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NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS**

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

AUGUST 8, 2000

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This transcript had not been reviewed, corrected and edited and it may contain inaccuracies.

1 UNITED STATES OF AMERICA  
2 NUCLEAR REGULATORY COMMISSION

3 \*\*\*

4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 \*\*\*

6 THERMAL-HYDRAULIC PHENOMENA SUBCOMMITTEE MEETING

7 SIEMENS S-RELAP5 CODE FOR

8 APPENDIX K SBLOCA ANALYSIS

9 \*\*\*

10 Public Meeting

11 \*\*\*

12 Nuclear Regulatory Commission

13 Room T2-B3

14 Two White Flint North

15 11545 Rockville Pike

16 Rockville, Maryland

17  
18 Tuesday, August 8, 2000

19  
20 The above-entitled proceedings commenced at 8:30  
21 a.m., pursuant to notice, the HONORABLE GRAHAM WALLIS,  
22 Chairman, presiding.  
23  
24  
25

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1 ACRS COMMITTEE:

2

3 DR. GRAHAM WALLIS

4 DR. DANA POWERS

5 DR. THOMAS KRESS

6 DR. ROBERT SEALE

7

8

9 APPEARANCES:

10

11 DR. NOVAK ZUBER

12 MR. PAUL BOEHNERT

13 MR. JERRY HOLM

14 MR. LARRY O'DELL

15 MR. KEN CARLSON

16 MR. JOE KELLY

17 MR. R. LANDRY

18 MR. JIM MALLAY

19 DR. CHOW

20 MR. GENE JENSEN

21 MR. KEN GREENE

22

23

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

[8:30 a.m.]

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

ACRS members in attendance are Drs. Tom Kress, Dana Powers and Robert Seale, and we expect the arrival of consultant Novak Zuber.

The purpose of this meeting is for the subcommittee to begin review of the Siemens Power Corporation S-RELAP5 thermal-hydraulic systems code. The subcommittee will gather information, analyze relevant issues and facts, formulate and propose positions and actions as appropriate for deliberation by the full committee. I should also add that the committee will ask a lot of relevant questions.

Mr. Paul 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 July 13, 2000.

Most of this meeting will be closed to the public to discuss information considered proprietary to the Siemens Power Corporation.

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1           A transcript of that is meeting is being kept and  
2 the open portions of this transcript will be made available,  
3 as stated in the Federal Register Notice.

4           It is requested that speakers first identify  
5 themselves and speak with sufficient clarity and volume so  
6 that they can be readily heard. Clarity in this context  
7 includes clarity of exposition.

8           We have received no written comments or requests  
9 for time to make oral statements from members of the public.

10          Now, I think this is an important meeting, these  
11 codes are what we rely on to make predictions for reactors  
12 that have never been tested under the conditions that are  
13 predicted in the codes. So we are really looking forward to  
14 today.

15          The committee is much less familiar with the code  
16 that Siemens folks, so we are going to have ask a lot of  
17 questions in order to clear things up for ourselves. We are  
18 looking forward to your presentation. Please go ahead.

19          MR. HOLM: Good morning, my name is Jerry Holm, I  
20 am Manager, PWR Product Licensing for Siemens, and the  
21 purpose of today's and tomorrow's presentation is to discuss  
22 the Siemens S-RELAP5 code for PWR Appendix K Small Break  
23 LOCA Analysis. I am going to talk about the agenda and  
24 Siemens' future use of the code S-RELAP5.

25          I will talk about -- I have got two pages for the

1 agenda, the first for Tuesday and the second for Wednesday.  
2 We have readjusted the agenda a little bit from what we  
3 presented to you before based on our preparation and what we  
4 thought made the most sense for the actual sequence. We  
5 have the same information but in a slightly different order.

6           Leading us off today after my discussion of the  
7 agenda is going to be Larry O'Dell, who is going to talk  
8 about the development process and history of S-RELAP5 at  
9 Siemens. Larry is also going to talk about the code control  
10 process and the application control process, or how we  
11 control the use of the code at Siemens. These last two  
12 items have been a topic of discussion at the ACRS before.  
13 My discussion and Larry O'Dell's are in the vein of  
14 background information.

15           After Larry is going to be S-RELAP5 code  
16 conservation equations. Joe Kelly is going to give that  
17 presentation.

18           CHAIRMAN WALLIS: I can't believe he is going to  
19 take four-and-a-half hours. There are, what, four  
20 principles involved? In half-an-hour he should be able to  
21 do that. So he had better move along. Really, seriously.

22           MR. HOLM: We can certainly adjust the pace of the  
23 presentation depending on the level of questions.

24           CHAIRMAN WALLIS: It is going to be agony if we go  
25 through every -- we go at that speed.

1 MR. HOLM: Okay.

2 CHAIRMAN WALLIS: I want to see how they are used,  
3 and I think we have to get on to the constitutive equations,  
4 and I would like to move also to the solution methods.

5 MR. HOLM: Okay.

6 CHAIRMAN WALLIS: If he can possibly do that,  
7 because it is all one package.

8 MR. HOLM: Okay.

9 CHAIRMAN WALLIS: We have to understand the whole  
10 thing, not just the beginning.

11 MR. HOLM: Okay. As Joe goes through his  
12 presentation and we see how your questions are, maybe we can  
13 speed that part of it up then.

14 CHAIRMAN WALLIS: Well, maybe there is a problem  
15 with the conservation equations if you are going to take so  
16 long.

17 MR. HOLM: I don't believe so.

18 CHAIRMAN WALLIS: Okay. Thank you.

19 MR. HOLM: Okay. One comment I had is I would  
20 like to structure the presentation such that while Joe is  
21 giving his talk, we keep our questions to the material he is  
22 presenting. I know we have submitted to you a topical  
23 report and a lot of supporting information. If we could  
24 hold questions that you have developed from that area to  
25 this block of time on the agenda. If you have got a lot of

1 questions, perhaps we can expand the time.

2 CHAIRMAN WALLIS: I don't think we can do that. I  
3 think we are going to ask questions as they come up.

4 MR. HOLM: As they come.

5 CHAIRMAN WALLIS: Yes, I think so.

6 DR. SEALE: We are terribly undisciplined.

7 CHAIRMAN WALLIS: I think that is the most  
8 efficient way to proceed.

9 DR. SEALE: I was teasing.

10 CHAIRMAN WALLIS: Otherwise, you know, while you  
11 are still trying to resolve one issue, it is appropriate to  
12 ask the questions about that. Otherwise, you lose the  
13 continuity otherwise.

14 MR. HOLM: If we can make keep them as directly  
15 related to the presentation.

16 CHAIRMAN WALLIS: We won't get him off track. We  
17 will try not to get him off track.

18 MR. HOLM: Okay. That is the main point. The  
19 plan then is after Joe's presentation we will go into issues  
20 that are more directly related to the Appendix K small break  
21 LOCA use of the code. Ken Carlson is going to be presenting  
22 that part, and he has got about four main portions to his  
23 presentation, and the schedule shows he will go over the  
24 background of the methodology at the end of today.

25 And then on Wednesday, Ken Carlson again will talk

1 about the Appendix K small break LOCA methodology itself.  
2 We will start off with a short discussion of the important  
3 small break LOCA processes, go into the constitutive models  
4 and then go into the small break LOCA assessments that we  
5 have done on the code.

6 CHAIRMAN WALLIS: I have a question for you. We  
7 got a lot of paperwork, we got a whole box full of  
8 paperwork, and some of us read enough of it to have  
9 questions about it. Now, if we look at something like say  
10 the programmer's guide, are we ever going to get a chance to  
11 ask questions about that? I think it would be good if we  
12 had some spare time at the end when we can perhaps visit  
13 some of these other questions which have come up in our  
14 reading that you may be wishing to address, but sometime we  
15 would like to have some answers.

16 MR. HOLM: Okay.

17 CHAIRMAN WALLIS: Unless there is some other time  
18 we are going to meet to discuss them or some other process.

19 MR. HOLM: The way I had scheduled it is to try to  
20 do that at this period, but perhaps the 30 minutes needs to  
21 be expanded a bit.

22 CHAIRMAN WALLIS: My experience is the ACRS  
23 questions last about as long as the presentations.

24 MR. HOLM: Okay. We have brought a number of  
25 additional people today who I was going to introduce, who

1 hopefully will be able to answer questions that we haven't  
2 made a presentation for. Just going through their names, we  
3 have --

4 CHAIRMAN WALLIS: That is where the good, the  
5 straight answers.

6 MR. HOLM: We have Jim Mallay, who is Director of  
7 Regulatory Affairs for Siemens; Dr. Chow, who is one of the  
8 co-developers for S-RELAP5; Gene Jensen and Ken Greene.  
9 Okay. And while they aren't going to be presenting, they  
10 will be available to answer questions.

11 And the last introductory slide I have is to just  
12 give a picture of our vision of the use of S-RELAP5 at  
13 Siemens. S-RELAP5 was actually developed as part of our  
14 realistic large break LOCA methodology development program,  
15 and we used the word "realistic" rather than "best estimate"  
16 for the code. This effort is --

17 CHAIRMAN WALLIS: In a previous meeting we were  
18 told it was an evaluation model, not a best estimate code.

19 MR. HOLM: For the topical reports that we have  
20 submitted now, which is small break LOCA, this is an  
21 Appendix K use of the code, and we have thrust our  
22 presentation today first to talk about the conservation  
23 equations in S-RELAP5, which are basically applicable to all  
24 the uses of the code, but then we have cast the rest of the  
25 presentation specific to its use for small break LOCA and as

1 an Appendix K model.

2 CHAIRMAN WALLIS: You want it to evolve to be a  
3 realistic model?

4 MR. HOLM: Yes. Though the sequence, as I think  
5 Larry will talk about, is that we developed it to be a  
6 realistic model, but our first submittal of it is for an  
7 Appendix K application. And then we have also got a second  
8 topical under review right now to use it for non-LOCA  
9 methodology.

10 CHAIRMAN WALLIS: It is sort of hard for me,  
11 reading the documentation, to tell whether it is Appendix K  
12 or a realistic model.

13 MR. HOLM: The submittal, what we submitted as a  
14 topical report, is a description of the methodology and the  
15 assessment of the report for small break LOCA. And then at  
16 the request of the NRC, we submitted some additional  
17 information that in the past we haven't normally submitted,  
18 which is the S-RELAP5 correlations and models document,  
19 programmer's manual and user's manual. Those three  
20 documents were actually developed as part of the realistic  
21 LOCA program and, since they form of basis of it, were done  
22 before the completion of that program.

23 Our decision to use S-RELAP5 for these other uses  
24 is a recent one, probably in the last three years we made  
25 the decision that we were going to move to one code. And

1 then as part of that decision, we also made the decision  
2 that we would, after finishing it for the large break LOCA  
3 work this year, we would then in the future go on to  
4 developing and assessing the code for BWR applications.

5 The motivation behind this vision is I would say  
6 twofold, one, quality and, two, efficiency. By focusing our  
7 efforts on assessments and development for one code, we  
8 think we can do a better job than if we focus it on three or  
9 four codes.

10 With that, I will turn it over to Larry O'Dell.

11 CHAIRMAN WALLIS: Thank you very much.

12 MR. HOLM: You're welcome.

13 CHAIRMAN WALLIS: Before you start, why is the  
14 history important? When we read the documentation, we don't  
15 really know the history, we just evaluate the documentation  
16 as we see it.

17 MR. O'DELL: I think the only reason for providing  
18 the history is to try to make the relationship between  
19 S-RELAP5 code and particular the RELAP5 Mod 2 code and  
20 RELAP5 Mod 3, because there is a connection between those  
21 codes.

22 CHAIRMAN WALLIS: I think we need -- if you could  
23 tell us the most important things we need to know, because I  
24 am trying to grapple with the question of why the history  
25 matters. In our assessment we haven't -- I don't know what

1 my colleagues feel, I have certainly haven't taken much  
2 account of history. I don't want to have to dig into  
3 history in order to figure out why something is in the code.

4 MR. O'DELL: No, and I don't think that that is  
5 the intent here at all. I think the intent here is to  
6 simply build the relationship between S-RELAP5 and the other  
7 codes.

8 CHAIRMAN WALLIS: It has parents and grandparents.

9 MR. O'DELL: Right. And I think the other part of  
10 the presentation is, at least in looking at previous  
11 transcripts of the ACRS, there was an interest in, you know,  
12 what is a "frozen code" version and how do you define it.  
13 And I want to make sure that we are all on the same  
14 wavelength.

15 CHAIRMAN WALLIS: It is a bit like Henry VIII, to  
16 evaluate him, we don't go back to William the Conqueror.

17 MR. O'DELL: Exactly. Exactly.

18 Okay. As Jerry indicated, I am Larry O'Dell,  
19 Manager of U.S. and Far East Research and Technical. I have  
20 got three items on introduction agenda. One of them is the  
21 S-RELAP5 development process and history, and, as I  
22 indicated, the intent here is to show the connection between  
23 the S-RELAP5 code, the RELAP5 Mod 2 code, and RELAP5 Mod 3,  
24 then briefly I wanted to go through the code control process  
25 that is followed at SPC for controlling the development of

1 codes, and then go through the application control process  
2 as to how the applications of those codes is controlled.

3 As I indicated, the objective here is to provide a  
4 common understanding of the S-RELAP5 code development  
5 process and to demonstrate the relationship between S-RELAP5  
6 and the other RELAP5 code versions.

7 CHAIRMAN WALLIS: Did SPC develop S-RELAP5 or did  
8 they send it out to be done by some contractor?

9 MR. O'DELL: No, we developed it in-house from the  
10 RELAP5 Mod 2 version.

11 CHAIRMAN WALLIS: Thank you.

12 MR. O'DELL: And this is the only reason unrelated  
13 history slide. We did start with RELAP5, in early 1981 we  
14 obtained RELAP5 Mod 1, Cycle 25 from INEL. The initial  
15 application of that was to the main steamline break  
16 analysis. We did modify that version of the code to address  
17 the now specific requirements, and there was a NRC submittal  
18 made in 1984.

19 We then switched from basically Mod 1 to RELAP5  
20 Mod 2, Cycle 36.02. We obtained that version of the code  
21 from INEL in 1985. The initial application of that code was  
22 a small break LOCA analysis, and, again, we modified the  
23 code to address the analysis-specific requirements and,  
24 following those modifications, we renamed the code to  
25 ANF-RELAP.

1           We received a SER for the small break LOCA in  
2 1988. We then moved the main steamline break methodology to  
3 ANF-RELAP. Again, we modified the code to address  
4 analysis-specific requirements, we moved those modifications  
5 from Mod 1 to Mod 2 and received a SER in 1988.

6           We then applied the code ANF-RELAP to the non-LOCA  
7 transients and received a SER in 1992 for that methodology.

8           Now, the process that has been followed at SPC is  
9 we received the code in the base code and associated models  
10 were developed at INEL. Significant code benchmarking had  
11 been performed by a large number of different organizations  
12 on various code versions. We accepted the base code and  
13 associated models when the code versions were first brought  
14 into house. By that I mean we did not perform at that time  
15 any model-by-model verification or validation process.

16           The initial SPC code changes primarily were driven  
17 by licensing requirement for analysis of interest, main  
18 steamline break and small break LOCA, and acceptability of  
19 the code was demonstrated by comparison to integral test  
20 facilities, and we believe that that approach was consistent  
21 with the licensing expectations at that time, as  
22 demonstrated by the TMI action items.

23           The S-RELAP5 development was initiated from the  
24 ANF-RELAP for the PWR realistic large break LOCA project, as  
25 Jerry indicated. And as he also indicated, the current two

1 topical reports, one for the non-LOCA methodology and one  
2 for the Appendix K small break methodology of the code -- or  
3 the methodologies asked are under review.

4 The S-RELAP5 code verification was been performed  
5 where we would define verification as the process of  
6 ensuring that the coding and the documentation are  
7 consistent. We have gone through that process.

8 CHAIRMAN WALLIS: You mean the typos in the  
9 documentation are duplicated in the coding?

10 MR. O'DELL: I would not mean that. I would mean  
11 that the models that are indicated in the coding, I believe  
12 are consistent with the models that are in the codes. So  
13 the code and the documentation have the same models.

14 CHAIRMAN WALLIS: I don't think this committee has  
15 ever looked at the code, but we do look at typed equations,  
16 and typos do occur. So, we always wonder what happens in  
17 the real code.

18 MR. O'DELL: Well, I would hope that those typos  
19 aren't in the real code, and I don't believe they are.

20 The verification process identified models which  
21 deviated from the original model correlation references.  
22 Some of the models were modified to be consistent with the  
23 original references, some were not. The decision here was  
24 based on results of assessment calculations that are  
25 performed with the code. The current code documentation we

1 believe is consistent with the code.

2 CHAIRMAN WALLIS: How do you make sure the code is  
3 consistent with documentation? Someone goes not line by  
4 line, but syllable by syllable.

5 MR. O'DELL: Well, they basically go into the  
6 code, what we did here is we used both our in-house staff,  
7 people from Duke Engineering Services, some people from INEL  
8 to look at the various models within the code. They took  
9 the documentation. They went and looked at the way the  
10 coding was inside the code and did the check against --

11 CHAIRMAN WALLIS: Checked off every line then.

12 MR. O'DELL: Well, yes, for each of the major  
13 models and stuff in the code.

14 CHAIRMAN WALLIS: Are we ever going to look at  
15 those lines of coding? Is there a chance to do that?

16 MR. O'DELL: I believe the NRC has the code.

17 CHAIRMAN WALLIS: I would hate to have to do that,  
18 but it would be interesting to do a spot check.

19 MR. O'DELL: I wouldn't want to do it either. The  
20 code validation has been performed in support of the code  
21 development process. We have what we call a standard code  
22 test suite, it is developed and maintained so as we move  
23 from one version of the code to the next, that test suite  
24 continues to be run. It is composed of both integral and  
25 separate effects tests.

1           The test suite for S-RELAP5 was developed to  
2 support the realistic large break LOCA project. It includes  
3 tests from LOFT, FLECHT/SEASET, CCTF, UPTF, THTF, Marviken,  
4 GE Level Swell test, MIT Pressurizer test and Bennett Tube  
5 tests.

6           CHAIRMAN WALLIS: Was someone going to tell us  
7 about the philosophy here? One philosophy is to simply say,  
8 here is what available, we will run the code. The other  
9 thing to do is say, here are features of the code we need to  
10 test, and then say that this test is specifically used for  
11 testing this feature of the code, and so on. That is a more  
12 systematic approach. When I looked at the various documents  
13 submitted, I used that approach. I said, look at this test,  
14 what does it actually really challenge the code to do? And  
15 I would hope that sometime you might tell us that in the  
16 next two days.

17           Some of these tests really don't challenge the  
18 code at all. Some of the challenge it much more. And I  
19 think you should be aware of that when you making the  
20 comparisons.

21           MR. O'DELL: Well, and that is exactly true. What  
22 we have done in the realistic LOCA project, we have put  
23 together a very significant test matrix, okay, where we have  
24 gone in and said, okay, this is what -- we have tried to go  
25 through and say this is what we need to test, these are the

1 tests that are available that we can get information and  
2 run. And we have tried to go out and get that data which is  
3 in and of itself time-consuming, as it turns out, and not  
4 easy to do.

5 CHAIRMAN WALLIS: That is what should be said. I  
6 mean if there is a real shortage of tests to test some  
7 particular part of the code, that should be pointed out, not  
8 covered up in some way. Maybe the NRC are the ones who want  
9 to be aware of that. And I think you as professionals also  
10 have to be aware of that, you know, sort of stick your neck  
11 out if you have something in the code which has not really  
12 been tested.

13 MR. O'DELL: I understand. Again, outside of the  
14 realistic LOCA project, though, SPC has continued to rely  
15 primarily on integral assessments for the non-realistic  
16 methodology validation.

17 CHAIRMAN WALLIS: Non-realistic is a very  
18 interesting adjective.

19 [Laughter.]

20 MR. O'DELL: I would agree, okay. Not the best  
21 choice of words.

22 CHAIRMAN WALLIS: That is the kind consultants  
23 might use.

24 MR. O'DELL: Yes. For a conservative methodology.  
25 Both the current non-LOCA and small break LOCA

1 submittals are not realistic or best estimate methodology  
2 with no associated need to quantify uncertainties. The  
3 current submittals rely on the demonstration that the  
4 overall methodology is conservative, where methodology is  
5 defined as the combination of code and specific code model  
6 selection, plant nodalization and associated application  
7 process with clearly identified conservatisms.

8 CHAIRMAN WALLIS: That is, of course, difficult.  
9 I mean if you take some conservation principle and apply it  
10 to some control volume and make assumptions, I have not the  
11 slightest idea how you know if those are conservative or  
12 not.

13 MR. O'DELL: Well, when I am talking about  
14 conservatisms here, I am primarily talking about biases and  
15 stuff that are required by the Standard Review Plan.

16 CHAIRMAN WALLIS: When you start putting in -- you  
17 know, every time you make an engineering model, you make  
18 assumptions, and they introduce biases.

19 MR. O'DELL: And that is where we go and look at  
20 the integral assessments, again with the goal of looking at  
21 how does the code predict the data, is it predicting it  
22 conservatively?

23 CHAIRMAN WALLIS: Oh, so, your conservative is in  
24 some of integral way when you compare with data, it is not,  
25 you know, each assumption.

1 MR. O'DELL: Exactly.

2 CHAIRMAN WALLIS: This is biased in conservative  
3 way.

4 MR. O'DELL: Exactly.

5 CHAIRMAN WALLIS: So, therefore, it is only  
6 conservative for a particular application. If used for  
7 something else, it might well not be conservative.

8 MR. O'DELL: That's correct.

9 CHAIRMAN WALLIS: That is correct. Thank you.

10 MR. O'DELL: The code changes that were  
11 implemented to create ANF-RELAP from RELAP5 Mod 2 consisted  
12 of the addition of the Moody critical flow model, the  
13 Appendix K requirement. There were changes made to the heat  
14 transfer and CHF correlations. A new mixture level model  
15 was added. Again, this was in response to the small break  
16 LOCA review process on the original methodology. A new CCFL  
17 model was installed, and the Baker-Just metal-water reaction  
18 rate correlation was installed in the code.

19 CHAIRMAN WALLIS: I am trying to remember if this  
20 is the code which has the Baker-Just model with the  
21 exponent, the wrong sign, so that everything goes the wrong  
22 way. Maybe we will get to it. I think it is.

23 MR. O'DELL: Okay. I would look at Dr. Chow for  
24 that, I am afraid.

25 CHAIRMAN WALLIS: It is one of those typos.

1 MR. O'DELL: Okay. Again, the changes that were  
2 made to ANF-RELAP for the non-LOCA and steamline break  
3 transients was to extend the Biasi CHF correlation to the  
4 steam generator secondary and the Moody model for breakflow  
5 was modified to get steam-only flow out the break. These  
6 two changes related to the steamline break and there were no  
7 specific changes made for the non-LOCA transients.

8 CHAIRMAN WALLIS: So these are somewhat cosmetic  
9 changes really?

10 MR. O'DELL: Yes.

11 CHAIRMAN WALLIS: Or do they make a big  
12 difference?

13 MR. O'DELL: Pardon?

14 CHAIRMAN WALLIS: Do they make a big difference  
15 for some transients?

16 MR. O'DELL: I don't think they made any large  
17 differences. A good part of them were, particularly, the  
18 Moody, the Baker-Just, et cetera, are things that were  
19 required in order to meet the licensing requirements with  
20 the model.

21 And then the code changes that were added to  
22 ANF-RELAP to create S-RELAP5 include the multi-dimensional  
23 capability. We added the two-dimensional capability to the  
24 code. We reformulated the energy conservation equations to  
25 reduce the energy errors. The numerical solution of the

1 hydrodynamic field equations were modified. The state of  
2 steam non-condensable mixture was modified. This was to get  
3 around code failures when the nitrogen came out of the  
4 accumulators. The hydrodynamic constitutive models were  
5 modified. There were modifications made to the heat  
6 transfer models, choked flow model. Counter-current flow  
7 limiting correlation was replaced again. The component  
8 models were modified and there was new fuel models added.  
9 The fuel models consisted of approved ROD X-2 code, is a  
10 conservative fuel design code and a best estimate ROD X-3  
11 code.

12 And we did incorporate some models directly from  
13 RELAP5 Mod 3. The code structure of S-RELAP5 was modified  
14 for code portability, very similar now to the structure of  
15 RELAP5 Mod 3, and we incorporated the reactor kinetics  
16 package, control systems and trip systems for RELAP5 Mod 3  
17 and to S-RELAP5.

18 In summary then, from this part of the  
19 presentation, I have believe I have shown the relationship  
20 of S-RELAP5 code to both RELAP5 Mod 2 and to Mod 3 and the  
21 development process that has been followed at SPC for the  
22 S-RELAP5 has been described.

23 CHAIRMAN WALLIS: At this point we have nothing to  
24 evaluate until we see what you actually did.

25 MR. O'DELL: That would be correct. Yeah, this is

1 just again an overview process to provide you the  
2 background.

3 The next part of my presentation will deal with  
4 the code control process. The objective here is to  
5 demonstrate that SPC's code control process is consistent  
6 with current software standards and QA practices, and to  
7 define SPC's interpretation of a "frozen code" version.

8 Again, our control processes are documented in  
9 EMF-1928, which is the "Engineering/Research and Technology  
10 Work Practices." Specifically, it is Work Practice 104,  
11 121. The basis for the approach is the NUREG/BR-0167, the  
12 ASME standard on requirements for computer software in  
13 nuclear facilities, and two ANS standards, one on  
14 documentation and the other on guideline for verification  
15 and validation of scientific codes.

16 CHAIRMAN WALLIS: Do these requirements require  
17 that someone who signs the document read it?

18 MR. O'DELL: Yes.

19 CHAIRMAN WALLIS: Because one of these documents,  
20 I was tempted to say that -- I did, I wrote it down, but I  
21 am not going to say exactly what I wrote down. It was  
22 signed by several people, but I thought I found a lot of  
23 typos in the equations, and I just wondered how that  
24 happened. Maybe we should get to it. But that should be  
25 one of the things that shouldn't happen.

1 MR. O'DELL: Well, I would agree with that.

2 CHAIRMAN WALLIS: Maybe I am wrong, it is just  
3 that if I read it, six people who knew what they were doing  
4 read it, they would presumably have caught this long before  
5 I did, if they are typos. Maybe we need to clarify that at  
6 some point.

7 MR. O'DELL: Yes. And I think as we go through  
8 the models and stuff, hopefully, we will get to that.

9 Within our control systems we have what we call a  
10 USE code classification. These are codes with broad  
11 applicability for use in product design and engineering  
12 calculations, and they are documented in what we call a  
13 software development record. And these include mechanical,  
14 neutronic and safety analysis or thermal-hydraulic codes.

15 We believe the USE code classification meets the  
16 "frozen code" version. It is documented in theory,  
17 programmer's and user's manuals. There is verification and  
18 validation performed on those. A formal QA review is  
19 performed, a formal release to engineering application  
20 organizations, and the code is then stored in our Code  
21 Management System, or CMS system, in a read-only format. It  
22 ensures the use of the latest code version and it  
23 automatically archives the code so that you can retrieve it  
24 at any point in time in the future.

25 CHAIRMAN WALLIS: Now, the way in which the

1 scientific and engineering developments are often given QA  
2 is by publication, and they are out in the world and anybody  
3 reads them. And I think one trouble with the codes is they  
4 are proprietary, so that they are not out there in the  
5 world, so you don't have the kind of exposure that lets you  
6 get feedback that might be helpful about things like  
7 confusing definitions or typos or whatever. So you have to  
8 do an especially good job yourselves.

9 MR. O'DELL: Well, and I believe we attempt to do  
10 that with respect to the code from the standpoint that we do  
11 have formal processes. There is an entirely independent  
12 review done.

13 CHAIRMAN WALLIS: So you pay some consultant or  
14 someone to check this thing out?

15 MR. O'DELL: We have used consultants in the past,  
16 and we have done it inside.

17 CHAIRMAN WALLIS: Withhold their payment until it  
18 goes by the ACRS?

19 [Laughter.]

20 MR. O'DELL: Well, that is something we hadn't  
21 thought of. It might not be a bad idea, though. I don't  
22 know how many takers we would get on that, though, that is  
23 what worries me.

24 CHAIRMAN WALLIS: Well, you should get many that  
25 are capable people.

1 MR. O'DELL: Well, most of them work for dollars,  
2 you know. If it doesn't come in and they have to wait for  
3 it, they may not appreciate that.

4 The software development record documents the  
5 development of a new USE code version, identifies the parent  
6 USE code version, contains the references. A software  
7 quality assurance plan is to put together at the initiation  
8 of the project. Software requirement specification, and,  
9 again, both the quality assurance plan and the software  
10 requirements specification involve the applications people  
11 to make sure that the final product will meet their  
12 requirements.

13 There is also the design, software design  
14 description which is we believe contained in the theory or  
15 models and correlations document, and the programmer's  
16 manual and user's manual. There is a software verification  
17 and validation plan put together that states what the  
18 requirements are from the -- you know, actually how well it  
19 has to compare to the transients or the assessments.

20 Then there is a software verification and  
21 validation results report that is put out. Again, any of  
22 these two things would aim at the standard test suite of  
23 cases for the code, plus any additional tests that have to  
24 incorporated to address the model changes.

25 There is independent quality assurance review

1 performed, and then a final code released to applications.  
2 And should there be any restrictions that come out of this  
3 process, that is included in the code release to  
4 applications.

5 Okay. In summary of this then, I believe I have  
6 described the SPC process for controlling the code  
7 development, provided a definition and described the  
8 required documentation for a USE code, and we believe the  
9 USE code classification meets the "frozen code" version.

10 CHAIRMAN WALLIS: Now, this code is developed over  
11 how many years?

12 MR. O'DELL: Well, --

13 CHAIRMAN WALLIS: Not going back to RELAP. I mean  
14 you mentioned 1980s and so on. But what we are looking at  
15 today, with its modifications and all the checks you have  
16 just described, has been done in, what, in the last five  
17 years or something?

18 MR. O'DELL: No, it has been longer than that.

19 CHAIRMAN WALLIS: So some memory has been lost, I  
20 mean someone may have developed something and then left the  
21 company, and someone else has to figure out what he did.

22 MR. O'DELL: I think almost all of the development  
23 on this code has been done by Dr. Chow.

24 CHAIRMAN WALLIS: So we still have the same  
25 people?

1 MR. O'DELL: Yes. Okay. And my final topic was  
2 the application control process. The objective here is  
3 define SPC's approach for controlling how a specific  
4 licensing analysis is performed. This includes the  
5 development of the code input decks, the plant nodalization,  
6 et cetera, selection of the code options, and compliance  
7 with approved methodology and associated SER restrictions on  
8 that methodology.

9 CHAIRMAN WALLIS: You select the code options on  
10 what basis?

11 MR. O'DELL: The code option selection comes about  
12 from the methodology development process and in these  
13 particular cases would be based on the requirement of trying  
14 to demonstrate conservative performance of the code on the  
15 assessments.

16 CHAIRMAN WALLIS: So in that case, you would take  
17 the least beneficial options and see how they did?

18 MR. O'DELL: I wouldn't say the least beneficial  
19 option, because the least beneficial option --

20 CHAIRMAN WALLIS: Conservative.

21 MR. O'DELL: It may be conservative.

22 CHAIRMAN WALLIS: Make the worst assumptions and  
23 see what happened.

24 MR. O'DELL: I would agree with that. On the  
25 other hand, you would like to at least be able to pick up

1 the trends and stuff in the assessments, okay. And if you  
2 go through a process where you take nothing but the worst  
3 combinations of everything, then you do a very poor job of  
4 predicting.

5 CHAIRMAN WALLIS: Yeah. Maybe we will get to that  
6 when we talk to someone else. But my impression is that  
7 codes get tweaked till things look good, instead of being  
8 tweaked in order to find out when things get bad. And I  
9 wonder which is the right philosophy.

10 MR. O'DELL: I would say in the tweaking process,  
11 okay, you pass through several of those kind of points.

12 CHAIRMAN WALLIS: Yeah, but you show to us is the  
13 best or the worst?

14 MR. O'DELL: It is still conservative relative to  
15 the assessment data.

16 CHAIRMAN WALLIS: Well, we will get into that  
17 question later. At least the other members of your team  
18 have heard it.

19 MR. O'DELL: Okay. SPC uses analysis guidelines  
20 to control the performance of licensing analysis. They are  
21 developed based on the NRC approved methodology. It covers  
22 the codes to be used, like I indicated, the plant input  
23 model development analysis flow. It requires applications  
24 and regulatory affairs management approval and sign-off.  
25 The regulatory affairs is basically the tie-in to make sure

1 we are in agreement with the NRC approved methodology and  
2 the SER restrictions.

3 The code input guidelines define the plant  
4 component nodalization, for example, reactor vessel, hot  
5 legs, pumps, pressurizer, steam generators and ECCS.

6 CHAIRMAN WALLIS: Where do we find that?

7 MR. O'DELL: Pardon?

8 CHAIRMAN WALLIS: Where do we find that? I never  
9 saw it in all the paperwork that came me, a picture of a  
10 reactor vessel or anything.

11 MR. O'DELL: Well, this is, like I said, the code  
12 input guidelines. These guidelines are developed based on  
13 the final approved methodology that goes to applications.  
14 Okay.

15 CHAIRMAN WALLIS: Yeah. But all the documentation  
16 that came describing the model and the programmer's guide  
17 and all this stuff never told me what problem you were  
18 addressing or had pictures of these things, or so on.

19 MR. O'DELL: Well, that would be in --

20 CHAIRMAN WALLIS: It would have helped a great  
21 deal if someone had put that upfront.

22 MR. O'DELL: Well, I think that is in the  
23 methodology documents, the methodology submittals.

24 MR. KELLY: This is Joe Kelly from Siemens Power,  
25 and I will just break in for a second, because the analysis

1 guidelines were something that I was not familiar with and  
2 were a very pleasant surprise for me when I moved into  
3 working in industry. Rather than a generic user guideline,  
4 you know, that is a very large document that no one reads,  
5 these are very short but very specific user guidelines for  
6 each type of transient. So if you are doing a main -- there  
7 is a document for a main steamline break, and it will say  
8 that this component should be noted this way. And they get  
9 very specific.

10 For example, in one of them for the downcomer, it  
11 says the downcomer should have seven axial nodes, node  
12 number 1 is from the top of the nozzles to the top of the  
13 hot leg, node number 2 covers the span of the hot leg, and  
14 so on. And they are also very specific about what options  
15 should be turned on and all the various different parts of  
16 the system, and also what biases should be taken on things  
17 like neutronic coefficients.

18 And so just one of these, they are fairly small,  
19 but they are very specific for each type of transient.

20 CHAIRMAN WALLIS: So it has seven nodes because  
21 eight nodes gives a different answer?

22 [Laughter.]

23 MR. KELLY: I didn't work with the guidelines, so  
24 I don't know. You'd have to ask.

25 CHAIRMAN WALLIS: That's nice to know. You're

1 telling me something that's completely new to me. Thank  
2 you.

3 MR. KELLY: Yes, it was new to me, too, and it was  
4 also very refreshing. And part of that is that the  
5 assessments also have to be run under the same guidelines as  
6 the analysis would be run under, and that, of course, is the  
7 way that it should be done.

8 CHAIRMAN WALLIS: That gives me a good feeling and  
9 a bad feeling; a good feeling in that you're being very  
10 specific about it, the bad feeling, that if you have to be  
11 so specific, what happens if I do something else?

12 Okay.

13 MR. O'DELL: Okay, again, as Joe just indicated,  
14 it defines the code options to be selected, defines the  
15 control systems and defines the trip systems to be used,  
16 and, again, requires an independent QA review check, and  
17 that independent QA review check includes a check back  
18 against the guideline to make sure that the guideline was  
19 followed in performing the -- in the development of the code  
20 input.

21 Again, as Joe indicated, it covers the specific  
22 Standard Review Plan analysis. It describes the event to be  
23 analyzed, describes the analytical methodology being  
24 applied.

25 It defines the regulatory criteria and

1 requirements, including an SER restrictions. It defines the  
2 codes to be used, defines the calculations to be performed;  
3 the specific cases that are to be run, the analysis  
4 assumptions, which includes any required input parameter  
5 biasing, equipment and trip status.

6 Then it details each of the calculation steps, and  
7 finally identifies the key input and output parameters that  
8 have to be displayed within the calculation notebook for QA  
9 review.

10 It also defines the quality assurance review  
11 requirements which include a documented review of the key  
12 analysis elements, key input parameters, key output  
13 parameters, and, again, the check against the specific  
14 analysis guideline to ensure that it was used and followed  
15 correctly.

16 In summary, then, I think I have provided SPC, a  
17 description of SPC's process for controlling codes  
18 development and performing analysis.

19 This includes the relationship of the S-RELAP-5  
20 Code to both RELAP-5 Mod 2 and Mod 3. It details the  
21 development process followed for the S-RELAP-5 code, given  
22 the definition of, at least SPC's definition of a frozen  
23 code version.

24 And, in conclusion, I believe that I have  
25 demonstrated that SPC has processes in place to control both

1 code development and code application in the performance of  
2 a licensing analysis.

3 I hope that I have demonstrated that analysts do  
4 not have the freedom to modify codes or their application to  
5 improve analysis results.

6 That's all I had for today.

7 CHAIRMAN WALLIS: How much are you locked into  
8 then? You're locked into the code and the nodding and  
9 everything?

10 MR. O'DELL: Yes, that's the intent of the  
11 guidelines.

12 CHAIRMAN WALLIS: Well, what does the user do that  
13 you haven't already done?

14 MR. O'DELL: He basically executes the  
15 plant-specific analysis, and documents that analysis.

16 CHAIRMAN WALLIS: So if his pipes are of a  
17 different length someplace, he has to put that in?

18 MR. O'DELL: Right, that goes in with the -- yes,  
19 I mean, it's a plant-specific plant model that's put  
20 together.

21 CHAIRMAN WALLIS: Well, the impression that I get  
22 is that the main part, sort of the cooling system, hot leg,  
23 cold leg, all that stuff that you've already done, doesn't  
24 get touched at all?

25 MR. O'DELL: I don't know what you mean by doesn't

1 get touched at all. But, I mean --

2 CHAIRMAN WALLIS: You give me the impression that  
3 you're specifying all the nodding and the options and so on.

4 MR. O'DELL: Yes.

5 CHAIRMAN WALLIS: Ahead of time.

6 MR. O'DELL: Yes, that's specified. The analyst  
7 simply takes -- you know, if you look at -- let's say we  
8 were to get a new plant that we had to do an analysis for.

9 The first step would be that you would take the  
10 input guidelines, you'd go develop the plant model, okay,  
11 which is basically the input, nodalization, et cetera.

12 CHAIRMAN WALLIS: Now, you're going to give this  
13 source code to the NRC?

14 MR. O'DELL: Yes, they have it.

15 CHAIRMAN WALLIS: So if they want to run nine  
16 nodes instead of seven, they can do that?

17 MR. O'DELL: Yes.

18 CHAIRMAN WALLIS: And that may be a good thing to  
19 do. Thank you.

20 MR. GRUSO: Dr. Wallis, this is Ralph Gruso from  
21 the staff. I'd also note that Larry mentioned these code  
22 input guidelines and the analysis guidelines.

23 As part of the review, we are also spending time  
24 at the site where the work is being done.

25 Although we have not received copies of the code

1 input guidelines, they could be audited as part of our  
2 review, and I anticipate we'll probably do that at some  
3 point during the review.

4 CHAIRMAN WALLIS: Thank you. Have you done your  
5 one-hour presentation in half an hour?

6 MR. O'DELL: Looks like it.

7 CHAIRMAN WALLIS: Let's keep going at this point  
8 at the same speed. Thank you very much.

9 MR. O'DELL: At this point in time I'll turn it  
10 over to Joe Kelly.

11 CHAIRMAN WALLIS: Joe, maybe we have a break after  
12 35 minutes or something, whenever is good?

13 MR. KELLY: That's good. And has been stated, one  
14 of my tasks here today is to describe the --

15 REPORTER: Use the microphone.

16 MR. KELLY: Sorry. Is that okay?

17 MR. BOEHNERT: I guess that now we have to discuss  
18 closing for proprietary material. Joe, when should we do  
19 that?

20 MR. KELLY: Well, some of my slides, the bulk of  
21 my slides are non-proprietary.

22 MR. BOEHNERT: Okay.

23 MR. KELLY: But there are individual examples here  
24 and there that are. And so I guess that would be Jim or  
25 Gerry Holm to decide.

1           But I think the plan was to have it closed now; is  
2 that correct?

3           MR. HOLM: Yes.

4           MR. BOEHNERT: Okay, then we'll need to close the  
5 session. We'll go to a proprietary transcript, and Siemens  
6 people need to validate that anybody here that you don't  
7 know shouldn't be there, has to leave. NRC people, of  
8 course, can stay.

9           I didn't say that very well, but you know what I  
10 mean.

11           [Whereupon, at 9:18 a.m., the meeting proceeded  
12 into closed session.]

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REPORTER'S CERTIFICATE

This is to certify that the attached proceedings  
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NAME OF PROCEEDING: THERMAL-HYDRAULIC PHENOMENA

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