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NUCLEAR REGULATORY COMMISSION

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MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

THERMAL-HYDRAULIC PHENOMENA SUBCOMMITTEE

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WEDNESDAY

JANUARY 17, 2001

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, White Flint Building 2, 11545 Rockville Pike, Rockville, Maryland, at 8:30 a.m., the Honorable Graham B. Wallis, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

THE HON. GRAHAM B. WALLIS, Chairman

DR. THOMAS S. KRESS, ACRS Member

DR. NOVAK ZUBER, ACRS Consultant

VIRGIL SCHROCK, ACRS Consultant

ACRS STAFF PRESENT:

PAUL A. BOEHNERT

I-N-D-E-X

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 continuation of the meeting of the ACRS Subcommittee on Thermal-Hydraulic Phenomena.

I am Graham Wallis, the Chairman of the committee.

The ACRS members in attendance, the ACRS member in attendance is Dr. Thomas Kress.

The ACRS consultants in attendance are Virgil Schrock and Novak Zuber.

The purpose of today's meeting is for the subcommittee to continue its review of the Siemens Power Corporation's S-RELAP5 thermal-hydraulic code and its application to Appendix K small break LOCA analyses.

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

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

The rules for participation in today's meeting have been announced as part of the notices of this meeting previously published in the Federal Register on December 28th, 2000 and in January 9th, 2001.

Portions of today's meeting will be closed to the public to discuss information considered proprietary to the Siemens Power Corporation.

A transcript of this meeting is being kept, and the open portions of this transcript will be made available as stated in the Federal Register notice.

It is requested that speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

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

I'd now like to begin the meeting, and I call on Ralph Landry from NRC's Office of Nuclear Reactor Regulation to get us going.

Good morning, Ralph.

MR. LANDRY: Thank you, Mr. Chairman.

As the Chairman said, I am Ralph Landry, lead reviewer for NRR on the Siemens S-RELAP5 code.

This morning what we would like to do is present the results of the staff's review of S-RELAP5 and the conclusions of our review. None of the material that I plan on speaking on today is proprietary.

We have had the SER reviewed by Siemens for proprietary content, and since the discussion that I had prepared for today deals specifically with the SER, we do not believe we will be providing any proprietary material in our part of the discussion.

Siemens will have to inform you when they get up if anything they're saying is proprietary.

Okay. The material that we intend to cover today, we want to go over the milestones, refresh your memory of what we've gone through in the course of this review, some of the dates the key materials were provided, the requests that we received.

We will talk a little bit about some of the modifications that have been made to the code. I'd like to point out right up front that the code that we've been reviewing is a combination of codes that have all been reviewed and approved previously with the proviso that modifications have been made and models have been added to one of the codes.

Now, specifically, the ANF RELAP code was a modification of RELAP5, which was provided by what was then Advanced Nuclear Fuels. It had been Exxon Nuclear and became Siemens Power Corporation.

ANF RELAP had been reviewed and approved by the staff in the late '80s for small break LOCA. That code was combined with the Rod X2 code with the 2-D2 code and with the IZCON, which is a derivative of CONTEMPT, and into one integrated code package.

If you're familiar with the way code analyses have been done using these codes in the past, material would be taken or information taken from one code, manually put to the next code. That would give feedback information that would have to go back and forth between codes in a manual iterative method.

What Siemens has done is taken all of those codes, combined the codes into one integrated code so that the different parts of the code will interact with each other in an integrated fashion without having to manually transfer data from code to code.

Siemens also made modifications to the code, modifications to the numerics, to some of the heat transfer correlations, and to the various other parts of the code.

We'll talk about specifically some of the numerics. We feel that Siemens has done a very good job of upgrading numerics. We got very deeply into that review. We had not planned on spending a lot of time looking at code numerics, but as we dug into it, it became a challenge to us to sit down and understand what they were doing because the semi-implicit methodology that they put into code seems to have added a great deal to the robustness of the code and makes a code that, from our observations of playing with the code -- excuse me -- working with the code, reviewing the materials, we have had the impression that the code is far more robust than the RELAP5 code family had been previously.

CHAIRMAN WALLIS: You know that when they presented here we had some questions about the numerics, but it didn't seem clear from the documentation what was actually done, and there was the business of whether you use things at the previous time interval, the next one, and how you go through this.

Has that been fixed up so that someone like us can understand what they're doing now?

MR. LANDRY: It's very difficult to follow through. That's another reason we spent a lot of time with the numerics.

We spent a lot of time trying to figure out what was happening, whether we were using old time, new time, old variable, new variable, variable from the center of the volume, variable from a junction.

It's very difficult to track through.

DR. ZUBER: Let me ask you.

MR. LANDRY: But we felt what they have done was very good because some of the numeric changes they've made have helped with the, oh, historical problem that the code has had with generation of mass air and energy air and problems with numeric diffusion and numeric instability.

DR. ZUBER: In read in your handout that there were some errors in the documentation, and they will be addressed in the final version, correct?

MR. LANDRY: Correct.

DR. ZUBER: Okay. What not include these explanations about the numerics also in the final version? Why would you or somebody else leave to a reviewer to have to dig and try to find out all these assumptions and derivations?

If we have a final report with corrections, why not include a section in an appendix where they go from A to Z how they did it and why and so on and so on, can easily follow, and then agree with that?

MR. LANDRY: When Siemens response to the SER later today, hopefully they'll be able to make some comments about what they are including in the documentation in the way of that level of detail, but we did have --

DR. ZUBER: It's just to make easier for the reviewer to follow it and approve it. You know, if you cannot follow it, you'll get go through it and then either you'll dismiss it as incomplete or not satisfactory, and then we get into theological arguments. If they have a good presentation and evaluation, one can, indeed, follow it and put it to rest. It is for their own benefit.

MR. LANDRY: We did ask questions in the request for information that we sent out addressing at least a couple of the equations that we looked at and said, "We don't understand what time, what location you're using." So --

DR. ZUBER: You see, a person who is inimical to this industry, they can say, "Oh, they are not hiding something. They're covering up or something," and that is not a good way to conduct reviews.

MR. SCHROCK: Could I ask a question?

MR. LANDRY: I think part of this problem is the difficulty of the numeric structure and understanding it, that for someone who is not a specialist in code numerics, which we weren't, we spent a great deal of time trying to dig through the numerics.

It's very complex, and especially when you consider that they've added a two dimensional capability to the hydrodynamic field equations that makes it a very complex description to work through.

But --

MR. SCHROCK: Could I ask a question concerning the process here? Does the NRC approval of this code depend upon a review of the final document or will the approval be given with the understanding that a document will be suitably revised?

If that is the case, will that document ever be reviewed, seen again by this committee?

MR. LANDRY: The procedure that has been followed all through code reviews by the NRC staff has been that we make comments, we write the SER, and the recommendations of the SER, any recommendations for change in documentation are to be made by the applicant after the SERs and approval is granted.

The applicant takes the SER, publishes the SER as a part of the document. That's where they get the PA designation for proprietary approved document, which incorporates all of the changes and corrections that are to have been made in the documentation.

The staff has at its disposal, and always has had, the option of going out and inspecting and auditing what has been done at the applicant.

We do receive the final published version of the report. We can go back, inspect that report, determine if they've adequately responded. If they haven't, we always have the option of audit and inspection to insure that the report is upgraded to the standard that we think it should be.

CHAIRMAN WALLIS: But there's a conceivable scenario where you guys issue the SER and everyone is happy, and then the document comes back to the ACRS when it's submitted for best estimate code or something.

And we find exactly the same things we didn't like the first time. Then this doesn't look very good for several people.

MR. LANDRY: This submittal is unusual in that respect, Dr. Wallis, in that typically the code comes in as approved, and the applicant goes away.

Now, this code is being submitted, again, for, as you pointed out, for best estimate or realistic large break LOCA, and when we have the code in again, the documentation in again, we'll get another shot at it.

CHAIRMAN WALLIS: But it would be somewhat tragic or comical or a mixture of the two if the ACRS found exactly the same errors in the document after you'd been through all of your SER and all of that stuff.

DR. ZUBER: On the stuff, you know, you receive the comments, you receive the criticism. You say it will be addressed. A year later the thing is not addressed. Then the question comes what did the stuff do. What did the management at NRC do? What kind of management NRC has?

MR. LANDRY: We haven't had that difficulty in the past. We make a comment. We say that a document has to contain certain material, has errors, has to be fixed. We haven't had the problem with people refusing our negligently not fixing.

So we'll simply have to see what we get back.

CHAIRMAN WALLIS: Yeah, that's the expectation. It's always been my expectation, but experience indicates that it doesn't always work that way.

MR. LANDRY: Well, like I said, this code we will have another opportunity to look at.

CHAIRMAN WALLIS: Now, you were speaking about numerics. We have some questions. It seems to me there were two issues that we raised at the time. One was the solution procedure itself, and then there was the numerics. These are not really quite the same thing.

It seemed to me that the solution procedure needed to be clarified because it wasn't in the documentation, and then how the numerics actually do that is a separate thing really, but the solution procedure needs to be laid out very clearly, and that isn't so difficult to do. It gives you a road map for what you're going to find when you look at the numerics, and I hope that is fixed up in the new document so we don't have to struggle with it next time.

We're slipping all of these things in for the benefit of the audience, of course, as well as you.

MR. LANDRY: I assume the other topics that we had planned on discussing were the heat transfer models, the heat transfer correlations that have been changed in the code.

We were going to talk a little bit about the point kinetics model. It's very uninteresting.

MR. SCHROCK: Oh, I think it's quite interesting, and I think there's an issue --

MR. LANDRY: Relative to three dimensional kinetics.

MR. SCHROCK: No, no, no. I'm not talking about the dimensionality of the problem. I'm talking about the simple facts of physics, the real world.

MR. LANDRY: Yeah.

MR. SCHROCK: And I'm referring to the fact that when you try to find out what any of these codes are doing with regard to the delayed neutron population, the population of delayed neutron precursors, you find in some of the descriptions the older RELAP and I think also in track if I remember correctly, values for beta are listed for Uranium 235. None are listed for other contributing species.

Plutonium 239 becomes equally important and has a very different value of beta. The kinetics, whether you're analyzing it as a simplified, one dimensional problem or a multi-dimensional problem is critically dependent upon the value of beta.

And, indeed, the density of delayed neutron precursors is spatially dependent in the reactor. So this means that in a point kinetics model there has to be some kind of spatial averaging in order to come up with an effective beta.

I've asked now several times for guidance on how to understand how the codes deal with this problem, and I don't hear anything, except I'm hearing you say now that this is a problem of not very great interest.

Ralph, I think it's quite the contrary. If you have the wrong value of beta in there and you have a core which is much more responsive than you think it is because you're putting in U-235 properties, you may have a serious, very serious problem on your hands.

So, please, show me how the calculation is done. I don't think it's a terribly difficult calculation, but I can't imagine why it's not important to include that in the documentation of what the calculation is doing.

MR. LANDRY: Yeah, I'll ask the Siemens people if they can respond to that later today, if they can put their heads together for a minute and respond to it.

CHAIRMAN WALLIS: This is one of the questions we asked of Ralph.

MR. SCHROCK: It's been in writing several times.

DR. ZUBER: It's getting hotter out, is it?

MR. LANDRY: Pardon?

DR. ZUBER: It is getting hot here.

MR. LANDRY: Well, I wore a sweater because I didn't know if we were going to be next door in the walk-in freezer or if we were going to be in this room. So --

DR. ZUBER: And what kind of questions you can get.

MR. LANDRY: So if we're going to be next door in the walk-in freezer, I wanted to have sufficient clothing on.

Okay. One of the other things that we're going to talk about a little later is some of the exploratory studies that we've been doing on the staff. Several times questions have been coming up of how do you model such things as a bend in a pipe with a straight pipe.

Well, we've been doing some studies looking at calculations with effluent, computational fluent dynamics code versus calculations done with RELAP, TRAC, and some of the other thermal-hydraulics codes, systems codes.

And we're going to present some of those results, the preliminary results that we've been giving, to show the kinds of calculations and the kind of phenomena that we see occurring from a CFD code.

Then we're going to talk a little bit about the assessment that has been done on S-RELAP5 for small break LOCA.

DR. ZUBER: That's been by you or by --

MR. LANDRY: The assessment by the applicant, which is required under the regulatory requirements for a small break LOCA.

We'll talk a little bit about some of the sensitivity studies.

CHAIRMAN WALLIS: So they present some curves, and you believe the curves. Do you ever generate the curves yourselves?

MR. LANDRY: No, we go back and --

CHAIRMAN WALLIS: So there is --

MR. LANDRY: That's why we insisted on having the code.

CHAIRMAN WALLIS: Right. So you have actually run the code and checked that some of these curves are real?

MR. LANDRY: We haven't checked these codes, but we have been working with the code.

CHAIRMAN WALLIS: Because you know the guy with the code can always twiddle things to make the lines look good, if they want to.

MR. LANDRY: Yeah.

CHAIRMAN WALLIS: But you trust them to do it honestly, but then it's sort of good to have an independent check that if somebody else comes along and uses the code, they get the same curve.

MR. LANDRY: Yeah, we have to operate at a certain level of trust on all the calculations.

CHAIRMAN WALLIS: Yeah, but I think it's still useful to have that independent check.

MR. LANDRY: Because now that we do have the code --

DR. ZUBER: When did you get it?

MR. LANDRY: I'll get into that in the milestones.

Now that we do have the code, we have that capability to run any of the cases that they have run for an independent check on our own computers, and of course, the last thing to talk about are staff's conclusions.

CHAIRMAN WALLIS: WE need to know what you actually did. I mean, you have the capability, but if it is not used, you might as well not have it.

MR. LANDRY: We'll move on into that stuff later.

CHAIRMAN WALLIS: I think it would be useful actually, and maybe this should be a precedent. When we see these assessments by the promoter, vendor, user, that there should actually be an independent assessment by the staff using the same code to show -- I expect it's going to be exactly the same, but at least it gives that additional credibility.

MR. LANDRY: In theory they should be exactly the same, especially using the same make of computer.

CHAIRMAN WALLIS: Right, and if you have some difficulty getting the same officer, then you want to know why.

MR. LANDRY: Right.

DR. ZUBER: Well, that is a good comment. Let me add to it you should also do this with sensitivity studies. When you have a question of a model which URB or somebody else can question, then there are in the sensitivity calculations on that model, and then you can agree with this statement of the applicant or disagree, but at least you have some way to make a judgment.

So especially for question number one, that you should really run a sensitivity under plus or minus ten, 20 percent and see what the effect is. Since you have that capability, you should use it.

MR. LANDRY: In some of the milestones --

CHAIRMAN WALLIS: Now, this would be particular true of the best estimate type code because you're going to have to sort of say, well, let's pick something where we think the code is sensitive to this and investigate it because, you know, there we are looking for uncertainties about predictions.

So we could exercise the code in that mode, and I would hope that you'd have the time, money, and people to be able to do that.

MR. LANDRY: The biggest problem is the people.

DR. ZUBER: Well, if you don't do it, people can question about can break calculations be repaired. It's only to approve somebody gives you a piece of paper and you put your name to it. That's not the regulation. That's not the responsible way to do business.

MR. LANDRY: Well, there's not much that I can do without --

DR. ZUBER: I know. I know, but here is your management, and this is on the record, and there is a letter from the ACRS to this effect. You should have this capability to perform this calculation and make your own judgment and then pass it to public and then to the ACRS, and then we have the confidence.

MR. LANDRY: Okay. Some of the milestones in this review. A year ago, almost exactly a year ago, we received a formal request from Siemens to review the S-RELAP5 code for a small break LOCA.

At that time, we also received the electronic version of the code. We've had the code in house for a year now. We have it installed on one of our UNIX computers. The code is operational. We put the electronic arm on. We also built the code to see that we could do the build of the code ourselves.

CHAIRMAN WALLIS: And what did you do with it?

MR. LANDRY: Run it.

CHAIRMAN WALLIS: Now you've got it operational. What did you do with it?

MR. LANDRY: Well, we'll get to that later.

CHAIRMAN WALLIS: You're going to tell us what you did with it?

MR. LANDRY: Hopefully. The --

CHAIRMAN WALLIS: You're going to tantalize us, are you?

MR. LANDRY: Yeah.

CHAIRMAN WALLIS: Tantalize us and tell us later?

MR. LANDRY: If I tell you the bottom line now --

CHAIRMAN WALLIS: Okay.

MR. LANDRY: -- there's no point in going through all of these slides I put together.

(Laughter.)

DR. ZUBER: That is one way to put it. We are so old and we are senile and we should forget our questions by the end of the meeting.

MR. LANDRY: I didn't say that.

DR. ZUBER: Well, you could, I mean.

(Laughter.)

MR. LANDRY: During the time from January 2000 until December, the staff was reviewing the material. We had met with the ACRS, and we were putting together questions which we sent to the applicant electronically as E-mail throughout the year, and finally we put all of the questions together as a formal package in December of 2000.

The applicant had copies of the request for additional information as we were developing them. They got the formal request in December, and we have received a draft response to the questions. They are in the process of going through their final QA procedures to sign off on the formal response to the questions.

This is a system that we instituted in previous reviews that we found to work very well. We would ask questions informally as we went along in the review, get responses back, and when we had all of the questions together, we could send them a final formal set and get a final form response very quickly.

CHAIRMAN WALLIS: Well, I've looked at this so far. Is it going to go around again? It's not clear to me that all of the answers were responsive to the questions. So the question could perhaps be asked again.

MR. LANDRY: We have had telecons with the applicant where we went through a number of the questions, a number of questions that we had that we felt needed further discussion, and we discussed them.

CHAIRMAN WALLIS: You discussed them because there was merit in one question, and they never appeared in the answer.

MR. LANDRY: We discussed verbally with them some of the other questions, too.

We prepared our draft safety evaluation report, and we want to emphasize that this is draft. I might even say "rough draft" after reading it over last night again and seeing some of the grammar and some of the spelling.

CHAIRMAN WALLIS: And the content.

MR. LANDRY: Content, good. The typing leaves a lot to be desired. It has not gone through the review process. So the SER will no doubt go to review and is subject to change and hopefully, based on enlightenment today, we can make further changes in the SER.

CHAIRMAN WALLIS: But if you're going to be going to the full committee in February, you want to go through that process pretty quickly.

MR. LANDRY: Right.

CHAIRMAN WALLIS: Because we would like to see, you know, the loose ends tied up by then.

MR. LANDRY: We intend to get through this. We're putting a major effort on wrapping this up in the next few weeks.

We have met with the subcommittee in the spring of 2000, in the summer of 2000, and again today to talk about the draft SER.

CHAIRMAN WALLIS: Now, let's talk about that. You met with us in March, and that was a formal meeting where we said things were coming along or something. You didn't dig into things very much.

MR. LANDRY: Right. That's --

CHAIRMAN WALLIS: And in August, was it August when we dug into things?

PARTICIPANT: Yes.

CHAIRMAN WALLIS: And we had a lot of questions.

MR. LANDRY: That's correct.

CHAIRMAN WALLIS: And you received a whole bunch of questions from the committee, consultants, and so on, and it seemed to me that there's not that much connection between what the ACRS' questions were and what your questions were in your RAIs.

MR. LANDRY: We tried to factor some of the concerns that you raised into the RAIs. There were some RAIs -- we were trying to not take information from the committee and write it directly as an RAI, but we were trying to factor in concerns that you raised in some of the other questions that we were raising so that we could hit a number of the high points, such as the thing we were talking about a few minutes ago about how do you determine are you doing the calculation at the old time/new time, old velocity/new velocity.

We have some questions dealing with trying to clarify what is the subscripting/superscripting in these equations. What does it represent, and what is it telling us?

So we tried to factor in the concerns that were being raised into the RAIs that we were asking.

DR. ZUBER: Doesn't the factoring also imply some possible filtering? I mean you can filter questions, I mean, according to some criteria, and you don't pass that, and then you come to another meeting with the same questions.

MR. LANDRY: Well, we were trying not to filter them out. We were trying to filter them in.

CHAIRMAN WALLIS: Well, I think though this is part of our learning curve. Sometimes things the ACRS is concerned with are not the same as you feel constrained to be concerned with when you're enforcing regulations, and that may mean that regulations omit something.

MR. LANDRY: Well, that gets into a difficult question of the separation of the two functions within the NRC, and as you said, we're in new ground here. We're trying to interact very closely with the subcommittee, taking into consideration your concerns in our questions to applicants.

We did that on RETRAN 3D. We're doing that on S-RELAP5. We're trying to incorporate that into our questions on GE's TRACG code.

But we're trying to walk this fine line at the same time, where we're not using the subcommittee as consultants to us. This gets to be a careful division, but we're trying to work closely with the subcommittee, take into account your concerns, but not use you as a consultant at the same time.

CHAIRMAN WALLIS: Yeah, that is one of the concerns. The thing that I'm more interested in here is the two worlds where the sort of criteria used by the ACRS has been some outsiders from the agency looking in on what they're doing, may be different from the criteria that you folks use when you're used to enforcing regulation and all the history of the way that the agency works, and so on.

And I sometimes feel I'm in two worlds.

MR. LANDRY: Well, sometimes some of us feel like we're in two worlds, too, when we're trying to be technically responsive to material we're looking at, and yet operate within the constraints of regulatory requirements. Sometimes what we see as perhaps a technical problem is not a regulatory problem, and we don't have that regulatory backing to enforce.

DR. ZUBER: Pardon me. It goes back to enforcement, similar to the applicant, is exposure to sunlight, and the technical community outside was aware of some of the shortcomings we hear in these meetings. I bet the response of the industry would be quite different, and I think an exposure, some, should be shown at some of these meetings and some of these results which the applicant are presenting.

MR. LANDRY: I think --

DR. ZUBER: Otherwise -- otherwise it's a coverup. You can always cover up under regulation. This is not covered. If it is exposed to a technical argument, technical discussion, as at any meeting, you can defend it, and if it's poor, it should be dismissed.

MR. LANDRY: I think, Novak, that is occurring, not the coverup. I think it is occurring at the industry --

DR. ZUBER: Well, that's a coverup also. You don't have to say it, but I have seen it so far.

MR. LANDRY: The industry is becoming much more aware of the concerns, especially with the way in which we're conducting the code reviews today, but the industry is becoming much more aware of the concerns that we have, the concerns that the committee has, the interaction that we have, and from what we've seen, we feel that they've been much more responsive.

We've been -- this is getting closer to the bottom line -- but we feel that especially in this code Siemens has been very responsive to concerns that we've raised and directions we're trying to go in and review.

So, yes, I believe that they have been hearing many of these concerns. Perhaps they are concerns that they have problems responding to also, but as a general statement I think they've been responsive. I think they've been hearing the concerns, and they've been trying to take them all very seriously.

MR. CARUSO: I made the observation, and I'll go back on that. Unfortunately a lot of the issues that you're bringing up here with Siemens also have shown up in the other vendors.

DR. ZUBER: I'm sure you have probably more directed more by the other vendors than by Siemens, but since you are discussing code, I think this is the place to discuss it.

MR. CARUSO: Right, right. The issue of the documentation seems to be a common problem among all the vendors, and I think the committee has been equally -- has pointed out to all of the vendors in an equal fashion their shortcomings in this particular area. So I'm not sure how much of a coverup there's been.

And in all of the meetings that we've been having with the vendors where we meet individually with them, there have been representatives from their customers, and their customers observe our comments about the shortcomings in their codes.

So the customers are hearing this, and we had a meeting last week with one of the vendors about one of the reactors and reactor types. He made this point rather strongly, and I believe I get voted in Inside NRC this week on this subject. So I'm not sure how much this is actually being covered up as much as being --

CHAIRMAN WALLIS: So there's a good trend here.

MR. CARUSO: Well, I think it depends on how you view it as to whether it's good or bad, but there is definitely a trend.

DR. ZUBER: Is it coming out of the crowd?

MR. CARUSO: Well, it's being discussed, and I think everybody knows about it.

MR. LANDRY: There is improvement.

MR. CARUSO: I think there's an improvement. I think there's a lot of resistance mostly from the point of view of cost. I mean, clearly updating documentation and making these improvements cost money, and it's the old question of how good is good enough.

And I've had people in the industry tell me that the new requirements and the new SRP and the reg. guide will cause the industry to stop making changes because they can't afford to go through the process anymore.

I hope that doesn't happen, but I'm starting to hear this, and I think we'll have to work with them to show them that it's in their best interest to make the changes, to make them in a way that is visible and, as you say, transparent to both OSTU and to the industry, and I think we'll all benefit from it.

But it would be a bit of work.

MR. SCHROCK: Well, I'd just like to add one thing here. I hear what you're saying about the role of your regulatory group and the role of the ACRS. They do have somewhat different purposes, but their common thread is that they're dealing with the issue of the quality of the technical assessment.

This communication problem between the ACRS and NRR is one that I think is serious. You've been asked how can it be that the RAIs that you send to industry seem not to reflect some concerns that the ACRS has that have been thought at least by some here to be important questions.

But it's the vacuum that's created by no answer. An illustration of that is my simple question about how is the kinetics calculation done; what input, fundamental data, are utilized in that calculation, and why is it that you accept documentation that doesn't tell how that calculation is done?

It may be that you've seen it in enough detail that you think that it's perfectly fine, and the question is irrelevant and doesn't deserve the time to answer, but that's not a productive way of interacting.

You characterize the recent past as been an era in which the level of cooperation between NRR and ACRS has been greatly increased. I must say, Ralph, as an outsider that doesn't work with this daily, but listens to these arguments over and over again, I think you've got a long way to go in your communication.

If you hear something that has been thought to be of significance from the ACRS and you conclude that it's not important enough to put in your RAIs, then I think you ought to occasionally communicate with the ACRS and say, "For these reasons we don't think that is an issue that we have to take up with the industry that we're currently interacting with."

What's your response to that?

MR. LANDRY: Well, that may be a valid criticism, Virgil, that perhaps things are slipping through that we're looking at and saying, "Well, we're not real interested in that. This questions we are interested in. So we'll pursue this question."

If we are guilty of that, then I think we need to be aware of it earlier than we have been also. Perhaps what we need to do is provide you with our questions and our concerns at an earlier date in reviews than we have been so that you can see if we're capturing your concerns or not, and if we're not, tell us that we're not and what the concern is so that we can try to capture it in the request.

Without getting into the point that we're, again, using the subcommittee as our consultants, but we will take that back and attempt to make sure that we are more responsive to your concerns and to informing you of what questions we are raising so that we can capture your concerns.

CHAIRMAN WALLIS: this is much more efficient, as we've discussed before, than the ACRS waiting till the end and then suddenly being presented with something perhaps it doesn't like, and the only option it has is to say sort of yeah or nay without any chance to modify or change.

MR. LANDRY: Well, we've been feeling our way along on this with providing material faster to the subcommittee and to the committee, getting concerns back from you. We've tried to tell you what our concerns are.

We are walking along this path together, and I think that it still needs improvement, and where it's not where you think it should be, I'd like to know it so that we can figure out how we can improve this communication between us so that we don't walk into the meeting and say, "Well, we thought this kinetics was okay."

And then you remind us, "Well, we didn't think it was okay. We thought it was very serious."

And say, "Holy cow, he did say that, but I didn't catch it at the time." Then we have to backtrack.

CHAIRMAN WALLIS: It's in the transcript, and it's in the written document. Maybe you should go through ACRS written stuff and check them off or cross them out.

MR. LANDRY: Well, as I said, Graham, I think it has to be a two-way street, too, that when you see our request for additional information, you have to look at those right away and say, "Okay. You did not capture my concern," and not as a consultant writing the request for us, but saying, "I have a concern on this. Would you write something?"

CHAIRMAN WALLIS: I think we held back on it this time to see what you would do.

MR. LANDRY: And if we fell down, we apologize for that, but we're trying to work through this together so that as we get into these more difficult code reviews, we can perhaps iron out these problems now.

Because small break LOCA under Appendix K traditionally has been a very cut and dried review. If you look at the SER on ANF RELAP, it doesn't say a whole lot. It's a pretty cut and dried review that was done.

And we've tried to go into a great deal more depth in this review. We're working our way into greater and greater depth because we also know that we are going to be getting the best estimate LOCA to review, which is going to be a much more in depth review.

So as we're working through this, this is a learning process for us, a learning process for you guys, and a learning process for us working together.

CHAIRMAN WALLIS: Okay. Let's go on.

MR. CARUSO: Well, Tony Ulses is here, did the review of the kinetics, and I think he can address Dr. Schrock's question about the data values.

CHAIRMAN WALLIS: Let's address it now.

MR. ULSES: Well, actually I did part of the review of the kinetics, but let me just basically -- I think what we're looking at here is what I guess I would consider to be sort of a general I don't know if I want to use the word "problem," but like an issue of all of these regs. and systems codes is that they always have a default value for beta.

So that's a value that the analysts really should never use because it's not the appropriate value. What the analyst needs to do is they need to look at that as an input parameter which needs to be calculated off line by an appropriate last visit methodology, and it needs to go into the code.

And that's something that the staff would then review in an audit or an inspection or in the application review of the code, when we get the code in for the actual plant specific application.

But unfortunately all of these codes have to be filled out in the input manual, and there's really not much we can do about it, but it's a value that the analysts really I guess I would say in my judgment should really never use because it's not going to be appropriate because nobody is analyzing a clean, unburned quarry. Those don't exist, and that's what's in all of these codes unfortunately.

MR. SCHROCK: Well, I agree that it has to be calculated. It's a part of the calculation of the transient that's being addressed by this code, and it seems to me that in the spirit of having the models in the code fully defined, that is something that needs to be spelled out in the thermal hydraulics code.

I think it reflects the long history of separating the neutronics calculations and the thermal-hydraulics calculations and believing that you don't really have one physical world out there where these things co-exist.

That may be an explanation of why it exists this way, but what you've just described could lead to a conclusion that you have a safe system owing to the fact that the default value of beta has been used in the calculation.

What's to guard against that? How do you know that that isn't going to be the case?

MR. ULSES: Well, I guess I would say that that would be just as -- that that would be the same as, say, somebody putting in a loss coefficient into a channel. It's an input parameter which would affect the results, and it's a value that the analyst is actually required to put in because there are default loss coefficients in all of these codes. They're always zero, but they're there.

And it's something that the analysts have to be aware of, which is why these codes require highly trained, highly skilled users, and that's why the staff when we look at these codes in an application sense, we need to be really aware of this stuff, and we need to look at it closely.

MR. SCHROCK: Well, I'm not convinced that all of the code analysts are that versed in the neutronics side of this problem, and so I think that you will find if you really put that test to the population of code users out there, that you would get the wrong answer from a substantial number of them; that they would think that the default value was just fine.

Whereas the reactivity corresponding to prompt criticality may be different by a factor of two or more.

MR. ULSES: Certainly.

MR. SCHROCK: And that is a major factor, and such major factors shouldn't be left to essentially the chance that all of your code analysts are so well versed in every aspect of nuclear engineering that they're dealing with this one correctly, too.

The code should describe how it's to be done. If you don't describe how it's to be done, you leave yourself open to having the wrong answer.

How can you regulate under those circumstances?

MR. LANDRY: I would like to let Siemens respond to this question.

MR. O'DELL: Perhaps I can jump in here, Mr. Schrock.

It is Larry O'Dell with Siemens.

It's exactly the situation that was just outlined. We get our betas and our neutronics parameters from the reactor physics calculations for the specific design, cycle designs stuff that we're looking at, and we do a review of those every cycle to make sure what we've used in the analysis bounds the current cycle.

Okay. Now, as far as where that is captured, we don't capture that in the code, and the reason we don't capture that in the thermal-hydraulics code description is because we intend to use this code for multiple transients, and what is the correct value as far as picking a conservative value for a specific transient varies.

So we have in our analysis guidelines the description of what betas and what time in cycle should be used, and the thermal-hydraulic analysts simply goes, gets the information from the transmittal from the neutronics people, gets that beta, puts it in, references that transmission from the neutronics group.

The QA reviewer then goes through that analysis and checks to see that, in fact, that is the right beta value, and it is the one specified in the guideline.

So there's a double check on that process in going through the analysis.

MR. SCHROCK: Is there a place in the user guidelines that this is clear to the person who is exercising S-RELAP5?

MR. O'DELL: Yes.

MR. SCHROCK: And where is that? Why don't you point me to that documentation for this code?

MR. O'DELL: I can provide you the guideline documentation for the ANF RELAP methodology.

We generally put the guidelines together in detail after the NRC review is concluded, and the reason we normally do that is because quite often there are changes to the methodologies as a result of the NRC review.

Now, when you get the realistic LOCA because of the comments that we heard in the committee last time, you will get as part of the submittal the actual guidelines that tell you how we build the Infotech, and then turn around and tell you how you execute the transom, and that should cover all of --

DR. ZUBER: But as of now there is nothing in writing?

MR. O'DELL: Well, there is something in writing for the ANF RELAP methodology, but not for the S-RELAP5 methodology. I would not expect it to vary significantly in the neutronics parameters.

MR. SCHROCK: Well, there will be responses that are calculated in demonstrating the adequacy of the code that will have dependence on the point in the cycle in this regard, and I don't find that there is identification. When that kind of result is presented, there is not an identification of the point in the reactor cycle or the specifics of the core properties that are taken as the input for that analysis.

There needs to be a number of calculations when you look at the question of safety. What is the worst situation from that particular point of view? Is it for a new core? Is it for a core that's near end of life? Is it near end of cycle, at the beginning of cycle? What is it?

CHAIRMAN WALLIS: Is this true of small break LOCA, that the answer differs depending on the time in the cycle?

Presumably in n32 do43 or 53h slow break LOCA nothing happens. Little happens, if it's really new.

MR. JENSEN: I'm sure it is.

MR. SCHROCK: I don't know the answer to that offhand. I'd have to think about it a little more.

MR. JENSEN: Small break is very sensitive to the actual power profiles. So we look for the time in cycle. It tends to give the most up skewed power profile. I believe that tends to be end of cycle conditions.

CHAIRMAN WALLIS: So small break LOCA is analyzed at end of cycle conditions?

MR. JENSEN: Well, we analyze it at various points in the cycle, but typically find it's worse at end of cycle because of the actual power shaper.

MR. BOEHNERT: Could you identify yourself for the record, please? Could you identify yourself for the record?

MR. JENSEN: My name is D.A. Jensen with Siemens.

MR. BOEHNERT: Thank you.

CHAIRMAN WALLIS: Is this apparent to the reader of the documentation? I mean you're telling us some useful information. This is something supplementary to what's in the documents?

DR. ZUBER: Well, see, this was not in a document because when they asked me do I think it says, no, it is not in this. Where is the data? So it is not, not yet.

MR. O'DELL: Again, this is Larry O'Dell of Siemens.

But, you know, the reason it doesn't show up in the code discussion, S-RELAP5 code discussion, is, again, because we would use that code for a number of methodologies. Okay? The appropriate choice of beta varies between those methodologies.

So you have to handle that somehow separate from what's actually in the code write-up.

DR. ZUBER: Right, but then --

MR. O'DELL: -- you should it in --

DR. ZUBER: But then you should make a reference in discussion on that point in the manual in the core and give a general guidance and then refer the reader to particular documents that this is addressed, but as of now there is nothing addressing this issue, period.

MR. O'DELL: Well, see, I would say the reference has to go the other way because the analyst, he goes to his guidelines and says, "This is how I conduct and execute this analysis, and --

DR. ZUBER: But, see, you're really dividing the physics in two parts. I mean one is thermal hydraulics. The other is neutronics.

But Virgil pointed out physics is together. You cannot really separate, and you have one question in one document, another question in another one. There is always the possibility people will not go to more documents and will fall in between.

So I see absolutely no reason. If this is an issue, put it in the document and discuss it not to the detail you may need, and if there is additional detail then refer it, but there should be something in writing.

MR. CARUSO: Dr. Zuber, I think a more apt analogy would be a comparison of the description of the plant and the FSAR to the operating procedures. You have in the FSAR a description of how the pumps and the valves and the pipes are put together, of how the plant is actually operated as a detailed set of procedures.

And what we have here is a code description. It's the tool that's used, and they have a default value, but then Siemens and all the vendors have detailed procedures for performing the analysis that describe which particular values to use for beta, which particular values to use for loss coefficients, and they have very detailed --

DR. ZUBER: Well, that's fine. I mean that's good, but at least you just don't commit a total reading in this a small section discussing this and pointing to the procedure of how to do it. At least there is something in writing. Somebody can say, "Ah-ha, they have addressed this issue, and I feel good about it."

MR. CARUSO: The difficulty is that sometimes the codes are used mainly in multiple types of analyses. For example, as we heard today, they could be used -- this code could be used as a small break analyses or in transient analysis. You would have to include references to many, many different guidelines and operating procedures, like in BWR, for example.

If you had a description of the FSAR, you'd include references to all of the operating procedures for the RHR system, which breaks in I don't know how many different ways.

I mean you wouldn't want to clutter up the documentation of the code with all of the different -- with references to all of the different ways that it could be used.

CHAIRMAN WALLIS: I'm trying to think of what we're doing here. So, I mean, this is like saying are we going to approve a hammer because someone has used this hammer to drive a two penny nail through a two inch fir or something, and you say, "No, it's up to the carpenter to use it for driving a different kind of mail through oak," or whatever.

And that's a different problem. As long as the hammer works for whatever is in the regulations for the code review process, then we don't care. Well, it's up to somebody else to figure out how to use it for other purposes.

MR. CARUSO: No, no, it's not up to someone else. The people who are doing the code review are the same people that reviewed the applications. There are two parts to the code review process.

CHAIRMAN WALLIS: So then you have another review, which is looking at how we used it to drive this thing through the oak and did it work for them, and so on.

MR. CARUSO: Exactly, and if they decide they want to use the hammer to turn a nut someplace, then we'll say, "No, that's not appropriate."

CHAIRMAN WALLIS: You can do that, but it's a little tough.

MR. CARUSO: You can, but we would say, "No, it's not appropriate."

And one other point, and I think this came up during the power operating meeting we had several weeks ago, is that eventually we have the opportunity to actually audit the way these codes are used. We're going to do that for the power up rates. We do it in other circumstances where we send smart guys like Tony out there to look at the value of data and say, "Prove to me that that's the right value used in this calculation."

So this is part of a very large web of regulation that goes on, and it has just been impractical for us to insist that every part of the documentation for each tool described an entire process.

I think I'd like to have a road map document for these processes that you could refer to, but I haven't quite got there yet.

CHAIRMAN WALLIS: You're helping us. We are slowing down the presentation, but I think it helps us to put things in perspective, and then the question, of course, arises when this hammer is going to be used for lots of different things: how many assessments do you need at the level of improving the code that we're here for today?

It's part of this big process, but we look at a very little part and say, "It worked okay for these things. Therefore, it's okay to move on to the next step where it's now use for a broader applications," which we're now also going to investigate when we have to.

MR. CARUSO: Well, in your case, we have our statement from Siemens that they intend to use this code for small break LOCAs and transients and I'm not sure which plants. Westinghouse?

MR. O'DELL: Westinghouse and Combustion Engineering.

MR. CARUSO: But I mean, it's a particular two loop, three loop, four loop?

MR. O'DELL: Three and four loop.

MR. CARUSO: Three and four loop, but not two loop.

MR. O'DELL: Not quite yet.

MR. CARUSO: Okay. So we know what that universal applicability is, and we review for that particular universe, but then we have another bite at the apple when somebody comes in and wants to actually apply.

CHAIRMAN WALLIS: Okay. So are we ready to move on?

Have you lost track of where you were?

MR. LANDRY: Well, I was ready to start talking about some of the modifications that have been made to ANF RELAP to bring it up to S-RELAP.

The code was modified to add a multi-dimensional capability. This is really a 2D hydrodynamics modeling capability that's been added to the core. This modeling allows the code analyst to model such things as the Downcomer in an r theta method, and the core can be modeled as an rz method or model, or you can model one dimensional node. You can connect the one dimensional nodes to the two dimensional.

This gives the analyst the capability to break down areas where we see hydrodynamic effects that are not well represented by one dimensional modeling. They have the capability of going to two dimensional modeling or is captured in the analysis that's performed.

The code has been modified --

CHAIRMAN WALLIS: You asked them about 2D modeling and why they used it some places and not others, and they came back saying, "Well, we didn't use it where multi-dimensional effects were not expected."

I wonder if that's really adequate. I mean you don't really know what happens till you try it, and just to say you didn't expect them is a pretty poor reason for saying we shouldn't investigate it.

MR. LANDRY: Well, there is the background of a number of test programs, experimental programs where even though they're scaled, we have -- and everybody in the industry has been involved in these.

CHAIRMAN WALLIS: That would be helpful. That's okay.

MR. LANDRY: We've seen that their one dimensional modeling is not adequate. So that gives insight to the analyst to say, "Okay. Things like the Downcomer are not adequately modeled in one dimension. We need a two dimensional modeling capability."

We can look at particularly some pipes and say, "Okay. One D modeling in this type is okay."

CHAIRMAN WALLIS: That's okay. Then there's some evidence, but when you ask a question, presumably you ask a question, why didn't you use 2D modeling for a lower plenum, you have some reason to believe that it might be profitable to do so.

When they come back and say, "We didn't do so because we didn't expect multi-dimensional effects," this is simply a brush-off saying, "We just didn't want to do it."

There's no evidence submitted that because of the loft test so-and-so there weren't multi-dimensional effects and all of that. There's no way. It's just simply saying, "We didn't want to do it."

Is that an adequate answer?

MR. LANDRY: Well, we're talked with them on the telecon about some of these, too.

CHAIRMAN WALLIS: Yeah.

MR. LANDRY: The energy equations have been modified so that they can serve energy that are in the code. This has been a problem with RELAP and a problem that came out with a generic letter or code use on RELAP a number of years ago when we saw some users trying to take RELAP and use RELAP for containment modeling where we knew that RELAP did not conserve energy properly when there was a huge pressure differential between one volume and another.

Fixes have been made to the code so now S-RELAP is capable of conserving energy.

DR. ZUBER: What fixes?

MR. LANDRY: I'll have to get the code manual out.

CHAIRMAN WALLIS: Well, there is evidence, and we've seen numbers in the reply responses, I think, that show that energy is conserved better for some situations.

MR. KELLY: Hi. Joe Kelly from Siemens Power.

And I point out that it was not fixes to the energy equation, but rather actually recasting the equations completely that provide a difference.

CHAIRMAN WALLIS: This is was including terms which have been ignored before and things like that?

MR. KELLY: Yes.

MR. MARR: John Marr from the staff.

TRAC and RELAP, the original formulations, the work term difference of the volume PV term isn't captured properly when you do the finite difference. You just don't get conservation of that work term, and you have to reformulate the equation, and so you treat that properly.

It goes bad when you have big pressure differences between two volumes.

MR. SCHROCK: In response to RAIs, I read that certain things are negligible when compared to other things owing to some simplistic numbers that were provided. The comparison seems to be made, for example, for kinetic energy as compared to internal energy.

Internal energy is calculated with respect to some arbitrary datum conventionally, and so the magnitude of the internal energy may be positive or negative, depending upon where the datum is chosen.

So there is a question as to how one can compare a kinetic energy quantity at a point in the thermal-hydraulic system with the internal energy at that same point when the internal energy is necessarily calculated in such a way. Such a comparison would seem to be meaningless.

In fact, what needs to be compared in the computation is changes in the quantity, changes in internal energy in comparison with changes in other quantities to find out if it is justified to neglect the change in one thing as compared to changes in other things.

CHAIRMAN WALLIS: I think that's exactly the same thing in my notes on the RAIs, page 7 or whatever it is. It is changes that matter. So we don't know if you can accept that statement yet that it's negligible compared with the absolute value or the changes. Maybe now you won't accept it.

MR. LANDRY: Well, we'll go back and take a look at it now.

Okay. I said earlier that the numerical solution has been changed. To go to use of algebraic manipulation instead of a Gaussian elimination method for reduction of the hydrodynamic finite difference equations.

The state of steam by condensable mixture has been improved so that at low steam qualities, ideal gas equation is used for both the steam and the non-condensable so that you can calculate the state relations for both steam and the non-condensable gas and a lower steam quality mix.

Hydrodynamic constituative models have been modified significantly.

MR. SCHROCK: Do you find that steam non-condensable mixture -- in the RAIs there's also a response that calls out, again, something that was in the report that is very puzzling to me, and that is the virtue of something being a better description for a circumstance where thermal-hydraulic condition at temperature lower than the ice point.

In this context it seems to be really irrelevant, and it's a puzzle to me as to what that statement is trying to convey, but evidently it's something that's not puzzling to the staff.

I'd like to hear an explanation of it some time. What in the world is the argument here?

MR. LANDRY: Well, you can't get the ice point.

CHAIRMAN WALLIS: Well, you can, I suppose, if you take the reactor up into the --

MR. LANDRY: Joe.

CHAIRMAN WALLIS: -- and open it up.

MR. LANDRY: I guess there is one place where you can get down close to the ice point or before, when you're discharging accumulators in a large break LOCA, and that may be -- I'm not familiar with what part of the documentation you're talking about, but that could be what it's in relation to.

DR. CHOW: This is where -- that's what exactly we call it.

CHAIRMAN WALLIS: I can't --

DR. CHOW: Heiming Chow.

That's what happened when the in the large break the pressure and the temperature will go below ice point. I mean, that's what happened, and you have to be able to handle that.

THE REPORTER: Please use the microphone next time.

CHAIRMAN WALLIS: Okay.

MR. SCHROCK: So it's the isentropic (phonetic) expansion of the mixture in the accumulator that you're concerned with.

DR. CHOW: Yeah, that is the point. I think so.

MR. SCHROCK: Was there some particular reason that it was suspect at low temperatures.

DR. CHOW: Well, the problem is --

CHAIRMAN WALLIS: Can you get to the microphone here? He's having trouble.

DR. CHOW: The problem is when you're below the ice point, you don't have that in the proper dice (phonetic) or you just cannot continue to calculation. That's the basic problem. Okay?

MR. LANDRY: Okay. Thank you.

Okay. The hydrodynamic constituative models were modified to make the RELAP5 interface friction and interface mass trench -- modifications were made to the interphase friction and interphase mass transfer models.

Solar flow regimes, transient criteria were modified to be consistent with published data, and transient flow regimes were introduced for smoothing of the constituative models.

The transfer models are pretty consistent with what's in RELAP5/MOD2 and MOD3 codes, with a couple of exceptions. The Dittus-Boelter equation and gas flow was changed to the Sleicher-Rouse correlation. We'll talk more about that a little later.

The choke flow model was modified to include moody critical flow as required by Appendix K.

Counter current flow model was modified to go from Kutataladze type CCFL correlation to the Bankoff form. And this makes the model consistent with RELAP5/MOD3.

Component models, EPRI pump model, pump requirements model was introduced into the code. Pump head term in field equations was made more implicit.

ICECON containment code was made an integral part of the code. For the fuel, RODX2 and 2-D2 codes were made an integral part of the code so that there was a consistent calculation in going from RELAP to the fuel to the containment.

Now, the code architecture was finally modified to bring it into compliance with RELAP5/MOD3, and to use FORTRAN 77 throughout the code.

CHAIRMAN WALLIS: Is Baker-Just still the best around? Is Baker-Just still the best that we can do with underwater --

MR. LANDRY: Well, Baker-Just is what keeps being referred to.

CHAIRMAN WALLIS: Yeah, I know.

MR. LANDRY: And that's in Appendix K.

CHAIRMAN WALLIS: I know, but is it still the best? I mean, Appendix K, you don't want to be fossilized forever at the Appendix K level.

MR. LANDRY: Except when the code is made to be in conformance with Appendix K. It has to use what's required.

MR. SCHROCK: It's my recollection of reviewing the critical flow model in the documentation was that it deals predominantly with the Ransom-Trapp model and how that's implemented. The numerics of that I feel are a problem.

I expressed that in my report. There is fuzziness in the thinking about how to view the geometry between the last node in the computational system and the imagined choke plane, the difficulties of that kind.

But I don't remember an explanation of the numerics of implementing the Moody critical flow model. Is that in the documentation?

How does one go from the computational cell in which the flow properties are described in terms of the two fluent, six equation model to a choke flow condition at the break, which is governed by idealistic calculation which presumes that the two phases are in thermal equilibrium, but that there is slip between the two phases and has a value for the slip which is found to be dependent simply on the density ratio of the two phases?

What happens numerically as that's being implemented?

MR. LANDRY: Can some of the Siemens people answer that?

DR. CHOW: The problem for that choking is that the only thing we have is the core, and we have the junction property and warning property. And for an actual choking we have got to go through a channel or something, and that's a particular -- the point property you don't know. See, the code doesn't calculate that.

So basically you have to have some approach mentioned from the code, calculating velocity under the warning velocity, and then from there to calculate a choking, the property at the choke point, and that's why all of this calculation is in this. I mean you have an equation about it, but that's basically trying to get from there, from the boiling center property to the choke property and use that as a point for calculating choke.

And in terms of Mooney, basically it's assumed that equal velocity. That's why Mooney borrows this.

CHAIRMAN WALLIS: Equal velocity?

DR. CHOW: Equal velocity, yeah.

CHAIRMAN WALLIS: I thought he had a square root of density ratio.

DR. KRESS: Cube root of density ratio.

DR. CHOW: Yeah, the formula is like that, but the actual application is the choke. We use the same calculation. The formula is like that to get all of these. I mean he drive that to where he tried to say -- the equation is derived from flow velocity data, is something that cubic of that. Yeah, that's right.

DR. ZUBER: Yes, but I don't follow your argument at all. You call it the two fluent model, two momentum, two --

THE REPORTER: Can you come to the podium?

CHAIRMAN WALLIS: Can you come to the podium?

DR. ZUBER: I cannot follow your argument. You call it six equation, two momentum and two energy, two container rate, and at one plane. Downstream you had to combine them somehow, and you have in that deficient model. How do you do it? I mean you must violate something.

Either you have the momentum -- how do you do that?

DR. CHOW: I mean, that's the problem. That's why that you've got some approach mentioned between calculate from the 6 NM, 6 B, 6 equation into basically the kind of homogeneous models.

DR. ZUBER: But you have to have some rationale. Yes, you have conserved the momentum. You have conserved the energy. If not, what happens to the energy?

You combine these things, and you have a particular model with a particular slip --

DR. CHOW: No.

DR. ZUBER: -- at the end.

DR. CHOW: Usually, you still -- you still pack it. The enthalpy is still the same. I mean the enthalpy between the point and that point is still the same. Your H is still the same. The H is constant. I'm talking enthalpy is constant. Okay? So H is constant.

DR. ZUBER: But your cube of the density ratio comes from the kinetics, kinetic energy. That's where it comes from.

DR. CHOW: Yeah.

MR. KELLY: This is Joe Kelly again.

I'll see if I can make what we do a little bit clearer. There's basically two questions. One is what is the critical flow according to the Moody model, and then the second question is how do you modify the equations in S-RELAP5 so that you reproduce that magnitude.

And so what Dr. Chow has been talking about is how you extrapolate from the cell centered quantities to the cell edge quantities in order to calculate the Moody critical flow. In that the cubic root of the density ratio is used, but when it's actually applied -- so in effect what we --

DR. ZUBER: But you have a different slip in the center because you have -- there is no guarantee that you will have the same slip in the center and cubic root of the ratio at the end.

MR. KELLY: Yeah. At the junction where the critical flow model is applied, the two fluent momentum equations are overridden. So basically they're taken out, and you end up using, in effect, a flow boundary condition, and that flow is calculated from the Moody critical flow model.

And then there is a section in the manual, in the models --

DR. CHOW: Yeah, yeah.

MR. KELLY: -- that describes it.

DR. CHOW: What actually we do is we go back to the data poor table, and we make sure our cargo (phonetic) is the same as what we come out. It is the so-called Moody table. So that's why we end up with that.

MR. SCHROCK: Well, I'll go back and look at that, Joe, and see what's done there, and I suppose you can chalk it up to my own fault if it's there and I didn't understand it.

I was somewhat misled, I would say, by the length of presentation devoted to the use of the Ransom-Trapp model that's presented in the documentation, and I guess I find it a little surprising that the main concern in the NRR review here is not at all the Ransom-Trapp model, but instead the fact that the Moody critical flow model is implemented in order to make it compliant with Appendix K.

There still is an issue that I think needs to be looked at critically, and that is how good is that implementation of the Moody model, but I suppose NRR has done that.

It's not apparent from where I'm sitting.

CHAIRMAN WALLIS: The regulations forced you to do something which makes no sense physically at all. It's incompatible with the whole trend of the two fluent model to suddenly invoke Moody as a critical flow model.

MR. SCHROCK: Yeah, it is.

DR. ZUBER: Well, the issue is really --

MR. SCHROCK: Something artificial has got to be done.

CHAIRMAN WALLIS: It's almost like there's a regulation saying that you must violate the second law of Thurwood and Alex (phonetic). So you're forced to do it.

DR. KRESS: That needs to be fixed.

CHAIRMAN WALLIS: Okay.

MR. LANDRY: Well, Appendix K also says that you must use very fine noding. I don't have the exact words in mind on that, but it's right there in Appendix K, and that feature of Appendix K seems to be ignored in the regulatory process.

CHAIRMAN WALLIS: Well, it makes no sense if you suddenly override everything with Moody anyway.

DR. KRESS: Noting doesn't matter.

CHAIRMAN WALLIS: Okay. So you've gone to the next slide.

MR. LANDRY: I'll talk a little bit about the numerics. We spent a great deal of time, as I said earlier, looking at the numerics. Not being experts in numerics, we got very interested in what was going on because we knew that the RELAP5 codes had had numerical problems in the past. There were problems with numeric diffusion. There were problems with generating mass errors and so on.

So when we looked at the numerics, we started trying to track through the equations, and as you have also pointed out, we were having problems following all of the subscripts and superscripts and figuring out physically or trying to understand physically what the equations represented.

So we spent a lot of time, and we still are not experts on numerics, but we tried to look at what Siemens was doing with the code and see if it was really working and making the code more robust.

We felt that use of the semi-implicit numeric solution scheme was making the code more robust, that its use of partially implicitness in time was good. We felt that the foreign relation of implicit terms to be linear at new time, which seemed to be a pretty good idea.

We looked at the linear time advancement matrix that they were solving with sparse matrix techniques, introducing what was to us a new idea, and we were pleased with the general changes going to a semi-implicitness in the code.

CHAIRMAN WALLIS: Does this save run time as well?

MR. LANDRY: I don't know if it saves run time. In the past, a number of the changes were made into RELAP to make the code run faster and in the process created other problems.

What we've been looking at, the impression that we've gotten is that Siemens wasn't so concerned with run time as with robustness with these changes. So our feeling was they're going in the right direction. They're getting out of this mindset that we've got to make the code fast and run in real time. Let's back up. Let's make the code get rid of some of the errors or let the code calculate without generating errors where there shouldn't be errors.

MR. SCHROCK: Does it have any impact on the frequency of code failures, required restarts?

MR. LANDRY: In fact, one of the goals of the numerical changes was that the restart -- the code would be smoother for restart, but the code would not have to be restarted as much because the code would not fail as frequently.

MR. KELLY: This is Joe Kelly from Siemens Power, and I'll give you an example of that.

You're probably familiar with when the INEL was using the RELAP5/MOD3 code for the AP-600, and you had to baby your calculation along, you know, part of the transient. You get it done, and the code would fail. You'd have to back up and restart and take a number of different calculations before you got to the final answer.

And as we went through the AP-600, that get better and better, but still RELAP5 was plagued with what are commonly know as water property failures.

Those are almost unheard of at the version of the code that Dr. Chow modified for Siemens. For example, in the realistic large break LOCA, we typically put in a job that will do 70 large break LOCA transients, and all 70 of those were run to completion with no failures. That's common, and that takes about three days to do 70 large break LOCAs.

MR. SCHROCK: I think that's impressive, and I would think you'd want to highlight that as a major improvement in the RELAP computations. I think, in fact, one needs to be suspect of calculations that have been carried to completion with so-called restarts, the idea that you can really set up initial conditions to correctly carry on the continuity in a calculation that's terminated by a code failure or machine failure.

DR. KRESS: Worrisome.

MR. SCHROCK: Yeah, very worrisome.

DR. KRESS: You don't know how far --

MR. SCHROCK: I don't know that it's ever been shown that, indeed, there's any legitimacy to it at all.

CHAIRMAN WALLIS: So you get a start for that.

(Laughter.)

MR. KELLY: Is it black or gold?

(Laughter.)

MR. LANDRY: Continuing with the code numerics, we talked already a little bit about the one dimensional/multi-dimensional mix that's permitted. We were satisfied with the work that they'd done in this area, and of course, there is the question of why do they use multi-dimensional in this location and not this.

Well, there has to be some pre-knowledge or predetermination of where it's going to be important, but we feel that what they've added to the code making it two dimensional capable is a big change to the code and a big improvement over the old RELAP5 methodology of the multiple capable junction flows out of a node which were not really multi-dimensional; pseudo multi-dimensional that wasn't real and was not really physically justifiable.

CHAIRMAN WALLIS: Well, now you have the code, and the relevance of stabbing in the dark and saying, "Well, why didn't you use it for the low plenum?" you could say that we have used it. We, NRR, have used your code and found that there are significant multi-dimensional effects when you use a 2D model in this part, and we wonder why you didn't do it.

You're in the position to do that if you have the resources.

MR. LANDRY: Well, we have the code at this point.

CHAIRMAN WALLIS: Otherwise it seems to me your RAIs are based on a kind of intuition that maybe there's something to be investigated here. But if you have actually investigated it yourself, you're got really firm ground. You could say, "No, we've run your code, and we find that there is a two dimensional influence."

MR. LANDRY: Well, one of the problems we ran into is while we have the code, we were very limited in staff capability or staff availability to make some of theses runs. We lost a few significant people during this review that we had been counting on to do those roles.

CHAIRMAN WALLIS: Well, ACRS has been saying, and they just said it last week or something that this was a more efficient -- the process of review should be more efficient now that you have the codes to run yourselves.

And maybe we're wrong. Maybe you just don't have the resources to do that, but it seems to me our intuition is that if you can run it yourselves, then you have much more insight about what questions should be asked and what questions you could put to rest yourselves without even asking them.

MR. LANDRY: Well, in this case, the availability resources were spread just too thin to do too many investigations.

CHAIRMAN WALLIS: But if it's a more efficient process as we maintain, it should require fewer resources. So I don't quite know. Maybe we're wrong in saying it's a more efficient --

MR. LANDRY: Well, but there have to be the resources, and when you lose the resources, then you have to determine where are we going to put those resources in looking at what the codes are capable of doing.

MR. ULSES: Ralph, this is Tony Ulses of the staff. I just wanted to jump in here.

We did actually run the code. I actually ran the code on some sample problems. I ran some test problems, very simple elbows, pipes, and Ts, those kind of problems, just to sort of exercise the model.

And so we did exercise the code in this case.

CHAIRMAN WALLIS: But you didn't run a small break LOCA calculation with different assumptions or --

MR. ULSES: That's correct. We didn't actually go through and do like a sensitivity study, for example, you know, change the lower plenum say from a 1D model to --

CHAIRMAN WALLIS: So you're still very dependent in what the applicant chooses to show you

MR. ULSES: Well, I'd argue in this case that that's the kind of thing that I would find to be more beneficial when we look at the best estimate application of the model because here we're sort of locked into what they can do with this model, you know, but that's an Appendix K I guess you could say artifact in a sense, but that's certainly where it is.

CHAIRMAN WALLIS: The one we get to is these realistic codes. Then you're going to have to have the resources to do the things which are necessary.

MR. ULSES: Exactly, and I think we are planning -- we're planning for that modeling, my boss included.

DR. ZUBER: How are you more than a upper plenum, just as the 1D, 2D or 3D?

MR. LANDRY: I'll has to ask Siemens how they modeled it. The upper plenum, is it --

MR. JENSEN: This is D.A. Jensen at Siemens.

I believe the upper plenum model with a small break is one dimensional. We're treating it one dimensional.

DR. ZUBER: And what is the best estimate?

MR. JENSEN: The best estimate gets pretty complex. I think there are two dimensional components with best estimate.

MR. LANDRY: Okay. The code was modified in the one and two dimensional finite difference formulation to --

CHAIRMAN WALLIS: One of the things when we looked at the documentation, there was some what appeared to be strange and probably more than strange documentation which claimed to represent one and two dimensional in the same equation. It had some definition of the divergence which looked very unusual in areas where areas don't belong inside the properties for which you take the divergence because the divergence itself takes care of areas.

So I guess that's going to be fixed up?

MR. LANDRY: I think we have caught some of that and had some discussions with Siemens.

CHAIRMAN WALLIS: Well, it didn't appear in the RAIs. So I assume that somehow in some other channel it's been transmitted that that needs to be fixed up. Because we don't want to see those again, those strange -- "strange" is a polite way of saying what we might say. It looks strange. Therefore, one tends to think that it's wrong.

We look at it more and more and say it's stranger and stranger.

DR. ZUBER: It's worse and worse.

MR. SCHROCK: I have a little trouble with the next to last bullet: "extension to multi-dimensional flow is by adding subscripts to appropriate parameters to account for all directions."

Starting from the differential equations, you have in your 1D application simplifications that introduce lump parameter properties that have to be evaluated from experiments somehow. You'll have heat transfer coefficients, interfacial area, all of those gory details.

And there's some arguments that have some rationale for the 1B case. When you go to a multi-dimensional case, now, you have to go from that level, again, and see what it is you're arguing and what are these new parameters that have an appearance similar to the 1B case, but must have different meanings in a multi-dimensional application.

So it seems to me that's a very naive statement that you have in that bullet.

CHAIRMAN WALLIS: You mean that something like a heat transfer coefficient, is it correlated with the absolute velocity or --

MR. SCHROCK: Well, all of the parameters in the two fluent model. All of these things that are lumped representations of the physics locally for a sizable control volume in this computation.

After all, this is not a finite difference computation, however much it may appear to a casual observer to be. It is not.

CHAIRMAN WALLIS: Well, for instance, the drag force in the Y direction in the one dimensional flow is not just calculated from the velocity in the Y direction. It has got to be calculated from some combination of the velocities and resolution of the resultant force.

MR. SCHROCK: Sure.

CHAIRMAN WALLIS: And it's not clear that that's done properly.

MR. SCHROCK: So these are newly defined quantities that have to be found empirically, don't they, in order to solve the equation?

So how are they found empirically? What do they even mean?

I don't think that it's so simple as saying the multi-dimensional flow equations are obtained simply by putting subscripts to have different directional significant. I mean, you have to say something about how you get the numbers.

CHAIRMAN WALLIS: It's something like in the facial friction and annular flow in the pipe this is one dimensional.

MR. SCHROCK: Yeah.

CHAIRMAN WALLIS: There's no way that you can say that this somehow applies to a three dimensional case. I mean, you don't even know what annular flow looks like in the three dimensional. Probably the concept itself is meaningless.

Am I sort of following up on your --

MR. SCHROCK: Yeah.

CHAIRMAN WALLIS: -- thought processes?

MR. SCHROCK: Right, exactly.

MR. LANDRY: Well, I said that we are not numeric experts, but this was our interpretation of what we were reading, that --

CHAIRMAN WALLIS: This is one of the troubles we have in the documentation, was I think with this particular part, and that may need to be cleared up for the next time we see it.

MR. LANDRY: Okay, but we're interpreting that when they're going from one dimensional to multi-dimensional, two dimensional, that parameters that are required to be maintained in the second dimension were carried over by adding the subscript, going from a J plus one to J subscripting I to I plus one; that there's a subscript addition to account for the variables that had to be accounted for.

MR. SCHROCK: Well, it's certainly true that a rational approach to a multi-dimensional computation will result in terms having subscripts that denote directional features as variables, but you don't take a one dimensional description, which is approximate, and go from that to a multi-dimensional description simply by adding subscripts to the equations. At least I've never seen such a procedure.

CHAIRMAN WALLIS: Basically that implies that the two dimensions are independent, and they're not in terms of things like heat transfer coefficients, friction factors, the things that you would add a coefficient on.

MR. LANDRY: Yeah.

DR. ZUBER: Did you, you or the applicant, make any sensitivity calculations on the friction factor's interfacial or on the solids and see what effect it has on the results?

MR. LANDRY: Last August during the presentation, Joe Kelly was talking about he multiplied the interfacial friction by a factor of five, if I remember correctly.

MR. KELLY: Divided by.

MR. LANDRY: Or divided by a factor of five. The same thing. Altered it by a factor of five, and saw very little change in P fighting temperature for a calculation.

CHAIRMAN WALLIS: But it modified the pool swell.

MR. LANDRY: Yeah.

CHAIRMAN WALLIS: In order to get the void fraction in the core right, you had to change the interfacial friction quite a lot. It didn't make much different to be peak clad temperature.

MR. LANDRY: Right.

CHAIRMAN WALLIS: And that's one of the things that's interesting, and the argument about we don't need better codes always seems to be, oh, well, peak clad temperature isn't sensitive to all of these things, but there may be other criteria for safety than just peak clad temperature.

And if those turn out to be important, then the codes may be tested in other ways. It's remarkable how insensitive to anything peak clad temperatures seems to be. I don't know if it's luck or skill that's made this happen.

MR. LANDRY: Well, for this application, the overriding criteria are peak cladding temperature and clad damage. So if you don't make any changes in those, then whether you're emptying the system a little faster or the mixture is a little greater or a little less, we don't have a way to put a requirement on that.

CHAIRMAN WALLIS: Small break LOCA is not too bad a test. When you've got a pot of water boiling and you've got a hole somewhere, the rest of the system doesn't do very much.

MR. LANDRY: Okay. We looked at also the solution to the finite difference equations, and while we were looking at those solution methods, we saw that the equations were are solid for the independent variables with momentum being solved at the old time.

New time saturation temperature, phasic temperature and density are expressed in the independent variables using a first order Taylor series expansion.

We saw that sparse matrix solver is used to then solve for a delta P for each volume, and the delta Ps are used for computing new time phasic velocities for all of the junctions.

Phasic energy solution was obtained for the volumes and quality and new time void fraction for each of the volumes. The bottom line, and there is a correction scheme built in that mitigates numerical anomalies, inconsistent daughtering between the cells.

Excessive fluent flowing out of a volume, water packing, some of the problems which were alluded to a little earlier.

CHAIRMAN WALLIS: So these are improvements made by Siemens to the RELAP5 code as it was before.

MR. LANDRY: Right, improvements that make the code more robust, more stable.

CHAIRMAN WALLIS: By "robust" you mean that it doesn't crash?

MR. LANDRY: It's less likely to crash. It's less likely to generate errors, mass errors, energy errors.

DR. KRESS: Your nest to last bullet there, sub-bullet, is that done internally and automatic in the code?

MR. LANDRY: Yes. They're done, and the user cannot alter those. They're out of the control of the user.

The code will use a number of different methods for time step checking to look for problems with Courant limit violations, mass air checks. Water pot rechecks were one of the things that Joe Kelly was mentioning earlier.

Excessive extrapolation. These are done for each of the volumes. So this makes the code in this respect less user dependent.

Turning to the heat transfer, heat transfer coefficients, critical heat flux are essentially the same as in RELAP5/MOD2. Most of these have had extensive peer review. There are some modifications that have been made, but basically the correlations that are used are ones such as modified Zuber, Saha Zuber, Chen correlations, correlations that have had a lot of use, a lot of peer review.

Those --

CHAIRMAN WALLIS: Ralph, I was just thinking about the time here. Maybe the agenda that I have is not describing what you're saying because it looks to me as if you might still be on introduction and background, but you're actually -- your presentation is this set of slides, or are there three other presentations coming after it?

MR. LANDRY: No, this is it.

CHAIRMAN WALLIS: Okay. So it doesn't quite follow the agenda I have. That's all. I was just worried about the time if you had three other presentations following.

MR. LANDRY: No.

The changes that were made in the heat transfer correlations were changes made to go to correlations that the applicant felt had better data bases, better support.

Looking at the transition and film boiling is where we find one of those major changes, and that is switching from the Dittus-Boelter to the Sleicher-Rouse correlation.

When they were looking at the Dittus-Boelter correlation, if you got into the high vapor flow regimes for certain ranges of Reynolds and Prandtl numbers, the Dittus-Boelter correlation would be off by as much as ten to 25 percent with respect to the data.

Work had been done by --

DR. ZUBER: Which?

MR. LANDRY: In particular, FLECHT-SEASET and some of the vapor data that Sleicher-Rouse were looking at.

DR. KRESS: Dittus-Boelter is a single phase, well developed flow, and you have it left under transition and film boiling. I don't understand the connection.

MR. LANDRY: Well, primarily this is looking at it in the single phase vapor flow.

DR. KRESS: Vapor flow.

MR. LANDRY: But there --

DR. KRESS: But -- yeah, okay.

MR. SCHROCK: There are correlations for heat transfer to gases at high temperature which are quite different. As Tom has just said, Dittus-Boelter is an average value of the heat transfer coefficient, fully developed flow and some minimum L over D, which I think was 80. I don't remember for sure, but it's not a local value. It's being used in the code as a local value.

That's to begin with a problem, but I think the Sleicher-Rouse correlation is probably in the same category. I don't believe it's based on local conditions.

DR. KRESS: No, it's the same thing.

MR. SCHROCK: But there are correlations in the literature for high temperature, for high surface temperatures to gases, which would be more appropriate in this particular domain. It would make a lot of sense to look into that rather than to sort of willy-nilly take such a simple approach as looking at Sleicher-Rouse as maybe being better when it's clear on the face of it that it's not really intended as a local heat transfer coefficient.

You characterize the things as having extensive peer review of models. That's misleading, Ralph, because these things have been said over and over and over again in peer reviewed discussions about the fact that the codes seize on simplistic fixes for things that are not well understood at the time the original versions of the code were being developed.

People had to put something in in order to develop a running code. Understandable at the time, but to perpetuate that and to say in the year 2001 what's in there is good because it's had extensive peer review is so counterproductive to the regulatory process I just can't believe that you would come here and say such a thing.

MR. LANDRY: We felt that a number of correlations that were being put into the code that Siemens was using now --

MR. SCHROCK: I don't think you heard what I said.

MR. LANDRY: -- are ones that are an improvement.

MR. SCHROCK: The reason Dittus-Boelter was there was at the time people didn't think there was a better correlation out there to use for the purpose, and something had to be put in in order to make a running code.

That doesn't mean that people who peer reviewed it said, "Yeah, this is great." They acknowledged that it's about as good as you can do today when today was 1975 or 1980 or even 1985. It's not the best that you could do in the year 2001.

And if you want to argue that the safety valuation codes in use by the industry and NRC are good because they've had extensive peer review, you're doing something that is absolutely counterproductive to your purpose in life.

MR. LANDRY: We felt that the switch from the Dittus-Boelter to the Sleicher-Rouse was doing just that, that it was switching from a correlation which has historical usage to one that does a better fit to data, and in particular, the FLECHT-SEASET test was compared with both correlations, and the Sleicher-Rouse correlation does a better job of fitting data from FLECHT-SEASET.

Both correlations overlay temperatures at 72 inch elevation in one of the FLECHT-SEASET tests for most of the range of the test, but then Dittus-Boelter starts to diverge, and the Sleicher-Rouse correlation continues to give a very close calculation of the test.

Now, in fact, from the information that was shown the Sleicher-Rouse correlation deviates only about 4.2 percent from the data, whereas Dittus-Boelter starts to emerge further.

CHAIRMAN WALLIS: Well, let's get back to the peer review. I get the impression then that the peer review was to review to see how well these models fit in some nuclear type, say, nuclear safety type data, and they were not looking at how good these models were from a more general viewpoint, as some outsider might say.

It's very strange to see this model used for this application, but your peers actually said, well, but it works for this application. Therefore, it's okay.

I mean they were not really saying from some more general that it looked like the best thing that could be used.

MR. LANDRY: However, they seem to work well for these applications, and that's things like Virgil's --

CHAIRMAN WALLIS: That's what the view really was about.

MR. LANDRY: Yes.

CHAIRMAN WALLIS: Was that they worked for these applications.

MR. LANDRY: Yes. And using Saha-Zuber correlation, Chin correlations, that these have been looked at and seem to work very well for this specific application.

So our view was that they have had a fairly good peer review. They've been looked at by the international community, and that's a good recommendation.

DR. ZUBER: But what Virgil is saying is still correct. Some of these cards go back for 30 years ago, at least 25 or 26. At that time we had not enough data or not enough information. We put the best we could, but then just by plain inertia or mental laziness, people are using the same thing and reusing without really looking what's better, what they should do for the future.

And I think the point he is making, and I think this is what you should really also think in the industry, in the year 2001 we should have much more information. What better correlations, equations I can put in the code?

I think you should as a regulatory encourage the industry to do this.

MR. LANDRY: I think that's one of the things that we're trying to say we're trying to do, Novak, is to point out that while the vast majority of the heat transfer correlations are historical, there are some that they put in the code which are more modern and that have had more extensive peer review for this application.

And one of those is, we feel, Sleicher-Rouse. We look at what Siemens has done in the way of supporting this correlation and feel that they've come back and said that, yes, there is good assessment against FLECHT-SEASET, which is a prototypic test part of this application.

The correlation is doing a better job than the historical correlation for this application. It has less uncertainly. It's overlaying the data very well, and we feel that that is an improvement to the code.

So we are not trying to argue with what you and Virgil are trying to say. We are trying to say, yeah, we are trying to encourage that thinking, that just because a correlation is -- or anything in the code -- is historical, if there's a better way, we'd like to see it done that way.

DR. KRESS: This is a FLECHT-SEASET test. Are those the ones that are being redone at the University of Pennsylvania?

MR. LANDRY: I don't know.

DR. KRESS: To get a better --

MR. LANDRY: I don't know if this is one of those that's being redone or not. This was the steam cooling test.

DR. KRESS: It didn't have any --

MR. LANDRY: No, this is was --

DR. KRESS: Strictly steam?

MR. LANDRY: -- pure steam cooling test.

CHAIRMAN WALLIS: So it's not transitioning from boiling.

DR. KRESS: Well, I was thinking about the refuel phase.

CHAIRMAN WALLIS: Well, he says it's just steam cooling.

Is this just steam cooling? Yeah?

MR. LANDRY: Yeah.

DR. ZUBER: Well, then your title to the bullet is a little bit misleading.

MR. LANDRY: Well, I was looking at the transition and film boiling and said, "Okay. What in transition and film boiling can I say?"

Well, we can say something about Sleicher-Rouse, in particular, which is really film boiling. It says steam cooling and vapor flow, but in other words, just lumping out of that whole bracket.

MR. SCHROCK: And what about the geometry? Sleicher-Rouse is still based on data and tubes, is it not?

MR. LANDRY: Yeah, but it's less dependent upon entrance effect.

MR. SCHROCK: Well, my point is that you're concerned with bundles and not with tubes.

MR. LANDRY: This was stated for fully developed flow, had a wide range of Reynolds number, and it was at varying distances from the entrance.

MR. SCHROCK: Was the distance from the entrance one of the independent variables in the equation itself?

MR. LANDRY: This is for application against FLECHT-SEASET in the range of 72 to 78 inches up the rod.

MR. SCHROCK: I see, but it was an average over that range.

MR. LANDRY: Joe Kelly, did you want to say something?

MR. KELLY: Joe Kelly from Siemens Power.

As part of the getting ready for the realistic large break LOCA, one of the things I did was compare the Sleicher-Rouse correlation versus in all of the steam cooling data in the FLECHT-SEASET program, and as was rightly stated, it was developed for tubes.

It is a LOCA conditions correlation, you know, averaged across a cross-section course, but you know, at some LOCA condition.

And when I compared it to rod bundle data, of course, some things stand out. There's no enhancement due to grids, and since the grids are about 50 L over Ds apart, you're never fully developed, and Sleicher-Rouse is for fully developed flow conditions.

So what you would expect is for it to under pick data, and, yes, indeed, that's exactly what happens. When you look at all of the 161 rod bundle steam cooling data, the mean under prediction was seven percent, and the uncertainty, the one sigma standard deviation was 15 percent, plus or minus.

CHAIRMAN WALLIS: Which is fairly big.

MR. KELLY: Yes.

CHAIRMAN WALLIS: So this errs on the conservative side?

MR. KELLY: Yes.

CHAIRMAN WALLIS: That's one of the fall back positions if all else fails. Ah, but it's conservative.

DR. ZUBER: Appendix K.

CHAIRMAN WALLIS: We're going to keep going, Ralph, I think, in hopes that you will give us a break.

MR. LANDRY: In hopes that I'll finish?

CHAIRMAN WALLIS: Well, normally we take a break about now, but you seem to be doing so well. Is it okay if we continue?

MR. LANDRY: Fine with me. As long as my voice holds out, I'll continue. It's a terrible time to get a cold.

Continuing on with the heat transfer, core reflood modeling we noted has changed to allow user activation of a rezoning in the heat structures, not a rezoning in the hydrodynamic nodalization, but a rezoning in the heat structure, which should give a more accurate representation of the different heat transfer regimes. We felt that this was doing a better job from what we saw, looking at the documentation of capturing the heat transfer profile.

The rezoned axial nodes extend from the bottom to the top of the active fuel with the finer zones in the regions of nucleate and transition boiling.

Hydrodynamic loading is retained with the hydrodynamic conditions being applied to the heat transfer zone.

We looked quite a bit at the scaling and applicability of the correlations. Most of the heat transfer correlations that are used have been used quite a bit in other codes, such as RELAP5, TRAC, COBRA/TRAC.

We looked at the examples of the scanning dependency that the Siemens Power Corporation had provided in the documentation and felt that they had done a good job of looking at the correlation, seeing that the correlations are used in the proper range of parameters and that the correlations are applicable to the use for this code.

Okay. We've already talked quite a bit about the kinetics. So I'd just say very briefly that the code still uses the old point kinetics model, computes immediate fission power, decayed fission power, and is based on ANS 5.1, 1973, and ANSI ANS 1979.

CHAIRMAN WALLIS: Is that required in Appendix K?

MR. LANDRY: Yeah, Appendix K requires --

MR. SCHROCK: Seventy-three ANS.

MR. LANDRY: -- 73 ANS.

MR. BOEHNERT: Seventy-one actually.

MR. SCHROCK: Well, it was modified to 73.

MR. BOEHNERT: Oh, was it? Okay.

MR. SCHROCK: That was the objective to the exponential fit, raised the issue is to curb the standard there is the exponential fit to the standard.

So the committee decided to say the curb is the standard.

That's the only difference.

DR. KRESS: Yeah. Could you go back to the previous slide? I had a question on that.

Under the first bullet, your third sub-bullet, your zones where you have nucleate in transition and film boiling vary with time. They move around.

Does the code actually do its own internal noding depending on where those things are?

MR. LANDRY: I'd defer to Siemens for that.

MR. KELLY: Joe Kelly from Siemens.

This mic is powerful.

(Laughter.)

MR. KELLY: The answer is yes. It rezones the fuel rods, not the hydrodynamic cells.

DR. KRESS: Oh.

MR. KELLY: And typically for a calculation it will take one, you know, computation by the fuel rod and split it into 32.

DR. KRESS: Okay. Thank you.

MR. LANDRY: Actually I wanted to bring up it's not contained in the handout. Tony Ulses is going to spend a few minutes talking about some of the exploratory studies that have been done using fluent to see some of the effects in piping configurations.

MR. CARUSO: Did you want to take a break before he starts or --

MR. ULSES: I was going to say I could volunteer. Do you want to take a break? This is a principle to RELAP, but we wanted to talk about it mainly because we wanted to engage the committee early in our thinking here, but it was not --

CHAIRMAN WALLIS: Does it look as if the NRR presentation will extend to lunch then if we have a break now? Will that leave Siemens enough time?

MR. HOLM: Jerry Holm.

Do you mean leave enough time for our formal presentation?

MR. LANDRY: We only have a couple of topics left to talk about: the assessment, some specific assessment issues, sensitivity studies and conclusions.

MR. ULSES: I can volunteer that I wasn't intending to really take a long time. I just wanted to sort of give you a feeling of where we're going with this.

CHAIRMAN WALLIS: I think we should take a break. We'll take a break until quarter to 11.

(Whereupon, the foregoing matter went off the record at 10:30 a.m. and went back on the record at 10:46 a.m.)

CHAIRMAN WALLIS: Let's come back in session and continue.

MR. LANDRY: Tony Ulses is now going to talk for a little bit about some of the scoping studies, exploratory studies that he's been performing for us.

MR. ULSES: Let me see if I can get this up. I'm not quite that tall. Geez, now I broke it. There we go. There's a clip on it. Okay. I'll just leave it alone. I can lean over it.

Anyhow, instead of talking about the question of the wall friction factor earlier, and that's actually an interesting lead-in to my talk.

Hey, there we go. Oh, that's perfect. I guess I should go back to school to learn how to work with mics.

It's actually an interesting lead-in to my topic because I've been spending some time thinking about conservation of momentum, and what I want to do, let me start out by handing these out. I'll go the other way. Oh, Paul, perfect, excellent.

Where I am right now is we're very early on in our thinking process on this, and we want to try to get our hands around the issue.

And so what I've been doing is I've been trying to basically essentially go back and sort of unlearn what I think I know and start from the beginning again by looking at simple problems, say, a pipe, say, an elbow.

And I want to go back, and I want to see if I can use RELAP and TRAC and if I can calculate the float, in other words, the pressure drop across that particular component which is -- oh, thanks -- which is the relevant -- which is what we're really interested in in reactor safety, is the float.

So I have here just a couple of slides. I've only really done a couple of problems here so far. I've exercised both the TRAC and the RELAP codes and decided to put in a couple of edits from the TRAC code because, well, they're actually a little bit easier for me to understand and to describe.

DR. ZUBER: This is which TRAC?

MR. ULSES: This is actually TRAC G actually I was actually exercising.

DR. ZUBER: TRAC G?

MR. ULSES: Right, yeah. We're actually exercising it in the context of that review, but the codes for these kind of simple problems should really give about the same results. So basically this is kind of where we are.

I'm missing a viewgraph here.

Well, okay. I'm missing my viewgraph, but if you look at the first one, that's basically a vertical pipe. It's a one meter vertical pipe, but that's the fully developed velocity profile from a line from the center of the pipe out to the wall. That's calculated by the flue at code.

That's fine. That's fine. I don't need another. That's fine. It's very simple.

And so basically the question I had in my mind is: can I set that model up in, say, TRAC and RELAP, and can I calculate the pressure drop across that pipe?

And if you look at the next page, what you're going to see is the output from the TRAC G code, and if you go out and if you do the hand calculation, which is what this really is, you can determine that the code actually is giving us the right answer for this particular component, and this is without having to go into the code and modify or add any particular values for loss coefficients or that sort of thing.

CHAIRMAN WALLIS: I don't understand. This goes back to a single phase?

MR. ULSES: Yes.

CHAIRMAN WALLIS: And then the next phase is --

MR. ULSES: It's water velocity. No, it's a water with a velocity boundary condition at the inlet that fits --

CHAIRMAN WALLIS: But the next phase says vapor velocity, liquid velocity.

MR. ULSES: That's the standard output from the TRAC code. All that information is essentially nonsense.

CHAIRMAN WALLIS: So you've proved --

MR. ULSES: In this particular context.

CHAIRMAN WALLIS: Oh, so I'm not quite sure what I should look at then.

MR. ULSES: What you should look at is the pressure drop, and you should look at the liquid velocity, and what this is telling me if we go back and we do the hand calculation, we're going to see that we're getting the right answer for this particular component.

CHAIRMAN WALLIS: For straight pipe with a --

MR. ULSES: For vertical straight pipe. Very simple. All single phase.

And actually when we're looking at these kinds of calculations with the flue at code, we're going to have to restrict ourselves to single phase because that code cannot handle multi-phase flow, but right now in the context of what we're trying to do in the early phases of our thinking about this is we'd like to start out with these very simple problems.

CHAIRMAN WALLIS: So this is about problem number one?

MR. ULSES: This is problem number one, and I would characterize this as probably high school physics level kind of flow. It's very simple stuff, but I wanted to see whether or not the code would give me the right answer.

CHAIRMAN WALLIS: Okay.

DR. ZUBER: And this is the velocity across the cross-section?

MR. ULSES: Yes, sir, from the center line out to the wall. That's at the exit of the pipe actually.

CHAIRMAN WALLIS: But the TRAC isn't predicting that.

MR. ULSES: No, no. And that's actually an excellent point. The TRAC has actually no knowledge of that.

DR. ZUBER: What turbulence model do they have here in that to predict that profile?

MR. ULSES: It uses the --

DR. ZUBER: K epsilon or what?

MR. ULSES: -- K epsilon model. However, we have many different ones to choose from in fluent. We can use an RNG K epsilon model. We can model the Reynolds -- we can actually model the Reynolds stresses directly in the pivot if we chose to do so.

But for this application, we just use the basic K epsilon model, but that's an excellent point. If you look at the velocity profile, the TRAC code has absolutely no knowledge of that velocity profile. What it's doing is it's calculating the friction by determining a friction factor.

And if you look at the output, it is correctly capturing the gravity head term in the pipe, and so we are getting the right answer basically or the correct delta P across the vertical pipe.

A very simple problem, but I thought it best to start with the simple problems.

CHAIRMAN WALLIS: How does fluent determine the delta tables?

MR. ULSES: It's actually solving the Reynolds average.

CHAIRMAN WALLIS: You mean Reynolds?

MR. ULSES: It's actually solving the Reynolds average numbers in those equations, and it's actually calculating, but then we see that every point on that line actually corresponds to a node if you looked at a cross-section across the pipe.

CHAIRMAN WALLIS: Okay.

MR. ULSES: So we are correctly predicting the boundary layer in the model itself.

CHAIRMAN WALLIS: And code you're comparing it --

MR. ULSES: Well, actually that's probably what's actually wrong with RELAP and TRAC. I chose to show the TRAC results because I personally find them a little easier to discuss.

DR. KRESS: But the TRAC is just using a friction factor based on Reynolds.

MR. ULSES: Right, and RELAP is doing exactly the same thing.

DR. KRESS: Okay.

MR. ULSES: Then if we move on to the next problem, I decided to make things a little bit more challenging. So I decided to model an elbow, and what we have there is we have an elbow with a horizontal section, which is one meter long leading into a vertical section, which is one meter long, and what we're seeing there obviously is -- I actually do have this one right here.

This is actually the velocity magnitude. In other words, this is the scale of velocity from the solution, and obviously we're seeing the flow separation around the corner as we would expect for this particular component.

MR. SCHROCK: It was really in a sharp corner in this elbow?

MR. ULSES: Yes, this was a sharp corner. I did not round it off as I could have. That is an option I could have.

CHAIRMAN WALLIS: And this is a 2D pipe or something?

MR. ULSES: Actually it's actually --

CHAIRMAN WALLIS: A round pipe?

MR. ULSES: It's actually three dimensional. This is a plane, cut down the middle of the plane in the vertical direction.

MR. SCHROCK: So it is a circular plane?

MR. ULSES: Yes, sir. And, again, the question I asked myself is can I model this with RELAP and TRAC and can I get the correct delta P across the pipe, which is, again, what we're really interested in when we do a reactor safety type application.

Actually the next few curves are really just intended to show --

MR. SCHROCK: Do you have some experimental data for such a problem?

MR. ULSES: On this particular problem, no, I don't. However, I also did --

MR. SCHROCK: It would be surprising if it doesn't exist.

MR. ULSES: Well, certainly it does, and I went back and I asked myself before --

MR. SCHROCK: Well, maybe not for your assumed geometry. I mean, you've got a --

MR. ULSES: Well, the corner would be what actually would get me there, the sharp corner.

MR. SCHROCK: You've got a separation.

MR. ULSES: Right.

MR. SCHROCK: But that may not exist.

MR. ULSES: That would be actually what would get me, but one thing I have done also that I actually don't have with me here is I have asked myself the question why should I believe fluent, and what I've done is I've gone back and looked at an infinite flat plate, and I looked to see if I could predict, say, the Gaussian solution for that problem, which is an analytical solution that I know that I can get, and if you look at the fluent results, that they do very well for that problem as one would expect.

MR. SCHROCK: But why would you believe that K epsilon report? That problem is going to serve this sharp cornered elbow.

MR. ULSES: Because I also looked at it with the RNG K epsilon model, and it gave me exactly the same answer. So I did a sensitivity study on the turbulence modeling itself. I used another turbulence model, ran a sensitivity study and didn't see any problem. I didn't see any changes in the answer, which is basically -- that's actually what you should do when you're running any kind of CFD simulation. You should never look at the answer and actually believe it.

MR. SCHROCK: I didn't understand the alternate K epsilon curve.

MR. ULSES: Well, it's a new model that's referred to as the RNG model. It's a written formulation of the K epsilon model.

MR. SCHROCK: It still is spatially dependent parameters that are derived from circular pipe/straight pipe data.

MR. ULSES: That is correct.

MR. SCHROCK: Yeah, and this is not the case with the problem that you have here.

MR. ULSES: Right, but it also does --

MR. SCHROCK: That's an inherent problem in that modeling of this kind of multi-dimensional situation. The parameters are found empirically in simplistic situations and then applied to more complex situations, which leaves open the question of what validity has the input -- the K epsilon selection --

MR. ULSES: Right.

MR. SCHROCK: -- for that 3D problem.

MR. ULSES: And what that leads us to is we have to do sensitivity studies. That's the only way you can really address those issues because these are, in fact, the state of the art turbulence models that are available. There really is nothing better.

So we're left with having to do -- since we have to run sensitivity studies on these types of simulations in order to give ourselves a level of confidence in the results.

CHAIRMAN WALLIS: -- to track. You've got these velocity profiles which TRAC doesn't produce.

MR. ULSES: It is actually no understanding of the velocity profiles, and so what we're doing basically is we go into TRAC.

This thing is killing me here. There we go. How about that? That's fine. I've got it.

And how we would model this elbow in TRAC and RELAP is we put a form loss coefficient in there to deal with the elbow because TRAC and RELAP had absolutely no understanding of velocity profiles.

And so what I've done is I've gone back, and I've put in a form loss coefficient into the model, and I can, indeed, predict the appropriate delta P.

Then if you vary the inlet velocity, and if you hold the form loss coefficient in the TRAC and RELAP models the same, you can, indeed, correctly predict the trends and the changes in delta P.

So that's basically it. This is effectively where I am right now. This is all we've done. Like I said, we're trying to get a start on this. We're trying to get our hands around the question, and we're trying to bring in our new tools into the process, namely, CFD.

MR. SCHROCK: Now, in the code you have three dimensional capability supposedly, and so one would have to wonder what result you would get with that two dimensional capability.

MR. ULSES: It would be an interesting test.

CHAIRMAN WALLIS: Well, we should probably move on.

MR. ULSES: Well, what I wanted to do basically was to sort of --

CHAIRMAN WALLIS: This has a long way to go before you use it for reactor safety.

MR. ULSES: I just wanted to engage in a discussion where we're going and what --

CHAIRMAN WALLIS: It would be interesting if you could, say, look at lower plenum flows or something and see how one dimensional they are and, you know, make some comparison with a reactor situation. That would be interesting.

MR. ULSES: Any comments, questions? Like I said, this is very early on in the process.

CHAIRMAN WALLIS: Yeah.

MR. ULSES: We're just trying to get started on it at this point. Okay. Excellent.

Thank you.

CHAIRMAN WALLIS: Thank you.

MR. LANDRY: Okay. That was intended, as Tony said, to give you an introduction to what we're doing in the way of looking at scoping and exploratory studies. We talked on a number of occasions about what we would like to do, and so we're just getting a start on it, but trying to explore what happens within different components with one code and what does that mean with the systems codes that are being reviewed for licensing application.

I'd like to now turn to the code assessment which was done for S-RELAP5. The code assessment is in some ways fairly cut and dried. There are requirements in Appendix K, 5046 for code assessment, but there are also --

CHAIRMAN WALLIS: You need to get rid of that tall mic.

MR. LANDRY: I think it's better with that one down. That one was pointed up at the speaker.

There are additional requirements in NUREG 0737, which came out after the TMI-2 accident and lessons learned effort, and Section 2(k)-330 of NUREG 0737 specifies calculations and assessments which must be done by an applicant for the small break LOCA specifically.

Two (K)-330 says that the analysis methods used by a nuclear steam supply system vendors and/or fuel suppliers for small break loss proned accident analysis for compliance with Appendix K to 10 CFR, Part 50 should be revised, documented, and submitted for NRC approval. The revision should account for comparisons with experimental data, including data from LOFT tests and semi-skilled test facilities.

After NUREG 0737 can out and was applied, the assumption was that two of the tests that were mentioned in the supporting material in 2(k)-330, specifically semi-skilled test 07-10B and LOFT test L-31, were tests that were required for all small break LOCA analyses.

In reality, the sections simply suggest that these are possible tests that can be used. Siemens, in looking at S-RELAP5, looked at available data and said that there are better data available and better tests that these two tests at this point.

That report was written in 1980, and since that point, there have been a lot of other tests run, and there are other tests that could be used to fulfill the requirements of 2(k)-330. A couple of specifics that were used S-RELAP5 are the semi-skilled test S-UT-8, LOFT LPSP-3, which was one of the tests run under the international program, the OECD program on LOFT. That's a large or a low pressure small break test in which the high pressure safety injection was locked out so that it caused core heat-up and then would come in and recover the core by low pressure and by accumulator flow only.

Siemens used 2D flow tests, UPTF tests, in particular some of the full size loop seal tests, and also used one of the BETHSY small break tests. These are some of the later test facilities, better instrumented, and some very good data.

CHAIRMAN WALLIS: So the small break LOCA covers a range of break sizes.

MR. LANDRY: Right.

CHAIRMAN WALLIS: And presumably in that one semi-skilled test there was one break size.

MR. LANDRY: Well, the semi-skill experiments covered a range up to ten percent.

CHAIRMAN WALLIS: But it say semi-skilled tests, S-UT-8. That's only one test. That's not a range of tests.

MR. LANDRY: that's right.

CHAIRMAN WALLIS: So if someone selected one test out of a batched -- why don't they compare with all of the tests?

MR. LANDRY: Because these tests were specified to bring out particular aspects of the code that should be investigated. The NUREG report does not specify every test because it doesn't say you have to validate or assess a code against every test that's been run, but very specific tests to look at specific phenomena that are occurring.

And the same for the LOFT test. It said L3-1 because it wanted to look at particular phenomena occurring in L3-1, whereas there is a whole series of tests. The L3 series run up to test seven. There is the LPSP series of tests run under the international program of small break tests and LOFT also.

So what Siemens has done is gone back and looked at the tests that are available and put together what is what they want to call a PIRT. It's similar to a PIRT: a chart that looks at the different effects that they want to see in particular locations. So it's just the decor.

CHAIRMAN WALLIS: It's an effect that was put in after the fact.

MR. LANDRY: No, this was put into the --

CHAIRMAN WALLIS: I lost the discussion.

MR. LANDRY: This is in the small break. Well, they alluded to it in the small break report, and then answered one of our RAIs with further details with a PIRT. They call it an informal PIRT because they didn't go through the complete PIRT procedure, and we have to be clear because Appendix K doesn't require that.

Appendix K does not require a PIRT, but Siemens has done a great deal of the work of a PIRT, and pointed up phenomena that are important in particular locations of a system, what tests are available to address those phenomena, and have gone back and looked at a lot of these test facilities that are not required under the regulations and under the NUREG, assessed the code against these facilities so that they have assessed particular phenomena that are occurring

DR. ZUBER: What did they look at under the UPTF?

MR. LANDRY: With UPTF they looked at for this case I'm talking about right now the loop seal. They've also used --

CHAIRMAN WALLIS: You addressed that last time, and there seemed to be troubles modeling the loop seal.

MR. LANDRY: Well, it's a question about the way it's modeled.

CHAIRMAN WALLIS: And yet your SCR says everything's fine, how well they modeled that, but in fact, the water retained was off by a factor of three and a half or something. So I'm not quite sure why you decided it was a good test of code. The 2D flow tests don't really test very much for a single phased mixing test in a strange sort of channel, which --

MR. LANDRY: Well, the UPTF --

CHAIRMAN WALLIS: And then the -- then the LOFT test, LBSB-3, simply a core dry-out with steam flow through a break, which follows from some energy balance for the core, not really a challenge to much of the code.

So I think we sort of concluded last time that the semi-skill and BETHSY tests were more extensive. But that's just two tests. It's amazing to me that that's a good enough assessment of the whole code.

MR. LANDRY: If you look at the assessment that they've done, they've used a number of different tests, not just these few tests.

CHAIRMAN WALLIS: I think in the responses to the RAIs you get a lot more comparisons, which is helpful.

MR. LANDRY: That's what I'm referring to right now.

CHAIRMAN WALLIS: Right.

MR. LANDRY: There they've referred to a number of other tests. They've used UPTF to look at CCFL, the inlet plenum. They've looked at horizontal stratification flow regimes. They've looked at condensation, two dimensional modeling.

But they've used different UPTF tests to look at different --

CHAIRMAN WALLIS: But the philosophy is so different from what one might suppose. The philosophy seems to be -- and look at the NUREG suggests to test -- to take this code and compare it with a couple of tests, and if it doesn't do too badly, it's okay.

I would think from an outsider's point of view, you can to explore a whole lot of tests and find out when the code gets into trouble rather than just showing that for a couple of rather arbitrary tests it looks okay. That's a very sparse test of anything.

I mean if you test something like Dittus-Boelter correlation, Dittus-Boelter is tested overall in a tremendous range of stuff to see when it works and when it doesn't.

This is not really a test of when the code doesn't work. It's just showing that for certain selected tests it looks okay. Is that good enough?

MR. LANDRY: Well, we have, as we've said earlier, we have the regulations which tell us what has to be done. However, in this case, looking at what Siemens has done, they've gone far beyond those two tests that were required.

CHAIRMAN WALLIS: But have they gone far beyond? They've used a semi-skill and the LOFT test and the Brentortian Effect C (phonetic) test.

MR. LANDRY: Well, they've used semi-skilled. They've use LOFT. They've used BETHSY.

CHAIRMAN WALLIS: Two D is probably not very significant.

MR. LANDRY: UPTF.

CHAIRMAN WALLIS: UPTF results were not particular good for the loop seal clearing.

MR. LANDRY: They used 2D flow tests.

CHAIRMAN WALLIS: Well, that's not -- that was just a single phase and a rather strange geometry, and we went over that when we were here before.

MR. LANDRY: But in the test assessment matrix that they presented in response to the RAI, they've gone in and they've used THTF tests, FLECHT-SEASET tests.

CHAIRMAN WALLIS: But you see, the philosophy that bothers me is if I have an automobile I want to put on the market, I don't just test it on one highway and one dirt road. I drive it all over the place and see when it works and when it doesn't, and that doesn't seem to be the approach to these codes.

DR. ZUBER: You see, Graham, it's tied to the cost. It takes so much time and so much money to run these different tests that industry really ties to avoid it.

CHAIRMAN WALLIS: The cost has got to be traded off against the cost if you're wrong and if there's a major disaster. And that cost is so big that -- what is this great emphasis on cost?

DR. ZUBER: The only way to enforce it is for the regulatory agency to do it, and so we are tied because the regulations only request two or three experiments. So, I mean, you are tied, on one hand, by a regulation and the other one by the cost, and we can bitch all we want.

MR. LANDRY: If you look at the PIRT chart in the assessment cases that they have run in response to the RAI, you see that they have run a great many more in the two.

CHAIRMAN WALLIS: Now, that's very assuring.

MR. LANDRY: They've run not only the 2D flow tests and the LOFT test B3. They've run the BETHSY test, THTF test, Bennett heated tube test, FLECHT-SEASET, CCTF, and two of the LOFT large break tests, another semi-skilled test. They've run another semi-skilled test, a UPTF test.

CHAIRMAN WALLIS: That's very good.

DR. ZUBER: Graham, one way to address this problem really from the outsider or from the technical community is for the regulatory agency to take this code and really exercise it, and if they have the code, they should have then the measurable stuff, support, and to run these tests and then make an assessment and then make a presentation.

CHAIRMAN WALLIS: Well, I don't buy the cost argument. The cost argument was good maybe 30 years ago when it was a real struggle to make a code work and it ran for days and you couldn't, you know -- you were very pleased if you got a couple of results.

But nowadays with computers able to do what they can do, it should be possible to do a lot more comparisons with tests.

MR. LANDRY: And in this case a lot more comparisons have been done.

MR. STAUDENMEIER: Joe Staudenmeier from the staff.

I think that TMI action item recommended tests weren't meant to be an extensive assessment of the code or the only assessment of the code. I think that particular tests were picked to demonstrate that the code could realistically simulate integral effects that would happen in the reaction, and I think, in particular, its natural circulation and breaking of natural circulation and also deep core uncovery and recovery from deep core uncovery, I think that's the specific reasons that these tests were chosen, to show that the small break codes could in a realistic manner predict these integral phenomena, and they weren't meant to be an extensive assessment of the code.

CHAIRMAN WALLIS: But they may have evolved into a sort of minimal requirement instead of just the suggestion where the expectation was that more would be done. So if that's all that's required, maybe that's all that's done.

MR. STAUDENMEIER: Yeah, and unfortunately it probably has. Historically it was treated like that, and it evolved into that. I don't think it was meant for that originally. I know people have done better than just that minimum requirement.

DR. ZUBER: If the agencies should really run these codes extensively and for different situations get the feel for how they run, how they perform, I think that will be really a good contribution and a good effort.

MR. LANDRY: We're working on that.

But when we looked at some of the results of their assessments and we looked at what they did with the semi-skill test that they examined, we saw that the core mid-plane temperature was fairly well predicted,a nd this is using the decay heat model in the code that's supposed to match the experiment.

Now, for an Appendix K calculation, of course, they're using the Appendix K required to the K heat model, which is going to be considerably higher, which is going to raise the temperatures considerably higher also.

So they're over predicting the measured temperature. In this case we would expect for a large analysis with delay heat raised 20 percent that we'd have a considerably higher temperature there.

When we looked at the results from the BETHSY cases they ran --

DR. ZUBER: Well, the idea that you have here is quite different. I mean, there's a discrepancy between the stored energy calculated and what was measured.

MR. LANDRY: But if we look at the BETHSY, they've got BETHSY even better. We look at the BETHSY case. They've got the core collapse level very accurately, and if you look at the temperatures, the peak temperature, the first time we looked at that we thought, "What's wrong? Nobody ever hits the temperature like that."

Apparently they've done a good job of modeling the BETHSY facility.

CHAIRMAN WALLIS: The BETHSY comparisons, these sudden leaps and the things that look like needles coming out of the graph, those are from S-RELAP5? Because presumably the core collapsed level doesn't behave like that, but if you look at the end of the collapse and where it suddenly recovers --

MR. LANDRY: Yeah.

CHAIRMAN WALLIS: No, look at the minimum.

MR. LANDRY: That looks like --

CHAIRMAN WALLIS: The minimum, there's sort of a spike that goes straight up in the air and comes back down again. That must be S-RELAP5. What are those doing? They indicate that the code is not as robust as it might be, that it has a tendency to make some wild excursions?

MR. LANDRY: It looks like it could be a numeric problem. We didn't examine the detail of that calculation.

CHAIRMAN WALLIS: Those are from the prediction. They're not from the measurement.

MR. LANDRY: Yeah.

CHAIRMAN WALLIS: It's hard to tell that figure. Do those sorts of spikiness bother you at all?

And if you look at the behavior of the code, I'm not quite sure which is which again. It's doing some spikiness early on as well.

MR. LANDRY: We've seen those so often from the codes. I guess we tend to overlook some of those spikes because they're not real. We know that they're not real. We know that they're numerics.

CHAIRMAN WALLIS: But if a spike went down and suddenly predicted a level of zero, would that bother you?

MR. LANDRY: If it was infinitely small and --

CHAIRMAN WALLIS: In time that wouldn't bother you?

MR. LANDRY: In time, no.

MR. SCHROCK: Are these S-RELAP5 calculations the Appendix K version?

MR. LANDRY: These are the code modeling the test facility using the energy, the core energy, that was used in the test facility, not using the Appendix K required to K heat.

MR. SCHROCK: But what about other features, such as critical flow?

MR. LANDRY: They're trying to hit the flow rate out the break correctly so that it's not using Appendix K break flow.

MR. SCHROCK: So it's not an Appendix K RELAP5 that's exercised. It's the best estimate.

MR. LANDRY: Yes, in that case it's a best estimate attempting to accurately model the test facility and show that the models predict the test facility properly.

Appendix K then adds on --

MR. SCHROCK: How does that fit into the present purpose of approving the code for Appendix K applications?

MR. LANDRY: Well, Appendix K application then is intended to add conservatism on top of those models. That's true whether it's this facility or any facility. The code is never run against a facility in Appendix K space if you're trying to predict the response of the facility accurately.

CHAIRMAN WALLIS: It's very strange.

MR. LANDRY: The only time we did that was one time. That was when we ran the LOFT L.2.2 test, the first LOFT large break test we attempted to run, a code calculation of what the test should -- what should have happened during the test, and we attempted to run a calculation in full Appendix K, which would be a full conservative calculation to see what the code would say before the test.

There was absolutely no relationship whatsoever between the pre-test calculation and the test.

CHAIRMAN WALLIS: If you put Appendix K on this graph, you might well find that it goes way off and is very different from the data.

MR. LANDRY: It may.

CHAIRMAN WALLIS: Which indicates the strangeness of Appendix K.

MR. CARUSO: But hopefully the results would be conservative.

(Laughter.)

MR. SCHROCK: But maybe you should find out it that, in fact, true.

MR. LANDRY: Well, it would be because when we did the LOFT L.2.2 test, because I was in charge at that time --

CHAIRMAN WALLIS: Well, this is why we're moving to realistic codes.

MR. LANDRY: -- the calculation we did, the MXK calculation we did for L.2.2 showed a peak clad temperature of 6,500 degrees. We measured a peak clad temperature of 1,200 degrees. There was no relationship whatsoever between the calculation and the test, other than they both went up in temperature.

CHAIRMAN WALLIS: Except that one is the legal requirement and one is the reality.

MR. LANDRY: Right.

MR. SCHROCK: Well, somebody's reality.

MR. LANDRY: Okay. After doing all of the assessments, Siemens went back and did some sensitivity studies. One of the requirements for the code is that a number of actors have to be looked at for sensitivity in effect on large pipe calculations.

Siemens became with the Westinghouse three loop plant, first its sensitivity to find the highest peak clad temperature resulting from break size; determine the break size resulting in the highest PCT, and then started varying time steps, varied restart conditions, varied the loop seal model, varied the pump model, radio flow, form loss coefficients, nodalization, and the bottom --

CHAIRMAN WALLIS: Are these the guys who had three different loops so that they had to artificially make one of the loop seals higher than the others to make sure that things happened in a predictable way in terms of bias to the loop seal?

MR. LANDRY: This, they had to work on it. That's done to get a consistent result because the clearing is a statistical phenomenon, and they wanted to get that statistical phenomena out of an Appendix K calculation, but we'll have it where they come in for the --

CHAIRMAN WALLIS: But for the realistic case, you just run it and let it do whatever it wants to do, and if it wants to be statistic, let it be so.

MR. LANDRY: Well, we wanted to force it to operate so that they could actually get a peak clad temperature and not a lower clad temperature.

The result of the sensitivity studies was that Siemens found that --

CHAIRMAN WALLIS: I like this redial flow. Is that where you redial some of the variables and see what you get?

MR. LANDRY: Oh.

(Laughter.)

MR. LANDRY: This is rough draft also.

(Laughter.)

MR. LANDRY: You can't buy these things out of a catalogue.

CHAIRMAN WALLIS: I think it's very revealing. This is one of those Freudian --

(Laughter.)

MR. LANDRY: It's a radial flow, radial.

Siemens found in doing the sensitivity studies that each of the factors that they looked at had an effect on peak clad temperature of less than five degrees. So this indicated that the solution is converging, and that they have been able to answer the concerns that we have on all Appendix K calculations, that they have properly done sensitivity studies and that they have set up a model that can operate with each of the sensitive areas in its most conservative direction.

CHAIRMAN WALLIS: The other interpretation is that this is a very good reactor design because no matter how much you vary these things, it works.

MR. SCHROCK: What is a radial flow?

MR. LANDRY: Joe?

MR. STAUDENMEIER: I think that's the parallel channels. It's the loss coefficients between the parallel channels does of the core, I think is what this refers to.

MR. SCHROCK: Cross-flow.

MR. STAUDENMEIER: Yes.

CHAIRMAN WALLIS: So you guys didn't do these. These were all sensitivity tests performed by Siemens.

MR. LANDRY: By Siemens, right.

CHAIRMAN WALLIS: And as we said before, you haven't really got to the point where you're running the code for the whole scenario.

MR. LANDRY: Right.

DR. ZUBER: Let me ask you. How long does it take to run an experiment like the calculations?

MR. O'DELL: Yeah, I think the issues -- I was tempted to respond to Dr. Wallis' comment. The issue is not really the computer time of running these experiments. The issue is getting the information to model the facility, getting the data, getting it all pulled into a consistent format, setting everything up to run each one of the experiments.

Because once you get a facility set up, to run additional experiments is not that big an issue. It's going through this whole process of finding the information. For example, on semi-skill I actually went and got a ton of drawings from INEAL (phonetic), and we went through them and pulled out the drawings we needed.

But the period of time that that takes is on the order of months. It's not --

CHAIRMAN WALLIS: You know, that's another issues. We talked to the NRC about that. There should be sort of a data bank which is an electronic form, and you just pull it out and use it. You shouldn't have to dig it out of a report.

MR. O'DELL: And, you know, some of the stuff we were having trouble --

DR. ZUBER: But some of these calculations were done with different codes. Information on semi-skill or LOFT or from BETHSY aren't available. I mean, that should be a big deal.

MR. O'DELL: Well, getting the electronic data is kind of a big deal, and the issue that we had on the realistic LOCA, I mean, we were actually looking at trying to go to the data reports or considering going to the data reports and trying to digitize the data.

But then if you're trying to come up with an uncertainty, what's the uncertainty in the digitizing process and how do you figure that out?

So we couldn't use that. So, I mean, the issue really is just setting it up to run.

CHAIRMAN WALLIS: That's the problem that the NRC has. I mean, they take a long time to come up to speed and get all of the input stuff. You could help them with that, of course, sine you've done it.

MR. O'DELL: Well, for what I've got.

CHAIRMAN WALLIS: You could share that with them, and that would help them to set up a problem. Then they could try some sensitivity stuff of their own.

MR. STAUDENMEIER: Dr. Wallis, I think I'm hearing some good recommendations about having us do some more sensitivity runs of our own, but I think we just couldn't have the manpower to build test facility models from scratch for each of the vendors' codes. What we would have to do is we would have to ask the vendors for their models of the facilities, and then we would look at them to get a sense of how well they were put together and how creative they were.

CHAIRMAN WALLIS: Is there a chance that you could get those or is that beyond practicality?

MR. STAUDENMEIER: That's always a possibility in asking for additional information from the vendors on these issues. We're just in the process of asking them for the codes. We're starting to do that now, asking them for the test cases, and I believe that they've provided us with some of the models that they use.

MR. HOLM: This is Jerry Holm with Siemens Power Corporation.

One of the additional pieces of information we provided for this review was we provided the code, which has not been common practice in the past. We provided sample problems for the plant we used so that the NRC could run it, and we provided at least some of the experimental facilities so that they could run those if they wanted to.

CHAIRMAN WALLIS: So why did they not run them?

DR. KRESS: Manpower.

CHAIRMAN WALLIS: Isn't there a plug-in version or is there a big learning curve?

MR. LANDRY: Well, it's what we said earlier. One of the problems that we have is resources available to do all the different runs.

CHAIRMAN WALLIS: But you have somebody running fluent on the problem which is not really nuclear yet.

MR. STAUDENMEIER: I would observe that part of our resources that help the ACRS in other areas, but I understand we're going to get that resource back.

DR. ZUBER: Well, let me ask you. Can you enlist some help from research for them to provide you the models? Because they have run some of these tests with their codes. So I mean to provide this information so you can use it.

MR. STAUDENMEIER: In the case of some of the codes like RELAP, I imagine they could be, but I would be worried about taking a model of LOFT that was built for the research version of RELAP and then try to apply it to a Siemens RELAP.

There are all sorts of reasons why I would not want to do that. First of all, because I want to test the ability of Siemens to be able to --

DR. ZUBER: But that was taking information on the facility and on the data.

MR. STAUDENMEIER: I could. I'm just not sure whether it's as valuable as the expenditure of the resources would warrant. I would must rather get the input models rather than -- I might ask the Office of Research to help do some assessments of the actual vendors' models. That's a possibility.

CHAIRMAN WALLIS: I think this is something that we may want to address in our letter to the Commission, that Siemens has been very forthcoming and provided all of these very useful things, and you seem to be held up by not having enough resources to use them.

MR. STAUDENMEIER: I would agree with your characterization of Siemens' cooperation in this matter. They have been quite cooperative, and I think it's helping some of the other vendors. The shame factor is useful.

(Laughter.)

DR. KRESS: Ralph, the different sensitivities stays with the code, I presume varying those parameters one at a time. It would be nice if we had an uncertainty analysis which combined the uncertainty, and is that ever going to be possible on any of these best estimate codes?

MR. LANDRY: With the best estimate we should see that. There's no requirement for uncertainty analysis on Appendix K code.

DR. KRESS: Not on Appendix K because you take care of that by making it conservative with your fees, but as I understand, they're going to use this code eventually for best estimate.

MR. LANDRY: Well, they're supposed to be coming in very soon with that.

CHAIRMAN WALLIS: Are they going to use the CSAU process?

MR. LANDRY: We're anxious to see what is on the submittal?

DR. ZUBER: When are they coming?

MR. LANDRY: In the next few weeks is our understanding. Two weeks.

PARTICIPANT: Two months.

MR. LANDRY: Two months? Two weeks?

MR. HOLM: This is Jerry Holm.

Our realistic estimate is the end of March this year.

CHAIRMAN WALLIS: I think that's something we're really looking forward to.

MR. HOLM: We are, too.

MR. STAUDENMEIER: To a certain extent this has actually been a good preparation for that. We will be using the same code. We've got experience with it. You've had some experience raising some issues, and although those issues, we don't entirely agree that they're appropriate -- no, I don't want to say "appropriate" -- germane to Appendix K, since they are certainly on point with the best estimate.

MR. LANDRY: Well, this is more impetus to us to get this review complete so that we have room for the resources to work on the large break LOCA when it comes in.

Conclusions from our review. We believe that the ANF RELAP code, which was approved by the staff, has been modified to operate in an integrated manner with these other codes, and we feel that that's a good move. That provides a more stable platform and consistent calculational capability.

The code documentation supports the modifications. We are accept the modifications that they've made.

We have pointed out problems in the code documentation. We've discussed those with Siemens. The committee has pointed out problems and discussed those in meetings, and the intent of Siemens is to correct errors in the publication of the documentation.

And the final conclusions that the staff finds in S-RELAP5 code is acceptable for use in satisfying the requirements for a small break LOCA analysis under 10 CFR, Part 50, Appendix K requirements.

DR. KRESS: The ICECON code is a containment code?

MR. LANDRY: That is the old CONTEMPT code or it's a derivative of CONTEMPT.

DR. KRESS: But why was it felt necessary to include it in the RELAP?

MR. LANDRY: In particular for large break LOCA, the best estimate LOCA, it becomes more important because it gives you an accurate back pressure calculation.

Containment LOCA calculations in the past have made a certain assumption of what is the most conservative back pressure for the action you're looking at, and those can vary. What is conservative for one may not be conservative for another.

And then the output of the LOCA code is fed to the containment code, the mass and energy release data, to calculate the response of that containment.

Well, that's assuming that these data are conservative now for the calculation with the containment.

If you can marry the two codes so that at appropriate time intervals the codes exchange mass and energy, back pressure data, then you have an integrated calculation which shows you a more accurate representation of what the reactor system is going to see and a more accurate representation of what the containment system is going to see.

DR. KRESS: I was wondering if that was in anticipation of the best estimate rather than for Appendix K.

MR. LANDRY: It's possible.

DR. KRESS: Appendix K doesn't seem like it --

MR. LANDRY: It's probably more aimed at the best estimate of realistic LOCA, but it's a way of getting around problems also that we've seen with

RELAP5 in the past, discharges from high pressure to low pressure and errors that have occurred there.

You know, they make a numeric fix that should help. Here you're discharging to the right containment condition.

Joe?

MR. STAUDENMEIER: I think in the past when they were uncoupled, containment back pressure is real important in large break LOCA because if you look at brief heat transfer coefficients, they vary greatly in pressure from one point. The Downcomer head varies a lot and you get a lot different boiling in the Downcomer, and in the past you had to transfer this information manually from one code to the other, and in some cases you probably even had to iterate and do multiple runs to get consistent things.

And I think doing it in this manner --

DR. KRESS: Well, that's why I asked, because I thought it was only important for large break LOCA and this is an Appendix K small break loca, and I was wondering if there was anticipation of --

MR. JENSEN: You are correct. We did this for the large break LOCA. It really is never used for the small break application at all.

DR. KRESS: I appreciate that perspective. Thank you.

MR. SCHROCK: I just have a little concern yet that your process will end up closing out arguments or discussions of problems that may have been foreseen in the review of the code as it was submitted, the code documentation as it was submitted.

One thing that comes to mind is the description of the critical flow model, Ransom-Trapp and modifications and so forth. If this is approved, is that going to be up for review when we talk about the next stage in this?

I think I read someplace in your -- maybe it was the SER -- that you won't ask questions about the things that have now gotten this approval. So I suppose it's a question of what are the definitions of things approved.

Can you shed a little light on this issue? Are we going to review in depth the critical flow calculation in S-RELAP5 when we take up the best estimate version?

MR. LANDRY: Yes. When we do the review for best estimate, this approval does not approve S-RELAP5 for all application. This is an approval for

S-RELAP5 for application to small break, loss of critical accident under Appendix K.

The code will be re-reviewed when it is applied for the realistic LOCA.

MR. SCHROCK: But what is it that it says at the end of the SER that caused my concern? Do you remember?

MR. CARUSO: I think those are the standard words that we put into topical report reviews so that licensees who want to reference this topical report in the licensing application will have some assurance that we're not going to re-review this code for Appendix K applications. It's an assurance to the licensee that the process is not --

CHAIRMAN WALLIS: That's on page 13 that the staff will not repeat this review, whether it appears as a reference in license applications.

MR. CARUSO: License applications, and that's the key. I think those are the words you're talking about.

MR. SCHROCK: Except to insure that the material presented applies to the specific plant involved.

MR. CARUSO: Exactly.

MR. SCHROCK: But also if the NRC's criteria for regulations change so that in its conclusions about the acceptability of the report or invalidated SPC or the applicant referencing the report, or both, will be expected to revise and resubmit its respective documentation, and so forth.

So the reason we do a review of a code is to give reassurance to the industry that we've reviewed the code, they can apply that code within the constraints of its review without having to submit the code every time they want to use the code.

MR. CARUSO: This is an efficiency -- the reason we do it this way is to promote efficiency so that we don't have to re-review it for each application. We do it one time, and it's referenced then as long as it's applied within the limits which was approved, it's acceptable, and we don't do a review of the code itself again, but we do review applicability, and we can, of course, at some future state change our mind.

We don't like to do that, but that's always a possibility if new information comes in.

CHAIRMAN WALLIS: I just have one question about the SER for the moment. It's the statement the loop seal collapse liquid levels are accurately predicted for the UPTF tests.

And in my notes when I was looking at the previous documentation, the UPTF loop seal, I got some quotations from Siemens that predictive level after clearing was three and a half times greater than measured.

Now, I'm not quite sure why these two statements are compatible. I just haven't looked at the original source, but I've just got on my notes a quotation I pulled out of Siemens. One is three and a half times greater than measured.

And your statement is that this was an accurate prediction. Maybe it's too difficult for you to go into this now, but I'm trying to reconcile these two statements.

MR. LANDRY: When we were looking at the report, EMF 2328, looking at figures in Section 5.4, which show the loop seals and UPTF, the prediction versus the data, this is on page 552 and following. Looking at the comparisons between the water data, the water from S-RELAP5 steam data, statim S-RELAP5, I see data and calculations that very closely overlay each other, time and in magnitude.

CHAIRMAN WALLIS: So I was just wondering. This quotation came right out of Siemens' report, the three and a half times greater.

MR. LANDRY: But when I was looking at these, I thought to me these looked like they're pretty good predictions of the water and steam in the loop seal for UPTF.

And that's why in light of that I think that that's a pretty good prediction.

CHAIRMAN WALLIS: So I probably owe you going back to figure out where my quotation came from.

MR. LANDRY: Let me go back and find that.

CHAIRMAN WALLIS: Maybe you can find it before I do.

Do we have any other questions for Ralph at this time?

(No response.)

CHAIRMAN WALLIS: How long would your overview take, Terry? Could you give us an overview of Siemens' presentation?

Has IRR finished its presentation then?

MR. LANDRY: Yes.

CHAIRMAN WALLIS: Thank you.

But you're going to stay around for the end of the day in case you have something else to say.

MR. LANDRY: I wouldn't miss it.

MR. HOLM: I'm hopeful I can do it in about 15 minutes.

CHAIRMAN WALLIS: Can you, yeah, I guess, whet our appetite?

MR. HOLM: My name is Jerry Holm. I'm Manager of Product Licensing for Siemens.

I'm going to be giving a short overview of the agenda for our presentation, and I'll be providing some comments on the staff SER. We moved that in the agenda. It seemed to fit, to follow on with the staff presentation.

Again, the Siemens presentation today is I'm going to start out with a few comments on the staff safety evaluation report, and then we're going to provide responses to the ACRS comments in the information that Paul Boehnert sent to us.

We'll start out with loop seal modeling, which will be presented by Gene Jensen. That will address one of the comments. It's probably our most technical part of the presentation. We're going to provide a justification for the bias that we do and a rationale for why we think that's necessary.

And then the other comments we've broken down the two main categories: comments related to documentation and comments related to benchmarking, and Larry O'Dell is going to talk about those.

And at the end of the meeting, as appropriate. I'll provide some concluding remarks.

At the risk of not having my bulletproof vest, I do want to make a pitch that Siemens believes we've provided good documentation to support our Appendix K submittal.

In defining the expectations of the NRC, we reviewed the submittal we made for ANF RELAP. We reviewed submittals made by our competitors, the nonproprietary versions, of course, and defined what we should put into a topical report.

And one thing I want to make clear is the topical report is EMF 2328, which is our small break LOCA model definition, and that's what we submitted, and that primarily describes the changes we made to RELAP5 and how we model a small break LOCA.

The staff then asked us for additional information, which we provided. This information was primarily developed for the realistic LOCA model, and we provided a models and correlation document, which is EMF 2100, and a programming manual.

Also in response to the staff's request, we provided a CD with the code executable in test cases. If you looked at the ANF review, none of this additional information was provided or requested at that time. So our view going into this process was that we were providing additional information.

I realize the ACRS has made some requests for even further information, but I'd like to at least make the point that our intent was to provide more than we had provided in the past.

MR. SCHROCK: I don't remember seeing the EMF 2328.

MR. HOLM: Yes.

MR. SCHROCK: Is that something? We never got that, did we?

MR. HOLM: I don't recall offhand. I know I sent the reports I had. I don't know if that was one of them. You should have received three reports, I would expect: EMF 2328, EMF 2100, and then I can't remember the number for the programmer's document.

MR. BOEHNERT: Twenty-one, oh, one.

MR. HOLM: Twenty-one, oh, one.

MR. LANDRY: All of that material is provide on the CD and was provided --

MR. BOEHNERT: I had paper copies of that. I didn't have a CD on them

MR. LANDRY: I thought I gave you a CD also of material.

MR. BOEHNERT: Of Siemens? I have the TRAC one, but not Siemens. I don't recall any Siemens.

MR. SCHROCK: Do you have the capability of making CDs from that as well as PCs?

MR. LANDRY: It's a PDF.

MR. SCHROCK: A PDF.

CHAIRMAN WALLIS: Yeah, we had something called S-RELAP5 Programmer's Guide. We had something called Small Break LOCA Evaluation Model, and then we had something called Models and Correlations.

So those are the three reports.

MR. HOLM: The second one is the topical report.

I guess I should make the point that --

CHAIRMAN WALLIS: We spent most time, I guess, perhaps on the models and correlations. That's more aimed at the realistic code, is it?

MR. HOLM: Yes, it was developed for the realistic code. I mean it describes the code as it exists. So it's appropriate for the small break LOCA.

DR. ZUBER: This is the one you're going to be submitting in March. Is there any change in documentation between now and March?

MR. HOLM: Yes. To steal Mr. O'Dell's thunder a little bit, when we provide the response to the request for additional information, we'll provide revised models and correlations document and revised programmer's manuals to attempt to correct the documentation deficiencies that were identified. Okay?

The point I really want to make though is that the topic report is EMF 2328. When the staff issues their SER approving the use of this code, they're approving the use of EMF 2328, and that's the report that I'll issue with in a version of it.

I'm not planning to issue EMF 2100, which is just supporting documentation, and that is typical of the process.

MR. SCHROCK: I'm glad you clarified that because I, for one, didn't understand that that was what you were seeking approval on. I thought it was on the S-RELAP5 code in the more general sense.

CHAIRMAN WALLIS: I think they were looking for input on that.

MR. SCHROCK: Yeah, yeah.

CHAIRMAN WALLIS: The actual approval decision being made now is just for small break LOCA.

MR. SCHROCK: That's my misunderstanding.

MR. HOLM: If you looked at the submittal for ANF RELAP, we submitted something similar to the EMF 2328. I think we've done a better job on EMF 2328, but we've never submitted a description of the computer code previously, and we're not wanting to issue EMF 2100 as an A version document.

And our plans are to use it right now for small break LOCA as described in that topical report which has, you know, more restrictions than you'll see in that EMF 2100.

EMF 2100 tries to describe the code, and there's options in the code that aren't used for small break. It describes them, but we're constraining ourselves for this application.

I thought to provide comments on the staff SER I would state what the SPC goals for a safety evaluation report are. These are the two goals that we have when we submit the topical report.

The first goal is we want to get a statement that the NRC accepts the documentation that's suitable for referencing and licensing applications.

As Ralph Caruso mentioned, this is an efficiency measure. Basically we don't want to have to go through this same review every time we use it for each plant, for each application. And that's really its only use: efficiency.

The second goal we have is we don't want any conditions on the use of the evaluation model beyond the topical report definition of the evaluation model. If we get additional conditions, that means we haven't done our job in creating the topical report.

And so our goal actually is no additional conditions, and I'll try to talk about the SER in light of these two goals.

I have a blank space here for a minute.

The first goal is satisfied by statements in the SER, and the first statement is that the S-RELAP5 code is capable of performing an integrated calculation of a small break loss of coolant accident in the PWR of a Westinghouse or Combustion Engineering design.

And then the bottom line is the staff will not repeat its review of the matter described in the subject report when the report appears as a reference in license applications except to insure that the material presented applies to the specific plant involved.

So I believe our first goal is met by the draft SER, and we're very pleased with that.

The second goal is not met quite as well. The first condition that the SER places is that we can't use this above ten percent of the cold leg flow area. I find that acceptable though since that's the intent of the topical report, is we'll use it below ten percent. So that really just reaffirms what's inside the topical report. So that's acceptable to us.

The second condition though is that it restricts us to use 1.02 times the license power level of the reactor. Our preference would be that that condition be deleted. That is just one of the Appendix K requirements. We have to follow all of the Appendix K requirements, and I do not see a reason to call that one out specifically.

If the staff feels that they want to keep that condition, I have a suggested modification to it. As you may realize --

CHAIRMAN WALLIS: Isn't this an Appendix K requirement anyway?

MR. HOLM: Yes, it is.

CHAIRMAN WALLIS: Although the ACRS is -- I guess the Commission has now said that in the future we'll back off from that if you have good reason to justify the accuracy of your power measurement.

MR. HOLM: Right, and my suggestion is if it's felt necessary to keep this particular restriction that it would be modified to be consistent with the current Appendix K requirements, which the first sentence here is what's in the SER, and the second sentence tries to add the verbiage which was added to Appendix K in this last year, and that second sentence says an assumed power level lower than this level may be used provided the proposed alternative value has been demonstrated to account for uncertainties due to power level instrumentation error as required by 10 CFR 50, Appendix K, Section 1(a).

So if we need to keep the restriction, I'd just like it expanded, and --

CHAIRMAN WALLIS: This is just reaffirming the regulations.

MR. HOLM: Right, and that's why I don't see the necessity to --

CHAIRMAN WALLIS: No real restriction.

MR. HOLM: Right. It's not really a restriction.

CHAIRMAN WALLIS: So you're just clarifying what's in the regulation. Is that it?

MR. LANDRY: That condition was placed in this SER, in this draft because those were the two conditions on ANF RELAP for a small break LOCA on their SER. We don't have a great deal of strong feelings about this last point that Jerry has brought up because we are heavily involved in the efforts to change Appendix K requirements, 10 CFR 5046 requirements, on measured power levels.

So since it is already covered in Appendix K and 10 CFR 5046, we're ready to go back and rethink what we want to have, if we want to have that conditions or we want to drop the conditions and just say that this will be maintained within the restrictions and limitations, the requirements of Appendix K.

DR. KRESS: It seems like we should just drop it since it's already in the requirements. Otherwise people wonder why you're spelling it out specifically.

CHAIRMAN WALLIS: I'm not sure it's really an ACRS matter though. It seems to me it's perfectly negotiable and decidable between you.

DR. KRESS: Yeah, that's up to you guys, whatever you want to do.

MR. HOLM: The agenda had me providing comments on the SER, and I felt this was my major comment really.

MR. SCHROCK: You're got to be unhappy about something.

MR. HOLM: Yes.

(Laughter.)

CHAIRMAN WALLIS: You must be very pleased to have nothing more major than that.

MR. HOLM: Yes, we are. We were pleased with the draft SER. Again, we met our primary goals. We want to use this in licensing applications, and we don't want any restrictions on the use of the code.

Again, I looked at restrictions as indication I haven't done my job in preparing the material in the topical report, and I've had topicals where we've had restrictions where it's indicated we didn't do as good a job as we should have. I'd like to avoid that.

While it's not a goal for SERs in general, SPC did have an underlying goal with this review that's related to realistic LOCA. This gives the staff an opportunity to look at S-RELAP5 and to prepared for the coming realistic large break LOCA submittal.

We think that the staff has done a good job reviewing the code fairly in depth, and we're hopeful that this will facilitate the review of the realistic LOCA because they've had an opportunity to do this.

DR. ZUBER: How much difference do you expect in these documentation in the future?

MR. HOLM: As I say, with the RAIs, which hopefully will come in next week, we're going to modify the document to try to find all of the typos. Since Graham didn't tell us what they were, this is sort of a test of our ability to find them.

(Laughter.)

MR. HOLM: We did put a fair amount of effort to try and to find them.

For the realistic LOCA there will be some changes to the models and correlated document, to the programmer's manual. For one thing, the code is not identical for the realistic LOCA and small break. I mean, I would say it's 99.9 percent the same, but there have been some changes made to improve its use for realistic large break LOCA, and those will be added to the document before we submit it.

MR. SCHROCK: Is there some reason that you don't view the best estimate option as beneficial for these small break LOCA applications?

MR. HOLM: I think our decision is one of cost rather than benefit. We have not yet submitted our realistic large break LOCA methodology. We started that development in 1985.

DR. ZUBER: '85?

MR. HOLM: '85. We're now submitting that in 2001. We felt that we needed to get that approval before we went off into other best estimate codes. We want to make sure that what we've done satisfies the ACRS and the NRC.

And once we know that or get any modifications that come out of the review process, then we may decide to go off and do other best estimate developments. But we didn't think it was a good idea to do a best estimate small break now.

We have some difficulties with the current small break LOCA methodology that we wanted to resolve, and we felt that since we had the S-RELAP5 code, which was developed really for best estimate large break, that we could leverage off that even though it's an appendix case base, and make some improvements to our current small break LOCA methodology.

And a lot of those improvements are shown by a sensitivity study. I mean, a major goal of our small break LOCA development project was to make it insensitive to the kinds of changes we showed you, and we were fairly successful with that.

The one place I would say we weren't as successful with respect to our initial goals was loop seal clearing behavior, and we'll talk about what we did to try to do the best we could on that.

We went in wanting to let the code calculate it, but we determined after working on it for a few years that we hadn't succeeded in that, and Gene will talk about that in more detail after lunch.

And that concludes my presentation.

CHAIRMAN WALLIS: Thank you very much.

We have come up to just the right time to go to lunch, I think, and so, therefore, we'll take a break, one hour, until one o'clock.

(Whereupon, at 12:00 noon, the meeting was recessed for lunch, to reconvene at 1:00 p.m., the same day.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

(1:03 p.m.)

CHAIRMAN WALLIS: Let's come back into session.

We're now on the record, and we'll continue with the Siemens presentation on their S-RELAP5 code.

MR. JENSEN: My name is Gene Jensen. I'm a team leader in the methods development organization for Siemens Power Corporation, and I'll present the next few slides.

The subject I want to talk about is loop seal modeling. It's been alluded to a couple of times in discussions this morning.

In our small break methodology, we bias the loop seals to promote a conservative loop seal clearing pattern. The ACRS subcommittee had comments regarding this treatment of the loop seal clearing, and the purpose of my presentation is to provide the basis of what we're doing and why we're doing it.

CHAIRMAN WALLIS: Why is it conservative to do this?

MR. JENSEN: Can I get to that --

CHAIRMAN WALLIS: Oh, you're going to get to that? Okay.

MR. JENSEN: First, before I get into that one, I'll present a discussion as to what the problem is. Most of the NSSS systems, the way they're designed, the coolant loops, particularly the loop seal portions of it, all the loop seals have basically analytical geometry.

Now, we recognize that there are some differences because the pressurizer is connected to one loop and the break is on another. So they differ to that, but the geometry is essentially identical, and what we find is our calculated small break loop seal clearing behavior is essentially the same for all loops; that it is up to the point that the loop seal vents. If you look at the calculated behavior in the various loops, all of the loops behave essentially in an identical manner.

What happens then when the level is being depressed in the loop seals, it's being depressed on all of the loop seals, and it approaches the point of venting steam for all of the loop seals. Then some small variation in it is calculated between the loops.

DR. ZUBER: This goes back, and I may have forgotten, but I recall many years ago there was some situation where you had oscillations because of the loop seal between one steam generator and another. It was a dynamic effect, and it was really caused by the clearing of the loop seals.

MR. JENSEN: Well, this is before the loop seal clears, and we're not saying any really significant. If you look at the level plots and overlay them, they're essentially overlays up to the point of loop seal clearing.

However, there's some small variation that's calculated. We model each of the loop separately. So they're each calculated separately.

DR. ZUBER: I have a problem. You say calculated. That's LOCA. Loops has behaved -- behavior is the same in all loops. Well, --

MR. JENSEN: Up to the point of --

DR. ZUBER: Well, the point is when you have a dynamic effect, they may not be the same. I mean, they may -- you may obtain oscillation, see, and I recall I have seen the results of such oscillations.

MR. JENSEN: Yes, if there is --

DR. ZUBER: So they don't behave the same.

MR. JENSEN: With the small breaks that we're calculating, the small breaks which are limiting, the calculations with S-RELAP5 shows that they're the same.

CHAIRMAN WALLIS: If they're all the same, and this is a symmetry, it wouldn't seem to matter which one of them clears.

MR. JENSEN: I don't know. I'll discuss that a little bit later, but what happens then is there is a small variation put between these loops, cause a prediction of one or more loops to clear in preference to other loops.

CHAIRMAN WALLIS: So you are modeling the loops separately.

MR. JENSEN: We're modeling each loop separately.

CHAIRMAN WALLIS: Because if they were all together, you wouldn't notice this at all.

MR. JENSEN: Pardon?

CHAIRMAN WALLIS: If you were modeling them identically, there's a lump in the loops as one.

MR. JENSEN: If you lump them, then you wouldn't see it.

CHAIRMAN WALLIS: You'd never seen it.

MR. JENSEN: But because we model them separately you do.

The other problem that we see is if you have no two small break calculations and you're comparing these, the results are very nearly identical on a lot of these calculations up to the point of loop seal clearing, but then what you see is a divergence at this time because some variation in a small change which causes the loop seals to clear causes a change in the number and which particular loop seal clears.

DR. ZUBER: And these brings you the dynamics of the system.

MR. JENSEN: This starts the dynamics, and you see a divergence, and this divergence can cause significant changes in peak cladding temperature. We've seen differences --

CHAIRMAN WALLIS: Well, doesn't it mean that this thing is sort of teetering and it could have this seal go or that seal or both? It could happen. So these changes in PCT are presumably realistic.

MR. JENSEN: That's a very real possibility. In fact, I think my next slide mentions that. In addition to our calculated results, there are actually some experimental results.

I was told that they're in the BETHSY calculations, the BETHSY test that they did, they ran three tests which were very similar. Two of them were essentially identical. In two different tests different loop seals actually cleared. The third test, which was very close, another one cleared for that.

So the three loops, they have tasks showing for nearly identical small break conditions any one of those three loops can clear.

What this means is that if we are going to predict this capability with the S-RELAP5 code, we must determine this, be able to calculate this loop seal behavior by oscillating consistently the small variation between the loops.

CHAIRMAN WALLIS: It seems you're asking to deterministically calculate something which is probabilistic.

DR. KRESS: Probabilistic, yes.

CHAIRMAN WALLIS: Which is incompatible.

DR. KRESS: The other approach would be to fix the system so that you can automatically cause the loop seal to clear that you want to clear and then do all of them to see which is the worst.

DR. ZUBER: If you want to come, you come to this kind of bifurcation that a small perturbation can throw the system on one leg or the other leg, and if you have three loops, they may talk to each other.

MR. JENSEN: That's right. They do interact with each other, and there are variations between the loops, and each of those loops is a minometer, and if excited, it's going to want to oscillate, and there are phenomena occurring which will excite them.

There are relief valves on the steam generators which are opening and closing, and the timing can be different in each of the loops.

CHAIRMAN WALLIS: Well, even if it's deterministic, it may be that you've got these little oscillations between the loops. If you started off with 1/1,000 percent difference in power or something, you might hit a slightly different time in the cycle and the other loop seal would go.

So even if it's deterministic, just uncertainties in --

DR. KRESS: And numerically.

DR. ZUBER: The trouble is you have to calculate the pressure very, very close, and a small delta P will really induce one oscillation in the other one.

CHAIRMAN WALLIS: But that's not the precision of the whole code anyway. So --

DR. ZUBER: Well, that's the problem they're looking at.

MR. JENSEN: Well, yes, and we believe that S-RELAP5 really does a pretty good job of predicting the underlying behavior for the small break LOCA sufficient for most of the dominant phenomena.

However, we don't feel that it is sufficiently accurate to calculate phenomena to the level of these small variations, which are causing this perturbation which control loop seal clearing.

DR. ZUBER: Okay. Now, let me ask you the question. If you have these oscillations, what is the effect on the core?

MR. JENSEN: Can I continue? I think you'll get into the solution and you'll see the differences that can occur because of this. I'll show you how to treat it.

Now, we have this situation where we don't feel we can accurately calculate what's going on. So how do we propose to handle it?

What we're proposing is to use then a conservative pattern of loop seal clearing, and we need to establish this conservative pattern, and we did this by doing numerous calculations both with our previous model in this one and it has consistently shown the following behavior.

PCT decreases with the number of loop seals which are calculated to clear, and PCT also decreases if the loop seal on the broken loop clears in preference to a loop seal on an intact loop.

CHAIRMAN WALLIS: Is that likely? Because it's a different loop, isn't it? Where it's broken it's presented very differently.

MR. JENSEN: It's possible. The BETHSY tests actually had intact loops that were clearing and not the broken loop, and our calculations say they all behave the same until you -- pardon?

CHAIRMAN WALLIS: Is it even when one is broken they all behave the same?

MR. JENSEN: The broken loop is modeled separately, and they all behave the same, basically the same. The conclusion from this is that the highest PCT then results when the minimum number of impact loop seals clear.

CHAIRMAN WALLIS: The minimum number being one.

DR. KRESS: One, right. One impact loop.

MR. JENSEN: Well, let's discuss that a little bit further, too.

CHAIRMAN WALLIS: Not very long.

(Laughter.)

MR. JENSEN: We believe this is phenomenological, the loop seal effects which cause this conservative pattern for the number of loops, is the larger the number of loops that clear reduces the resistance for the steam flow to the break. This is a slight reduction on the pressure at the top of the core, dealing in a slightly higher mixture level in the core, better cooling and reduced PCT.

Also, there's a second effect that when more loop seals clear, the water inventory in those loop seals is pushed into the vessel, and the water inventory is in the vessel and coil rates between the Downcomer and the four, and you also generally get a higher level.

So more loop seals clearing, you would expect to reduce PCT, and there's a similar effect on the broken loop. When you clear the broken loop, the preference to the impact look, you also reduce the pressure drop to the break, and this again for the same reasons yield a slightly higher mixture level in the PCT.

Following on with our solutions, we currently perform small break analysis for three and four plants, three with plants with the Westinghouse design, four loops being a CE two by four design.

Conservative loop seal bearing pattern for the three loop Westinghouse plant is the clearing of one intact loop seal. So one is the minimum definitely there.

The conservative pattern for loop seal clearing for the four loop plants we found is the clearing of two intact loops.

CHAIRMAN WALLIS: That sounds a little different from the rationale you just gave us. It seemed that the minimum number of loops claimed was the most conservative. Now you've got two instead of one.

MR. JENSEN: That's right, and the reason that we established this pattern is we tried, as you'll see through our biasing, to promote the clearing of one loop seal in a two by four plant, but even with the promotion, the code consistently predicts that two loop seals will clear, and we believe that --

DR. ZUBER: Why is that?

MR. JENSEN: There's enough steam being generated that even if one clears you build up enough pressure to clear a second one.

CHAIRMAN WALLIS: They don't clear at exactly the same time?

MR. JENSEN: They don't clear exactly at the same time.

CHAIRMAN WALLIS: So it doesn't seem to matter. I mean you clear one and bias it, and if the other one clears anyway, that's just extra benefit. That wasn't part of the bifurcation we're looking at, but it's just the continuation of loop seal clearing sequentially.

MR. JENSEN: It's fallacious for why we believe two because the code, even if you try to make only one clear, it will consistently show that the second one wants to clear. So we established a conservative pattern in loop seal clearing, and how can we impose this on our calculation?

And we promote this pattern by artificially increasing or biasing the depth of the loop seals that we want to remain plug.

CHAIRMAN WALLIS: If you bias one of these, just to go back, if you bias one of these full loop plant loop seals, another one will clear anyway, is what you said.

MR. JENSEN: If you bias three of these to plug two will clear.

CHAIRMAN WALLIS: Anyway two will clear. Two will clear anyway.

MR. JENSEN: One that you promoted will clear, and another one will --

CHAIRMAN WALLIS: Well, you biased the plug rather than biased the clear.

MR. JENSEN: You bias the plug, and if we move --

CHAIRMAN WALLIS: Of course, it's the same thing.

MR. JENSEN: -- the depth down a foot.

CHAIRMAN WALLIS: And the amount of biasing is being investigated, too. Sensitivity to the amount of biasing must have been investigated.

MR. JENSEN: We've found that one will promote it, and as I said, it promotes it, doesn't guarantee it. If the pressure builds up, you --

CHAIRMAN WALLIS: But three inches or six inches or a foot or two foot of biasing doesn't make much difference.

MR. JENSEN: I don't know that we looked at two, but we looked at less than one, and less than one doesn't solve the problem. You need about a foot to get there.

DR. ZUBER: Is that a possibility since you may have oscillations that during these oscillations there is a time period where you can store the liquid in part of the system and, therefore, deprive the core of liquid?

MR. JENSEN: I'm not sure what you're referring to.

DR. ZUBER: Well, we have a system, two loops or three loops or four loops, and it oscillates, and presumably the mass goes from one place to another,a nd if you store the liquid in one place so that it doesn't really get to the core, you may have a time period where the core may have insufficient liquid, and my question is: is there a possibility that you can store sufficient liquid somewhere in the system and deprive the core of the liquid?

MR. JENSEN: We don't believe so because the liquid over these long duration transients will accumulate in the low spots, and the low spots are the lower plenum of the reactor vessel and the bottom of these loop seals.

And this is what we're addressing, is the bottom of the loop seal, to clear that sufficiently. The plugged loop seals still stay plugged, and the inventory of the water is still over in those loop seals. We're not taking any credit for that improvement.

I don't know of anyplace else in the system where water can be stored that would deprive the core of cooling.

DR. ZUBER: But in steam generators.

MR. JENSEN: But steam generators are either U tubes. There's a lot of time. In the same generator basically at this time is not a heat sink. It's a heat source. So I would anticipate that it would void under those conditions.

CHAIRMAN WALLIS: If you artificially lower the loops, you're actually putting more water in there than --

MR. JENSEN: No, sir. We're maintaining the same volume in the loop seals.

CHAIRMAN WALLIS: Well, what are you doing then?

MR. JENSEN: You're basically increasing the gravitational head on those loops as required in --

CHAIRMAN WALLIS: So you're distorting the shape and maintaining the same length of pipe?

MR. JENSEN: Yes.

CHAIRMAN WALLIS: The other thing you could do is just put a little bump in the bend or something.

MR. JENSEN: It's must easier to bias an input bumping --

(Laughter.)

CHAIRMAN WALLIS: It comes to the same thing in the end.

MR. JENSEN: Yes. Anyway, our proposed solution, I've detailed it. There's really two reasons why we feel this conservative approach is necessary.

First, we need to assure bounding PCT for all possible configurations of loop seals could occur. So, you know, if the code would predict the broken loop cleared, well, that may be a possibility. It maybe could, but the PCT would be lower. If on another small break an intact loop cleared, PCT would be higher.

You need to be able to assure for safety's sake that you've bounded the maximum PCT for the transit. We feel we've done that.

CHAIRMAN WALLIS: Well, when you get to realistic codes, you're going to have to ask the question again what's the best thing to do because we're not --

MR. JENSEN: Well, for large break LOCA, you clear all the loops. So I'm not sure if the loop seal clearing is the same

If we ever get to a realistic model for small break --

CHAIRMAN WALLIS: In realistic, you might run 100 runs and say, well, 20 percent of the time one loop clears and 50 percent of the time two loops clear, and therefore, we'll take an average of PCTs.

MR. JENSEN: We might use a probabilistic approach.

CHAIRMAN WALLIS: Well, that's it. That's the basis of realistic.

MR. JENSEN: Anyway, the other item which we feel fairly strongly about is we do lots of sensitivity studies. Very many times on these sensitivity studies you're making a small change. You want to see the sensitivity of the system response to that small change.

In order to do that, you can't allow this variability introduced by loop seal bearing to happen where you'll calculate big variations from small changes.

So using this approach produces a consistency we need to do the sensitivity calculations so they can be meaningful, and if you look in the report, as was alluded to, we did numerous sensitivity studies, and the results of those with this model are showing quite consistent results. In fact, they're extremely consistent to anything we've seen before. A variability of five degrees is very good.

That is essentially our approach to loop seal clearing.

CHAIRMAN WALLIS: You're talking about loop seals. Remember I asked this question earlier about this statement in the Siemens documentation about being off by a factor of three and a half and the amount of water that was left behind in the loop seal.

MR. JENSEN: That was in the UPTF loop seal experiment. Calculations predict more water in the horizontal leg of that than was observed in the test. We feel that's a conservative prediction. If the water is over in the leg, it isn't in there, and it doesn't necessarily mean that the overall calculation is bad because you're just looking at what is remaining in that one volume of the loop seal compared to the overall inventory of the loop seal.

CHAIRMAN WALLIS: Well, in terms of accuracy, the calculation is bad. It gets the wrong answer. So you fall back on the conservative argument that errs in the right direction.

DR. ZUBER: Okay. Do you ask yourself why was the result calculated? I mean what caused it?

MR. JENSEN: And I'm sure it's the horizontal stratification model that causes it.

CHAIRMAN WALLIS: It was part of RELAP's --

DR. ZUBER: Oh, no. I was hoping he would identify the shortcoming in the quote.

CHAIRMAN WALLIS: RELAP doesn't really fit the situation of going around the bend with stratification in the middle of it. It doesn't really model that at all.

MR. JENSEN: And the other issue is if you really look at what was observed there, there was fairly high velocities, and looking along that pipe, there's a gradient in that level, and if we model that as a single node, there's no way we're going to predict that gradient.

CHAIRMAN WALLIS: this is where maybe more sophisticated CFD could do it, but you've got to go a long way from the results you saw here, and you'd have to have an interface model of some sort.

MR. JENSEN: It would be a much more complex model, and I'm not sure you'd gain all that much more from it.

CHAIRMAN WALLIS: Anything else on loop seals?

(No response.)

CHAIRMAN WALLIS: Thanks very much.

DR. ZUBER: Well, let me say the only full scale test facility was UPTF, and in all my experience looking at calculations, we always did very poorly on UPTF. I think the entrainment was always poor. The horizontal legs were always poor, and we always argue our cores are good, but we are putting them on small scale, and we apply across a large scale; they don't look so well.

CHAIRMAN WALLIS: If they have --

DR. ZUBER: No, that's disappointing because this was the only full scale test we had which was instrumented and a good way to test the codes, and whenever we make a comparison, the comparison is always on the poor side.

It's not only your code. I mean every code I have seen.

MR. JENSEN: This particular UPTF was a Siemens conducted test. That's a proprietary test.

So it's not generally available, and when we started looking at this, it looked like it would be a very good test to test the loop seal capabilities. As I got farther into it and looked at it in more detail, some of the velocities in the ECC injection rates were more typical of European reactors, and you know, it gives you a test of your capability to predict phenomena, but it's not very prototypic really of loop seal behavior that we would expect here.

DR. ZUBER: Yeah, but it shows you the capability of short terming of your code. If you can predict, then when you feel better. If you don't, then you have to use arguments, conservative or whatever.

MR. JENSEN: I would have felt better if the difference between the remainder was less than the magnitude that was stated, yes.

DR. O'DELL: I would say we're running several other UPF tests as part of our realistic LOCA centers. So you will see more of those, and we're doing fairly well on all of our --

DR. ZUBER: On entrainment?

MR. O'DELL: Yeah. So --

DR. ZUBER: Even on entrainment?

MR. JENSEN: -- to the lower plenum. I think we're doing much better.

DR. ZUBER: Well, we'll see.

MR. O'DELL: Okay. I'm Larry O'Dell, Manager of U.S. and Far East Research and Technology. I'm also project manager for the realistic large break LOCA project.

CHAIRMAN WALLIS: Your research doesn't correlate with longitude in some way, does it?

MR. O'DELL: My what? With longitude?

CHAIRMAN WALLIS: Far East research is somehow different from --

MR. O'DELL: Oh. Don't ask me where they come up with these titles. You know, they pat you on the shoulder and say, "Congratulations. You are now," whatever that means.

What I would propose to cover today is first I thought I'd like to start off with just SPC's perspective of the August 2000 ACRS meeting, and then go into addressing the ACR subcommittee comments on both the documentation and the additional benchmarks.

Again, I want to start off with a little background type information. The SPC basically defines methodology as the combination of the codes being used and the application of those codes and the performance of the analysis.

Acceptability of a methodology then can only be determined by examination of all the elements of the methodology. This includes codes, the plant nodalization, the assessments, which is validation of the code and plant nodalization through comparisons with the experimental data, and the simulated plant licensing analysis.

CHAIRMAN WALLIS: If we substitute the word "quality" for "methodology," it would be equally true, that they've come up with the quality of the code without context which is going to be used.

MR. O'DELL: Yeah, I think you could say that --

CHAIRMAN WALLIS: Not just the methodology itself, but the evaluation of that methodology in terms of its quality.

MR. O'DELL: Right, right.

CHAIRMAN WALLIS: Also, you need to look at the whole picture.

MR. O'DELL: Right.

CHAIRMAN WALLIS: I would agree with that.

MR. O'DELL: I think the only point I wanted to make about the simulated plant licensing analysis, the SPC conservatisms, one of which for this particular application is the loop seal biasing, and then on top of that there's the Appendix K conservatism.

Now, if you look at the development of an Appendix K methodology, what we do is we use one of the things that came up out of the last ACRS meeting, was this question of what's your figure of merit, and basically it's the demonstration that the code and plant model, the combination, provide a reasonable or conservative, conservative being high PCT results, without application of the Appendix K conservatisms.

And that's why we try to make the comparisons to the assessments in a best estimate mode, so that we can demonstrate this, and what I mean by reasonable is it goes through the data as opposed to bounding the data.

Then if we follow this approach, then the additional conservatism is assured when the Appendix K conservatisms are added to the plant licensing analysis, and I believe this approach is really consistent with other vendors because if you go look at the types of peaking factors that are supported at the plants by Appendix K methodology, there's not significantly different -- there's not a large, significant difference between them.

CHAIRMAN WALLIS: But your figure of merit is PCT, but there are other situations where there might be another figure of merit.

MR. O'DELL: Exactly.

CHAIRMAN WALLIS: For instance, fresh rose thermal shock. If your code predicts that you never get the stagnation conditions and so on, which could make it happen, then you'd be happy.

MR. O'DELL: Right.

CHAIRMAN WALLIS: But then the sort of figure of merit would be how close you come to some other situation where some other limiting factor like pressurized thermal shock matters.

MR. O'DELL: Right, or in a non-LOCA transience such things like DNB, center line melt become --

CHAIRMAN WALLIS: That's right. We've lost a code because the predictions of PCT are insensitive to assumptions. It doesn't mean to say it's blessed for some other criterion for evaluation like pressurized thermal shock

MR. O'DELL: And that's why, you know, when we make a submittal we make a submittal on a small break LOCA Appendix K.

CHAIRMAN WALLIS: Look at the use to which it's going to be put.

MR. O'DELL: Exactly.

CHAIRMAN WALLIS: And we probably won't -- I know we'll never reach the day when we'll bless a code for all purposes.

MR. O'DELL: I think we're a ways away from that based on where we currently are with codes, yes. But hang in there. You never know.

Again, with respect to SPC's presentation in August 2000, we had two objectives. First was to familiarize the ACRS with the S-RELAP5 code. To do this we provided a description of the theoretical basis for the code models important to the small break LOCA, and we provided a description of the relationship between the code models and the associated numeric approach that was --

CHAIRMAN WALLIS: You provided two descriptions of the theoretical basis, one written and one oral.

(Laughter.)

CHAIRMAN WALLIS: As I remember.

MR. O'DELL: Provided an amplification.

(Laughter.)

DR. ZUBER: My question is whether they're the same or they're different.

DR. KRESS: They were a little different.

CHAIRMAN WALLIS: The different explanations, but I guess that the result was --

MR. O'DELL: The result.

CHAIRMAN WALLIS: -- was the same.

MR. O'DELL: The second objective, again, consistent with our definition of a methodology, was to present our methodology for the performance of the Appendix K small break LOCA. We described the methodology, the event scenario, the plant nodalization being used, and the event biasing. We described the important processes in the small break LOCA. We demonstrated a relationship between those processes and the code assessments that were performed.

We also presented the important small break LOCA constituative models and demonstrated the applicability of the code to small break LOCA scenarios.

We then presented the small break LOCA code assessments, for example, the semi-scale LOFT, UPTF loop seal clearing test, and the BETHSY test.

CHAIRMAN WALLIS: You also presented a sort of retroactive PIRT, as I remember.

MR. O'DELL: Right.

CHAIRMAN WALLIS: There was a description of --

MR. O'DELL: And that was --

CHAIRMAN WALLIS: -- saying this isn't our PIRT. This is someone else's PIRT, but if we had done a PIRT, it would have looked like this.

MR. O'DELL: Well, I don't think I would phrase it exactly that way.

CHAIRMAN WALLIS: See, that's the way I remember it, something like that.

(Laughter.)

CHAIRMAN WALLIS: And, now, you didn't mention PIRT in your slide here.

MR. O'DELL: Well, I did from the standpoint of describing the important processes and then demonstrating the relationship.

CHAIRMAN WALLIS: And the concern that we've had all along with these PIRT type exercises is that there's usually a big section on how the experts said these were the important phenomena,b ut then there isn't always the tie-in which says, well, this particular assessment checked these particular high ranked things, and this is how we decided that we resolved the issues raised in the PIRT.

And I think it's still a bit weak on that, probably because the regulations don't ask you to do it.

MR. O'DELL: Right.

CHAIRMAN WALLIS: But if you're going to go through the PIRT and have all of these things which say, yes, these are all very highly ranked and need to be understood, then eventually logic would say at the end you've got to go back and say, "Did our assessment really show that we did model those things?"

MR. O'DELL: Right.

CHAIRMAN WALLIS: Maybe in the future that's going to happen.

MR. O'DELL: I hope for the realistic large break LOCA --

CHAIRMAN WALLIS: That we'll have them, yeah.

MR. O'DELL: -- we will accomplish that.

CHAIRMAN WALLIS: Yes.

DR. ZUBER: I think again the key word, I think, is "understood," and one of my concerns in this technology is people who have run these scores obtained an agreement or this agreement. Here's the calculations that delivered that, without really understanding why the results and what does it mean.

And I think if you take a PIRT and you identify something which is important, then you can address it.

Then if you have an explanation, why is it, what is really happening, a physical thing, I think this is important for two reasons.

One, actually this also applies to the staff. I think that you are getting a synthesis of the knowledge. I mean, just having a calculated curve is not knowledge. I mean the computer does, but if you understand why the curve has this shape, you understand the physics, you can then transmit this information to the next generation of engineers or the people who work, and I think the disconnect at this point in these technologies, there is a disconnect between understanding the process and just running a code.

And I think using a PIRT as a guideline, then calculations understanding the process and documenting the reason of the physics, I think, gives you a synthesis, and it would make not only your job easier, but also to the regulators because you have addressed the understanding.

You understand, and the dialogue can be much more efficient without arm waving.

MR. O'DELL: And, you know, I don't disagree with that. I think what we found in going through the PIRT process on realistic LOCA is that, you know, we got a lot of people together. We got our in-house people together. We had Dr. Hochrecter worked with us in putting together the PIRT and Marv Thurgood. So we brought in outside consultants to work at developing the PIRT.

And we got differences of opinions obviously from everyone, and we got peer review meetings together, and we put all of this down on paper, and then we've gone off and said, "Okay. This is sort of everybody's opinion," and I think Joe mentioned we go off and we run these 70 cases and at least at two different power levels and stuff. So we're running like 140 sensitivity calculations based on looking at what the experts said was important in the PIRT and then running the calculations to see, well, does it bear out or not. If not, why?

So this whole CSAU process is a fairly large learning process, I think, is what I'm trying to say. I agree with what you're saying.

DR. ZUBER: No, no, no, no, no. It's a messy problem, but there is one more thing, you see. If you understand what is important, then you can really reduce the number of sensitivity and calculations, and then you can be more efficient. The same thing applies to the regulator. You don't have to look at every comma, every itsy-bitsy information in the code.

You can focus on what is important, and you do this only if you get the synthesis of the understanding of the process and you document it, and I don't see this when you present your results or listen to this stuff at the research. I don't have a feeling that really there is an understanding why.

So what is important? Sure, the code predicts, but it doesn't say what is important so I can focus next time on that issue. I don't have to take all of the itsy-bitsy datas which our codes have.

MR. O'DELL: You mean important from the standpoint of what models in the code --

DR. ZUBER: Well, no. We have so many models in these codes, I mean, and so many coefficients. I mean, they're coming through our ears, and the issue is not all of them are important.

There is an important 25 years or 30 years because we didn't know much about the process. So we put everything like in the cooking, put everything in the pot and let it boil.

Now we have data, and if you understand what is important, it can then focus. When I do a sensitivity analysis, focus on the important things, and I don't think either the industry -- I don't think in your reports you focus. This is the important process. I have to focus on this, and this is the sensitivity.

We did --

MR. O'DELL: I think what you're seeing though, Dr. Zuber is really sort of the opening I want to say gamut on this CSAU approach because one of the things that I see out of the CSAU approach is exactly what I think you're alluding to, and that is that you find out what models are really important, where the code deficiencies are and where you need to go concentrate on improving the codes.

DR. ZUBER: Yeah, but see, we developed that method ten years ago, and I didn't see any learning, anything that we have learned much since that time.

See, I see all of these new codes that have the same amount of details. My own guess is an NG (phonetic) is probably 80 percent and not important, and yet we carry all of these calculations, all of these coefficients, all of these theological arguments, this is important, that is not important, between us, between the staff and so on.

And I think if the staff and the industry -- I mean, you cannot do it one without the other -- focus, this is the governing process for this phase of the -- or this type of accident, let me focus on the important phenomena; you understand the physics. You can explain it. You can transmit it to other engineers, and you can reduce your number of calculations, and you are efficient economically.

MR. O'DELL: And we're trying to do that.

CHAIRMAN WALLIS: Yeah, I put it a different way. Maybe it's another slant on what I think Novak is getting at here. I'm not so impressed by 30 experts sort of estimating or opining about what might be happening and what might be important, but if I can get one Joe Kelly, you can get up there and answer every question we ask and explain why it does what it does and show that we really understand the effect of this assumption, that assumption, and so on.

That's worth far more to me than the opinions of 30 experts. I don't know how long they've spent on it, whether they have the experience, and so on.

So if you can do that, if you can come back with, you know, not necessarily Joe, but whoever it is, you can really stand up there and robustly answer the questions, show an understanding, that's worth a lot.

DR. ZUBER: More than that, if you can document it in your report, after we have heard from these calculations, okay, this is the important thing. This is the governing thing, and it confirms not the PIRT or something, then you have learned something, and you have helped everybody in this technology.

I think the same thing you should. When you review these codes, you have to document it. If you have a failure, why has it failed? And what is important so you can then transmit it to the next generation?

MR. O'DELL: All right. That concluded what I had to say on our perspective with respect to the last meeting. I now want to address the subcommittee comments, particularly on documentation and additional benchmarks.

CHAIRMAN WALLIS: So the SPC perspective on the meeting was essentially your view of what you did.

MR. O'DELL: Yeah. It was basically --

CHAIRMAN WALLIS: It wasn't your view of what the ACRS said.

MR. O'DELL: No, it was our view of what we were trying to accomplish, I think, in that meeting. Okay?

With respect to the documentation issues that were provided in the approved minutes, I think there were three that I lumped things pretty much under. One was the misleading/incorrect items in the models and correlations document.

There was an undocumented upper plenum nodalization model, and there was incomplete derivation of equations in the models and correlations document.

CHAIRMAN WALLIS: There was something about the solution procedure, I think. We didn't understand the solution procedures, numerics. We had some problems with that. Remember?

MR. O'DELL: Okay. I don't recall that from the specific minutes that we received. It may have been.

CHAIRMAN WALLIS: Well, I remember we talked about it.

MR. O'DELL: Well, we talked about the --

CHAIRMAN WALLIS: The solution procedures. We couldn't understand the solution procedures. Then there was some explanation. There was quite a lot of explanation given to us orally, which helped.

MR. O'DELL: Okay. In Joe's presentation?

CHAIRMAN WALLIS: And that's going to be fixed up in the new documentation.

MR. O'DELL: Okay. What we've done, and Jerry Holm alluded to this earlier with respect to the misleading/incorrect items in the models and correlations document, when we went home we broke the document up by sections and basically turned it over to individual people to review in detail each one of those report sections.

We've also received the RAIs from the NRC, some of which pointed out and asked questions on specific documentation issues, and as Ralph indicated this morning, we had provided draft responses, are in the process of finalizing those now.

The document has also been revised and is in the process of being reissued, and the intent is to provide this revised document with our formal responses to the RAIs.

DR. ZUBER: And these will be for the small break?

MR. O'DELL: Yes.

DR. ZUBER: Or these will be also for the best estimate?

MR. O'DELL: No, it will be for the small break.

CHAIRMAN WALLIS: So this has been reviewed by enough people that we're not going to find a divergence where there should be a gradient or a D by DX where there should be a D by DT and that sort of thing? We're not going to find any of those again?

MR. O'DELL: I certainly hope not.

CHAIRMAN WALLIS: All right.

(Laughter.)

MR. O'DELL: With respect to the end document and upper plenum nodalization model, the initial upper plenum nodalization model was developed based on the previous experience with RELAP5. The adequacy of that model was then confirmed through performance of the assessments, and what I mean by that is it's an iterative process coming up with one of these nodalizations. You sort of, I think, as Ken Carlson said in the last meeting, you use tribal knowledge as your first guess. Then you run assessments and ask yourself how does the model and the nodalization work.

If it didn't work out well, then you go back in, fix up the nodalization so, in fact, it gives good agreement with the assessments, and obviously back through the process you then confirm that against the actual plant calculations to make sure it doesn't introduce something strange in your plant calculation.

And you have a final plant nodalization model, and assessment results were document in the methodology submittal, EMF 2328, as Jerry was talking this morning, and while there was no specific discussion relative to the upper plenum, the nodalization is shown in Figure 6.1 within that document as to what's being used.

DR. ZUBER: Are you using the nodalization for your best estimate?

MR. O'DELL: No. We're using more 2D components in the best estimate approach, and we've got more detail in --

CHAIRMAN WALLIS: Greater or smaller sensitivity due to different nodalization and see what happens

MR. O'DELL: Yes. We started off with a fairly simple model initially, and as we progressed, it got steadily more complex.

DR. ZUBER: Then I'm really curious to see what you did because my recollection, experience, that was always a weak point of all our codes.

MR. O'DELL: The nodalization?

DR. ZUBER: Upper plenum, upper plenum phenomenon.

MR. O'DELL: We've got a very detailed upper plenum to the model.

With respect to the incomplete derivation of the models code document, we believe that the purpose of the model code document is to document what models and correlations are contained in the computer code.

This is to support the code verification and applicability activities which have to be performed, where we define verification as the process providing an adequate level of assurance that the code contains the documented models and applicability is defined as the process of demonstrating that a code has models which address the important phenomena for a specific event scenario and nuclear power plant type.

CHAIRMAN WALLIS: That is right for the NRC, but for the public so that the university, academic, professional community, they want to see, I think, models and correlations which are justified in an appropriate professional way, and they don't really at this level worry about whether or not the code seems to work. For nuclear purposes, they look at this thing and say, you know, if a student wrote this to me, would I accept it. That's the kind of level that they're at.

So I don't think you want to ignore that.

MR. O'DELL: Well, and I'm not saying that one wants to ignore that, but again, it's sort of, you know, if you go look at CSAU and the methodology, what it does is it references the track and RELAP5/MOD3 manuals as being appropriate levels of documentation for --

DR. ZUBER: -- advanced. You don't want to -- there is an expression in the Bible I have forgot. Anyway, when we started that work on CSAU, we didn't have any documentation. Our documentation for TRAC and RELAP are almost nonexistent. We were almost blackmailed by LASA (phonetic). They didn't want to provide us with a document to see what was in the TRAC because they didn't want to expose the stinking --

(Laughter.)

DR. ZUBER: Really. I'm quite serious.

MR. O'DELL: We hope that's not the case.

DR. ZUBER: No, no, no, no. This is -- and then when we got something smelly, but it was still something. Those are the -- we at least have something to work with, but that was ten years ago. Now, don't go back to that kind of level of development or something. Since then we have learned more or we should have learned more and have a better quality control because those documents which were referring really were almost obtained at gunpoint from the contractors.

MR. O'DELL: Okay. Well, that's news to me, but on the other side of the coin, you know, the point is I have a NUREG, and it lays out a process, and I'm trying to follow that process in the development of a methodology, and that process, you know, references these as at least adequate --

DR. ZUBER: It was the first try, you see, at that point, but if you go with this methodology, especially now, you're trying to get more power out of the reactor, and you should. Then you really have to try to satisfy the technical community and everybody around them doing the best thing I can.

MR. O'DELL: Well --

DR. ZUBER: And those references are not the best we could have done since then. We can do much better now.

MR. O'DELL: Well, and I don't disagree with that. I think we have the -- and I'll get into that in a little bit in some of the following slides. I think SPC has the capability to produce the type of document I think you guys are interested in seeing.

CHAIRMAN WALLIS: When I was a member of the public and I came along and I looked at these things, and I said, "Gee whiz, how can you make this kind of assumption?" We'd never allow that in the student thesis or something.

They'd say, "Well, it's because it's okay for nuclear safety purposes."

And I'd say, "Gee whiz, you mean that the standards for this very difficult and important thing for society, nuclear safety, are lower than they are for some undergraduate homework and so on?"

They'd say, "Well, it's in the regulations. Therefore, that's what we have to do."

That's very surprising to an outsider to come in and say, "Gee, for nuclear purposes you can do reckless things that you wouldn't normally do."

MR. O'DELL: And I wouldn't agree with that statement.

CHAIRMAN WALLIS: I said that's the impression I had before I learned more about what's really going on.

MR. O'DELL: Right.

CHAIRMAN WALLIS: That's the impression you give if you're not careful. So I think we've turned it around a bit now, but the impression was given at --

MR. O'DELL: I would say, you know, ten years ago the process that I described here for developing Appendix K methodology is the process we were following. I mean, it's not that you're going off and doing what I would call reckless things. You're, in fact, trying to develop models. You're trying to compare them to assessments to demonstrate that the models are at least good agreement with the data or conservative relative to the data such that when you stick the Appendix K type conservatisms on them, you're guaranteed of having a conservative model.

CHAIRMAN WALLIS: The problem is that, yes, we understand that. The more you understand the whole picture, the more anyone can sort of say, "Yes, that's okay."

MR. O'DELL: Right.

CHAIRMAN WALLIS: But it shouldn't take this kind of indoctrination with the methods of the NRC in order for some outsider looking in get a reasonable assurance that a good job is being done.

That's the thing I'm concerned about.

MR. O'DELL: Well, again, these documents are going to be proprietary, and if we produce that type of document, because I believe the cost of actually producing that kind of document and following all of my quality assurance procedures is going to be very high, okay, and the people and resources that I've got tied up doing those documents are not doing anything else. Okay?

And they're not supporting my five-year plan for R&D development at the company.

DR. ZUBER: And they're providing you with some bread on your table. Otherwise if you did have these documents, how could you justify your product?

MR. O'DELL: Well, and that's what we tried to do, I think, in the presentation with Bill

Kelly, was to demonstrate that we have personnel in house that understands the code, okay, and it's not just, you know, Joe Kelly, Dr. Chow, and Ken Carlson that understand the code. We have three other guys, Dr. Franz, Dr. Martin, and Alan McGuinnes working on the codes coming up behind them.

So it's not like we don't understand the codes internally with the company ourself. Okay? And we're always stuck with this situation of I can spend these resources building this documentation or I can spend these resources trying the improved methodologies and moving on and, you know, following through on what we have for a five-year plan --

DR. ZUBER: How can you convince an outsider, a regulatory agency, that what you are doing is really correct and good or technically sound if you don't have documentation?

MR. O'DELL: Well, I'm giving someone a little documentation. The question is the level.

CHAIRMAN WALLIS: I think in the long run it's more efficient to do a good job in documentation right from the beginning, and then you don't get into the TRAC situation where the documentation was so nonexistent that there's a terrible time trying to figure out what was really going on.

And if you have to recoup that later on, it becomes much more expensive than doing a good job from the very beginning making absolutely clear what you're doing.

MR. O'DELL: Yeah, if you look at -- I've got a slide on that coming up -- if you go out and look at these current software standards and stuff, it would say that you developed this design document early in the cycle, okay, as you're going through the process, and you would have that information.

But what we've got is a code that we would be going back and retrofitting that level of documentation for, and the question for each of the vendors is sort of is it worth the expenditure of resources that I could be using to do something else.

DR. ZUBER: You can always find something else, but the point is if you want to have something approved, I don't see how you can do it without documentation, and this is the only thing one can make a judgment on, on your documents, and if you have good documentation, as Graham says, you save yourself money in the long run, even in the short run.

CHAIRMAN WALLIS: Well, it shouldn't be so difficult to do good documentation.

MR. O'DELL: It's difficult to go back. The process that we would have to go through is, for example, I would have to start off and Joe would have to take his presentation, and he would have to turn that into the initial part of the document. We would then have to go through, and we would have to also incorporate, to reach the level of documentation I think you're talking about; we would then have to go in and start discussing all of the constituative models, all of the fits between all of the constituative models in this document.

Once I finally have that produced, now in order to insure that the document is correct, I get to go do a quality review of this document, right? Which is almost, for that type of a document, which is almost a total repeat of the whole process.

CHAIRMAN WALLIS: Well, I guess our view is a lot different. We say you guys are the experts. You know what you're doing. It ought to be trivial to write down clearly what you're doing. If you can't, then it brings into question whether you know what you're doing or not.

So we sort of think it's rather trivial to write --

MR. O'DELL: Well, I'm not saying I can't.

DR. ZUBER: No, no, no. You're not only the only ones who is presenting the code. I have seen codes which have really wrong field equations, period. I mean just a mantagle (phonetic). They have energy equations which are incorrect, and the trouble is without that documentation, they would never have been able to see whether the thing was correct or not, and these people were not able to produce a correct formulation.

So you cannot go on somebody's believe that he's doing a good job. You have to have a document, and the better the document, the easier it is to go through the process of review. If I can follow your steps or --

MR. O'DELL: Again, Dr. Zuber, the point is we're trying to finish a realistic LOCA methodology. If I pull Kelly off to do that, okay, and put this documentation together, he's not going to be doing the uncertainty analysis, and I don't have any other resources to put on it. Okay?

So it stops while I create this document.

DR. ZUBER: Okay. How do you want to have a judgment on the quality of your work without the document? You cannot do it.

MR. O'DELL: Well, I think it's the combination of code, assessments, nodalization, the results of the calculations. I mean there's two ways to prove something is right. One is to compare things, experimental data, and another is to, you know, study, for example, each tree in the forest and determine whether the tree or the forest is healthy.

I mean, you can take either approach.

CHAIRMAN WALLIS: -- that analogy. I mean, this is a technical thing.

MR. O'DELL: I understand.

CHAIRMAN WALLIS: And you have some technical rationale which is justifiable, and trees in the forests don't really have technical rationale that you have to testify, but in this case, the credibility of your technical approach is very important to you and to everybody else. It has to be established.

But I think we've said this before, and you realize where -- I think that you realize the importance of this, too, and I think that things are moving certainly in the right direction. We don't want to belabor the documentation, but it's got to be clear enough so that a professional person can look at this and be reassured these guys know what they're doing. That is absolutely essential.

MR. O'DELL: Well, and I don't disagree with that, you know, and again, I would say that if we are starting off developing a new code and you're developing a new code right now and you didn't have a software design description document, that you would be deficient in following --

MR. O'DELL: The danger is if you don't do that is that there's some kind of an error which has been accepted for years and no one has really questioned because no one has had to write it up and explain why it's there, and it just goes on that thing forever. That's the real danger.

Then it comes back to haunt you 20 years from now when someone discovers, gee whiz, we've let it be there all the time.

DR. ZUBER: Especially if this error doesn't like this technology. My students will never have made this error, and you are licensing a reactor with this error in the codes.

MR. O'DELL: Well, again, you know, it's still, like I said -- if we go produce this level of documentation, it would be a proprietary document because it's going to be you've got to protect your investment in stuff, and there's other people using RETRAN, which is sort of following the same approach, TRAC which is sort of following a lot of the same approaches. It's got some different constituative models and stuff in it, but overall the approach on nodalization in that is the same. Okay?

MR. SCHROCK: Well, I think that you've suffered from the fact that you chose to use a code that was developed under the auspices of NRC, and so that major cost was essentially handed to you, and now what we see is that as we review in detail the documentation, such as it is, on the government version of this code, other codes, there are some serious flaws, and they need to be fixed, but the process isn't going to allow them to get fixed because of continual arguments that they're good enough, on the one hand. It'll cost too much to make such changes, and now you're saying, well, the documentation even itself is too expensive to tolerate.

MR. O'DELL: And it's not that I'm saying they are too expensive to tolerate. I am not trying to take that position. I'm just saying, you know, that as a manager of resources to do research and development for a company, okay, I have to ask myself what's the priority of producing this type of a document when I can clearly point to three individuals already in the organization that understand the code and three additional individuals that I'm bringing along suffering the expense of training them to understand the code and working the code, and --

MR. SCHROCK: There are a lot of examples out there of where that kind of capability gets lost as evolution proceeds, and I don't think you can be sure that you always maintain it person to person in that way without documentation.

MR. O'DELL: And, you know, I'm not arguing that the documentation wouldn't be a valuable thing to have. I would love to have the document. Okay?

It's just that, again, it's a tradeoff. It's simply a tradeoff on resources and how I would see using those resources.

CHAIRMAN WALLIS: Well, my experience in doing engineering work is that maybe you have to put aside about half your resources to document what you did; that you do the work, and that's only half the job in explaining what you did, and often in doing the documentation explaining what you did, you find out that you didn't do it quite right.

But this writing up what you did is half the work.

MR. O'DELL: Well, on the changes and stuff we made, okay, to the code, we document those in software development records, and those are all clearly documented in software development records, and they're clearly QAed by an independent reviewer. Okay?

So the history of the code and what we've done in the way of changes are all included in software development records.

DR. ZUBER: Is that right? I hate to be sarcastic. Nobody really forced you to take RELAP. You're taking advantage of a code which your government put money to develop it, and now you're carrying that with our shoulder and says, "I cannot really write a document for this code because I have to move people from one assignment to another."

You have the full freedom to deal with a completely new code and write a good documentation. You didn't do it. You got a code with poor documentation and you realize it, and TRAC is the same conditions.

You want to use it for your own monetary benefit, and you should. Then there is a requirement. If somebody wants to assess the quality of your work, you have to have a document, and it is in your own benefit to have as good a document as possible. You make it easy for the regulator, for the reviewers, and for your own future stuff to learn something.

CHAIRMAN WALLIS: I guess we've made the point. You have to figure out --

MR. O'DELL: It's not unexpected. Okay?

(Laughter.)

DR. ZUBER: It really pains me. It's to your benefit to have a document. You would cut these reviews in half, half time.

MR. O'DELL: Perhaps.

DR. ZUBER: No, believe me.

CHAIRMAN WALLIS: It would certainly help at our level. The ACRS reads a document which looks really professionally prepared, follows rationally, and we're not so held up short by saying, "Gee whiz, where did this come from?"

Then we could just say, "Gee, these guys have just done such a good job we don't have any questions at all." That would be wonderful.

DR. ZUBER: And you come next time and you have the group agree.

MR. O'DELL: No questions at all, Graham?

(Laughter.)

MR. O'DELL: Okay. Again, I guess, based on the discussion, I'm not too sure that the next series --

CHAIRMAN WALLIS: Well, maybe you can go over them quicker.

MR. O'DELL: Okay. I guess what we concluded from our last meeting was, in fact, the document that you're really looking for or is a document, not just a models and correlations document, but you're really looking for a document that says, "Hey, this is the theoretical basis. This is the design description for the document and basically provides the connections between reference base equations and the equations and the numerical implementation.

So it starts from referenced equations, develops the equations in the form implemented in the code, and would include decisions made to accommodate the numerical solution and the stability, and would include the evaluation of potential impacts of those assumptions and the numerical --

CHAIRMAN WALLIS: I think a lot of these things are in some upcoming standard review plan stuff for best estimate codes. So they're the kind of things which are going to be required on paper by the NRC.

MR. O'DELL: I think we've got copies of it. We will be reviewing it and responding to those drafts.

CHAIRMAN WALLIS: You have significant cost for little value?

MR. O'DELL: Well, it should have been -- I don't think -- are you on the next slide?

(Laughter.)

MR. O'DELL: I wouldn't say "little value." I think that's poor selection of words. I would say it's not significant present value because we have people that understand the code, but I mean value --

DR. ZUBER: You have to convince some of the people that you understand the code, and only you can do it if you have something in writing.

MR. O'DELL: Well, I believe we tried to accomplish that through the presentation by Joe Kelly and --

CHAIRMAN WALLIS: Well, I think if you can get your code through and approved in two months instead of two years, that's tremendous value to you, and that happens if there aren't all kinds of questions raised about the documentation.

There was a tremendous value to SPC in doing a really good job of documentation. You just underestimate the value.

MR. O'DELL: I haven't been able to sell that value yet. Okay?

CHAIRMAN WALLIS: I think it also helps your people. Your folks have something to point to which they can go back to and say, "It's all there. We don't have to redo it. We don't have to be nervous about it."

You know, it helps tremendously the self-confidence of your own people.

MR. HOLM: This is Jerry Holm.

Can I make one comment? Hopefully it will help with Mr. O'Dell.

I don't want to leave the impression that we haven't recognized the value of documentation and haven't put forth effort to increase the amount of documentation that we provided for you.

As I mentioned, I think, previously, when we submitted ANF RELAP for small break LOCA, ANF RELAP for a non-LOCA, and it was reviewed and approved, we had no models or correlation documents. We had no programmer's manual. We had no assessment document.

And so we have identified those as things we want to add to our documentation list to approve the documentation. What we haven't accepted yet is the cost benefit of adding the derivations of the equations to the documentation, and perhaps at some time in the future we'll find that that has more value than other R&D projects, but at this time we've made the decision that the amount of extra documentation that we provided was suitable.

CHAIRMAN WALLIS: Well, the cost at some later date of Dr. Zuber or someone sort of discovering what your equations were and finding an error in them would be quite substantial or could be quite substantial.

Even though, you know -- well, maybe you don't think it matters because you've got approval from the NRC, but I would think that the cost of being found out later on would eventually come home to you somehow or other if there were errors.

MR. HOLM: Yeah, errors can cost us significant amounts of money. We see that in other instances.

DR. ZUBER: Do you know what this reminds me? Like a woman losing its virginity. Once you lose it, you cannot recoup it, and if you --

CHAIRMAN WALLIS: This happens to me, too.

(Laughter.)

DR. ZUBER: Well, that's not -- the point is -- the point is that a company, large company, without mentioning names, and the heavy documents for the delayed -- really have basic errors in the equations which a union in the university could detect, that doesn't contribute to the reputation of the company, and if an intervenor finds this, it can really harm the company and also this industry.

So it's for your own benefit. I mean for putting bread on your table, to do as good of a job as we --

CHAIRMAN WALLIS: Well, we shouldn't be at that level anyway. We should be way above the level of juniors.

DR. ZUBER: Through the errors, the errors. They're junior problems.

CHAIRMAN WALLIS: So anyway, let's go on. I think we keep going over the same stuff. But we're going to bring you around.

(Laughter.)

MR. O'DELL: Well, like I said, if I had the document I would be very happy. If somebody could hand me the document, I would be very happy to take it. Okay?

I think basically we've covered all of this. I don't know if -- I think we've covered it all.

CHAIRMAN WALLIS: Is there any prospect of getting away from this proprietary thing? I know the Commission is a bit concerned about this, that one problem with these things is that they're proprietary. So they're not in the open. So they don't have the sun shining on them that Novak talks about.

And maybe sometime down the road, and ACRS suggested some sort of collaborative industry effort, maybe NEI or somebody, say, "Look. There are common features of all these codes. These don't really need to be proprietary, but we're going to justify them once and for all."

And then the questions won't be asked anymore.

MR. O'DELL: And I would applaud that approach, okay? Or even if you could somehow get the national labs to go back and do this to the present versions of the code so that somebody could lay this on the table and say this is the document that I want to see for the code, and I could then look at that document and say, "Okay. I can produce this." Okay?

But right now it's sort of this nebulous thing, and everybody is going, "Well, my expectation is that this is going to be extremely time consuming and expensive to produce."

DR. ZUBER: But you want to have benefit out of it. You still want to increase your power, and you want to sell your capability to the utilities so they can increase the power of the plants, and they should.

Then have something on the table. If you don't have --

MR. O'DELL: Well, nobody is saying that you wouldn't like to have that document. Okay?

DR. ZUBER: I don't understand the document that you would like to have something without putting an effort to do it.

MR. O'DELL: Well, it's very simple. I've got X people and if you give me X plus five things to do, then something doesn't get done. Okay? And --

DR. ZUBER: This is a management problem.

CHAIRMAN WALLIS: But, see, if the effort is too great, that makes us suspect that something was wrong because if you really understood what you're doing, it should not be too difficult to explain it. It shouldn't be a major task. It really should not be.

It's because you've got, I think, this sort of uncertainty about whether or not things are justified or not that you've got to go back and do a lot of extra work. Maybe that's good for you to have to do.

But if you really were on top of it, it probably wouldn't be so difficult to just tell it the way it is.

MR. O'DELL: Well, but I think that you understand you've also gone through this with the national labs that produced them, the codes, right? And they don't willingly devote their resources to go out and put this documentation to --

DR. ZUBER: No, no, no, no, no, no, no, no. They first give us a cost which they thought they would not pay in order to have the -- they didn't want to produce a document because they didn't want to show what's in the code. That was the bottom, and once they paid to produce that documentation, I mean, correlations document, then we saw really what's in the code.

MR. O'DELL: Well, having worked at a national lab, okay, I would like to not believe that they didn't want to produce the document because they thought it was --

DR. ZUBER: We know that.

DR. KRESS: That couldn't have been the national lab I worked in. We'll take money to put the name on the document no matter what.

MR. O'DELL: Well, no, that wasn't what I meant. In fact, they didn't want to do it.

DR. KRESS: Yeah, I mean, that surprises me, too.

MR. O'DELL: Yeah. I mean I worked out at Hanford in the breeder reactor program, and we produced codes, and I wouldn't have been ashamed if I had the documentation with that. All someone would have had to do is say, "Here's the money. Go do it." Okay?

CHAIRMAN WALLIS: Well, the truth was it was difficult to recover because various people contributed to these codes, and things were being put into the codes without any explanation, and no one knew why they were there.

DR. KRESS: That was the problem.

CHAIRMAN WALLIS: That was the problem. I'm sure your code isn't in that state.

MR. O'DELL: Me, too.

CHAIRMAN WALLIS: So perhaps move on.

MR. LANDRY: This is Ralph Landry from the staff.

I think part of what Novak is saying is true, but also I think the NRC has to take some of the heat on that, too, because back in research in those days we did not heavily fund the documentation.

CHAIRMAN WALLIS: That's right.

MR. LANDRY: Plus we were constantly changing the requirements for the codes. We were constantly changing what we wanted, and we never would give the labs the time to sit and document what they had been doing either.

So it's not completely the fault of the labs. The way we were running the programs at that time was not conducive to writing documentation because the documentation never applied to what was being used at that particular time.

MR. SCHROCK: What you're saying is a management problem, whether it's in industry or government.

MR. LANDRY: I think what Dr. Wallis is proposing would be very good at least from a regulatory standpoint, a review of the different codes. If there was a good set of derivations of mass, momentum, energy, equations that are used the same in all of the codes, a complete document that gave all of the derivations and said this is the form of the equation that is going to be used, and then code XYZ could come in here and say, "Okay. We're using this standard for the derivation of the equations, and we're picking up at this point and going forward," and that takes the onus off of us of having to review from square one what is in this code.

And that would be beneficial from a review and regulatory standpoint, but could that be done in a time frame to benefit us on the codes we're currently reviewing? I would dare say probably most of us are going to be retired before that could be done.

So it's a great idea. You know, it should help us, but I don't think it will happen.

CHAIRMAN WALLIS: In your lifetime.

MR. LANDRY: No, I said in my working --

MR. BOEHNERT: Your working lifetime.

CHAIRMAN WALLIS: Okay.

MR. LANDRY: I hope.

CHAIRMAN WALLIS: So do you have another slide?

MR. O'DELL: Well, I'm going to move off of the documentation issue and discuss the benchmark comments that were included.

CHAIRMAN WALLIS: That's the assessment part?

MR. O'DELL: Well, it's a combination of things. You had comments in your minutes, some of them, in relationship to both Joe's and Ken Carlson's, where on momentum equations there was some suggested looking at trying to develop a quantitative way of saying that it's okay to ignore certain terms.

Okay. So there was a series of benchmark discussions, I think, throughout the whole transcripts. You can go back and read them. Plus there was the comments that were in the minutes.

There were a number, as I indicated, a number of additional benchmarks suggested during the meeting. We do believe that the benchmarks already performed and reported in support of the small break LOCA are sufficient to demonstrate that the submitted Appendix K methodology is conservative.

We have the comparisons to the assessments, which demonstrated a combination of code and nodalization provided the conservative --

CHAIRMAN WALLIS: Let me comment about that. You talked about equations. Suppose I have an energy equation that omits some terms or a momentum equation that makes some assumptions. There's no way that I can tell whether this is conservative or not until I put in these assumptions or change the equation or do something and end up with the consequences of it. I can't. There's nothing that says an assumption per se is conservative until you look at consequences of it.

So I think there's a lot of assumptions that are made at a very fundamental level which we don't know if they're conservative or not.

MR. O'DELL: Well, but you do know that when you run the assessments and do the comparison to basically the figure --

CHAIRMAN WALLIS: But you don't have to do things like saying the inertia in my momentum equation is uncertain because I've made assumptions, and it could be 50 percent bigger or less. So I'm going to change that inertia term in my momentum equation throughout the plant.

No one as far as I know does that. So there's some levels of uncertainty which we don't really know that they're conservative or not.

MR. O'DELL: On an individual basis, I would agree with that.

CHAIRMAN WALLIS: So the sensitivities are performed at some level, but not throughout the whole code. So we still are left with a little doubt about how conservative the code is.

MR. O'DELL: Well, with respect to the assessments shown, I think we showed that it either went through the data or was, in fact, conservative data. Okay?

So on an overall basis the code demonstrated a conservatism, and then when you applied the Appendix K conservatisms, those are additional conservatisms above --

CHAIRMAN WALLIS: So these could be some offsetting conservatisms or liberalisms or whatever the opposite is where --

MR. O'DELL: You could have quite a bit --

CHAIRMAN WALLIS: -- conservatism in the momentum equation offsets the liberalism or something. They could be offsetting things because the whole picture looks conservative. Okay.

MR. O'DELL: Now, with respect to the specific benchmarks, we would propose the following way of looking at those benchmarks. One of the comments was to evaluate the liquid level tracking model for two phased flow conditions, and again, we believe that we've already provided some information in the assessments we've done, the G level swell, the THTF level swell. Both of those were provided in the models and correlations document, and the LOFT test was provided in the methodology document.

There was a suggestion to rerun the BETHSY test, the 9.1B with the Moody critical flow model to demonstrate medium model conservatism. We don't believe that this is really doing to provide you an estimate of the conservatisms, and the main reason for that is for small break LOCAs, the conservatism is determined by selecting the limiting break size from a break spectrum analysis, and that limiting break size is dependent upon what you're using for a critical flow model.

So I don't know exactly what you would get for any particular break for any particular critical flow model because what you got is basically a -- I don't have a pen here.

CHAIRMAN WALLIS: As long as you cover all different sizes, it doesn't really matter what the critical flow model is.

MR. O'DELL: Exactly.

CHAIRMAN WALLIS: Because it's a combination of one times the other in a way.

MR. O'DELL: Right. That's exactly right.

CHAIRMAN WALLIS: That's always impressed me, that some of the assumptions made about the break are at a very coarse level, and then we fiddle around with these details of the code.

MR. O'DELL: Well, you know, the thing is it's basically that combination thing. If I change one of them, for example, change the critical flow model, all that really does it change the break size. It gives you the worst conditions in the core. It give you the worst --

CHAIRMAN WALLIS: Well, I think you realize that, and you're willing to do enough break sizes and really investigate enough that that seems okay.

MR. SCHROCK: It's always seemed to me that that is a big opportunity for industry to explore the dependence of the accident predicted scenario on the presumptions about the break and could maybe use better information about what breaks are possible, which is the higher probability.

You're not really --

MR. O'DELL: That would be an interesting --

MR. SCHROCK: You're not really doing that.

MR. O'DELL: Yeah.

MR. SCHROCK: And I think it's an area that could be very fruitful for you.

MR. O'DELL: Well, I've seen comments about how we didn't work at improving the codes, you know, and improving the models in the codes. Part of that is just driven by the Appendix K conservatisms. Again, like everything in industry or at least on the business side of things, it's a cost-benefit type analysis.

MR. SCHROCK: I'm not talking about Appendix K. I'm talking about best estimate.

MR. O'DELL: Oh, yes, and the best estimate -- you know, the best estimate, whenever you can find a model that you could clearly improve on, then there's a benefit to doing it. You can support better limits of the plant.

MR. SCHROCK: Yeah, I still have hope that some day you'll think a best estimate approach for a small break is productive, is in your interest. In fact, I think I've heard some industry people say outright that they think it is.

MR. O'DELL: I think it probably is. The issue thought is you've got to sort of get in, get your feet wet someplace, and we've chosen the large break LOCA to do that with, and again, this is the same discussion I'm having on resources, you know.

I did it realistic. We get through the support on that, and I will move on to other methodologies. It's development processes. I just have X amount of resources, and I can cover X amount of stuff.

With respect to there was, I think, at least three comments on the momentum model and a couple of different comments on the sub cooled boiling model, and what I would propose with these is that we will address those in the assessments that we're doing for the realistic large break LOCA. I think that's a more appropriate place to do it, and that will give us the time to, in fact, do that. So that's what I would suggest you do for those comments.

In fact, that's what I had to present.

CHAIRMAN WALLIS: Does that take us -- how far along does that take us in the Siemens presentation?

MR. O'DELL: I think that's the conclusion.

CHAIRMAN WALLIS: That's the end? You think we're ahead of time?

MR. HOLM: I might make a couple of concluding remarks, if I might.

CHAIRMAN WALLIS: Yes, please.

MR. HOLM: If we could caucus.

I guess the first point I'd like to make is that the intent of this small break LOCA methodology is to make an improvement to our current improved methodology using ANF RELAP, and we believe that we've done that.

We believe we've made the code less sensitive to small changes in input. We believe that we have provided the demonstration that the code is still conservative, that the model we've proposed is conservative without Appendix K, and that when you add the Appendix K conservatisms, we'll have a conservative result.

And we also believe that approval of this code, since it is an improvement, benefits SPC, benefits the NRC, and benefits our customers, and we would like to see the SER in the February time frame, as mentioned by Ralph Landry.

I've already got one customer that has authorized us to start using the model, and I'd like to be able to use the approved model.

Thank you.

CHAIRMAN WALLIS: Do you want some final words, Ralph?

MR. LANDRY: Well, I think we've said quite a bit about the way we've conducted the review. The review we feel was much more thorough than has been done in a lot of respects in the past. We've tried to learn from the review we did on previous codes, and we tried to learn from the discussions we had with the subcommittee on things we should be looking for and the way that we should be conducting reviews of the codes.

We've gone into the code in a lot of areas with a great deal of depth. We've come back with a feeling that this code is much more robust than the codes from which it is derived.

And we feel it is in compliance with the requirements of 10 CFR 50, Appendix K, and meets the intent of that, plus the NUREG 0737, which added some more requirements for Appendix K small break LOCA.

The staff's opinion is that the code is acceptable, and we would like to go forward with approval.

CHAIRMAN WALLIS: Okay. Thank you.

Now, we've spent about five hours today on this matter, and if my colleagues agree, then the next step would appear to be to bring this matter to the full committee, in which case we will have an hour and a half.

So first of all, I should perhaps ask my colleagues if they see any impediment to our bringing this to the full committee or if Siemens sees any impediment. Everyone seems to be upbeat enough that you probably don't see any impediment to going before the full committee.

(No response.)

CHAIRMAN WALLIS: So we're ready to proceed. So on February the 1st, we will have a presentation before the full ACRS, and we might discuss then this time what parts of the presentations we heard today is most important to present at that time because we can't do everything we did today.

From my perspective, I would like the staff to go over -- what I think was useful was the changes this code represents compared with what was there before and how they are improvements and what the evidence is for that.

If you could also show that Siemens has done more assessment than is the minimum required by a considerable degree, which I think was the message which eventually came through, and give a reassuring and convincing argument about why the requirements of the regulations are met by this particular code. And this would perhaps take half an hour.

Is there anything else they need to go through?

MR. BOEHNERT: I don't think so.

CHAIRMAN WALLIS: I think you probably are going to get questions about is the documentation going to be fixed up and when and who knows.

DR. KRESS: Be prepared to answer it.

CHAIRMAN WALLIS: Be prepared to answer that.

DR. KRESS: I wouldn't make a presentation.

CHAIRMAN WALLIS: Be prepared to answer those kinds of questions.

Is there anything else that my colleagues feel the staff should --

DR. ZUBER: Well, I think it's an acceptable code, specially when you have the Appendix K. I was a little bit saddened by the comments on the difficulty of documentation. I hope that time will teach or educate the cost-benefit of a good documentation early in time.

I see no problem where this could not be approved.

CHAIRMAN WALLIS: Now, the Siemens presentation to the full ACRS would be presumably like what we heard today, but it doesn't need to go in anything like as much detail into the questions raised by the subcommittee perhaps because you're reassuring us at this time, we hope, and the main committee does perhaps need to know all of those things.

MR. HOLM: Should we restrict it to the introduction I gave or do I need to go into loop seal modeling at all?

CHAIRMAN WALLIS: Well, I don't think we need to go into loop seal modeling. I think we may need to revisit some of the big questions, such as the assessment, why is it that this code works and the big picture rather than the details that we went into.

DR. ZUBER: I think what the staff could also comment, the positive response from Siemens in providing the code so they can really run the code and assess it turned around. I think that was a good benefit.

And you can also mention that the agency would benefit not if you had more resources to perform this calculations.

MR. CARUSO: No, no, no, no, no.

CHAIRMAN WALLIS: That's the usual refrain, yes.

DR. KRESS: We had benefit of a previous meeting.

MR. CARUSO: Research may do that, but --

CHAIRMAN WALLIS: Yeah, we did have benefit of a previous meeting which we didn't have this time.

DR. KRESS: Which the full ACRS hasn't had.

CHAIRMAN WALLIS: That's right.

DR. KRESS: And then I worry about how to cover that, particularly the very nice stuff we got presented by Joe Kelly, for example.

CHAIRMAN WALLIS: Right.

DR. KRESS: It really went a long way with me in believing that the code is going to do what it said.

Now, I don't know how. You know, that's a lot of stuff there. I don't know how we get that flavor in it. If somehow you had an abbreviated presentation of that part of it.

CHAIRMAN WALLIS: Yes. I think you do need to give the full committee an assurance that the code has a sound technical basis somehow, without having to go into all of the details we went into last time.

DR. KRESS: Because we had that benefit of that other meeting. The full ACRS has had none.

CHAIRMAN WALLIS: I'm just saying that it's like RELAP. It may not quite do it.

(Laughter.)

CHAIRMAN WALLIS: So maybe we need to have -- it would be good. I don't know how, but maybe we need to have Joe up there saying, look. He has looked at all of these constituative equations and the basis.

We've seen Joe before, and he's got some credibility, as long as he doesn't take too long.

(Laughter.)

CHAIRMAN WALLIS: And to assure us that the problems which keep recurring in our review of these codes, the formulation of the equations and --

DR. KRESS: Yeah, I would spend most of the time on that.

CHAIRMAN WALLIS: -- have actually been resolved by Siemens. If you could somehow do that in 15 minutes or something, ten or whatever, I think that would help the committee.

Because the full committee knows there are problems with these codes.

DR. KRESS: How much time do we have?

MR. BOEHNERT: An hour and a half.

DR. KRESS: I think that's worth half an hour.

CHAIRMAN WALLIS: Half an hour?

DR. KRESS: At least.

CHAIRMAN WALLIS: As long as he doesn't get out of hand.

(Laughter.)

CHAIRMAN WALLIS: No, I think what I said before about the PIRT. I mean, 30 experts' opinions is not worth as much to me as Joe Kelly really assuring me that he knows what's going on, that he's got it under control. I mean, you can give that impression to the full committee.

It does much better than going through the PIRT and saying, "Here are some Hs, and here are some Ns."

DR. KRESS: Yeah, I don't think we'll do that.

MR. BOEHNERT: I don't know if he's going to -- I can realistically think they can have about a total of 45 minutes. The staff is going to have 30 minutes.

DR. KRESS: Well, give Joe 30 and 15 for the rest of it.

MR. BOEHNERT: Yeah.

CHAIRMAN WALLIS: And then you are going to have some questions. You're going to have to have a team there to answer the questions.

DR. KRESS: I thought the seal loop was good stuff and very appropriate, but I think the full ACRS can rely on the subcommittee to tell them that that's okay.

CHAIRMAN WALLIS: Yeah.

DR. KRESS: And so we need --

CHAIRMAN WALLIS: Well, the loop seal was a sort of case study. I mean --

DR. KRESS: Yeah.

CHAIRMAN WALLIS: -- there is this issue about these things randomly lurking, and they may go together or separately, and this is how we resolved it.

That gives us assurance that you know how to resolve that sort of a thing. That helped there.

DR. KRESS: yeah.

CHAIRMAN WALLIS: You might keep that in reserve. If there's extra time, you can say, "Here's some examples of how we bid things in a successful way."

How you address the question of whether the assessment is good enough I'm not sure. That's always a question I personally have. I look at these and say, you know, it's okay for this example, but is it really good enough?

DR. KRESS: Well, I would come with some of those calculations and comparisons.

CHAIRMAN WALLIS: Yeah, I think you need some comparisons.

DR. KRESS: Yeah. I would have them ready whether we presented them or not and have them part of the handout.

CHAIRMAN WALLIS: And you may need to say, "We knew that we were really only required to do a couple of comparisons, but we did eight," or something.

DR. KRESS: And you will find those in this package here.

CHAIRMAN WALLIS: Yeah, something like that.

DR. KRESS: You don't have to go over them in detail. I think most of those things are kind of self-explanatory.

MR. HOLM: Can I ask a clarifying question? It sounds like what you're actually suggesting is a condensed, 45 minute peppy little presentation.

MR. BOEHNERT: Well, 45 minutes total. You've got to allow some time for questions.

CHAIRMAN WALLIS: Yeah, you've got a full presentation, and the thing is the ACRS is sensitive to the problems of technical justification of code. So you have to address those questions. You have to convince them somehow in a way in, say, half an hour or something because you haven't got much time.

I think you have to address that, and so assurances from management we're always going to get from anybody because that's their job, but that doesn't help the ACRS to dig in and say, "Well, behind that, what does is the substance?"

You need to get them presented with enough so that they can be assured that, yes, there's real substance to the work that's being done.

MR. HOLM: I guess I would say that if I'm going to do a 45 minute presentation with time for questions, which based on my experience with the ACRS is about 30 minutes of that 45 minutes --

DR. KRESS: We generally say half the time.

MR. HOLM: Half the time? That's not the experience I've observed though.

I would think all I could really do is summarize the types of things we've done to justify the code. I really can't come with plots and figures and --

CHAIRMAN WALLIS: Maybe a for instance or something.

DR. KRESS: Yeah, I thought maybe if you had those plots and figures just in a package to say, "If you want to see what we've done, here it is." We have handed that out to --

CHAIRMAN WALLIS: And if you made an improvement, maybe a before and after or something. So this is what we're able to do, and if there's errors, you know -- if there's errors in the energy equation, right, which amounted to four or five percent or something, and by our modifications, here's a table. We've reduced them to .05 percent.

DR. KRESS: Yeah, something like that.

CHAIRMAN WALLIS: Something which shows that you actually achieved some measures of success.

MR. HOLM: Okay. So you do want some technical information.

CHAIRMAN WALLIS: I think so.

DR. KRESS: Yes, yes.

CHAIRMAN WALLIS: I think if you don't give it, you're going to be asked for it, and then it's going to take too long.

DR. KRESS: Yeah.

MR. HOLM: Okay. I understand you telling me that. I'm not going to accomplish it yet, but I understand.

CHAIRMAN WALLIS: Because the problems with the codes, I think, the perception that we get from the old history is that sometimes in the past, management would get up and say everything is great, wonderful, and so on and so forth, but when you dig into it, you find it isn't quite the same as they say it is.

Now, we want to finish those days so that that never happens again. So we need some assurance that the substance is there, and I think you have to figure out how to put that across in a short time.

DR. KRESS: We believe it is there.

CHAIRMAN WALLIS: Yeah.

DR. KRESS: And that's why --

CHAIRMAN WALLIS: Certainly for SB LOCA. Now, for the realistic we know we've got another --

DR. KRESS: Yeah, we know that's a different animal altogether.

MR. HOLM: I guess if I were looking at a meeting like this, one thing that would help to carry that message is the fact that the NRC is going to stand up and say that they think the justification is there.

DR. KRESS: Well, that would help that. That's for sure.

MR. BOEHNERT: Right. They're going to od that.

DR. KRESS: Yeah, they'll do that.

CHAIRMAN WALLIS: I guess the subcommittee is going to have to say that, too.

MR. HOLM: You've got to give a report.

(Laughter.)

CHAIRMAN WALLIS: But these are ten wilful individuals, and they may not just accept the word of a couple of us. They will certainly take it into account, but they want to ask their own questions.

MR. HOLM: That fines, but it helps a lot to make the -- I make the assertion, the NRC concurs, and the ACRS subcommittee concurs. I think that's in a condensed time frame a more powerful message. It sounds like we're all willing to do that.

CHAIRMAN WALLIS: For the SB LOCA application.

MR. HOLM: Yes, for the application under review.

Thank you.

CHAIRMAN WALLIS: Now, we should discuss among ourselves, but I think we can come off the record.

Let's close the formal part of this meeting. Thank you all for your contributions.

(Whereupon, at 2:42 p.m., the meeting in the above-entitled matter was concluded.)