 version that we are running here and that we were
22 presenting the results of here, is the version that we
23 intend to use in the performance of analysis.

24 But we are starting the BWR development
25 process now, and we are going to start assessing the

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1 code on the BWR sets of conditions and stuff. If
2 there is something that comes out of that that says we
3 have got to go in and modify the code, we will go in
4 and try to improve the models and stuff in the code,
5 such that it can predict BWR phenomena.

6 And that is what I mean by it is going to
7 evolve, and we will have the versions that we are
8 going to have for the PWRs, but it will continue to
9 evolve and move forward from there.

10 CHAIRMAN WALLIS: Well, I am just trying
11 to formulate a feeling here that in the presented code
12 there has to be some kind of a description of what it
13 is and why it is good for this purpose.

14 Maybe it is somewhere in the
15 documentation, and maybe we should move on with your
16 presentation, but it is interesting to me that you
17 don't find it necessary to say anything about that.

18 MR. O'DELL: Well, our incoming position
19 was that we presented the code, and you had an
20 opportunity to look at it and comment on the code, and
21 we are going to be dealing primarily with that code's
22 application.

23 DR. SCHROCK: I had difficulty
24 understanding your bullet, 3D flow void distribution
25 and generation combined into a single phenomena. What

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1 does that mean? What is happening here?

2 MR. O'DELL: Well, I think if you go and
3 look at the PIRT and the compendium, it had two
4 components, or two phenomena listed. One was the 3D
5 flow, and one was a void distribution. And we felt
6 that given the power distribution that the calculation
7 of the 3-D flow and the void distribution were a
8 combined effect.

9 DR. SCHROCK: Well, you don't calculate 3-
10 D flow in it. The effects are not really combineable
11 into a single phenomenon. I don't understand what the
12 argument is here. I mean, the void will depend upon
13 the total enthalpy of the mixture, as well as flow
14 conditions.

15 MR. O'DELL: Right.

16 DR. SCHROCK: You can't relate void to
17 flow alone

18 MR. O'DELL: Yes, and that is not the --

19 DR. SCHROCK: That's not what the bullet
20 means?

21 MR. O'DELL: That's right.

22 DR. SCHROCK: So what I am asking is what
23 does it mean?

24 MR. O'DELL: Well, what it means is that
25 the calculation of the 3-D flow and the mixing within

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1 the various radio assemblies within the core sets that
2 enthalpy, which then in-turn sets the calculated void
3 distribution given the powers and calculated flow.

4 CHAIRMAN WALLIS: And so for the purposes
5 of the PIRT, you have sort of put these things in the
6 same basket. It does not mean that they are
7 thermologically related. Isn't that what you are just
8 saying for the convenience of the product?

9 MR. O'DELL: Right.

10 CHAIRMAN WALLIS: That you have got some
11 extra phenomena and you put them in this same
12 sentence, the same slot.

13 MR. O'DELL: Right. As far as being able
14 to rank them.

15 CHAIRMAN WALLIS: But if one of them
16 turned out to be very important on its own, you would
17 have to break it out and put it in as a separate item
18 it seems to me.

19 MR. O'DELL: Well, let's say, for example,
20 that I -- well, I think what we are trying to say here
21 is that if we said, okay, the void distribution is
22 extremely important, that that void distribution is
23 fed by the calculated flows to some extent, and by the
24 mixing that it calculates in there to get the
25 enthalpies for calculating that void distribution.

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1 So as I understand that if you looked at
2 one node, and you had the heat coming into that node,
3 and the enthalpy of the liquid in that node, you would
4 calculate the void distribution.

5 And what I am saying is that the enthalpy
6 coming in, the conditions of the fluid coming in to
7 that specific node is determined to some extent by the
8 calculated 3D flow distributions.

9 DR. SCHROCK: I am having trouble
10 understanding how you are viewing the relationship of
11 the PIRT to the code calculation. The PIRT is trying
12 to identify important phenomenological behavior of
13 this complex system, and to psyche out which things
14 are of greatest importance to the evolution of a major
15 transient, the one identified specifically.

16 And then to examine in a later stage how
17 well the code is able to do what you imagine from the
18 PIRT has to be done in order to get a reasonable
19 result. If you begin with an argument that 3D effects
20 and void distribution, and void generation are
21 representable by some single figure of merit, I am not
22 sure that you would be able to ask the right questions
23 about the code.

24 So what would your image be of what that
25 bullet leads you to from the PIRT to ask about what

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1 the code is doing.

2 MR. O'DELL: Well, I think if you look at
3 the assessments, we have done a series of calculations
4 where the flow and the void distribution have been
5 looked at.

6 We used the FRIGGO-2 test to look at void
7 distributions, and we used the -- I think it was the
8 GE level swell test, and THTF level swell test, all
9 looking at void distributions.

10 And we have used some multi-dimensional
11 tests, and I think they were performed by
12 Westinghouse, where they had two 15-by-15 assemblies
13 together, and where we tried to look at the effect of
14 the 3D flow.

15 And I think again to the extent that one
16 can separate out the effects of the two in those
17 tests, we presented comparisons to the test data.

18 DR. SCHROCK: Okay. I don't think I
19 should pursue it further. Thank you.

20 MR. O'DELL: And here is the CSAU Step-4,
21 which involves a selection of the frozen code
22 versions, and in these frozen code versions the
23 requirements are that you have consistency throughout
24 the process.

25 We selected frozen versions of the

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1 RODEX3A and S-RELAP5 code, and that is --

2 CHAIRMAN WALLIS: Who decided to freeze
3 the code? What is the process that decides that the
4 code is freezable and appropriate to freeze it at this
5 time, and not to change anything anymore?

6 MR. O'DELL: Well, it was integrative
7 process obviously. I mean, we picked a subset of the
8 assessments, including the interval and some of the
9 separate effect tests, and we ran those sets of
10 assessments.

11 And we also developed a model for the
12 plant, and we ran sensitivity studies based on that
13 plant model, and ran the assessments. And what we did
14 is we determined that the code was providing
15 reasonable results for those.

16 Now, as we went through the process and
17 added more assessments, we also incorporated the
18 results from those assessments and went back into the
19 code.

20 And then once we came to the conclusion
21 that the code was giving us acceptable results, from
22 the standpoint of being able to quantify
23 uncertainties, et cetera, for the code, then we froze
24 that code version, and made a final pass through all
25 of the assessments.

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1 So this was definitely an interactive
2 process getting to this condition for S-RELAP5.
3 RODEX3A, we had already gone through that process and
4 that code had been reviewed and approved, and we have
5 an SER on that.

6 CHAIRMAN WALLIS: So the code is sort of
7 adaptable until it fits most of the data, and then you
8 freeze it, and then you assess something else that is
9 independent of what you used before you froze it?

10 MR. O'DELL: Yes, and in fact, the whole
11 process involved exactly that kind of an approach, and
12 you will see as you look at the assessments that the
13 SETF, you would have to say that was jus a blind
14 assessment.

15 It took us so long to get the data that we
16 didn't get to use that assessment for as much as we
17 originally wanted to use it for.

18 And all we ended up using the SETF for was
19 a nodalization, because that was all that we had time
20 left for once we got the SETF data. But we did run
21 the set of assessments that we had planned to run all
22 along.

23 DR. SCHROCK: It seems as though the
24 identification of a frozen version is a bit vague, and
25 maybe impossible at this stage, if the code is still

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1 under review by NRR. And you may have to do things to
2 it in order to make it acceptable to NRR. But you
3 have already marched ahead with the process of
4 implementing CSAU, with a presumption that a frozen
5 version exists. How do you identify it?

6 MR. O'DELL: Within our own --

7 DR. SCHROCK: It just seems vague to me,
8 and that is my comment.

9 MR. O'DELL: Well, within our own --

10 DR. SCHROCK: The process seems out of
11 step and the identification seems imprecise.

12 MR. O'DELL: Well, I don't think the
13 identification -- well, I would disagree that the
14 definition is imprecise, at least within our own code
15 development hierarchy. When we come through --

16 DR. SCHROCK: I mean by that that in your
17 description of it to us, it seems imprecise. There
18 needs to be some way in which the existence of a
19 frozen code is describable and what does it mean.

20 MR. O'DELL: Well, what it means from my
21 definition --

22 DR. SCHROCK: A certain MOD version of the
23 code, with a --

24 MR. O'DELL: It is a use version, and we
25 quantify them with a use version. It is saved in our

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1 CSAU, our code control system, and that version
2 basically can't be changed, okay?

3 If we make changes to that code version,
4 then this designation has to be updated to whatever
5 version that code is. If we go through this review
6 process, and it turns out that we have to go back to
7 the code and make significant changes, then obviously
8 we are going to have to go back and rerun the
9 assessments, and we are going to have to rerun the
10 sample problems.

11 But again from the perspective of the CSAU
12 approach, we have to pick essentially what we would
13 call a frozen code version within our system in order
14 to be compliant with CSAU.

15 CHAIRMAN WALLIS: But this is why it is
16 important to make sure that your formulations are
17 correct, because there is an equation in your
18 documentation which has a D-by-DX, and where I think
19 it should be a D-squared-by DX-squared.

20 Now, that is in the equation. I don't
21 know what is in the code, but maybe in the code there
22 is a D-by-DX instead of a D-squared-by-DX- squared, in
23 case there is a fundamental error in the code.

24 And I don't know what the consequences
25 are. They may be absolutely minor. But it means

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1 that there is something which is fundamentally wrong
2 about a formulation which might conceivably be in this
3 frozen code, and what do you do then? Do you go back
4 and -- do you have to change it, or do you say, well,
5 it doesn't matter, or what?

6 MR. O'DELL: Well, if we were to find --
7 and again we have gone through the verification
8 process. Just based on the comments that we received
9 on the documentation last time, we went back and took
10 the documentation, and broke it up into sections, and
11 assigned an independent engineer to go through each of
12 the sections of the documentation to try to catch all
13 of these issues with the equations.

14 Once we got it all put together, we hired
15 an outside technical editor to go through the report,
16 from front to back, and basically try to catch all of
17 the English problems, okay? Now, I am not all that
18 sure what else I can do with that.

19 CHAIRMAN WALLIS: Well, it's not just
20 that. It's what do to do when you find an error, and
21 how does this affect what you may call a frozen code
22 and its assessment?

23 MR. O'DELL: Well, we have gone through a
24 --

25 CHAIRMAN WALLIS: It is an embarrassing

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1 position to be in, but I don't know what you do. I
2 mean, you get yourself a bit like Arthur Anderson and
3 ENRIN.

4 MR. O'DELL: Well, we have gone through a
5 verification process on these codes, where we have had
6 a number of people go through the codes, and we
7 sectioned the codes up by model type areas and stuff,
8 and had individuals go through the code.

9 CHAIRMAN WALLIS: We know that you have
10 done all the good things, but what do you do when an
11 error is discovered?

12 MR. O'DELL: Well, if you point out that
13 there is an error in the documentation, we would go
14 look at that documentation, and we would go and then
15 confirm that in fact that is not in the code.

16 If it is in the code, we would then go run
17 calculations and stuff to find out what the effect of
18 that is, and quantify the effect, and then presumably
19 we would fix the code.

20 CHAIRMAN WALLIS: Well, I have often
21 wondered though, it seems to me that English is a
22 pretty good language, and the equations we are very
23 familiar with. But it would seem easier to check the
24 written language in the equations than to check all
25 those details of this arcane code.

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1 So if there are errors in the equations,
2 then one might suspect that the errors in the code
3 would be greater.

4 MR. O'DELL: Well, I guess I have to
5 somewhat disagree from that because we are using Word,
6 okay? And Word knows more than the person telling it
7 what to do.

8 CHAIRMAN WALLIS: So is it equation
9 equivalent to what corrects the momentum if it doesn't
10 like it?

11 MR. O'DELL: Well, it comes in and does
12 things to you, and you print it out, okay? And I
13 think we went through the process, and you are going
14 to see some of it on some of these slides, and you
15 will probably see a few things, and I think Bob's
16 slides actually have some higher graphics in the
17 proprietary statement than --

18 CHAIRMAN WALLIS: Well, let me ask the
19 staff then, and the staff must face the same thing.
20 If you find an equation that has an error in some
21 term, the real question would seem to be is this a
22 typo, or is it fundamental.

23 And if it is fundamental, then is it in
24 the code. Do you actually look at the source code and
25 check that the source code matches what the equation

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1 should be?

2 MR. LANDRY: Ralph Landry from the staff.
3 The requirements for approved codes have been
4 established since 1974, when 5046 and Appendix K were
5 set out.

6 Whenever an error is found in a code,
7 whether it is found by the staff or by a licensee, or
8 by a vendor, the effect of that error must be assessed
9 by the owner of the code. It must be documented, and
10 fixes must be made.

11 Just because a code is frozen doesn't mean
12 that it is frozen into perpetuity. If an error is
13 found, it is fixed, and that is reported to the staff,
14 and that code version then becomes the frozen version
15 of the code.

16 There has always been a process in place
17 for discovery, correction, and documentation, and
18 approval of fixes to errors and codes, and that is
19 independent of whoever finds the errors.

20 CHAIRMAN WALLIS: Well, I guess I want to
21 be reassured that in the review process that somebody
22 is checking that the code reflects the right
23 formulations.

24 This is even more important than the fact
25 that there might be typos in the equations, let's say,

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1 and even if the equations are perfect, they might be
2 programmed in a way that doesn't reflect what is
3 really there.

4 Someone -- I just hope that you guys do
5 look at source codes, and check out suspicious or
6 anything that you have reason to want to check out
7 actually at the source code level, and see if this
8 corresponds to what should be there.

9 MR. LANDRY: Part of what we are doing
10 within this independent evaluation that I talked about
11 a little earlier is looking at some variations within
12 models, and in that process, if we identify something
13 that is not clear to us, or that is suspect, we would
14 bring it up with Framatome.

15 We are not going through the code itself,
16 the source code itself, and looking line by line to
17 evaluate it.

18 CHAIRMAN WALLIS: You don't have to look
19 at every line, but I think you ought to do some --
20 there are some equations which have a lot of leverage
21 in the answer, and someone ought to be checking to see
22 if the code doesn't have a two instead of a three or
23 something; something squared instead of something
24 cubed, and it is very easy for that to be there.

25 MR. LANDRY: Well, yes, that is a part of

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1 what we are doing with this independent assessment, or
2 this independent evaluation. Excuse me.

3 If in looking at these models we determine
4 that a particular model is one that we would like to
5 examine in detail, and would like to see the effect of
6 this model, of course to examine it, we are going to
7 have to go into the source code and make some changes
8 to evaluate its importance.

9 And in that process, looking at what we
10 determine to be interesting or important, we find that
11 we don't understand, we will talk to Framatome and
12 make sure that what we don't understand is because we
13 don't understand, or because it is wrong, and proceed
14 from that point. Does that answer your question, Dr.
15 Wallis?

16 CHAIRMAN WALLIS: Well, I don't know,
17 because I have yet to see an example of someone having
18 discovered an error in the code, although I have seen
19 oodles of examples of people discovering errors in
20 written equations.

21 The implication would seem to -- well,
22 there is no reason why the code should be purer, and
23 less prone to error, than the equation.

24 MR. LANDRY: Well, we don't think it is.
25 But there has been this process in place for years

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1 that if an error is found, it is corrected.

2 CHAIRMAN WALLIS: I know, but the process
3 of going after the errors is really what I am after.
4 I know that if you find an error that you have to do
5 something, but you can carefully avoid finding errors
6 by just not even looking carefully for them, and not
7 find them, or whatever.

8 MR. LANDRY: It is not a matter that we
9 are not looking carefully at what has been done. We
10 are trying to focus our resources --

11 CHAIRMAN WALLIS: Someone is looking at
12 the source code? You have to look line by line, and
13 you have to figure it out, and you have to say how do
14 they formulate, say, this energy conservation equation
15 in a way which does not have errors.

16 I just want to be very sure that someone
17 at some stage does that.

18 MR. LANDRY: But generally with these
19 reviews, we don't take a code and start going line by
20 line. We simply don't have the staff to do that.

21 CHAIRMAN WALLIS: Well, no, you can't look
22 at all the lines, but there ought to be a random or
23 some kind of a -- well, especially if there is --
24 well, everything depends upon the proper formulation,
25 let's say, of conservation of mass energy momentum,

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1 and that is the basis of everything.

2 So there is a real reason to get that
3 right, because if you get it wrong, and it is found
4 out 10 years later, then it is very embarrassing and
5 difficult.

6 MR. LANDRY: Yes, it is.

7 CHAIRMAN WALLIS: So if there is a real
8 justification, and motivation to get it right, then I
9 just wonder what steps are taken to make sure that
10 there isn't some error at some fundamental level.

11 MR. LANDRY: We will be looking as I said
12 at this independent evaluation at some models, and
13 then we will be trying to look at some of the more
14 important models, especially those --

15 CHAIRMAN WALLIS: So you haven't found or
16 identified anybody who is going to audit the code?

17 MR. LANDRY: -- identified within the PIRT
18 as important models, and going line by line.

19 CHAIRMAN WALLIS: Yes, going line by line,
20 okay. Someone will audit line by line, at least
21 occasionally, and with tenacity, and thoroughness?

22 MR. LANDRY: Right. And that's one of the
23 things that Sarah will be doing for us.

24 CHAIRMAN WALLIS: Okay.

25 MR. LANDRY: Of course, we can't through

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1 the entire code, but we will have -- it is just spot
2 checking.

3 CHAIRMAN WALLIS: Would it be possible for
4 the ACRS to get a look at some of these line-by-line
5 things, or is that something which is not allowed?

6 MR. LANDRY: If what we find will be
7 shared?

8 CHAIRMAN WALLIS: I mean, can we look at
9 it? I mean, we look at the equations --

10 MR. LANDRY: Well, would you like to look
11 at the source code itself?

12 CHAIRMAN WALLIS: I would hate to look,
13 but I may feel obligation.

14 MR. LANDRY: I guess the question is are
15 you asking to look at the code itself, or are you
16 asking to look at the staff while it looks at the
17 code?

18 CHAIRMAN WALLIS: No, I think the code
19 comes as a whole lot of statements in some language.

20 MR. LANDRY: FORTRAN.

21 CHAIRMAN WALLIS: FORTRAN. So it might be
22 possible for one of us to figure out what is going on,
23 and there must be some pages of code which are not
24 very long which describe, let us say, a momentum
25 equation in FORTRAN.

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1 MR. LANDRY: If you would wish to look at
2 the individual source code --

3 CHAIRMAN WALLIS: Yes, it might be
4 interesting to look at that.

5 MR. LANDRY: It would be possible for us
6 to make that available.

7 CHAIRMAN WALLIS: Okay. So we may ask for
8 it.

9 MR. LANDRY: I think it is possible.

10 CHAIRMAN WALLIS: And if we ask for it, it
11 will happen?

12 MR. LANDRY: It's possible.

13 CHAIRMAN WALLIS: Okay. Thank you very
14 much.

15 MR. HOLM: Dr. Wallis, if I could just say
16 one thing. This is Jerry Holm. You are asking about
17 what we do to devise a frozen code if it has to be
18 changed.

19 I think if you let Mr. O'Dell go through
20 the slides, he actually has an example of it, because
21 we are going to acknowledge that we actually use two
22 separate versions of the code in S-RELAP5.

23 And so I think it gives you an example
24 that we went through a verification process, and we
25 found something that needed to be changed, and we

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1 decided which part s of the assessment had to be
2 redone.

3 So I think if you let Larry go through the
4 slide in more detail, he will give you an example of
5 what you are asking about.

6 MR. O'DELL: And I would also interject in
7 this process, that as we went through the verification
8 of the code, we documented that in what we call our
9 internal calculation notebook process, and those are
10 available obviously for the staff to audit at any
11 time.

12 CHAIRMAN WALLIS: I know all the things
13 that you have done and that you are going to talk
14 about today, and it may well be quite possible for all
15 of this to be done, and there is still to be a two
16 instead of a one at some line, and which is not
17 important.

18 MR. CARUSO: Dr. Wallis, I guess I can
19 give you one example from -- well, I think about a
20 year ago, where the staff did a review, and I think it
21 was of TRACG, and we had some questions about
22 neutronic method.

23 And one of the reviewers, Dr. Tony Ulsys,
24 actually went into TRACG and looked at the details of
25 the actual coding to try to understand why it was

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1 doing something, and he did not understand.

2 And I believe he actually modified it to
3 see if he could make it do what he thought it should
4 do. In the end, he understood why it was working the
5 way that it was. So the staff does do this.

6 CHAIRMAN WALLIS: That's very good. That
7 is reassuring.

8 MR. CARUSO: And I believe he made a
9 presentation on that subject. The staff always has
10 the ability to do that, and whether we do it depends
11 on our -- what peaks our curiosity as I believe you
12 would say.

13 And in this case we have someone, Sarah
14 Colpo, who is going to do that. And I would offer
15 that this way of doing things is something that we
16 only started about 3 or 4 years ago when we started
17 the RETRAN review.

18 And we intend to continue with it, but as
19 Ralph Landry said, we don't intend to review every
20 line of the code, and we don't intend to verify that
21 every equation in the documentation has been
22 accurately transcribed into the code.

23 We just don't have the resources for that,
24 but we have curious people, and when they see
25 something, it is their job, and I hold them to it, to

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1 figure out why things aren't the way that they think
2 they should be. And I encourage them to ask probing
3 questions.

4 CHAIRMAN WALLIS: Thank you. Sorry to
5 hold you up.

6 MR. O'DELL: That's fine. With respect to
7 the RODEX3A code version that we use, the UJUN00 in
8 all fuel rod analysis, we did end up using as Jerry
9 Holm indicated two versions of S-RELAP5 in the report
10 of analysis, UJUN00, and UMAR01.

11 The UMAR01 included the additional of the
12 final set of multiplication factors for the
13 uncertainty analysis, and some corrections to the
14 RODEX3A implementation in S-RELAP5. The RODEX --

15 DR. SCHROCK: Are those the only
16 differences going from one version to the other, or
17 are there other things that are modified as well?

18 MR. O'DELL: No, these are the things that
19 were modified in going to this version of the code.

20 DR. SCHROCK: The only things?

21 MR. O'DELL: Yes.

22 DR. SCHROCK: I don't understand the
23 meaning of this statement, the final set of
24 multiplication factors for uncertainty analysis. What
25 multiplication factors are there?

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1 MR. O'DELL: Well, to apply the biases and
2 the range of uncertainty on the parameters, you have
3 to go into the code, and implement that. That is not
4 already in the code.

5 So we had to go into the code and make
6 changes to the code that allowed us to actually
7 perform the statistical analysis.

8 MEMBER KRESS:: You put a coefficient on
9 these, on some of the things --

10 MR. O'DELL: Right.

11 MEMBER KRESS:: -- that you can range.

12 MR. O'DELL: Exactly.

13 MEMBER KRESS:: What does the U stand for
14 in there?

15 MR. O'DELL: I stands for what we call a
16 use version, which is in effect a frozen version of
17 the code that has gone through our software
18 development process, and is now available once it is
19 approved, available for people to use in the
20 performance of licensing analysis.

21 DR. SCHROCK: But it seems inconsistent
22 that you have RODEX version UJUN used for all fuel rod
23 analyses, but then in the next bullet you have these
24 other versions used for electric rods in some cases,
25 and all nuclear rods in the other case.

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1 So you really have three versions involved
2 here.

3 MR. O'DELL: No, there is only one RODEX3A
4 version. That is UJUN00. These are versions of S-
5 RELAP5; UJUL00 and UMAR01, okay? They are two
6 separate codes. You run the RODEX3A code, and it
7 generates a file that then feeds into
8 S-RELAP5, an electronic file.

9 And it provides the initial study state
10 conditions for the fuel to start the S-RELAP5
11 calculations.

12 And we have implemented the models out of
13 -- the necessary models out of RODEX3A into
14 S-RELAP5, and it was when we went through the
15 verification of that implementation that we found some
16 difficulties with that implementation.

17 We then went in and corrected those, and
18 then in the software development record for UMAR01, we
19 ran a number, a fairly large number, of the electrical
20 heater rod cases which should not have been impacted
21 to prove in fact that they weren't impacted.

22 And we got the same results on the
23 electrical heater rod cases between UMAR01 and UJUL00,
24 and that is all documented in the software development
25 record for UMAR01.

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1 DR. SCHROCK: I see. Thank you.

2 MR. O'DELL: CSAU Step-9. I'm sorry,
3 Step-5, involves providing complete documentation
4 supporting the codes which must be -- and this
5 documentation must be consistent with the frozen code
6 versions.

7 We develop models of correlations
8 documents, programmers guides, and user manuals for
9 the frozen code versions, which I believe as Jerry
10 indicated have been supplied.

11 We performed code verification to ensure
12 consistency between the codes and the associated
13 documentation, and this verification was performed
14 with a combination of Framatome ANP and external
15 personnel.

16 CHAIRMAN WALLIS: Does that seem to mean
17 that there was an error in the documentation? It is
18 also in the code.

19 MR. O'DELL: I again would say that that
20 is not the case, okay?

21 CHAIRMAN WALLIS: Well, you don't really
22 know. It is being performed by all these experts, and
23 there is consistency between codes and documentation.

24 MR. O'DELL: Well, the task given to the
25 people performing the verification was that they were

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1 to look at the equations, and the references that were
2 given to those equations, and look at the
3 implementation within the code.

4 Now, the fact that you end up with some of
5 these errors in the documentation, as I indicated,
6 every time you run the bloody things out again, I get
7 a different result out of Word.

8 CHAIRMAN WALLIS: It never happens to
9 codes. It happens with typing, but it doesn't happen
10 with codes.

11 MR. O'DELL: Well, the word processor is
12 what is giving us most of the grief in the
13 documentation, okay?

14 DR. SCHROCK: I think IEEE has established
15 standards for this verification process; isn't that
16 true?

17 MR. O'DELL: That's true.

18 DR. SCHROCK: And do you use those?

19 MR. O'DELL: We used -- well, actually,
20 there were several standards that we looked at. I
21 think there is an ANS standard and there is an IEEE
22 standard that we looked at. And we tried to conform
23 to those standards.

24 DR. SCHROCK: Okay.

25 MR. O'DELL: One of the difficulties that

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1 you always have is that a lot of those standards are
2 put together for use as you are developing the code.
3 And since you are not developing the code from
4 scratch, you sort of try to mash the two of them
5 together.

6 CHAIRMAN WALLIS: The code has three
7 different sets of units; and old English units, and SI
8 units, and some other kinds of units all mixed up?

9 MR. O'DELL: Dr. Chow, I don't believe
10 that is the case.

11 CHAIRMAN WALLIS: I think in the heat
12 transfer correlations -- I am trying to think back
13 because it has been a year or so ago, but some of them
14 are formulated in SI units, and some of them are
15 formulated in BTUs, and some have some kind of mixed
16 thing. Is that right? Is that still the case?

17 MR. CHOW: This is Hueiming Chow. I think
18 that we always use British units, and so anything that
19 verifies a British unit, and most of the cases is that
20 in the reader files SI unit.

21 But there are some provisions that there
22 is only in the English unit, and we sometimes just
23 didn't convert it. But still we use the original
24 British unit, but in the course convert into the SI
25 unit.

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1 MR. O'DELL: Okay. And the verification
2 consistent with going through the coding to ensure
3 that the models in the documentation were actually
4 coded, or were actually in the code, and were coded
5 correctly.

6 This was performed on the RODEX3A code,
7 and the S-RELAP5 code, including the ICECON models for
8 the containment analysis. CSAU Step-6 is to determine
9 the code applicability, and here you can form the
10 presence of the code model for the important PIRT
11 phenomena.

12 And verification to perform an S-RELAP5
13 and confirm the presence of documented models, and the
14 presence of PIRT required conservation and closure
15 equations were confirmed in S-RELAP5.

16 The code numerics were demonstrated
17 through the code sensitivity studies, and the
18 assessments and the sample problem analysis, and code
19 ability to model selected NPP components were
20 confirmed by comparison of the required NPP components
21 and the code component modeling capabilities.

22 And in all cases the S-RELAP5 was
23 demonstrated to meet the requirements, and this is
24 documented in --

25 CHAIRMAN WALLIS: What were the

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1 requirements?

2 MR. O'DELL: With respect to what, MPP
3 components?

4 CHAIRMAN WALLIS: Well, it says
5 demonstrate to meet requirements. Is it numerical to
6 --

7 MR. O'DELL: NO, it is demonstrated to
8 meet the requirements that in fact it has the
9 appropriate --

10 CHAIRMAN WALLIS: About all of the things
11 above?

12 MR. O'DELL: Yes.

13 CHAIRMAN WALLIS: By the requirements you
14 mean to confirm the presence of; is that what you mean
15 by meeting requirements?

16 MR. O'DELL: Yes. Basically what I mean
17 is that it has conservation and closery equations, and
18 it is able to stable the code from the numeric
19 standpoint.

20 CHAIRMAN WALLIS: Okay. Thank you.

21 DR. SCHROCK: The application of the code
22 allows a fairly wide range of user options. How is
23 that controlled in the use of the code in this
24 application?

25 MR. O'DELL: Okay. Well, the way that we

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1 control it within our system is that we put together
2 a series of guidelines that say how you will model the
3 plant, and what the options and stuff are that you are
4 going to turn on in the code, and how the code is to
5 be applied.

6 We provided, I believe, a guideline in the
7 documentation that you have for both the development
8 of the input deck, and for the execution of the
9 analysis.

10 DR. SCHROCK: There are such things even
11 as multiple correlations for the same phenomena, and
12 they select different ones.

13 MR. O'DELL: And I believe --

14 DR. SCHROCK: And there are such things as
15 critical flow models, and Appendix K application, and
16 other things for realistic applications. The things
17 are in the code, but how do you assure making the code
18 as exercised for this purpose as regulated to use the
19 right selection?

20 MR. O'DELL: Well, for example, in the
21 critical flow, we use the HEM model, and it is stated
22 in the guideline that they use the HEM model for the
23 analysis.

24 And the way that we go through the process
25 is one engineer will run the sets of calculations

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1 following the guideline, and a second engineer will
2 come through and do a quality assurance QA review.

3 And part of that process is to look at the
4 guideline and make sure that the analysis engineer in
5 fact used the requirements and met the requirements of
6 the guideline.

7 So that is the way that the process is
8 controlled at Framatome.

9 DR. SCHROCK: That is a fairly important
10 aspect of the application, and I would think it would
11 be natural to describe it in some detail in the
12 documentation.

13 MR. O'DELL: Right. And like I said, I
14 believe, too, that we provided two guideline; one for
15 the development of the input model, and the other for
16 running the analysis.

17 DR. SCHROCK: Okay.

18 MR. O'DELL: Okay. Now we are moving into
19 CSAU Element 2, which is the assessment ranging of
20 parameters. CSAU Step-7 deals with the selection of
21 the assessment matrix, which consists of a series of
22 separate and integral effect tests.

23 These tests much support the code
24 evolution of the important PIRT phenomena, and defined
25 as those phenomena ranked five or higher in the PIRT.

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1 Must provide validation of the selected
2 NPP nodalization, and must support the demonstration
3 of the code's scalability from experimental facilities
4 to the NPP; and must support demonstration that even
5 if compensation errors exist in the code, the code is
6 capable of reliably predicting the selected scenario.

7 For all PIRT phenomena ranked five or
8 higher, a series of --

9 MR. BOEHNERT: Are you going to discuss
10 how you deal with compensating errors?

11 MR. O'DELL: Only from the standpoint that
12 if you look at the various assessments, and the range
13 that was done on the assessments and stuff, that if
14 there are compensating errors in it, it is shown to
15 exist across the range, and that we get reasonable
16 results.

17 We have tried to rely heavily on the
18 larger assessments, both separate effects in
19 particular, and we have used the UPTF for essentially
20 everything but the core, because it has full size
21 vessel for the downcomer lower plenum and upper plenum
22 type arrangements.

23 We have relied heavily on using FLECHT-
24 SEASET, CCTF, and as I mentioned earlier, to a lesser
25 degree, SCTF, and THTF for the core type regions.

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1 So we have tried to ensure that we had
2 full height in the core, and we have looked at various
3 different sizes radially, including the slab that runs
4 all the way out through the slab cut core, and slab
5 core test resulting.

6 So we tried to do that primarily though
7 the choice of the assessments that we have run. And
8 in the sensitivity analysis, we ran over 250 analyses
9 performed using the 3 and 4 loop NPP models.

10 We classified the results of these
11 sensitivities as basically high, medium, and low. And
12 based on the results of the sensitivity studies, we
13 determined -- we picked experimental facilities, and
14 specific tests to cover those phenomena.

15 And we also sent some of the phenomena or
16 what is listed in the PIRT as phenomena as actually
17 determined by the plant. We identified the required
18 plant data to support those parameters.

19 DR. SCHROCK: So you do this for more than
20 one plant type?

21 MR. O'DELL: Yes, we ran the sensitivity
22 studies on both the four loop and three loop problems,
23 and we ran them at different powers to drive the PCT
24 up closer to the limit of twenty-two hundred.

25 We ran a set of cases up there for both

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1 the 3 and 4 loop, and then we ran them at the more
2 nominal conditions. The thinking process there was
3 that if you -- you know, you may see somewhat
4 different sensitivities if you are running it like
5 1,800 degrees than you would see if you were running
6 the model at more like 2,000 to 2,1000 degrees.

7 DR. SCHROCK: Don't you dilute the purpose
8 of the thing by trying to cover more than one plant?
9 I thought the idea was to select a particular plant,
10 and a particular code, and then go to work on applying
11 that calculation?

12 MR. O'DELL: And what we did in
13 relationship to that is we basically built one for the
14 four loop set of important phenomena ranked by
15 importance.

16 That is, magnitude of the sensitivity; and
17 for the four loop plant, and for the three loop plant,
18 and then we basically said, okay, if it is important
19 to any of these plants, we are including it, okay?

20 And so that is the way that we handled the
21 differences in the plant types. You do see somewhat
22 different sensitivities between the plant types, and
23 we have gone in and directly made sure that we have
24 covered them.

25 Okay. Having looked first at the

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1 assessment matrix at the important PIRT phenomena, the
2 second thing we looked at was the nodalization, and
3 based on the assessment matrix generated from the
4 PIRT, the only added thing was the SCTF, which gives
5 us the slab running out regularly through the core.

6 And we picked assessments there with a
7 radio power distribution that would allow us to
8 confirm that the code is able to handle that. With
9 respect to scaling considerations, the assessment
10 matrix generated for the PIRT covered a scaling range
11 from 1 to 1500. and 1 to 1.

12 We did go in and try to pick a counterpart
13 LOFT and semiscale interval effect test to
14 specifically support the scaling analysis, and it was
15 023 in the LOFT, and S06-3 in the semiscale test.

16 With respect to compensating errors, these
17 occur if an when an error in one code model is
18 compensated for by an error in an other code model.
19 This may result in the code being able to predict some
20 assessments, but not others that produce different
21 results in the assessments in the NPP calculations.

22 This was addressed by including integral
23 effect and large scale separate effects tests as I
24 indicated in a previous statement, where we looked at
25 the FLECHT and FLECHT-SEASET, and SCTF, and CCTF, and

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1 THTF for the core phenomena.

2 And we used the UPTF for most of the other
3 MPP components, which is a one to one test. And then
4 we used LOFT and semiscale for the interval large
5 break LOCA scenario evaluation.

6 CHAIRMAN WALLIS: Why does that resolve
7 the compensating error question?

8 MR. O'DELL: Well, as we are going through
9 developing the uncertainties and stuff, and we are
10 using those assessments which are basically full scale
11 in an axial direction for the core, and full scale
12 components here for the development of the UPTF
13 component variations, it sort of gets around the issue
14 of does it scale from the bottom up.

15 And it also by looking at the LOFT and
16 semiscale, you have got the two integral tests at the
17 smaller scales. So by including a wide range and by
18 concentrating our efforts up here, we have tried to
19 reduce the potential impact of the compensating errors
20 if they exist.

21 The final assessment matrix included the
22 THTF facility, where we had 35 heat transfer tests
23 that we looked at, and three level swell test for the
24 void distributions.

25 I think we looked at the G-level swell in

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1 the FRIGG-2 test as I previously mentioned, again to
2 look at void distribution predictions. We looked at
3 the Bennett tube, and the heat transfer and spacer
4 effects, and FLECHT-SEASET, where we looked at heat
5 transfer, and did some nodalization studies.

6 And axial power distribution scalability,
7 and upper plenum and hot leg entrainment. We used
8 some of our own tests in the PDTF/SMART facility,
9 where we looked at the impact of different types of
10 spacers, looking at our HTP specific design and mixing
11 vain spacers.

12 We used the Marviken test, 9 test, to
13 examine the break performance of the code for break
14 flow.

15 DR. SCHROCK: There were no separate
16 effects tests involved in this kind of thing really,
17 huh?

18 MR. O'DELL: We would define all of those
19 just mentioned as separate effects tests.

20 DR. SCHROCK: Well, I wouldn't. For
21 example, Marviken is a blow down experiment, and the
22 credibility of the critical flow calculation depends
23 on the code's ability to calculate what is happening
24 in the vessel.

25 There are many, many controlled laboratory

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1 experiments, separate effects, that can be used as
2 well. But it has not been the practice in this
3 industry to do that. There are selected few tests
4 which are conventionally chosen, and the arguments are
5 that these are sufficient.

6 Nine tests to cover the full range of
7 critical flow phenomena is very sparse. Marviken had
8 more than nine tests.

9 MR. O'DELL: Again--

10 DR. SCHROCK: And that, together with the
11 other point that I made, that there is a wealth of
12 controlled laboratory separate effects experiments on
13 critical mass flow over a wide range of upstream
14 conditions, and conditions which exist throughout
15 parts of the transient in these reactors.

16 So what you have for assessment is
17 extremely sparse, and that is just one example.

18 MR. O'DELL: Well, I am not going to argue
19 that point.

20 DR. SCHROCK: Well, CSAU is not the place
21 where all these additional things need to be done, but
22 they have not been done at any level.

23 MR. O'DELL: Well, it has been the biggest
24 problem that we have had in this whole process, was
25 actually getting data, okay? Our original plan was to

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1 use a significantly larger number of the Marviken
2 tests.

3 We were able to get data for nine, okay?
4 It has been -- and as I indicated --

5 DR. SCHROCK: I know. It is a real world
6 problem. I understand that.

7 MR. O'DELL: Yes. Just trying to get this
8 information has impacted us from the very beginning of
9 this project, and all the way through, and has
10 basically delayed the project by significant amounts
11 of time, just because we didn't have enough data to in
12 fact feel like we could comfortably generate
13 uncertainties and things.

14 So I realize that there is a lot more data
15 out there, but it is a matter of getting the data, and
16 accumulating it, and we have started. We have got our
17 libraries built up in our own control system, data
18 management system that we have there at Framatome.

19 And as we get this data, we are
20 continually trying to get more of it, and we are
21 trying continually to enter it into our database and
22 build up a database so that future work will have the
23 data available when we start.

24 Right now, we are working at trying to get
25 some of the BWR data that is available out there to

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1 support our BWR project that is initiating this year.
2 And I have said that it is not an excuse. We are just
3 trying to get the data, and we use what we are able to
4 get our hands on.

5 CHAIRMAN WALLIS: Now, somebody later is
6 going to go through the results of this assessment
7 process?

8 MR. O'DELL: There will be some limited
9 comparisons in the assessments, and Gene Jensen will
10 present the integral effects test. And as I will
11 mention later, we use those integral effects tests to
12 first run them, and we then calculated biases from all
13 the other tests.

14 We reran the integral effects tests, and
15 the CCTF test, applying those biases to demonstrate
16 that those biases in fact moved the model as expected.

17 CHAIRMAN WALLIS: So someone is going to
18 explain this process of assessment later on today?

19 MR. O'DELL: Yes.

20 CHAIRMAN WALLIS: When I looked at the 200
21 plus figures in Section 4, and I don't quite know what
22 to conclude. And sometimes the comparisons are good,
23 and sometimes there are questions that one might have.

24 And I didn't quite know what to conclude
25 in general, and you are going to guide us, or someone

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1 is going to guide us through that?

2 MR. O'DELL: I don't think we are going to
3 go through every one of them in a high level of
4 detail.

5 CHAIRMAN WALLIS: Well, tell us how you
6 did this in the comparisons and assessments.

7 MR. O'DELL: Right.

8 CHAIRMAN WALLIS: And what criteria you
9 used and so on.

10 MR. O'DELL: Okay. Continuing on with the
11 assessment matrix, we used the Westinghouse EPRI one-
12 third scale nine test, and we looked at cold leg
13 condensation and interfacial heat transfer.

14 Again, we performed some of the CCFL tests
15 in our own mini-loop there at Framatome, where we
16 looked at the upper tie plate designs, and our own
17 specific upper tie plate designs for the different
18 types of plants that we were supporting.

19 We then looked at the multi-dimensional
20 flow, and these as I mentioned were Westinghouse
21 tests. We looked at three of these, and where we
22 looked at the performance of the code for predicting
23 the core flow distributions.

24 We looked at 14 tests in UPTF, and we
25 looked at ECCS bypass, and steam binding, and CCFL,

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1 and scalability, and nodalization. With CCTF, we
2 looked at those --

3 CHAIRMAN WALLIS: Four CCTFs, and UPTF, I
4 noticed the data was sort of on one line, and your
5 equation is on another, and it is not clear that the
6 comparison is very good, to make one statement about
7 it.

8 MR. O'DELL: And in fact they were fully
9 intended to be -- the selected parameters were fully
10 intended to be conservative from a CCFL perspective.
11 And the reason that we did that, and I will mention
12 that on one of the slides, is that we didn't have
13 sufficient information to determine what the actual
14 CCFL was on all of the different assessments.

15 So what we did is that we went and picked
16 a series of conservative ones, and then we ran these
17 tests, the CCFL tests, to demonstrate that they were
18 conservative for our fuel designs and we used that
19 consistently through that.

20 CHAIRMAN WALLIS: It is supposed to be a
21 realistic code, and not a conservative assessment
22 isn't it?

23 MR. O'DELL: I understand that, and I
24 would say that in some of the instances -- I mean, I
25 used the same sets of CCFL coefficients in all the

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1 assessments to generate my uncertainties and stuff,
2 all right?

3 And if I would have been able to generate
4 CCFL parameters, or add information for CCFL
5 parameters for all of the assessments, then I could
6 have used real information in all of the assessments,
7 and developed uncertainties.

8 But given that I couldn't do that, I felt
9 that the only approach that was actually defensible
10 was to choose conservative ones, and then demonstrate
11 that they were conservative, and use those throughout
12 the CSAU assessment.

13 CHAIRMAN WALLIS: That means that for a
14 bias in here that your values are always less than or
15 greater than the real one, instead of trying to model
16 the real one.

17 This has to be somehow reflected in your
18 statistical treatment of uncertainties later on then.
19 There is a bias in your CCFL for being somewhat on the
20 conservative side.

21 MR. O'DELL: They will be somewhat on the
22 conservative side. Now, we have not tried to try to
23 quantify that, or take any kind of credit for it, for
24 reducing PCTs. We just accepted that conservatism.

25 And I think when we get to Gene's

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1 presentation, you will see that the biases and stuff
2 that we did develop moved and improved the assessment
3 results as one would expect, but in general we can
4 still be somewhat to the high side.

5 MR. HOLM: Dr. Wallis, this is Jerry Holm.
6 I think this is an important point, because I think as
7 we mentioned in one of our previous meetings, we chose
8 the word realistic, trying to differentiate ourselves
9 from a true best estimate code.

10 We found that there are a number of
11 phenomena datasets that there just is not enough
12 information to develop models, and so for those we
13 tried to choose conservative models, and in the
14 presentation today, we will list where we had made
15 these decisions to not best estimate models like Larry
16 will state in his presentation later.

17 And to try and identify so that it is
18 clear where we are not best estimates. We need to
19 acknowledge that in our areas where there are not best
20 estimates.

21 MR. O'DELL: Okay. We ran four CCTF
22 tests, and steam binding, and again nodalization, and
23 scalability. With SCTF, we ran six tests, but we
24 actually only used the ones that confirmed our
25 nodalization.

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1 Again, that was primarily getting the data
2 late. We ran one ACHILLES test, and that is the
3 international standard problem number 25, where we
4 looked at the accumulator nitrogen discharge effects.

5 DR. SCHROCK: Do you have any separate
6 effects testing of the models in the code for this two
7 component case?

8 MR. O'DELL: Well, the two component case
9 was used, or the two component model was used
10 throughout the modeling on the UPTF. It was used to
11 model the UPTF downcomer, and upper plenum. So we
12 have used that model throughout these.

13 DR. SCHROCK: To react to this accumulator
14 discharge --

15 MR. O'DELL: There is no 2D model, and we
16 don't use a 2D model on the accumulator discharge.

17 DR. SCHROCK: And that is simply the
18 accumulator discharge into the primary system and not
19 its interaction within the primary system?

20 MR. O'DELL: Beyond the entrance point?

21 DR. SCHROCK: I just don't remember what
22 ACHILLES really involves. It is just simply the
23 blowdown of the accumulator?

24 MR. O'DELL: Right. It is simply a
25 blowdown of the accumulator, where they measure the

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1 effect of the nitrogen coming in, and what happens in
2 the core with respect to the temperatures and
3 predictions in the core.

4 DR. SCHROCK: It doesn't deal with the
5 role of the nitrogen in the primary system, and its
6 influence in the subsequent part of the transient when
7 the discharged containment involves two components,
8 and that is not modeled in that test?

9 MR. O'DELL: Well, it is modeled from the
10 standpoint that you have got the accumulator water
11 blowing down, and you blow down the nitrogen, right.

12 I mean, the ACHILLES test actually has the
13 nitrogen blowing down into the system, okay, blowing
14 down into the ACHILLES system. And we modeled that to
15 demonstrate the code's performance with respect to the
16 treatment of the nitrogen.

17 And as I previously indicated, we ran
18 integral effect tests for LOFT and semiscale. There
19 were four tests run, where we looked at overall code
20 performance, and nodalization, scalability, and
21 compensating errors.

22 Again, semi-scale, we ran two tests, and
23 one for the blow-down heat transfer, and the other one
24 for nodalization scalability and compensating errors.

25 Overall, we looked at like 15 separate

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1 effect facilities, and 130 tests; and two integral
2 effect facilities, and two IET facilities, and 6 tests
3 evaluated.

4 CHAIRMAN WALLIS: Well, I think you can
5 look at the first three of those -- the scalability,
6 nodalization, and overall code performance; but I
7 don't know quite how you would assess compensation
8 errors.

9 You can say that we didn't find anything
10 that was a clue that indicated that there might be.

11 MR. O'DELL: Right.

12 CHAIRMAN WALLIS: It didn't see this sort
13 of strange performance where it did a good job here,
14 and not a good job there, and we couldn't explain why
15 or something. But it is difficult to really pin down
16 whether or not you have compensating error.

17 MR. O'DELL: No, and that's exactly right,
18 and I don't think that any of us here is going to take
19 the position that there are no compensating errors in
20 the code.

21 CHAIRMAN WALLIS: You have sort of an
22 awareness that you are looking for the signs that
23 there might be something.

24 MR. O'DELL: Exactly. Moving now to CSAU
25 Step 8. This deals with the nodalization, and we

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1 selected a common nodalization for use in the SET
2 effects and IET effects, and plant analysis.

3 The nodalization has to be selected to
4 preserve the dominant phenomena, and minimize the code
5 uncertainty, support the NPP design characteristics,
6 but at the same point in time it has to remain
7 economical.

8 You have to be able to run a significant
9 number of calculations with that code in a reasonable
10 period of time. If you can't do that, then you can't
11 respond to plant questions, et cetera, and in order to
12 support a plant, you have to be able to run it in a
13 reasonable period of time.

14 CHAIRMAN WALLIS: Well, to minimize code
15 uncertainty is -- well, how do you show that you have
16 done that?

17 MR. O'DELL: Well, what I really mean
18 there when I say minimize code uncertainty is to
19 minimize the code numerical uncertainty. As you will
20 see when you look at the thing, we did a series of --
21 if you look at the submittals, we did a series of time
22 studies with the code, where we actually went in and
23 varied the time steps, and ran a series of cases, and
24 looked at how the range varied in the results.

25 And what I am saying is what we are trying

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1 to minimize here is that numerical uncertainty by
2 choosing the nodalization approach that in fact does
3 minimize that.

4 CHAIRMAN WALLIS: So there is a way to
5 minimize that? If you have, say, one unfamiliar of an
6 uncertainty, and a zillion node elements adding up to
7 some optimum number of nodes that minimizes the
8 uncertainty.

9 MR. O'DELL: Well, I am not going to say
10 there is a optimum number of nodes, okay? One of the
11 things that we found, and as you look through it, you
12 will see in UPTF that we did a nodalization study on
13 the lower plenum, okay?

14 And what we found is that if we used a 2-D
15 component down there, we improved our results compared
16 to the assessment, but what we did is that we hurt the
17 prediction of the code uncertainty in this time step
18 study, all right?

19 So what that told us is that by going to
20 that level, and to an increasing level of complication
21 in the lower plenum, it actually didn't help us in
22 regard to this particular piece of it.

23 I mean, it is a balancing act, and that's
24 why I think Dr. Schrock's comments on these guidelines
25 are very important, because we have to state how we

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1 are going to apply the code.

2 And if we don't state that, then we don't
3 minimize things like the code to uncertainty. We
4 don't control those. The process we followed was to
5 start off I think, and previously referred to as
6 tribal knowledge, but we developed our initial
7 nodalization on previous industry and Framatome-ANP
8 experience.

9 We then ran a series of sensitivity
10 studies using the plant models, where we revised this
11 initial nodalization. We then held a peer review
12 again, including Framatome and outside consultants,
13 and where we looked at the nodalization and developed
14 again some revisions to that nodalization.

15 And the final nodalization that we came up
16 with was validated and refined based on the
17 performance of the actual SET and IET assessments,
18 with heavy emphasis on UPTF, and SETF, and CCTF, and
19 FLECHT-SEASET, LOFT, and semiscale.

20 The key features of this nodalization and
21 where it was primarily different than what we have
22 done in the past involved the use of the two
23 dimensional component, and the downcomer core and
24 upper plenum regions.

25 CHAIRMAN WALLIS: Are you going to become

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1 proprietary at this point?

2 MR. HOLM: Yes, I was just going to
3 mention that. This is the last of the nonproprietary
4 information.

5 CHAIRMAN WALLIS: Would this be a good
6 time to take a break?

7 MR. HOLM: Yes.

8 MR. O'DELL: Well, it definitely works for
9 me.

10 CHAIRMAN WALLIS: I am very impressed with
11 your resilience and ability to keep going in spite of
12 all of our interruptions.

13 MR. O'DELL: Thank you.

14 CHAIRMAN WALLIS: Just to check, are we
15 running behind here? I don't see a schedule of
16 timing, but is this supposed to be for most of the
17 morning?

18 MR. HOLM: This is Jerry Holm. I think we
19 are in reasonable shape. I would like Larry to finish
20 number 11, I think.

21 CHAIRMAN WALLIS: So we have another
22 speaker before lunch?

23 MR. HOLM: Yes.

24 CHAIRMAN WALLIS: And so let's take a
25 break, and I think it would be good if we came back

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1 here at 20 minutes before 11:00. Is that adequate for
2 everybody? So we will take a break until then.

3 (Whereupon, the open hearing was recessed
4 at 10:30 a.m.)
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CERTIFICATE

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

Name of Proceeding: ACRS Thermal Hydraulic

Phenomena Subcommittee

Docket Number: (Not Applicable)

Location: Rockville, Maryland

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



Pippa Antonio
Official Reporter
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