UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE ON REGULATORY POLICIES AND PRACTICES

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THURSDAY,
OCTOBER 28, 2004

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. William J. Shack, Chairman, presiding.

COMMITTEE MEMBERS:
WILLIAM J. SHACK, Chairman
GEORGE E. APOSTOLAKIS, Member
MARIO V. BONACA, Member
THOMAS S. KRESS, Member
VICTOR H RANSOM, Member
STEPHEN L. ROSEN, Member
JOHN D. SIEBER, Member
GRAHAM B. WALLIS, Member

ACRS STAFF PRESENT:
MICHAEL R. SNODDERLY
NRC STAFF PRESENT:
RICHARD BARRETT, NRR
RICHARD DUDLEY, NRR
DAVID C. FISCHER, NRR
GARY HAMMER, NRR
GLENN KELLY, NRR
RALPH LANDRY, NRR
MATT MITCHELL, NRR
MARK RUBIN, NRR
BRIAN SHERON, NRR
ROBERT TREGONING, RES
JENNIFER UHLE, NRR

ALSO PRESENT:
LAWRENCE E. HOCHREITER
TONY PIETRANGELO, NEI
FRED SEARS

I N D E X

P R O C E E D I N G S

8:20 a.m.

CHAIRMAN SHACK: The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Regulatory Policies and Practices. I'm William Shack, Chairman of the Subcommittee.

Members in attendance are George Apostolakis, Mario Bonaca, Tom Kress, Steve Rosen, Jack Sieber, Graham Wallis and perhaps Vic Ransom.

The purpose of this meeting is to review the Staff's draft proposed rule language of a voluntary alternative rule that would allow licensees to implement a redefined large-break loss-of-coolant accident and associated risk-informed emergency core cooling system requirements.

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

Mike Snodderly is the Designated Federal Official for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting, previously published in the <u>Federal</u>

<u>Register</u>, on October 20, 2004.

A transcript of the meeting is being kept and will be made available as stated in the <u>Federal Register</u> 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, but we have received the request from members of the public for time to make oral statements. The Subcommittee will hear from Dr. Sears and Hochreiter after the Staff's presentations today.

We will now proceed with the meeting and I call upon Brian Sheron of the Office of Nuclear Reactor Regulation to begin.

DR. SHERON: Good morning. Let me get the slides here.

I'm Brian Sheron. I'm the Associate Director for Project Licensing and Technical Assessment in NRR and I'm just going to give kind of opening remarks and maybe set the stage for the rest of the presentations on this. Just in case anyone remembers, I seem to not be able to escape ECCS. I started doing it, working on this in 1976 and for some reason I still get sucked into it.

So anyway, meeting objective, I'll be pretty blunt. We would like to receive a letter from the ACRS --

CHAIRMAN SHACK: You can save that for the Full Committee.

DR. SHERON: Okay, I've got to get a plug in now -- to endorse release of the proposed rule for public comment.

Just for background, July of 2004, we got an SRM directing the Staff to risk-inform the large-break LOCA requirements from our Commission. They asked that the proposed rule be completed in six months. We briefed the ACRS, if you remember, in July on our conceptual approach. In August, we had a public meeting. We invited the -- the purpose of the meeting was not to debate the pros and cons of the rule, but actually to get input for the cost/benefit analysis, to find out from stakeholders what they perceived the benefits of the rule, as we envisioned it, would be, as well as any costs.

We solicited input at the meeting at that time. We did get questions, obviously, for clarification, which would help some of the stakeholders. And then subsequent to that we actually received three letters, one from the Boiling Water

Reactor Owner Group; the other from the Westinghouse Owners Group which is -- both CE and Westinghouse plants. And then also one from the Nuclear Energy Institute.

We have requested and CRGR has agreed to defer their review until the finale rule stage. Basically, this is a voluntary rule. It's an option so it doesn't even meet the category of a backfit.

What are the objectives of the rule? Why are we doing this? That's the real question.

One is we want to focus resources on more risk-significant issues. This is consistent with the Commission's direction to become a more risk-informed agency and risk-inform our regulatory processes and programs.

Basically, over the years, the conclusion has been that the large-break LOCA, specifically the double-ended guillotine or large breaks, are considered to be very low probability and low risk, yet they do consumer a fair amount of resources and time from the part of both licensees as well as the Staff.

So the thought is is that if we focus our resources and our efforts on those events that are more risk-significant, more likely you might say, that we, in fact, could improve safety.

DR. WALLIS: This is a hope or is this a prayer or is this a reality or is this predicted in some way?

DR. SHERON: This is a hope.

DR. WALLIS: Well, it seems very strange to make a rule based on a hope.

Why don't you actually analyze it and show that there's a risk benefit?

DR. SHERON: Well, it depends on how a licensee uses the benefits. In other words, not all licensees can use the -- you may say the benefits or the changes that we're proposing to the rule in the same way.

DR. WALLIS: It would seem to me there ought to be a pay off. If they're going to make changes which result in risk increases somewhere, you ought to have some compensating effort to improve safety somewhere. That would be much more acceptable to me and maybe to the public. You can't really make a rule on the hope that they might improve safety. Why don't you insist that they improve by doing these things?

DR. SHERON: Well, that's an option. I mean I think that's input that we would be looking for if that's one way we could write the rule is to say that it would be required.

DR. WALLIS: I think that would help a lot. And in the written material you sent us didn't emphasize the second bullet at all. It talked about the third one. I think you'd be in much better territory or you'd make a much better case if you could emphasize bullet 2 and show some numbers or something that would convince us in the world that there really are safety benefits.

DR. KRESS: On the other hand, we accepted the concept that we'll accept small, but not really significant risk increases in the name of reducing unnecessary burden. So it's not really necessary.

DR. WALLIS: Yes, but if you only emphasize that, that's what the public sees and that's not really very good publicity.

DR. SHERON: Well, I mean one way to argue this is that they already believe that the risk from the large-break LOCA is already acceptably low. And one really doesn't need to necessarily reduce it further.

Nonetheless, I think you've seen some of the letters that came in, particularly from NEI, all talking about what they believe are the safety benefits of this. So I added that bullet quite honestly after --

DR. BONACA: I would like to comment on that. In fact, I mean there is a list of safety benefits or supposed benefits, non-quantified, but it seems to me that every time you have to determine what you're going to do with this margin that you get, it's not that people are going to simply change the rule and sit there. They're going to increase power and they're going to do things.

DR. SHERON: They will make changes to the plant. That's correct.

DR. BONACA: So the question is, you know, what is the -- in other words, ultimately the objective is to determine the risk of the combined action of going to this rule and then do something with the margin. And so before I see all those claims of improvement in safety, I'd like to see what the combination, again, going through this rule, plus the proposed change will bring. It may not be, in fat, an improvement.

DR. SHERON: It may be risk-neutral, quite honestly.

DR. BONACA: And it may increase the risk, right?

DR. SHERON: Well, what we've said is that and you'll hear this later in the presentation, so we shouldn't probably dwell on it now, but basically I look at it, we've tried to fashion this a little bit like a diode, okay, in the sense that we're going to allow plants to make improvements, especially those which will improve safety or reduce risk. But for any changes that they propose that increase risk, okay, we're saying is that that risk has to be small. In other words, it has to be consistent with Reg Guide 1.174 guidance and they have to take into account defense-in-depth, all of the attributes over risk-informed decision making, if they do increase risk.

DR. APOSTOLAKIS: Let me understand this a little better. Let's say the rule is passed and the licensee says okay, we opt to go that way. What will they do immediately? What can they do? They can change the flow rate of the containment spray or the testing of the diesels?

DR. SHERON: No, not the testing of the diesels. We're not -- this does not talk about the LOCA/LOOP. But I mean they might, if they could demonstrate that they didn't need the fast start time.

DR. APOSTOLAKIS: Okay, so any change in the design or operation of the plant will have to be submitted to the Agency?

DR. SHERON: It has to be submitted to the Agency with the exception and you'll hear about it later, of inconsequential --

DR. APOSTOLAKIS: I understand that.

DR. SHERON: Okay.

DR. APOSTOLAKIS: So the moment I say this is a great rule, I'm going to follow it, I do nothing.

DR. SHERON: If you do nothing, you haven't affected risk in any way whatsoever.

DR. APOSTOLAKIS: Okay.

DR. SHERON: It's only when you make a change, propose a change to the plant that you effect risk and that's where we say we want, the Staff wants to review it, with meets certain criteria.

DR. APOSTOLAKIS: So all these safety benefits we're talking about will be realized if the licensee decides to do something and submits an application?

DR. SHERON: Yes.

DR. APOSTOLAKIS: Okay. So the rule by itself doesn't --

DR. SHERON: By itself, it's an enabling rule.

DR. APOSTOLAKIS: It's an enabling rule, exactly, exactly. So there is no question of whether the risk increases or decreases by just adopting the rule. You have to do something and propose something.

DR. SHERON: You have to make physical change to the plant or the way it's operated in order to either achieve a benefit or change the risk or safety.

DR. APOSTOLAKIS: The reason why I am asking the question and maybe we're jumping ahead now, but when you pick transition size for a large LOCA, 14 inches versus 8, that was the expert opinion, that doesn't mean anything, does it? As long as I don't propose anything to the Agency, I mean this is just on paper.

DR. SHERON: That's right.

DR. APOSTOLAKIS: Okay. Okay.

DR. SHERON: As I said, our expectation is is that, you know, that we would like to see risk reduction come about as a result of licensees implement the rule.

Some of the benefits, we think, are timing and flow of containment spray. Containment sprays take a lot of water from the refueling water storage tank, for example. It requires a quicker time to switch over. Switch over is one of the things that affects risk from the LOCA. Also, containments, you know, containment spray will produce more wash down in everything and possibly increase the risk, for example, of say clogging the sump, so obviously, if there are ways that you don't have to have the containment sprays initiate automatically, that would be a safety benefit.

I've been told a long time ago, Dr. Hochreiter is here, I don't know if he remembers, but a long time ago back in the 1970s he once told me, he said if we were going to design an ECCS system based on realistic and best estimate analyses, we'd never pick 600 pounds for the accumulators.

There may be a better way to pick set points for an accumulator, for example, stagger their injection, to provide better cooling. I don't know --

DR. WALLIS: I think Westinghouse suggested getting rid of the accumulator all together.

DR. SHERON: I'm sorry?

DR. WALLIS: I think the Westinghouse Owners Group suggested that they might even be able to do away with the accumulators.

DR. SHERON: I've heard one person say that. I'm not -- I don't know for sure yet. I mean that's something that they -- that we would have to go through the whole process.

When we address the LOCA/LOOP issue and as I said, this is not being picked up in this rule. The way we're addressing the simultaneous LOOP with the LOCA assumption that we make right now is we have a topic report in from the BWR Owners Group. We intend to start reviewing that at the beginning of the year in January, work our way through that. And then extend that to the PWRs, depending upon how that comes out with our review. But we will handle that on a separate track. Eventually, if we do find a way to accept it or modify it that would again lead to a change in the rule, but not through this particular rulemaking.

The bottom line here is that we don't want any proposed plant changes to ultimately result in a significant risk increase. That's the foremost goal we have here. We would like to see risk decrease. We think that plants can be made safer through judicious use of this rule, but we recognize that licensees could use it and some of those changes could, in fact, result in an increase and the whole question, what we want to make sure is we don't -- any increase that occurs is going to be small and acceptable and consistent with 1.174.

MR. ROSEN: Brian, you just said something that surprised me about the LOCA/LOOP coincidence, the way that was going to be treated.

Is there a rationale or reason why you are going to do it that way?

DR. SHERON: I think just as a matter of timing. It's a much more difficult issue to deal with. Right now the Commission has asked us to produce this rule in six months. I don't think we can do that if we had to address the LOCA/LOOP issue.

MR. ROSEN: Because in my mind and I think in many others, it was always tied into this issue.

DR. SHERON: It is tied. It's part of the LOCA analysis. But I mean the thing that bothers me, for example, personally, is the question of okay, so I get rid of the simultaneous LOOP occurring with a LOCA. People would argue and say yeah, what's the likelihood you're going to get a loss of power at the exact instant that the pipe breaks? Probably it's not very high. But the question is is that in this day and age with the grid the way it is, all right, and we've seen a lot of examples, you might say, would a LOCA which drops the plant off the grid, ultimately result in a loss of off-site power or some time later, a delayed LOOP. We need to look at that, okay?

A delayed LOOP, a LOCA delayed LOOP leads to a whole new set of questions like double sequencing and so forth. That's got to all be worked through and we've got to see whether or not how we deal with this.

MR. ROSEN: Let's say you do that and then you conclude that under certain circumstances, whatever they are, it's okay for someone to propose not doing the analysis with a coincident LOOP and LOCA.

DR. SHERON: Right.

MR. ROSEN: How do they then proceed? Do they come in under this rule change, 50.46, or do you need -- I think you said you need another rulemaking.

DR. SHERON: We would probably propose a second rulemaking to deal with the outcome of the LOCA/LOOP review.

MR. ROSEN: So that would delay that resolution even more.

DR. SHERON: It allows this resolution to go forward. In other words, if we were to deal with LOCA/LOOP today, I would not be standing here saying I need to get a rule, a proposed rule out by the end of the year, because I wouldn't be able to do it.

CHAIRMAN SHACK: But you are saying in the current version of the rule that for breaks larger than the transition break size they can take credit for off-site power being available?

DR. SHERON: Yes. In other words, it's the best estimate analysis.

CHAIRMAN SHACK: Okay.

DR. SHERON: But for the small break, below transition, they would still assume a LOCA/LOOP.

CHAIRMAN SHACK: But for the large break, you are building it into the rule.

DR. SHERON: Yes, although there is -- we do want to make sure that a plant, if it does have and you'll hear about this later in the presentations, okay, but if you have a large break, and if they require, for example, two RHR pumps in order to mitigate it now, in other words, you can't take the single failure, okay. They can't be operating, with one train out of service. Let's say they took a diesel out for maintenance and they have a train out of service. If they can't handle the large break without -- even without a single failure --

CHAIRMAN SHACK: Even if they could justify it under an A-4 analysis on a risk basis?

DR. SHERON: Right now, yeah, that's our defense-in-depth and we'll get into that a little bit, you know, in later presentations. So I'd like to defer that.

MR. ROSEN: But you don't need the single-failure when you're talking about the large break.

DR. SHERON: Right, that's correct.

DR. KRESS: On your previous slide you had a bullet on no significant increase in risk. When we look at this rule change there was a whole shopping list of changes that could be made in the plants as a result of the rule and my concern is how are you going to keep track of the cumulative change in risk? I know 1.174 calls for that, but I don't know what the mechanism is for tracking these.

DR. SHERON: I don't think we need to change cumulative change in risk because if you think about it, 1.174 sort of has that built in.

DR. KRESS: So long as you don't change your PRA and the PRA keeps giving you a new CDF, a new LERF.

DR. SHERON: Well, for example, a plant comes in and proposes a change and let's assume that it increases the risk by some small amount, okay?

DR. KRESS: And you move along the absolute axis of the --

DR. SHERON: Right. And let's say we

approve it because it meets the 1.174. Let's assume a -- they make some other changes to the plant.

DR. KRESS: Somewhere else on the axis?

DR. SHERON: Yes.

DR. KRESS: So the tracking mechanism is just the PRA result of the absolute values?

DR. SHERON: Glenn, do you want to --

DR. KRESS: That bothers me a little.

MR. KELLY: This is Glenn Kelly from the Staff. We will be talking about this later, particularly in the presentation tomorrow. But basically, there are mechanisms that we have there to assure that the cumulative changes that occur are reflected in the PRAs and that the licensees continue to assure that over time that the changes that are made under 50.46a would not, over time, come to represent an undue increase in risk.

DR. KRESS: I'll be interested in seeing that.

DR. SHERON: Because if the risk were to start increasing and incrementally, all right, if you follow the criteria of 1.174 today --

DR. KRESS: It has breaks in it.

DR. SHERON: It would not allow certain

increases to occur, you know. In other words, as you move up in risk, the allowable increases become smaller and smaller.

DR. KRESS: As long as your PRA is constant and stays the same and you're not changing it.

DR. SHERON: An the Staff will talk to you about their plans for a review period.

DR. APOSTOLAKIS: This assumes though that you can quantify changes in the models.

DR. KRESS: That's my problem.

DR. APOSTOLAKIS: If you are affecting redundancy --

DR. KRESS: And then there's some gaming you can do. You can offset risk by changing time and the uncertainty of these things are different.

DR. APOSTOLAKIS: I mean we've seen that in power uprates where we really didn't have a good quantitative estimate of the CDF, but the argument was that it's small. So you will have a bunch of those and you will not have a quantitative estimate, so it would be very hard to keep track of the cumulative --

DR. KRESS: This is my concern, how they track this.

DR. SHERON: Well, I think if you see in

the fourth bullet here, process for approval of plant changes, I think when we get into that presentation, hopefully that will answer a lot of your questions.

Just so you know what you're going to hear today, you're going to hear an overview of the proposed rule. They're going to talk about how we went about selecting the transition break size, how we got to the numbers we did. In other words, I know if you look at the expert elicitation and you look at, for example, the 10^{-5} break size, it's not the size we picked. There's a reason for that.

ECCS analysis requirements, we'll talk about what we expect licensees to have to submit regarding the analysis. Other conforming changes. One of the biggest difficulties we had when we were formulating this rule is and I'm going to use the word, it's tentacles. 50.46, as you know, kind of permeates through the whole design of the plant. It affects a lot of aspects of it.

And one of the things we had to make sure is that when we changed 50.46, does it have -- what effect does it have on other parts of the regulations, other parts of requirements and so forth.

DR. APOSTOLAKIS: Brian, I keep hearing that and I would like to see an example or two of these tentacles.

DR. SHERON: You will get - you will hear --

DR. APOSTOLAKIS: We will hear?

DR. SHERON: Yes.

DR. APOSTOLAKIS: Okay.

DR. SHERON: And then you'll hear about our process for approving plant changes based upon the new DBA. This is the question you asked, is when a licensee comes in and says I now want to avail myself of this rule and make a change to my plant, we'll talk about the process that we will go through.

Just so you know what our schedule is, we want to complete our statement of considerations in November. This is basically the background document that explains the basis for the rule and so forth that we put out in the Federal Register as part of the rulemaking process and it basically provides the reader the whole background of why we're doing what we're doing and what the basis is, what the justification is.

We would also like to receive an ACRS endorsement letter in November. We would like to -- our plan now is to send the proposed rule package to the Executive Director in December and presuming that the Executive Director is satisfied with it, we would hope the EDO would forward that to the Commission by the end of the year.

One thing that we're not going to talk about in detail here, but I'm sure will be the subject of a number of other Committee meetings or Subcommittee meetings is that in order to implement this rule, we believe there needs to be a reg guide that goes along with it, that provides more detail in terms of how to, what are acceptable ways to implement this rule.

We plan to have a draft reg guide available by the summer which would go out for public comment and the hope is is that we would have at the time we have a final rule, we will also have a reg guide that will accompany it so that people will know exactly what is an acceptable way to implement the rule.

And I believe with that, that's the end of my presentation.

DR. WALLIS: This will be a reg guide that actually does explain how you're going to do things. It doesn't just say you've got to do them?

DR. SHERON: Yes. And again, we're still in the planning stages, so I don't think we're in a position to really talk in detail about it, but we're going to have a task group, tech staff that are going to be working on this and we'll be scheduling meetings with the Subcommittee over the course of the year to provide you more information on it.

With that, Dick, I believe you're next.

MR. DUDLEY: Well, good morning. I'm Dick Dudley. I'm the NRR Rulemaking Project Manager for the revision of 50.46. I'm going to start talking to you about the structure of our draft proposed rule.

Basically, we've left 50.46 essentially unchanged, except that we've added to it an additional provision that would allow licensees to be either 50.46 or the new section we've added, 50.46a which is a voluntary alternative.

In 50.46a, we've included all the requirements for this risk-informed alternative, different ECCS requirements, different acceptance criteria, PRA criteria and the process for doing plant changes.

In order that there are no conflicts between 50.46a and the existing general design criteria, we've made some conforming changes to the GDC. The GDC for electric power systems, ECCS GDC 35, containment heat removal; GDC 38, containment atmospheric cleanup; GDC 41; GDC 44 on cooling water;

and GDC 50 on containment design basis. And you'll hear about these changes in some detail in a later presentation.

As Brian has already told you, the 50.46a proposed rule addresses only LOCA redefinition. We're going to do the LOCA/LOOP issue separately in the future.

The structure of the draft rule is discussed on this slide. Basically, we've taken the full spectrum of LOCAs and we've broken it into two regions by defining what we call the transition break size or you'll probably refer to it as TBS. We've selected the TBS based on frequency and other considerations, not just frequency.

Under this rule structure, the breaks in the smaller break region continue to be design basis accidents, therefore they must continue to meet the current requirements in 50.46 for the analysis requirements and acceptance criteria. But breaks larger than the TBS would become beyond-design-basis accidents. However, we are going to require that mitigation capability is demonstrated for breaks in this larger break range up to the full double-ended break up the largest pipe in the reactor coolant system. But we would allow the licensees in doing this mitigation analysis, to use less stringent analysis assumptions and less stringent acceptance criteria.

However, as Brian has also discussed, we will require that mitigation be demonstrated for all at power operating configurations. All sequences or series or groups of equipment that the licensee plans to operate with should have been analyzed and should have been shown that with that equipment, they can mitigate the double-ended break of the largest pipe.

DR. BONACA: For "mitigation," you mean something else, right?

MR. DUDLEY: Pardon?

DR. BONACA: For "mitigation", the objective of mitigation here is coolability rather than being a strict definition of temperature?

MR. DUDLEY: Well, yes. Our acceptance criteria are a little bit more liberal for this -- what we call mitigation for this which would be a beyond-design-basis accident.

DR. BONACA: So I think at the bottom I would like to see another bullet that says less stringent acceptance criteria.

DR. APOSTOLAKIS: I don't understand what that means?

The accidence criteria are more liberal or the assumptions are more stringent?

MR. DUDLEY: Well, both, both the assumptions and the ECCS analysis acceptance criteria. And we're going to have a lot of detailed presentations on that upcoming, so I'm sure that will be made clear.

DR. WALLIS: "All at-power" means low power as well? Does not mean shut down? What is "All at-power" mean?

MR. DUDLEY: It doesn't mean shut down. And we really haven't looked at that in great detail, but I believe that we consider it to be all at-power when you're greater than zero power.

DR. WALLIS: So if there are any neutrons at all, "at-power"?

MR. DUDLEY: I'll have to have somebody else discuss that with you, really.

DR. WALLIS: There are even neutrons at shut down.

MR. DUDLEY: Mostly what we're talking about is near full power or higher power conditions. We haven't really looked at the range of power that we need to be very careful --

DR. WALLIS: Have you looked at it?

MR. DUDLEY: Unless anybody else can add to that? I think we just haven't really looked at that yet. It is a proposed rule and it might also be something we'd get some help from the industry and the public with other comments.

Brian?

DR. SHERON: Graham, let me give you an example, if I could.

A licensee comes in and proposes to uprate power, say 10 percent. In order to mitigate the double-ended guillotine, even with best estimate assumptions, they assume that -- not assume, but they calculate that they have to have both low pressure injection pumps available. And they only have two pumps.

Let's assume that they want to take a diesel out of service. This is the one I talked about before for maintenance, for 14 days. If they were to have a loss-of-coolant accident and they lost the offsite power which they would assume, they would not be able to mitigate the event.

What we're saying is that they have several options. One is they can shut the plant down while they take the diesel out of service or they can reduce power to a level such that one low pressure pump would be able to mitigate the event and meet the criteria. If they chose that, they would have to have an analysis, I believe, that would demonstrate that under those operating conditions they could mitigate the event. So they would have, in other words, they would be at a lower power level than what their license says, but because they have a pump out of service, they would still have to demonstrate they would meet the acceptance criteria. Does that make sense?

DR. WALLIS: Yes, but I was just wondering how big a range of power is covered here when you say "all at-power"? How low does the power go for which they have to demonstrate effectiveness?

DR. SHERON: I think from all of our experience, I mean obviously running at full power is typically the most limiting condition because of decay heat and linear heat generation.

DR. WALLIS: But if you temporarily decrease the power, you haven't really changed the decay heat yet?

DR. SHERON: No, but if you temporarily decrease the power for reasons of demonstrating that you can still mitigate the event with one train out of service, for example.

DR. WALLIS: I just wonder if you meant all power from zero up to the maximum allowed or if there's some cutoff at low power? That's what I'm really getting at here.

MR. DUDLEY: The way the rule is currently written it would be critical and above.

DR. UHLE: This is Jennifer Uhle from the Staff. Yeah, it's whenever you're critical, so it's modes one, two and three.

DR. WALLIS: Whenever you're critical, whatever the power level may be?

DR. UHLE: Yes, right. So shutdown is not considered. At that point you're into tech specs where we have requirements for being able to take things out of service or not.

CHAIRMAN SHACK: But again, this trumps A-4 analysis where you could analyze this on the basis of risk and demonstrate that you could operate that way. So you would have prescriptive requirements above and beyond the A-4 requirements?

DR. SHERON: Yes.

MR. DUDLEY: So a licensee that opts to use the 50.46a alternative would perform a new ECCS analysis for breaks larger than the transition break size. After completing this analysis, some plant designs would no longer be limited by the double-ended guillotine break of the largest pipe. This would allow a licensee to propose a significant number of different changes to plant operations or plant design. All of these changes must either be approved by the NRC as a license amendment or meet an inconsequential risk criterion.

DR. WALLIS: That's a new word, is that the same as 1174?

MR. DUDLEY: No.

DR. WALLIS: It's something new.

MR. DUDLEY: It's a new one, yes.

DR. APOSTOLAKIS: And you have a document that describes that?

MR. DUDLEY: We will describe it quantitatively, I guess, in a reg guide.

DR. WALLIS: But you have not yet.

MR. DUDLEY: But the rule does not really say what inconsequential would be.

DR. APOSTOLAKIS: Shouldn't -- I mean the first time or few times that the licensees will do this, shouldn't the Staff look at it and get --

MR. DUDLEY: We'll get into that. We will. Plus you're going to hear about it in great detail tomorrow.

DR. APOSTOLAKIS: This will be something like 50.59?

MR. DUDLEY: Right, yes.

DR. WALLIS: Remember how much we quibbled about 50.59 and what you meant by "minimal" and you took a whole day to try to sort out.

DR. APOSTOLAKIS: If it takes a day, we will be lucky.

(Laughter.)

MR. DUDLEY: Let me get to the next slide and if it's still an issue, please stop me.

All the license amendments, those that come in for formal approval should be risk-informed license amendments. Then they would have to meet criteria, acceptance criteria consistent with Reg Guide 1.174. Defense-in-depth would have to be adequate. Safety margins would have to be adequate. A monitoring program would need to exist. And the licensee would have to meet an acceptable risk criterion as --

DR. WALLIS: Now there's something different here. The safety margin issue has slowly changed. The first statement I think from the Commission said maintain safety margins, it seems to me means that the same safety margin -- now you're talking about adequate safety margins. That seems to indicate you could shrink the safety margin until there wasn't any left. So it's a very different statement.

MR. DUDLEY: Well, if it wasn't any left, we wouldn't call that adequate.

DR. WALLIS: See what I mean. The original statement said maintain. That seems to me meant have the same safety margin, not shrink it.

And they've changed it now to adequate, so it could be shrunk, but still be adequate.

DR. APOSTOLAKIS: Well, how can we maintain? Then we can't do anything.

DR. WALLIS: Exactly, but the original language said maintain.

DR. APOSTOLAKIS: But maybe it was loose language, I don't know.

MR. DUDLEY: We're going to talk about that issue all tomorrow morning.

DR. WALLIS: We'll talk about it tomorrow?

MR. DUDLEY: Yes, we will.

DR. KRESS: Let me ask my question again about tracking by way of 1.174. I envision a plant having a PRA that has perhaps some inadequate models in it. And they want to improve those models. They go in and change a PRA to make a better model for say some of the severe accident parts or something and the net result is that they change their predictions of CDF and LERF to much lower values.

Now they reposition themselves on the 1.174 curve. Now -- so tracking the cumulative risk, they may jump backwards so they can actually move forward again.

My question about that is how are you going to track the PRA changes? Is such a thing going to be allowed? I think probably should be, but how are you going to go back and say okay, you didn't just gain your PRA, you actually made an improvement.

MR. DUDLEY: Right. I believe, Glenn, we have all of that covered in the way we've laid out -- it will be gone over in detail tomorrow morning, but I believe we're going to discuss all of that for you.

DR. APOSTOLAKIS: You have PRA experts on your team?

MR. DUDLEY: Yes. And tomorrow morning is when they're planning to give that presentation.

DR. APOSTOLAKIS: Geez.

MR. DUDLEY: Mark will go ahead right now.

MR. ROSEN: What Tom describes is a very

likely scenario because if PRAs were, in fact, done originally in a very conservative manner, so the models when they're improved typically do reduce risk.

MR. RUBIN: I'm Mark Rubin. A good segue, Dr. Rosen, thank you. We have seen decreases in risk as the PRAs have been improved, updated, more current plant-specific data has been put in and we're certainly aware that plant risk changes can reflect fiscal plant changes, operational changes, but also modeling changes, the data updates.

And so we'll describe tomorrow, you'll see that what we're going to try to do on tracking cumulative risk is as plant PRA model updates are done, have the licensee look at the bundle 50.46a plant changes that have been implemented by the authority granted in this rule and then re-evaluate what the delta risk impact is, using the new, call it a baseline risk model, if you will.

So they'll continually re-investigate that the 50.46a changes meet the acceptance criteria for small risk increases. There could be other changes, totally unrelated to 50.46a allowance that could affect changes perhaps to LPCI, accumulators, other sequences that weren't originally considered in the rule. So we do periodically update. The rule requires that every other refueling outage will be re-looked at and we'll describe our approach, at least in the draft rule for you tomorrow.

MR. ROSEN: I think what you're saying to be sure I understand, Mark, is the model, the PRA model at a given moment in time, when you improve it, to model something you didn't model before and the risk goes down, you now have two models. The first model doesn't somehow evaporate. It's on the computer someplace. It's still there, so you can then use both of those models to look at the difference that the modeling makes given a change. Am I correct?

MR. RUBIN: Well, it's difficult to try to strip out what drives all the changes, some are modeling changes. Some are plant-specific physical changes or implementation or operational changes. You're right, we could try to separate each of the changes out and what their source is. Over the years when we've struggled with that, we found it's very difficult to do and rather than ask the licensee to keep a number of models, in effect, and keep trying to re-assess as each model advances, we thought it would be equally or perhaps more easily implementable to have them have a re-assessment of the now current baseline model looking at the 50.46a allowable changes because the bottom line is are the changes you're doing under this rule authority resulting at most a small increase in risk?

The most current PRA model is the proper tool to give you that insight and so rather than have different PRA models in that time sense, what they're going to have is a variation of your current new baseline PRA model with the changes in and out and then look at the delta risk.

DR. KRESS: I think that's a rational way to do it. The thing that worries me about is the uncertainties will change also with these changes. I'm not sure how you're dealing with the uncertainties. For example, I could actually envision a change, giving you a lower absolute CDF in the calculation, but the uncertainty gets a lot larger. So you might end up making a decision that's different.

But I think it's only rational. You can't have 15 versions of a PRA. Just the current one that has the best representation of the plant and the best representation of the model is probably the one you ought to use.

MR. RUBIN: That's what we believe, yes sir.

CHAIRMAN SHACK: You also get into this thing that every change in your PRA is now going to send you back to re-look at all your bundled 50.46 changes?

DR. KRESS: No. If the change in the PRA gives you an increase in risk, I think you may have a point there. Then you may have to go back and look.

MR. RUBIN: We have two trip points and we'll be talking about them tomorrow. But it is possible, I believe it certainly is possible that you could have a decrease in risk in your new baseline PRA model, but have an increase in the delta risk contribution from the allowable 50.46a changes.

So yes, and the answer to Dr. Shack's point is, yes, the licensee will have an obligation for monitoring and feedback when they update their model, to go back, look at the bundle 50.46a changes and assure themselves it has a small increase in risk at the most. But it should be trivial.

DR. KRESS: So you will have to have some sort of tracking of each of the 50.46 changes that are made?

MR. RUBIN: Yes.

DR. APOSTOLAKIS: Well, I realize we're going to talk about it tomorrow, but as a prelude, it seems to me that this discussion, plus the documents I have read take it for granted that all these changes can be reflected in the PRA and I have serious doubts that that can be done, especially when I read in 50.46a that the uncertainties in the calculated results can be estimated and there is a high level of probability that the criteria would not be exceeded.

It seems to me that most of these changes would affect margins and I really don't know of any PRAs that quantify margins, so I don't understand how we're going to do all of these things and maybe there is something there I don't see, but maybe tomorrow you can address that question.

MR. RUBIN: We'll do the best we can.

DR. APOSTOLAKIS: The issue is quantification of margins, the way I read all this. And PRAs deal with redundancies, not margins.

Margins are done separately. In fact, we heard here in the new licensing - -what is it, framework for future reactors, even there they say margins are done separately from the PRA which deals with traditional defense-in-depth redundancy and so on.

So I don't know how we're going to do all this, keeping track of cumulative changes, making sure there is a high probability that the criteria will not be exceeded. All that is smelling of margins to me and --

DR. BONACA: I think it is very important what you're saying, George. I think it is very important what you're saying. We have seen already, for example, if you have a relaxation and you're using that margin to increase power, we already have seen in the power uprates the difficulty that they are having in including all contributions to risk. Typically, what we get is a snapshot of the impact of a longer or lesser time to perform an action.

DR. APOSTOLAKIS: Right.

DR. BONACA: Okay, but when we ask questions regarding larger amount of activity, for example, in containment, resulting in a severe accident, if you are a power uprate, we -- those issues are not considered.

DR. APOSTOLAKIS: And as I recall, most of the time it was really judgment calls.

DR. BONACA: Absolutely.

DR. APOSTOLAKIS: We said if the available times are reduced from 42 minutes to 39, we don't know what the impact is going to take, but come on now, everybody knows this is small.

I don't know, if we are basing all these evaluations and arguments of this type, how we can quantify and keep track of cumulative changes and all that, I mean the impression I get from the rule, the draft rule that I read is that doing this is kind of easy. All we have to do is tell you we're going to do it.

I have a little bit -- I am perplexed. Dr. Powers is not here, so somebody has to be perplexed.

(Laughter.)

So we discuss this tomorrow, right?

MR. RUBIN: Yes sir.

DR. APOSTOLAKIS: Okay, thank you.

MR. DUDLEY: Fifty-forty-six-a has its own requirements for PRA quality and scope also.

Now talking a little bit more about the inconsequential risk plant changes. The licensees would be allowed to make these changes without specific NRC review of that individual change. But before we would allow that, the licensee would have to submit their risk assessment to us and their internal review process for making sure that defense-in-depth and other criteria like that were maintained.

And after NRC approved both the PRA and

the licensee's internal review process, then licensees would be allowed to make these inconsequential risk changes and for this the licensee must make sure --

DR. WALLIS: Are these inconsequential things, this 20 percent thing which we're going to talk about later?

MR. DUDLEY: No, no.

DR. WALLIS: It's something else?

MR. DUDLEY: It's a different criterion and it's not specifically called out in the rule.

DR. WALLIS: Okay.

MR. DUDLEY: We have to numerically or quantitatively do that in guidance.

And they have to keep track of the cumulative risk increase for all the inconsequential risk changes that they do and the sum total of all those changes that we don't see should also be inconsequential.

DR. APOSTOLAKIS: And a lot of these will be judgmental, so it will be very hard to do that.

MR. DUDLEY: In some cases, yes. The design change licensing process for the changes that aren't inconsequential, again, the licensees submit those design changes as risk-informed license amendments. The NRC would review and approve those license amendments and any possible security aspects associated with those changes would be evaluated during the amendment review process.

Again, a little more detail on inconsequential risk. The licensee submits its PRA and review process to us. The PRA must meet our acceptance criteria and the licensee's review process must ensure defense-in-depth and safety margins.

The NRC would then approve this licensee's PRA and review process. We would modify their license, perhaps we'd add a license condition or whatever that would authorize the licensee to make future inconsequential changes --

DR. WALLIS: Now this to ensuring defense-in-depth and safety margins. In all the discussion I saw, that seems to be very qualitative and it's again up to the judgment of somebody. It's not something which has any numbers associated with it.

MR. DUDLEY: I think that's correct, but they would still have to have a process that might not be a quantitative process.

DR. WALLIS: It's a wishy-washy logical process, isn't it? You never define what you mean by safety margin.

MR. DUDLEY: Again, additional on that

we'd have to give you tomorrow.

MR. ROSEN: Can you tell me some more by what you mean by PRA must meet acceptance criteria? What, in general, do you have in mind?

MR. DUDLEY: Well, I guess the quality and scope. I'm sorry, the quality and scope requirement for PRA. Acceptance criteria was a poor choice of words.

MR. ROSEN: And you're going to define those out of whole cloth or are you going to rely on standards, ANS standards or ASME standards? Is there any tie to any of that body of work?

DR. APOSTOLAKIS: It should be.

MR. DUDLEY: I'm going to get some more help here, if you don't mind.

DR. APOSTOLAKIS: I mean it's the phased-in approach to PRA.

MR. ROSEN: Well, I don't know. I'm trying to find out what they think.

MR. RUBIN: Yes, sir. Dr. Apostolakis, that was the answer. We're going to be trying to implement and be consistent with the phased-in period, quality -- particularly taking advantage of the ASME, the ANS standards and DQ 1.200. This would be one of the most intensive applications of 1.200. And the quality requirements that would consequently be intense.

DR. WALLIS: When you get to the reg guide could you perhaps give us some examples of requests which would be turned down on the basis of not ensuring defense-in-depth and safety margin?

I'd like to see an example of something which would be turned down based on inadequate defense-in-depth or safety margin.

DR. APOSTOLAKIS: Or something that has been --

DR. WALLIS: Has been turned down.

DR. APOSTOLAKIS: You guys have been making regulatory decisions based on 1.174 for a long time now. Has there ever been a case where you turn down something when the delta CDF was small, but because of the qualitative arguments regarding defense-in-depth, you said no.

DR. KRESS: Sprays in AP600.

DR. APOSTOLAKIS: Mark? No, we did that.

MR. RUBIN: Let me think about that. I can think of only one example in the heat of the moment. And that was an ILRT type A extension request where there was some uncertainty in the baseline risk. The licensee did not have a very complete model and the impact from the 15-year extension was pushing the acceptance criteria. And it got into an area of uncertainty and confidence and the lack of modeling scope and because of that, we limited the extension to less than the licensee had originally requested.

There could very well be others, but --

DR. APOSTOLAKIS: Could you send us a few of those at some point?

CHAIRMAN SHACK: Every risk-informed inspection request essentially has a defense-in-depth floor because based on purely risk alone, they could almost eliminate inspections and they maintain a floor. So there's a defense-in-depth argument there.

DR. APOSTOLAKIS: But this is part of the way of doing business there. The question was does anybody come in with a request that met the delta CDF/delta LERF criteria, but the Staff said no because the qualitative defense-in-depth and safety margin requirements are not met. If they could send us a couple of cases like that that would be very enlightening.

DR. WALLIS: That would explain the rationale to why they were turned down.

DR. APOSTOLAKIS: Now defense-in-depth, this is a philosophy really. It's a broad concept and when you say defense-in-depth you mean the list of bullets that are in 1.174?

MR. DUDLEY: Yes, yes, that's basically -- again, we've pretty much taken Reg. Guide 1.174 criteria and we've essentially, if you look in the regulation, in the rule language, you'll see a lot of familiar criteria.

DR. APOSTOLAKIS: Now in light of what happened at Davis-Besse, should we make part of defense-in-depth to think about safety culture?

MR. DUDLEY: We haven't expanded that definition of defense-in-depth past what's in Reg Guide 1.174.

DR. APOSTOLAKIS: Maybe it's something you ought to think about.

MR. DUDLEY: Well, if we're going to finish this rule in six months --

DR. APOSTOLAKIS: Well, on the other hand, this is reality.

MR. DUDLEY: Yes.

DR. APOSTOLAKIS: I was reading the expert opinion -- by the way expert opinion elicitation, not expert opinion elicitation. Anyway, I was reading that. It said safety culture was an issue, safety culture we thought about. Then at the very end it says the experts decided not to include safety culture.

So somebody at least thought that that was an important issue. I realize it's very difficult, but we can't take credit for the various problems that are in place without considering the possibility that they would not be implemented correctly, that other things may happen.

The other thing that was incredible there is that experts and materials were passing judgment about how safety culture would improve in the future. I mean if you're an expert in one field, you're an expert in everything right, especially materials, I guess.

It seems to me some reassessment of what we mean by defense-in-depth is in order here. Don't you think, Mr. Rosen?

MR. ROSEN: I'll pass on that, George, but I would like to ask the question about your third bullet. When you say "NRC approves", I think what you mean is the NRC is going to approve the PRA and the licensee's review process, am I correct?

MR. DUDLEY: Yes, that's correct.

MR. ROSEN: Now that says to me that NRC is going to be in the business of approving everybody's PRA who comes in for a change and that's different. NRC has not approved PRAs. They've approved applications of PRAs, but are you just using loose language here or do you really mean they are going to approve the PRA for the use?

MR. DUDLEY: Yes, that's exactly.

MR. ROSEN: Okay.

MR. DUDLEY: We'll be approving their approach and their justification basis for making the 50.46a changes either the small inconsequential ones, below small -- the inconsequential ones we can talk about more tomorrow, that they have an adequate analysis, evaluation basis to support that, as well as the individual changes that might have higher, but still small increases in risk that their PRA methods, their data an their implementation of the decision making process is adequate.

So we won't be approving "the PRA". So yes, you're right.

MR. ROSEN: No global approval of PRA.

MR. RUBIN: That's correct.

MR. ROSEN: I think that's the right way of saying that.

MR. RUBIN: Yes.

MR. DUDLEY: Thank you, Mark. Since the

selection of the TBS was based in part on frequency, the NRC will continue to monitor LOCA frequency information. If any significant changes result in the future, we may change the transition break size. We could do this by rulemaking or order, depending upon the significance of the change.

DR. KRESS: Let me ask you about that. The reason that they pulled together an expert panel to elicit their opinion on frequency is because you didn't have enough information, actual data on breaks to establish the frequency for various sizes. Does this bullet mean you're going to periodically call together a new panel of experts and do a new expert opinion elicitation?

MR. DUDLEY: The detail we'll have on that will be the next presenter, but I mean I would think that more than likely it would just be if we have some actual events that occur.

DR. KRESS: But you're not going to have those.

MR. DUDLEY: Cause us to question --

DR. KRESS: You're not going to have those, I don't think.

CHAIRMAN SHACK: But you might find new mechanisms of degradation that the panel haven't considered.

DR. KRESS: Yes, but then you have to call it a new panel.

CHAIRMAN SHACK: Well, at least you would indicate, right, that you'd have to rethink this.

MR. DUDLEY: It would depend, I guess, on what we found as to how we would pursue it.

CHAIRMAN SHACK: Suppose you have your new super duper probabilistic fracture mechanics model and find you were way over conservative. Would you reduce the break size?

DR. KRESS: Good question.

MR. DUDLEY: Yes, we would absolutely consider that.

MR. ROSEN: I think those would likely be very disruptive changes, but I don't see any alternative to keeping your eyes and ears open and accept the consequences that operating experience dictate.

MR. DUDLEY: That's correct. And because of that, if we do make changes to the break size by increasing it, plant design changes that have already been made under this regulation, we'll still be required to continue to meet our acceptance criteria. This may require licensees to restore their design in certain areas or make other compensatory changes to their facility so that they can meet acceptance criteria and because of this that is why we made a change or we're proposing a change to the backfit rule so that both changes in TBS, that the NRC would make, and other changes that licensees might have to make to their facilities would not be considered as backfits or would be allowed and not prohibited by the backfit rule.

CHAIRMAN SHACK: But why are risk increases due to this so important that they don't need to be backfit, but all other risk increases do?

MR. DUDLEY: Once again, I'll receive some assistance here.

CHAIRMAN SHACK: I never understand coloring risk.

MR. KELLY: This is Glenn Kelly from the Staff. Part of the justification for why we believe that that's the appropriate thing to do in this case is that we're going from a situation where we have coverage for large break LOCAs mitigation capability for large break LOCAs including simultaneous loss of offsite power, plus on top of that an additional limiting single failure and we're relaxing that criteria above the TBS break size on the basis of what we understand the risk associated with those breaks today so that you no longer have to consider single failure. You wouldn't be looking at simultaneous loss of offsite power and we believe that if information should arise that would cause us to think that the basic underlying information that we use for determining the TBS size, if that should change, that therefore it's appropriate to restore what we originally had to assure adequate public safety.

CHAIRMAN SHACK: That's an answer.

MR. DUDLEY: The next three slides are basically administrative summaries of the outline of 50.46a rule language. The first paragraph is definitions. The second is applicability and scope.

Paragraph C in 50.46a is the ECCS evaluation requirements for both regions above and below the TBS.

Paragraph D gives the ECCS acceptance criteria.

DR. WALLIS: Are we going to get into these in detail some time today?

MR. DUDLEY: Later, this afternoon, that's correct, absolutely.

Acceptance criteria for above and below the TBS.

Paragraph E would allow the NRC, the

Director of NRR, to impose restrictions on licensees whose facilities didn't meet 50.46a.

Paragraph F is pretty much the meat of the rule. It's the process for design changes under 50.46a. And as Brian has said earlier, unless you make a design change there's no change in risk for this facility. It doesn't matter what analyses you do or not and that's why this design change process is quite detailed and we think thorough.

DR. WALLIS: I was really curious about what a risk assessment, a non-PRA risk assessment was. I thought risk assessment was by definition the result of a PRA.

MR. DUDLEY: We should have started with PRA, shouldn't we have, Mark?

(Laughter.)

MR. RUBIN: No, no. It's the nonquantified method. It's margin methods, bounding methods --

DR. WALLIS: I don't accept any non-quantified method. It doesn't mean anything to me.

MR. RUBIN: It's certainly a good point. The quality standards, the ASME and ANS standards both recognize non-quantified risk assessment methods as part of the methodology and is, in fact, included in the standards.

DR. KRESS: These are things like FIVE and the seismic margins?

MR. RUBIN: Some are pure margins. Some are like semi-quantified, FIVE could be partially a bounding numerical calculation, rather than a --

DR. KRESS: That's a quantification you can see.

MR. RUBIN: Right. But it has to be high competence, obviously. It's a low impact, based on a qualitative or semi-qualitative assessment.

Looking to follow through the phase quality initiative, the guidance is clear that it can be a major contributor to the risk profile. It should be quantified or a very strong basis given that it's an insignificant impact.

MR. DUDLEY: So paragraph F has PRA submittal and approval process, acceptance criteria for design changes. PRA acceptance criteria, we talked about that earlier. Non-PRA acceptance criteria. Monitoring and feedback requirements, that will be discussed in more detail tomorrow. And it also has a process for going through these inconsequential risk changes. And finally, F7 is the operational requirement where it requires licensees to mitigate the double ended break of the largest pipe for all at-power operating configurations.

DR. WALLIS: Do I understand you're not going to tell us what you mean by "inconsequential"?

MR. DUDLEY: Tomorrow we'll discuss it.

DR. WALLIS: Are you going to define it? Or are you just going to waffle around it?

MR. DUDLEY: We'll do that in the guidance and I really can't --

DR. WALLIS: So you're not going to tell us what it is until June or something like that?

MR. DUDLEY: Yes, I believe that's correct.

DR. WALLIS: So you're assuming that the concept is going to be a meaningful one. It's going to be enforceable and somehow or another a miracle will occur by June to make it something which is usable.

MR. DUDLEY: Hopefully, it's less difficult than waiting for a miracle.

DR. WALLIS: It's very vague at the moment.

MR. DUDLEY: Yes sir, it is. And paragraph G and H are documentation and reporting.

I is reserved. I have to find out what for sometime.

And paragraph J is the paragraph that talks about when we make changes to the TBS and that they would not be considered -- how we would go about doing that.

And that completes my presentation. If there are any other questions on the general aspects of this, as opposed to the specific technical details, I'll try to handle them.

DR. WALLIS: I think the devil is in the details, as usual.

MR. DUDLEY: Yes sir. Seeing no questions, do we want to break or --

CHAIRMAN SHACK: We are actually ahead of schedule, amazingly enough. But let's go on to the transition break size.

DR. APOSTOLAKIS: But we still have to be here tomorrow morning.

CHAIRMAN SHACK: Well, depending how far along we get.

DR. WALLIS: Are we going to take an hour before the break?

DR. APOSTOLAKIS: There's nothing wrong with having longer breaks.

(Laughter.)

MR. ROSEN: This is a kinder, gentler George Apostolakis.

DR. WALLIS: If we like an early lunch --

DR. APOSTOLAKIS: It's just friendly suggestions to the chair.

CHAIRMAN SHACK: George, we're thinking of your health. Just think how many cigars you might smoke if we broke now.

MR. HAMMER: Good morning, I'm Gary Hammer in the Division of Engineering of NRR. And I worked on the selection of the transitional break size.

And the concept is basically that we wanted to pick it based on pipe break frequency estimates, as near as we could estimate them and take into consideration some other things that might address some uncertainties in that.

In the past, there have been a number of studies of LOCA break frequencies and I'm sure some of you are familiar with them, WASH-1400 which goes all the way back to the 1970s. That's pretty old information.

And NUREG-1150 which came along as a result of the severe accident study in the early 1990s, I believe, and then later on in the 1990s there was a NUREG/CR-5750 which estimated the frequency of all kinds of events, including LOCAs which had a little more comprehensive study.

DR. APOSTOLAKIS: I understand the OECD has a program now?

MR. HAMMER: I beg your pardon?

DR. APOSTOLAKIS: The OECD has a program on collecting pipe failure data and all that? PIPEX, whatever they cal lit?

MR. HAMMER: I only listed a few of them. Yes, there are some others.

DR. APOSTOLAKIS: But isn't that the latest and the best?

MR. HAMMER: These are certainly not the latest and the best.

DR. APOSTOLAKIS: I didn't see that mentioned anywhere in the documents I've read and I was wondering why not. Are all the estimates and the judgments and everything consistent with that database?

MR. HAMMER: Well, you know, what I was going to get into next was the next step that we took and there were a lot of other sources of information that were taken in the development of our most recent estimates. And --

DR. APOSTOLAKIS: One of your experts is, in fact, involved in that, so I was surprised not to see that, Lydell.

So when was the expert opinion of the station, when did it take place? Was it a year or two years ago?

MR. HAMMER: When did the --

DR. APOSTOLAKIS: When did you actually do it, yes.

MR. HAMMER: I think it was in the last year and they're wrapping it up currently, they're putting the report together right now.

We have someone here who can answer questions about that expert elicitation. But as I was going to say, the old studies are based on a limited amount of pipe break data and we realized that we needed better estimates.

DR. APOSTOLAKIS: Well, see that's what confuses me. There is a paper by Fleming and Lydell, fresh out of print, that says there's a lot of data. Now what kind of data, limited amount of pipe break, you mean the catastrophic rupture, is that --

MR. HAMMER: Yes. I think -- yes, I guess I need to characterize that a little bit. There's a lot of data in industry, in general, regarding pipe failures, etcetera. Some of that might or might not be applicable to nuclear experience. We don't have a lot of experience with failure of nuclear break piping, except some in the smaller diameters. We had no large break failures, certainly in the primary system. And what we're trying to do is get a means to extrapolate and get frequencies in those larger sizes and this becomes the difficult task.

And so the Office of Research convened an expert elicitation panel, as I said, in the last couple of years to try to develop better estimates of pipe break frequencies and some of the data has been presented in some detail to the Committee before and I didn't want to go into it in great detail.

They did look primarily -- well, really only at degradation-related mechanisms and by that, that involves failures of pipe that would be due just to the material degrading under normal service conditions. You wouldn't add on to that large loads or other things like that that might make it fail with lesser degradation. So you're looking at -- that was considered one of the big area of contribution in the study and that's summarized in the SECY report 0060 earlier this year.

And we used those results as a more or

less as a starting point for selecting the TBS.

CHAIRMAN SHACK: Well, just before we -- do you agree that failure of the pipe due to the degradation mechanism is the dominant mechanism for large break LOCAs?

MR. HAMMER: Well, it probably is, but what we're seeing is that there might be some other areas that might deserve some closer attention, particularly in the seismic and I was going to mention these a little later, seismic large loads that are very infrequent, but they might b eon the same order of magnitude of these kind of frequencies, since we're picking fairly low frequency, 10^{-5}.

CHAIRMAN SHACK: So we might expect these frequencies to double or triple?

MR. HAMMER: In terms of the size selection might double or triple?

CHAIRMAN SHACK: No, no, the frequency for a given diameter.

MR. HAMMER: I wouldn't know how to characterize it at this point, really. You know, I think a significant would be order of magnitude, maybe, something like that.

CHAIRMAN SHACK: Okay.

MR. HAMMER: Because we're not using a

whole lot of precision in selecting these sizes anyway, but we're trying to get fairly close and that's an order of magnitude.

DR. APOSTOLAKIS: But you are really picking a size that is much larger than what the experts say.

Right? You go to the median, you find the number; you go to the 95th percentile, another number; and then you say ah, what the hell, that's low, double it.

MR. HAMMER: Right, there are a lot of ways to --

CHAIRMAN SHACK: We'll get to discussing that, George.

MR. HAMMER: Yes. So let's see, go to the next slide.

And as I mentioned, we're going to use the nominal frequency here of one in 100,000 reactor-years or 10^{-5} per reactor year. And we consider that an acceptable approach as we mentioned earlier because it's really a transitional break size between these two regimes of analysis. And what we're doing is we're still maintaining mitigation capability above this size. So this is more or less just a dividing, separating criteria, as you look at the spectrum of events.

MR. ROSEN: See, someone reading this slide would not know what you mean by "it is complemented by mitigation capability for LOCAs greater than the TBS." I mean that is -- really what you said is what you meant, is that yeah, we're picking this, but it's really because we're keeping mitigation capability for breaks larger than the TBS. But this slide is -- doesn't really say that. It doesn't say anything. I looked at it --

MR. HAMMER: I apologize for any confusion there.

But this is discussed in some detail in a SECY paper and --

CHAIRMAN SHACK: But the one in 10^{-5} actually comes from the framework document where that is sort of defined as a --

MR. HAMMER: It was sort of a starting premise that we had, yes.

CHAIRMAN SHACK: Beyond sort of consideration, you know. You pick some sort of frequency, but that -- it's sort of a -- it's been typically understood as the kind of frequency that you sort of stop considering events. The fact that you're, in fact, you're still going to have mitigation beyond that is, in fact, a defense-in-depth.

MR. HAMMER: Right, right.

DR. WALLIS: Are these all pipe breaks?

MR. BARRETT: Can I say a word about that? This is Richard Barrett with the Regulatory Staff, NRR.

I don't think we've used 10^{-5} in the past as a criterion for selecting events that will have no mitigation. I think in the past we've -- I could probably get some help from some of the staff here, but I think we've chosen much lower numbers than that for events that are not to be mitigated or that cannot be mitigated.

CHAIRMAN SHACK: Well, I mean your PTS frequency once upon a time was five times 10^{-6} so you know -- you don't use it all up with any one unexpected event. So there is a consideration from that point of view, but it really is the notion that those are the very unusual events.

MR. ROSEN: Well, reactor vessel failure is a 10^{-6} event and we don't mitigate that.

MR. KELLY: This is Glenn Kelly from the Staff.

MR. ROSEN: You can see where the limit of that discussion is.

MR. BARRETT: I'm going to ask Glenn Kelly to address this. We gave this a great deal of discussion in our group.

Glenn?

MR. KELLY: The 10^{-5} that you see up there represents a number that was suggested by the Commission in an SRM as an appropriate value to use for selecting a transition break size based on the fact that the Commission was also requiring that mitigation capability continue to be provided in the region above the TBS up to the double-ended guillotine break.

So I think that's what Gary's slide is trying to indicate there, that that's what that complementary mitigation capability is. So it was felt that at this point we were, the Commission would be satisfied with the choice in the area around 10^{-5} as long as adequate mitigation capability was being provided for the breaks.

DR. WALLIS: These are all pipes?

MR. ROSEN: No.

DR. WALLIS: No other things like --

MR. ROSEN: No, they're not all pipes.

DR. WALLIS: There are manways and things like --

MR. ROSEN: There are reactant coolant

pump. DR. WALLIS: There are seals.
MR. ROSEN: Well, no. I'm thinking about the housing itself.
DR. WALLIS: I was thinking about things which are bolted on which can be overtorqued.
MR. ROSEN: Exactly, that's what I'm talking about.
DR. WALLIS: Things which can fail because of human error, rather than the degradation mechanism.
MR. ROSEN: I'm trying to give you an example of exactly what you're talking about. The reactor coolant pump --
DR. WALLIS: There are bolts --
MR. ROSEN: There are bolts in that that hold --
DR. WALLIS: And they can be overtightened by --
MR. ROSEN: Or they could corrode because boric acid leaks --
DR. WALLIS: That's degradation mechanisms. But there could be human error which could be a force.
MR. HAMMER: And those are some of the other things that we're also considering.
DR. WALLIS: You're just talking here

about pipe breaks. I was wondering if you included all those other --

DR. APOSTOLAKIS: Is the vessel included in all of this? And if not, why not?

AUDIENCE MEMBER: The answer is yes.

DR. APOSTOLAKIS: The answer is yes somebody said.

CHAIRMAN SHACK: But you have other considerations that try to limit the frequency of vessel breaks and that's why we have a PTS rule. You know, that's why we have embrittlement criteria.

DR. APOSTOLAKIS: So you might say it's included.

DR. KRESS: It's implicit.

CHAIRMAN SHACK: But certainly in the elicitation process, I don't think they were considering this.

MR. HAMMER: Yes, they really only are looking at degradation mechanisms and they're the things that you normally think of like that pipe cracking, corrosion, erosion, things like that that degrade the material itself. Things like active failures are another consideration besides that due to large loads and that's what I've got here on this slide.

We made some attempt to select for those uncertainties.

MR. TREGONING: Sorry to interrupt, Rob Tregoning. I just want to clarify Dr. Wallis' question and Dr. Shack's discussion about what was considered and not considered.

We did consider all passive system component failures that could lead to a LOCA. That includes the vessel itself. We looked at vessel head failures where, for instance, an entire vessel head could go out. We didn't look at PTS events with respect to the vessel because that's handled separately. We looked at other types of events with respect to the vessel and all the other large non-piping passive system components, pressurizer, steam generator tubes, reactor coolant pumps, Class 1 valves, all those types of components.

DR. WALLIS: Manways?

MR. TREGONING: Yes, manways, all of --

DR. WALLIS: How did you deal with human error like overtightening of bolts on the manway?

MR. TREGONING: The way we talked about is we discussed the scenario that would have to occur in terms of how many bolts would need to fail, what sort of mechanism would cause that, what sort of procedures are in place, both operationally and programmatically, to prevent that and then each of the experts had to weigh that consideration in their testimony.

DR. WALLIS: So these are materials experts deciding what people will do again?

MR. TREGONING: Well, not just materials experts. I mean we have a relatively large operating database to fall back on as well, so we had systems experts as well.

MR. ROSEN: Rob, what about the very specific question I raised about the reactor-coolant pump bolting and the evident, the degradation we've seen on reactor-coolant pump bolts caused by boric acid, corrosion of the bolts.

MR. TREGONING: We talked about common cause bolting failures from such things as you know, multiple locations that are corroded due to boric acid. And again, it was brought up as specific failure scenarios to look at.

I will say that not one expert really identified any bolting failures as a significant cause for concern, but again, it was something that was discussed and considered within the elicitation.

MR. HAMMER: Okay, so there were some other things that we wanted to consider which might include inadvertent actuation of active components. And some of these other things, large loads which go beyond just degradation-related stuff. And degradation and specific piping and specific pipe sizes, and what we mean there is specific piping which might exhibit some higher than normal degradation that you predicted on a generic basis. An example there would be pressurizer surge line which has a lot of a fatigue issues. If you compare that to another 12 or 14-inch pipe you won't see those kinds of degradation. So we wanted to be sure we accounted for some of these uncertainties.

And what we ended up with was for PWRs, the TBS was 14 inch and for BWRs it was 20 inch and as we mentioned earlier, we want to periodically update frequencies to ensure that they remained valid. We want to update it with data as it comes in about additional failures or degradation mechanisms and just to --

DR. APOSTOLAKIS: I don't understand how you're going to do that since the 14 inch and 20 inch choices were really judgments. I mean those guys, the experts, I think was 8 inches or less than that?

CHAIRMAN SHACK: Seven inches is 1 times 10^{-5}. There's a factor of 48 or 42, depending on how you compute the difference.

MR. HAMMER: Right.

DR. APOSTOLAKIS: A factor of 48. And if you look at the table from the experts, a break size of 7 or 14 inches for a PWR according to the experts has a mean frequency of 2 times 10^{-6}. So now you are saying no, it's really 10^{-5}?

Is that what you're saying?

MR. HAMMER: You can aggregate the data a lot of different ways and get different numbers than the ones you just gave.

DR. APOSTOLAKIS: No, but I'm trying to see what frequency, at least according to the expert elicitation, what frequency the 14 inches corresponds and it corresponds to 2 times 10^{-6}.

CHAIRMAN SHACK: No, 2.4 times 10^{-7} is what I compute.

DR. APOSTOLAKIS: It's on the table. It's on the table here. I didn't compute it. It's in Table 1 of the SECY.

DR. SHERON: George, this is Brian Sheron. Don't try and, if you would, don't try and equate the --

DR. APOSTOLAKIS: I'm trying to get some mean size, Brian.

DR. SHERON: Let me tell you how we came about with the 14 and the 20 inches, okay?

We looked at the frequency tables, okay, 10^{-5} and so forth. They had values there at the 50th percentile and 95th percentile. We also scratched our head as you heard about all of the mechanisms, possible degradation mechanisms that were not accounted for in the expert elicitation process and how do we deal with that.

Also, the fact that the expert elicitation process in and of itself has an uncertainty associated with it. It's judgments and the like.

So we said well, we just don't want to pick the 50th percentile of the 10^{-5}. We need to account for these uncertainties.

As we moved up the chart, we recognized, we said well, what is the largest pipe size in a PWR anyway that's attached? Not withstanding the primary coolant pipe? And we said gee, it's 12 inches. That's the size of what most surge lines -- and we said nah, except for South Texas, that's got 14 inches. And we said if we pick 14 inches, we have covered at least from a mechanistic standpoint all of the attached piping for all PWRs.

When we used that same logic for the BWRs saying let's account for uncertainty and the fact that you don't have all the mechanisms identified maybe and there is uncertainty in the elicitation process itself. And what is the largest attached piping to -- in the recirc piping it's a 20-inch pipe.

And so we felt that we said how much impact would it make if we were to pick, for example, for the PWRs, gee, instead of 14 inches would it really make a big difference if it was 12 inches or 11 or 10 or the like?

And we didn't see that much of a difference from the standpoint of how one would deal with it and so we felt comfortable that by picking these numbers we had a -- there was sort of a little underlying mechanistic basis, namely this is a physical size of a pipe.

The other thing that we considered was regulatory stability and that was that as you heard before, the Commission had told us that we would not impose the backfit rule if these numbers were to change. Well, from the standpoint of a utility, if they're going to go off the spend money making changes to their plant, they don't want to have anything hanging over their head that says three years from now the Staff is going to go reevaluate this and I'm going to have to go back in and re-design and modify my plant. So we wanted to make sure that the numbers that we picked were not really going to change.

DR. APOSTOLAKIS: And that's why I am going to doubt that the second bullet doesn't mean -- unless you find something extraordinary.

DR. SHERON: Exactly. We need to look at it. We need to check ourselves to make sure that we're still -- but the point is is that we go with those numbers. We don't think there's going to be any new information that's going to force licensees to go back in and revise their designs. And that was part of our thinking.

DR. APOSTOLAKIS: That's a good point. Now one last point though over this. In the discussion of how these sizes were selected which is what we are just saying, you said that you looked at the 50th and the 95th percentile from the experts and then you went through these other considerations and increased even that.

But if you go to Table 1 or SECY-04-0060, it seems that the sizes you selected are really the 95th percentile is a little under 10^{-5} from the experts. And I'm wondering whether that's consistent with the other discussion? Well, that's what I see here. I mean unless -- LOCA size corresponding to effective break size for PWRs from 7 to 14 inches is $9/10^{-6}$. Isn't that what it says?

CHAIRMAN SHACK: Look at Table 3.

DR. APOSTOLAKIS: No, I'm looking at Table 1.

CHAIRMAN SHACK: Go to Table 3 where it's all nicely laid out for you in terms of --

DR. APOSTOLAKIS: Ah, but Table 1 is the only one that they will read. Everything else is in appendices. The only thing in the SECY, the rest of it is attachments is Table 1.

CHAIRMAN SHACK: This one lets me look at 15 years in the future. I take aging into effect.

DR. APOSTOLAKIS: No, what I'm saying is that I don't understand. The argument Brian just gave us which is also in the document says that even the 95th percentile was increased, but here it seems as if the 95th percentile with this new size is around 10^{-5} unless we're talking about different 95th percentiles.

And the other thing is the uncertainty. Well, maybe this is for another time.

We'll discuss this expert thing in detail, Mike, we'll discuss this in November?

MR. SNODDERLY: Yes, we're trying to

figure out what document are you looking at, George?

DR. APOSTOLAKIS: SECY-04-0060.

MR. SNODDERLY: Okay.

DR. APOSTOLAKIS: That's not right?

MR. SNODDERLY: That's it.

DR. APOSTOLAKIS: Dated April 13, 2004. But we'll discuss this in November?

MR. SNODDERLY: We're going to be discussing the documentation, the more detailed documentation of that data.

CHAIRMAN SHACK: We have different copies, George.

DR. APOSTOLAKIS: April 13, 2004.

CHAIRMAN SHACK: SECY-04-0060, right?

DR. APOSTOLAKIS: Yes.

CHAIRMAN SHACK: Boy, we sure get different numbers.

DR. APOSTOLAKIS: On page 4.

CHAIRMAN SHACK: I downloaded mine from the website.

DR. APOSTOLAKIS: Page 4, Table 1. It says preliminary results.

DR. WALLIS: It's a draft.

DR. APOSTOLAKIS: Well, it says "April." It's interesting though that you -- I mean yeah, this is really -- this is defense-in-depth, but I can't disagree with it. I think it's good.

DR. WALLIS: So now you're going to explain to us why this break in the hot leg knows it's got to stop when it gets to the size of 14 inches squared?

The break in the hot leg knows it's got to stop when it gets to the size? I understand breaking a pipe which has a diameter of 14 inches. I'm not quite sure I understand how that break in the hot leg knows it has to stop when it gets to an area --

MR. ROSEN: Okay, all right. We've given some thought about how you would apply the breaks to the system. That's what I was going to go to next.

DR. WALLIS: I'm puzzled by this longitudinal breaks having openings up to. That seems to be a very different question from does the surge line break. I can understand that. But I don't quite understand how the hot leg break knows it has to stop growing when it gets to a size equal to the area of the surge line.

MR. HAMMER: A smart hot leg.

DR. SHERON: It doesn't have to stop growing. It just says if it goes beyond that, the way we analyze it doesn't have to be as rigorous.

It has nothing to do with the break size. I mean it just says this is how we analyze it.

MR. HAMMER: I'll try to explain our thinking a little bit on this. This is an example of how we think the LOCA, postulated LOCAs would be applied and this for design basis LOCAs which are up to the TBS, double-ended opening.

So what you would do is you would postulate two kinds of breaks here, full circumferential which give you a double-ended guillotine break of a pipe that size, and longitudinal breaks having openings up to that area for that double-ended area in any pipe. So this is what you were talking about. You can have a hole in the pipe of a larger diameter than that size and what this would do is it attempts to address the uncertainty in whether or not a break of that pipe, that exact pipe is really the limiting location. You could have a surge line that's that diameter, for instance. You can postulate that break, but is that really the worse location? You might have to move it around.

And then, as I said, you postulate it in a variety of pipes --

DR. WALLIS: Do big-break pipes break this way, that they break and then they stop when they've got a -- I guess they do.

MR. ROSEN: Are you talking about -- yes, the pressure goes down, the driving force for the opening of the break goes down.

MR. HAMMER: Yes, we refer to it as a longitudinal break, but really it ends up being a fish mouth. An analysis space they consider a rectangular slot or this kind of thing.

CHAIRMAN SHACK: Well, I think the argument is that, in fact, you never get unstable in the large pipe, that you get a slowly growing crack and by the time you have a 14 inch hole, your leak detection system is sort of working.

DR. WALLIS: It's not automatically catastrophic and unstable. It can stop.

CHAIRMAN SHACK: It's a ductile pipe, right.

MR. HAMMER: Right. Now for beyond design breaks, it basically works the same way. You'd still want to postulate both longitudinal and circumferential breaks. Up to, however, a double-ended rupture in the RCS or the largest pipe.

And again, I'll emphasize at the limiting location, so it just wouldn't be one break, you'd have to find out where that was and I've got a graphic here which attempts to explain. As I said, you could have a break here in the 14-inch pressurizer surge line, but then in order to address the limiting location, you would have to move it around to see where it is and it would have the same cross sectional area as this double-ended effect. And then over here on the left side, I've attempted to show what some of those larger breaks for beyond design basis would be and that would include a double-ended guillotine or just some larger hole in the system at some other location.

CHAIRMAN SHACK: When you say longitudinal break, you're really just going to put a 14-inch hole in a big pipe, aren't you? I mean you're not going to sit there with a fish mouth that's got an area equivalent to the 14-inch hole, are you?

MR. HAMMER: Well, you can think about it and mechanistically, if you want to, but it's more of an analytical thing and since we're looking at it --

CHAIRMAN SHACK: It could be a circumferential crack. All you're looking for is a crack with an equivalent flow area of 14 inches, whether it's a longitudinal crack.

DR. WALLIS: Twice that.

DR. BONACA: Twice that.

CHAIRMAN SHACK: Yes, twice that, yes.

DR. APOSTOLAKIS: What does 2 times 14-inch means there?

DR. WALLIS: It would be a pretty big crack.

CHAIRMAN SHACK: Because it's a double-ended 14-inch diameter pipe.

DR. BONACA: Two holes of that size. Double-ended.

DR. APOSTOLAKIS: Two times 14 inch. What does that mean?

MR. HAMMER: Double-ended, basically.

DR. APOSTOLAKIS: Oh, I see.

MR. HAMMER: You've got flow out of both ends of the pipe when it breaks.

DR. APOSTOLAKIS: Oh, I see, I see.

DR. WALLIS: That's an area of 14 times the square root of 2.

DR. APOSTOLAKIS: Multiplied by the logarithm 5.

(Laughter.)

DR. WALLIS: It's about a 20-inch hole.

MR. HAMMER: That's all of my presentation. The next thing on the agenda is --

CHAIRMAN SHACK: Is a break. We'll come back at 10:30, George. Would you like to look at the frequencies?

CHAIRMAN SHACK: Now that the thermal-hydraulic guys take over we'll probably lose our schedule again.

(Laughter.)

DR. UHLE: I think I'm on the schedule for three hours, but please don't feel bad if you want to end this in a half an hour. I won't feel the least bit rejected.

CHAIRMAN SHACK: Maybe you will.

(Laughter.)

DR. UHLE: No, no, I'm more than willing to sit down early.

I'm going to be talking about ECCS analysis requirements. I put this together with Ralph Landry, who is sitting over there at the table. So I'll give him all the credit for the things that don't make sense, and I will ask him to answer all the hard questions that you might have.

I'm going to go over these particular items here, the current requirements in 50.46, just to update people; talk about what the transition break size really means as far as the analysis requirements; then talk about what those requirements are, the acceptance criteria, a bit about the documentation requirements, reporting requirements, and approach to the regulatory review.

Right now in the rule with 50.46 a licensee is required to have an acceptable evaluation model. Therefore, it has to be reviewed and approved by NRC. There's two types specified in the reg. One is what people say is the best estimate model, and we would prefer to call that more of a realistic model, but, anyway, a realistic model for which uncertainty has been determined. So I think the Subcommittee is familiar with the best estimate approaches and the determination of the uncertainty and the statistical methods used to do so.

Or there is the option of using an Appendix K approach which has prescribed models. The point of that is to not perhaps calculate each phenomena specifically, but with the prescribed models have an element of conservatism that the NRC is comfortable that the PCT predicted would not be exceeded during an accident scenario.

At this point, and we're keeping with this philosophy in the proposed rule, it is that a spectrum of break sizes up to the double-ended rupture, the largest pipe in the RCS, has to be proposed. In the current 50.46 analysis this is required and there's only one analysis approach used to do so, and the worst break size and location must be determined.

There is some prescribed conservatism in the regulation, and that is the licensee also has to propose that the worst single failure occurs and a coincident loss of offsite power occurs coincident with the LOCA.

The acceptance criteria, I think everyone is pretty comfortable with this. I'm going to be using these acronyms here during the talk.

Peak clad temperature, less than 2200; maximum clad oxidation, we called it maximum local oxidation, 17 percent or less; maximum hydrogen generation or core-wide oxidation, less than 1 percent. Again, this is really a parameter that's more focused on controlling hydrogen in the containment for hydrogen detonation reasons.

Also the requirement that a coolable geometry be maintained as well as long-term cooling --

DR. WALLIS: What does coolable geometry mean?

DR. UHLE: Hum?

DR. WALLIS: What does coolable geometry mean?

DR. UHLE: If you look at the reg, it's defined as a configuration that's amenable to core cooling.

DR. WALLIS: Well, that's ridiculous. I mean, the debris in Three Mile Island was cooled, too, and anything is coolable. To me, it means nothing.

DR. UHLE: Okay.

DR. WALLIS: And, yet, it's going to be the cornerstone of the new regulation.

DR. UHLE: But it will be defined or --

DR. WALLIS: It will have to be defined in terms like peak clad temperature --

DR. UHLE: It will be in the Regulatory --

DR. WALLIS: -- something measurable.

DR. UHLE: It will be in the Regulatory Guide.

DR. WALLIS: Without that, it's a meaningless thing. Anything is coolable.

DR. UHLE: Yes, I agree. There will be guidance in the Reg Guide that establishes what the staff finds acceptable --

DR. WALLIS: What is meant by -- okay.

DR. UHLE: -- as a definition of coolable geometry. The difference here, you're skipping ahead --

DR. WALLIS: So the devil, again, is in the details.

DR. UHLE: Yes. You're skipping ahead, but I can tell you now what the staff is comfortable with is at this point in time a coolable geometry is maintained when the clad is kept, the PCT less than 2200, less than and equal to 2200, and an oxidation of 17 percent.

DR. WALLIS: So it's the same thing.

DR. UHLE: Yes, I will get into that a little bit more, but you're jumping ahead.

DR. APOSTOLAKIS: These three quantitative criteria, how independent are they? In other words, can I violate one and satisfy the other two?

DR. UHLE: At this point, yes. Right now the peak -- okay, if you look at best --

DR. WALLIS: No, no. You have to satisfy them all.

DR. UHLE: His question isn't quite that. Can I answer the -- that's okay.

DR. APOSTOLAKIS: No, that was a different question.

DR. UHLE: Okay, that's right, all right. At this point peak clad temperature in a large break sense, if you maintain or if you're -- I mean the two right here, PCT and maximum cladding oxidation, and I see Ralph Meyer in the back and he can back me up on this -- really what they're trying to accomplish when the rule was promulgated is to ensure post-quench ductility and a coolable geometry. All right.

So, provided that the clad stays below that temperature, you are assured of the ability to quench the core without having it fragmented, because it's only been analyzed to have a parallel flow channel. All right. So, again, this to maintain the configuration, so you're not getting crumbling of the fuel.

At this point -- and you'll see and I will point this out a little bit later in the presentation -- that is, back when large breaks were the focus, peak clad temperature was really what everybody was worried about. There's also, based on the fuel data, a problem of having loss of ductility when you exceed this particular cladding oxidation regardless of the temperature.

However, at the time it was thought that you could control oxidation, like if a licensee hadn't changed their PCT, that in general the oxidation value predicted for that particular transient and plant wouldn't change that much because what's controlling oxidation is more temperature and time at temperature. When we were focused on large breaks, large breaks are over very quickly, in a matter of minutes, and they really didn't even have the real chance to change the time at temperature.

DR. WALLIS: With a large break, if you meet PCT, you almost automatically meet MLO -- there's no question -- if it's large breaks.

DR. UHLE: Yes, yes,

DR. APOSTOLAKIS: So that was my question really.

DR. UHLE: Yes, right.

DR. APOSTOLAKIS: I mean, is that the redundant criteria?

DR. UHLE: It is, but then, again, the regulation does cover small breaks. So you're not necessarily assured of having a large break where the transient is over in a couple of minutes. So there's the cladding oxidation because you don't want to let the cladding oxidize until whenever. If you're stuck up at a high pressure, high temperature, your PCT may be low, but you're sitting there cooking the clad. This criteria precludes that from happening.

But, in general, you're right, back when the focus was on large break, it was really PCT because the time at temperature really wasn't changed at all. And I will get into that point a little bit more further in the presentation.

Okay, so those are the acceptance criteria. We'll talk about them again in a couple of slides.

You've been introduced to the concept of a transition break size. Again, for PWRs, and I'm going to focus more on PWRs in this talk only because we think that the rule as written will be -- perhaps more changes with respect to core power can be gained for PWRs than BWRs.

I'm going to skip to the next slide. The reason for that is, in general, PWRs get more of a double-humped, it's a classic double-humped PCT versus break area representation, and that is that you have your small break region. Here, as you're increasing your break size, you're coming down in temperature because you're able to depressurize and get a cumulary injection quicker. As you increase your break size, of course, then you're also going to get to the point where you're depressurized but then you're losing so much more water, and you get another peak at this point.

At this time most plants are large break

LOCA-limited in the PWR series, and the PCT is typically around .6 to .8 of a double-ended guillotine of the largest pipe in the system. So that's where most PWRs are.

DR. WALLIS: When you get to the biggest pipe, it actually comes down again.

DR. UHLE: Yes, right.

DR. WALLIS: And those three semi-circles are just --

DR. UHLE: That's just a --

DR. WALLIS: A cartoon, yes?

DR. UHLE: That's right. This was pointed out, that we should probably change this slide, but we found that it was going to take a lot more time than we thought it would be worth to change. Management behind you may disagree with our decision.

(Laughter.)

At any rate, this is a cartoon. This is Ralph's drawing. See, this is where I'm going to start blaming Ralph. This is Ralph's fault.

(Laughter.)

All it is trying to represent here is this classic double peaked and the fact that most PWRs their power is limited by the double-ended guillotine around the .8. The transition break size that's been selected for PWRs or proposed at this point in time is more coming right around here. So it's still in the large break, which means that all the small breaks are still going to be analyzed in the same way they are today. However, the relaxation in this region, what could possibly be proposed is that licensees would be afforded the opportunity to uprate power if they could.

DR. WALLIS: So where does the two 14-inch area come? It comes there somewhere?

DR. UHLE: Yes. I mean this is -- it's about two square feet really. So one square foot is the demarcation really between small break phenomena and large break phenomena.

DR. WALLIS: So it's before the peak in PCT?

DR. UHLE: Yes, right. So it's about here, which is about two square feet. Again, it's not to scale because Ralph wasn't that detailed in his plotting capability, I guess.

Sorry, I'm going backwards. Here we go. So what that graph or cartoon really pictorializes is this concept that PWRs at this point are predominantly large break-limited. The break size is falling in between the small break and the large break phenomena.

Currently, there's no plant out there that has one methodology, meaning an evaluation model that spans small break and large break. They're currently analyzed in the small break region, and the limiting break size and location is found, and then in the large break region the same thing is done, where the break size, the limiting break size and location is found for the large break.

Really, the small break LOCA is dominated by two-phase level swell. The large break is more, the PCT is more dominated by dispersed flow film boiling. So you have methodologies that are more prescribed to each one of the competing or each one of the more important phenomena. So the way the break size has fallen on that plot is, again, it fits into this concept of a small break methodology and a large break methodology.

Transition break size for BWRs, BWRs are currently -- their worst break is the recirculation line break, and the 20 inches is, if you were to put it on more of a plot like this one, it's probably closer to here. So it's not going to afford BWRs perhaps as much opportunity to, say, uprate power. It would probably afford them other relaxations as well as the concept of reducing the diesel generator start-time issues, which then is looked at as an enhancement to safety. Whether or not it's realized, now that's yet to be seen.

DR. WALLIS: How much can these codes be moved around by changing your strategy for ECCS? Part of the argument for this transition break size was that you no longer focused on the large break. Therefore, you can optimize your ECCS. You probably change the shape of that curve you showed.

DR. UHLE: You'll be able to change it. I think you're still going to get that double-humped approach, but you would probably even out the peaks a little bit and again be able to in general uprate power. We have done some amount of analysis on that.

The problem is that our tools, our analytical tools, tend to be more conservative. You've seen the RELAP and the TRACE PCT predictions versus large break phenomena. They tend to be more conservative, and it's harder to really quantify, say, how much licensees would gain in margin by using those.

A better way is to look at the licensing tools that the industry uses, which are more best estimate in the sense of the word, less conservative. In addition, it's going to be plant-specific how much margin is gained by this change based on the particular design and the ECCS design as well.

So we've done some scoping calcs. I wouldn't say that they're publishing-worthy or peer-review-journal-worthy, but we're expecting there will be an opportunity to increase power as well as optimize the ECCS strategy with respect to accumulator pressures, what have you.

One and most important benefit I think is finetuning the accumulator response or the back pressure such that perhaps downcomer boiling is not eliminated but reduced or the probability of that or the severity of that reduced.

I just want to point out with the BWRs the reason why it's more difficult for BWRs to define a PCT plot is because pretty much all breaks turn into a large break based on the ADS.

So for the analysis requirements for 50.46(a), the less than and equal to the TBS, we're not changing a thing, all right. The greater-than-TBS range is where there would be some amount of less rigor.

CHAIRMAN SHACK: But he's going to have to have two analysis methods, right --

DR. UHLE: Yes.

CHAIRMAN SHACK: -- for the less than TBS?

DR. UHLE: Yes.

CHAIRMAN SHACK: Because part of that is a small break and part of that is a large break. Can he just use what he's got now and say it works?

DR. UHLE: Yes, yes. Where a particular plant falls on this particular plot, you know, maybe the line is here, but the break size is more into the small break phenomena. So it may, for a particular plant and a particular methodology, if the methodology has been approved to look at breaks that are a little bit larger -- you know, you're not really going to be focused on dispersed flow film boiling at this point in time. That's not until you're up here where you're really liquid-starved.

It will be up to the methodology in the plant to see where this demarcation is, but it is down off the main hump. So we expect that there will be, as usual, perhaps two methodologies. There doesn't have to be, but if the status quo is maintained, only Appendix K approaches are used in the small break range; there has been no best estimate that's been approved or submitted for approval. So there would be an Appendix K approach for the small break region using today's standard evaluation approaches.

For a particular plant, perhaps they would have to use their large break analysis, using the -- no, if the --

CHAIRMAN SHACK: If they happened to get over there.

DR. UHLE: Right, right. If the small break is not considered able to model the phenomena that start to occur here, then they would analyze it in a way that is currently prescribed in 50.46. At this point they could then have a relaxed or I should say less prescribed single failure and loss of small site power and less prescribed success criteria for this point beyond.

DR. WALLIS: Will they be using the same code?

DR. UHLE: They could use the same codes that are currently approved right now. There is nothing in the rule that precludes that. They could propose to come in with another methodology that does the grade and transition break size. They don't have to, but --

DR. WALLIS: That concerned me. If I read the language, it says, "A licensee may opt to submit a methodology for review and approval."

DR. UHLE: Yes.

DR. WALLIS: There's no guidance about what kind of methodology it has to be or any kind of criteria it has to meet.

DR. UHLE: It could be in Appendix -- sorry.

DR. WALLIS: It could be a completely new some hydraulic code, you know.

DR. UHLE: Yes, it could.

DR. WALLIS: Why not?

DR. UHLE: And NRC would review and approve that.

DR. WALLIS: So you guys might be inundated with all kinds of new things.

DR. UHLE: Yes, but that is highly unlikely. That is a possibility. The reason why we think it's highly unlikely is for one reason: Most plants are going to best estimate for large break. They are going to gain the most margin there if their analyses are more realistic, and they've already got input decks for their plants.

Now what could be done, though, is the amount of runs required right now for a best estimate is when you're trying to capture, say, a 95/95 for the three success criteria, 124 runs for the 95/95 probability, looking at the three success criteria, that would perhaps be reduced depending on how they came in with their statistical approach or whether or not they use a statistical approach. So that is yet to be decided.

I mean in our mind we are confident what we think is acceptable, but no one has come in, obviously, to submit anything yet because the rule isn't finally promulgated.

CHAIRMAN SHACK: Yes, I mean you would have more of an incentive to do a best estimate small break LOCA?

DR. UHLE: Yes, yes.

CHAIRMAN SHACK: Why does the BWR owners' groups think they're going to do small break reanalysis? They list that as one of the disadvantages of the new rule.

DR. UHLE: Say that one again.

CHAIRMAN SHACK: The disadvantage of the rule is they're going to have to reanalyze small break LOCAs. The cost to requalify small break LOCAs below the TBS, it's just the notion that their current model might not always --

DR. UHLE: I think that they might have been answering that question when they thought that we were requiring best estimate methodologies only. That was thrown around as a concept, that you're relaxing in one area, but if we're saying that small breaks are more risk-significant, then why not force them to go to a best estimate? I think the Committee had talked about getting away from a conservative approach and using a best estimate approach. I think that comment came from that original proposal.

CHAIRMAN SHACK: That discussion.

DR. UHLE: But since then, we have determined that it's acceptable to allow in the less-than-TBS range the same that's already allowed, which is best estimate or Appendix K.

DR. APOSTOLAKIS: Can you go back to seven? I have a question on seven.

You say that for breaks below or smaller than TBS there is no change.

DR. UHLE: Yes.

DR. APOSTOLAKIS: Now we have this Executive Summary of the draft rule that says that "for breaks at or below the transition break size, comparisons to applicable experimental data must be made and uncertainties in the analysis methods and inputs must be identified and assessed, so that the uncertainty in the calculated results can be estimated."

DR. UHLE: Yes, that's currently in the rule language, in 50.46 rule language.

DR. APOSTOLAKIS: Yes, but, I mean, when you say -- the no change refers to what?

DR. UHLE: The no change is that, if you look at 50.46 and what it requires --

DR. APOSTOLAKIS: Yes.

DR. UHLE: -- the less-than-TBS range, they're still going to be held to that standard.

DR. APOSTOLAKIS: But the current 50.46 does not require this quantification of uncertainty, does it?

DR. UHLE: Yes, in the best estimate.

DR. APOSTOLAKIS: It does?

MR. LANDRY: Jennifer?

DR. UHLE: Yes.

MR. LANDRY: Jennifer, it's Ralph Landry from the staff.

George, currently, 50.46(a)(1) says that the licensee must analyze and determine, on the basis of applicable data, the uncertainty or they must analyze under the guidance of Appendix K. You don't do an uncertainty analysis under Appendix K. You have the option.

DR. APOSTOLAKIS: What do most people do?

MR. LANDRY: Right now for small breaks they are not doing the uncertainty analysis.

DR. APOSTOLAKIS: Okay.

MR. LANDRY: But that option is there. The option is there for the entire spectrum today to do an uncertainty analysis or to do an Appendix K analysis.

Now what Jennifer has said is that we have not reviewed and approved a code for doing a realistic LOCA for small break at this point. However, both PWR fuel vendors, Westinghouse and Framatome, have a realistic small break LOCA code. They simply have not had it reviewed and approved at this point, but they do have their codes that have been set up. Both W-COBRA/TRAC and S-RELAP5 can do a realistic LOCA all over the entire spectrum, small break and large break, using one code.

DR. APOSTOLAKIS: And if use that code, then you will have to quantify, is that right?

MR. LANDRY: If you follow the realistic LOCA approach, you have to quantify the uncertainty. If you use the Appendix K, you don't.

DR. UHLE: But, again, those codes happen -- S-RELAP and W-COBRA/TRAC, they haven't been submitted to NRC for review and approval. So they have --

DR. APOSTOLAKIS: So there isn't a real case where somebody actually did this?

DR. UHLE: Right.

DR. APOSTOLAKIS: Okay.

CHAIRMAN SHACK: No, they do it for large breaks.

DR. UHLE: Large breaks, but not small breaks.

DR. APOSTOLAKIS: For large breaks they do what?

DR. UHLE: They do the best estimate approach.

CHAIRMAN SHACK: They've done that whole thing with the quantification of the uncertainty.

MR. LANDRY: For the large break, the Westinghouse W-COBRA/TRAC code and the Framatome S-RELAP5 code have both been reviewed and approved to realistic large break analysis, and with that method they have to quantify the uncertainty.

Now there are only a limited number of plants at this point that have submitted realistic large break analyses for their plants. Some plants, with their reloads, we're now seeing more and more coming in and wanting to do a realistic large break analysis, but not all have converted over at this point.

DR. APOSTOLAKIS: Okay.

DR. BONACA: Now regarding TBS-approved methodology, could you expand a moment on that?

DR. UHLE: The greater-than-TBS?

DR. BONACA: Yes.

DR. UHLE: Okay. Yes, I haven't talked about this point.

DR. BONACA: Oh, okay.

DR. UHLE: This is where we were discussing what we mean by relaxed requirements from the analysis standpoint. In the greater-than-TBS range, we will still require it to be an approved methodology. So if a licensee were to submit a new code for review, the question is, well, currently, it takes about a couple of years and quite a bit of staff time to review and approve a methodology, if it does ultimately get approved, for a best estimate scenario.

What type of review would be required for a greater-than-TBS? Well, right now, as it stands, when a code comes in for review, we look at not only the high-ranked phenomena but the medium-ranked phenomena and even the low-ranked phenomena as well. But, again, we're more focused on the high-ranked, but the scope of the review is quite wide and the data ranges, or we would be very clear to ensure that the code is not used outside of its range of assessment for the models that we find to be of significance, meaning the high- and the medium-ranked phenomena.

In the greater-than-TBS range, what we do, and there's little asterisks, the review would be more focused. Perhaps we won't be as interested in the medium-to-low-ranked phenomena and only really focus the review on the very most important. I mean that doesn't make a lot of sense grammatically, but the most, most important phenomena for the evaluation models in the greater-than-TBS range.

So what types of models are we talking about there? The radiation models, the dispersed flow film boiling models, things that are really dominating the PCT response in the case where you are reflooding from a pretty much voided core.

DR. BONACA: Well, why do you have to tie your hands right now? I mean, you know, you have a choice every time you do a review to choose how focused they are going to be. I mean you might find in a particular application that you want to review more some aspects of that. Why are you committing already to --

DR. UHLE: It's not in the rule language.

DR. BONACA: Okay.

DR. UHLE: This is what we're -- we want to provide some amount of regulatory stability.

DR. BONACA: I understand.

DR. UHLE: So it's our philosophy that perhaps, since it's a less probable event, that we would be less focused in our -- or more focused on the phenomena that we're more worried about and not have such a broad scope in our review. Therefore, the amount of time required, regulatory time as well as licensee's time, focused on reviewing that particular methodology would be, of course, reduced. That's the philosophy of the rule.

The no single failure prescribed, at this point in time, again, licensees are required to find the worst single failure, which is typically a diesel being out, takes out a whole train, as well as ECCS. We are saying that you don't have to prescribe the worst single failure. So this isn't a free lunch in the sense that you would say everything works.

If a licensee wanted to come in and say, yes, I'm going to do my calculation and everything works, well, as soon as they were to take something out for online maintenance, they would have to do something to accommodate that unless they could show that what they're taking out of service does not impact the PCT response. So that's why there's the double asterisks that says, "Only analyzed operating configurations are permitted."

MR. ROSEN: Well, taking a diesel out of service while you're online is a permitted operating configuration in some plants.

DR. UHLE: Right, and if they are to do that, then they would have to have a calculation that would be there to say that they're still meeting the acceptance criteria. So if a licensee wanted to take a diesel out, then they would kick over and they would say, okay, what power could I be at if I were to do this? And they would have to have an analysis that showed what that power is.

MR. ROSEN: Some licensees can do that at full power.

DR. SHERON: Steve, this is what I discussed before, and that is that a licensee, yes, they can take a diesel out of service right now, but they also have an analysis that demonstrates that with one diesel, okay, powering one train of ECCS, they can still mitigate up to the double-ended guillotine LOCA. So, in other words, they still have mitigative capability.

What Jennifer is talking about is that, if a licensee, for example, were to increase power or make some other change to their plant such that they couldn't mitigate the double-ended guillotine in the best estimate sense without having, say, both trains available, then if they took one train out of service, they no longer can mitigate the double-ended LOCA. What we're saying is they would have to make some adjustment, either shut the plant down or reduce power to a level where they could still demonstrate through analysis that they could mitigate. Does that make sense?

MR. ROSEN: Yes, it makes sense, but only if the licensee has previously made an uprate. If the licensee is --

DR. UHLE: Right.

DR. SHERON: Well, they may decide to take something else out -- I mean, for example, a licensee may decide that they're going to have a -- they can relax the tech specs on the accumulators. I'm making this up now, okay, obviously. Maybe they say, "I can take an accumulator out of service now for a month," or two months, and they do that. But when they do that, they may need both low-pressure trains. So they're not going to be able to take an accumulator out of service for a month and then also go ahead and take a diesel out of service. Okay?

MR. ROSEN: Okay.

DR. SHERON: You're almost into the maintenance rule essentially.

MR. ROSEN: Yes, I'm thinking you're talking 50.65(a)(4) when you start you start talking like that.

DR. BONACA: What kind of feedback have you had from the industry? I'm just curious to know the impact of this.

DR. UHLE: This particular proposal hasn't really been vetted. At the first point when we went out we had the original rule that was -- we had the public meeting when that was discussed. It was a different option. This one has been developed since then.

DR. BONACA: Because it may place a significant limitation to the assumption of no single failure.

DR. UHLE: Right.

DR. BONACA: It may be so inconvenient.

DR. UHLE: And this one will, again, go out for public comment, and we'll be getting feedback.

Here what we're talking about is prescription of nominal tech specs and operational characteristics. What we mean by that is, for instance, the decay heat curve that's required assumes infinite irradiation. However, licensees are required to address beginning-of-life peaking factors. So there's this, obviously, made-up configuration where you're going to have the most decay heat and the highest peaking factors. This will allow, if the licensee were to propose, nominal tech specs and operational characteristics. So they would be able to say, hey, look, I've only been up for this amount of time; therefore, my decay heat is reduced by such and such.

Again, the licensee would be required to go search around the loop for the limiting break size and location.

DR. RANSOM: Would you comment on the role that the NRC analysis capability would play in this process?

DR. UHLE: As far as independent review?

DR. RANSOM: Whatever you do with the NRC analysis capability.

DR. UHLE: Yes. Currently, and Ralph Landry was just at the NSRC meeting where he discussed the use of the analysis capabilities that the NRC has for doing independent calculations in regulatory reviews. This is going to, I would think, put more of a burden on the NRC to do more independent calculations. However, the licensees have already had methodologies approved. They are still free to use those methodologies.

We're going to be doing more scoping studies as time goes on. The fact that this was a six-month turnaround has limited how much we've actually been doing for independent calculation, but NRA and Research have been looking at what the impacts of having two trains injecting versus one train injecting, uprating power. So there is this idea that we are taking a look in our own minds to see what the impacts would be.

DR. RANSOM: Part of the reason I asked that is, should the NRC analysis capability be held to the same kind of scrutiny that, say, the licensees' analysis capability is held to?

DR. UHLE: It's always been a philosophy that what we're doing, if we are to run an NRC calc, is an independent review rather than -- you know, we don't make a licensing decision based on NRC's calculation, but it's a tool that we use to provide us more insight into the credibility of a licensee's calculation. So the smarter we are, I think the better it is for public health and safety.

So I think that won't change as far as what the tools NRC has to use. The main point is going to be for an independent confirmation of what a licensee submits, but it's the licensee's responsibility and the decision is based on what the licensee provides.

DR. RANSOM: Well, I guess my feeling was that has always been true, but in the past it seemed like the NRC's work had been more thorough and I guess felt to be of a higher standard than, say, the licensee's work, which oftentimes covered only one design, one set of experimental data relative to that design; whereas, the NRC's work was broader and presumably could be used as an audit capability.

DR. APOSTOLAKIS: I'm confused now what the question is.

DR. RANSOM: Well, I'm questioning what role does the NRC analysis capability have in this process. Is it a standard?

DR. APOSTOLAKIS: But you just said that it's much better than the licensee's.

DR. RANSOM: It used to be.

DR. APOSTOLAKIS: Oh.

DR. RANSOM: I don't know that it is today.

DR. APOSTOLAKIS: Oh, okay.

DR. UHLE: I mean, I would say whether or not it's better, I think in general NRC hasn't taken the time to come up with a more best estimate approach. We don't have the ability to quantify uncertainty. We're more interested in doing a bounding calculation because what it is is a more -- hold on; Ralph wants to add something, I think, behind you.

MR. LANDRY: It's unusual that Ralph wants to add something.

You're partially right, Vic. The NRC's analysis capability has at points been very good. Back, way back, we did not do much in the way of validation of our code. We put codes together, but we did not do a great deal of assessment. We're constantly changing the codes.

Then we did a lot of soul-searching and developed what we wanted to have as the assessment procedure for a code, which was then in two tiers. You and I did this at Idaho years ago, where we set up a developmental assessment and then an independent assessment because we felt that there had to be a more thorough and a structured approach to assessing computer codes to have confidence in the code.

So, from that respect, yes, there was a very good assessment program and confidence level in the calculational capability. Today what research is doing with the CAM program is an extension of that for independent assessment of the codes.

Now where I say "yes and no," our calculational capability has been held to a different standard than the industry in that we have not insisted that our code be a valid Appendix K approach to calculation. We have never put out an NRC code that complies with Appendix K. We've had models in that are compliant, and our codes have been taken by industry participants and made into Appendix-K-compliant codes, but we have never produced an Appendix-K-compliant code ourselves.

So in that respect, we have not had an equal calculational capability. We have been in the market for the last 20 years of putting out what we felt was a good, realistic approach to calculation. Our concern was to make a code that was applicable across the spectrum of plants and be able to represent those plants in a realistic manner.

So we have had an assessment program that is extensive, so that we can assure ourselves that these codes have been assessed across the spectrum of the vendor's plants and not unique to the vendor's plant, as Westinghouse or General Electric or an old B&W, or whatever company would have been. They wanted to assess and make sure that their code was applicable to the hardware design that they were producing.

So, in a sense, we do have a better calculational capability, and in a sense we have a different one. I think it is better to say that our ability is different because our goals are different. We are not doing licensing calculations. We are doing confirmatory calculations.

As long as I have been at the NRC, I have never seen us license a plant on the basis of our calculations. We license on the basis of calculations submitted by the licensee or the applicant, but we do perform calculations on our own to confirm or to satisfy ourselves that what we are seeing is proper, correct.

DR. RANSOM: Although that implies that you would use it, I guess, to sort of address the uncertainty involved in the calculation.

MR. LANDRY: Well, it gives us a feel for the calculation. Is the calculation in the ball park? We don't try to assess uncertainty by comparing our calculation with a calculation of a vendor, an applicant, or a licensee.

DR. UHLE: But, certainly, when the calculations differ, we focus in on those areas and try to figure out why and understand that, such that we're confident that there is nothing in the licensee's code that is making the answer wrong.

DR. RANSOM: Well, that partly answers my question, I think, but I was also interested in how you would judge the uncertainty involved in a vendor's calculation now, whether you look just at what he has done in terms of comparing it to data, his own code, or whether the NRC itself has some idea of what the uncertainty is in a calculation of this type.

DR. UHLE: I mean, each methodology, if it's a best estimate methodology, that is the only type, obviously, that requires a quantification of uncertainty. When it is submitted, the whole methodology is submitted for review, and in that methodology is their method for quantifying the uncertainty. That approach gets reviewed and, if applicable, gets approved. Then they use that, and that is their quantification of uncertainty.

The next slide here, as far as documentation requirements, this is probably part of the rule that the Committee may or may not be familiar with. This is more into the housekeeping. But the documentation requirements for the less-than-TBS range is going to be maintained the same as required in 50.46, and they are specified in Appendix K, Part II. It's indicating that really sufficient to demonstrate with high probability the performance criteria would not be exceeded. The performance criteria, of course, are the 2200, 17 percent, 1 percent, coolable geometry, long-term cooling.

What this is saying really is that, when submitting a methodology for review, NRC has to have in front of it, in front of the reviewer, adequate documentation so that we understand the code, what's in it. So that when we do our review, we are as cognizant of the code as possible.

DR. WALLIS: There's no requirement that the laws of physics be obeyed by the code?

(Laughter.)

DR. UHLE: No. That's a whole different ACRS meeting, if you want to go there, and I know that you like to go there.

(Laughter.)

But, hopefully, today we're not.

DR. WALLIS: Well, we usually assume that if you do follow good engineering practice and try to obey the laws of physics, then this probability will be high; it will be higher than if you don't.

DR. UHLE: Yes.

DR. WALLIS: So I understand the purpose.

DR. APOSTOLAKIS: So high we don't --

DR. UHLE: High? Where is high, high probability? The words "high probability" are specified in 50.46 currently. In the Regulatory Guide is where it is defined. When we say that you have to have high --

DR. APOSTOLAKIS: How much was it? Do you remember? I don't.

DR. UHLE: Ninety-five.

DR. APOSTOLAKIS: So you don't require, then, a high probability for breaks greater than TBS?

DR. UHLE: What we're saying here is that we want sufficient, and we will then quantify that in the Regulatory Guide.

DR. APOSTOLAKIS: But there is a quantification requirement even for those breaks?

DR. UHLE: This is the documentation. At this point it is saying the code documentation is sufficient to demonstrate that the performance criteria would not be exceeded. All right --

DR. APOSTOLAKIS: Go ahead. Sorry.

DR. UHLE: Okay. So, again, what we're talking about here is the amount of documentation as far as the theory manual and the level of review. What this is getting to is the level of review that would be required for a greater-than-TBS methodology would in some way be less than the small break --

DR. WALLIS: So with any probability now? You've taken out the words "high probability"?

DR. UHLE: Yes. We're taking out the words "high probability," and what we would require will be specified in the Regulatory Guide that we will develop.

DR. APOSTOLAKIS: Now this morning you were here --

DR. UHLE: Yes.

DR. APOSTOLAKIS: -- and we heard several times the discussion about cumulative risk increases, calculating changes in risk. If a licensee proposes a change under the new rule and calculates --

DR. UHLE: See, I know where you're going and I'm getting nervous, but go ahead.

(Laughter.)

DR. APOSTOLAKIS: -- and proposes a change, now is one of these or both probabilities of exceeding the criteria going to be affected? Or are these cast in stone? I mean let's say -- I don't know -- the power uprate, right, because that's one that will change and a change in the various factors and all that. You are changing these probabilities, I suppose, aren't you? The probability of exceeding or not exceeding the limits?

DR. UHLE: Yes.

DR. APOSTOLAKIS: You are changing those?

DR. UHLE: Yes.

DR. APOSTOLAKIS: But these probabilities will not appear in a 1.174 evaluation because they are not in the PRA.

DR. UHLE: Only if the success criteria is changed will the impact of the power uprate be exhibited in the PRA. Would you say that, Mark? Is that a good way to say that?

DR. APOSTOLAKIS: But we don't put those in the PRA.

DR. UHLE: The PRA, I mean if they were to uprate power and to keep the core below 2200, they had to have both trains of low pressure injection working; then that's going to show up in the success criteria and you would get a delta CDF difference. You would get a quantifiable value in your PRA. If they increase it just a little bit, such that the success criteria stays the same in the PRA, there's going to be nothing.

DR. APOSTOLAKIS: No, but, you see, that's the thing now. We're mixing two worlds, the deterministic and the probabilistic.

DR. UHLE: Yes. Yes, risk-informed, right?

DR. APOSTOLAKIS: Let's say the probability of not exceeding these was .96.

DR. UHLE: Uh-hum.

DR. APOSTOLAKIS: Then I make a change, and now that probability becomes .9. I don't know what that tells me about using two trains or one. I mean this is a probability calculation. It becomes .9. So I have had the change now from .96 to .9, and I still can work with the number of trains that the NRC has already approved. It's not that I have a major change that says, boy, you really need both trains now. There is a certain probability.

There is a change in probability which, as far as I know, doesn't appear in any PRA because it's outside.

DR. UHLE: Right.

DR. APOSTOLAKIS: So when I go to 1.174 --

DR. UHLE: You won't see it.

DR. APOSTOLAKIS: -- I will not have that then.

DR. UHLE: I agree.

DR. APOSTOLAKIS: But you are putting another requirement now. In the next slide you say, "but that probability should always be greater than .95." So now we are adding to 1.174?

DR. UHLE: I mean, the way we look at it here is you have the deterministic -- this is the deterministic calculation, and I skipped this slide and I apologize for that. I didn't mean to skip it. That is what the acceptance criteria is for the greater-than-TBS range.

DR. APOSTOLAKIS: But, Jennifer, I understand where you're coming from.

DR. UHLE: Okay, okay.

DR. APOSTOLAKIS: And I understand that it is a deterministic --

DR. UHLE: And there's going to be a less -- I mean right now it's a 95/95, typically is what's used.

DR. APOSTOLAKIS: Right.

DR. UHLE: Or at least a 95 is specified in the Reg Guide, the 95th percentile. In the Appendix K it's a conservative approach, so it's almost saying that we're almost 100 percent sure that you're going to be below 2200.

In the greater-than-TBS range, if they were to use the same best estimate approach, we would probably be inclined to relax the percentile and perhaps go down to 75 percent. And, yes, that says to us deterministically that there is perhaps a 25 percent chance that, if you were to calculate another run, you would see that the hot pin did exceed 2200. Okay?

DR. APOSTOLAKIS: Uh-hum.

DR. UHLE: So, yes, that's saying that we have less confidence that the success criteria will be met, and this is not reflected in the PRA.

DR. WALLIS: I don't understand why it's not.

DR. UHLE: Hold on.

DR. WALLIS: I don't understand why it's not.

DR. UHLE: Okay, hold on. Wait. No, no. Can I answer? Wait a minute.

DR. WALLIS: Yes.

DR. UHLE: But I want to point out that the PRAs are not that precise. The success criteria in the PRAs are not derived using the licensing basis tools, and in a PRA sense the success criteria, whenever they exceed I think it's 1600, they say, "Oops, core damage." So they're not using this and putting it into the PRA.

So you could say that the precision in the PRA accommodates this concern, that there's enough slack in the success criteria of the PRA that the risk wouldn't actually be shown to increase.

DR. APOSTOLAKIS: No, I agree with you. I agree with you, but --

DR. UHLE: And Mark is behind there and I don't want to speak --

MR. ROSEN: The margin in the PRA success criteria, whatever it was you just called it --

DR. UHLE: Mark, do you want respond?

MR. RUBIN: Well, Jennifer is absolutely correct.

DR. UHLE: I usually am.

(Laughter.)

MR. RUBIN: Naturally. So I can just sit down now.

MR. ROSEN: And if you're not, you're

still just as sure of it.

(Laughter.)

MR. RUBIN: I would just observe that the calculation she is talking about here would be success in a PRA. There's not a step change between just barely meeting or not meeting her relaxed acceptance criteria and failure of the bottom head of the vessel.

DR. APOSTOLAKIS: But that was exactly my point. This morning we're discussing delta CDFs, keeping track of the delta CDFs, keeping track of the cumulative change, and all that. And my point was that we can't do that because we are not quantifying the change, and you guys are confirming this now. You are saying all this is done somewhere else in the rarefied deterministic world where we know for sure what things are going to happen. But that is not taken back into the PRA. That's what Jennifer said; that's what you confirm.

Now I'm wondering where 1.174 comes into this. If the change is in place that is not in the PRA, even though there are some probabilities that have changed, I don't know how I'm going to make a calculation, I mean decisions, using 1.174, because all I did is change the margin here. From .96, I went to .9. But the PRA doesn't care because in the PRA the deterministic success rate here has not changed.

Unless I change this dramatically, the PRA guys will not see any input because they take the success criteria as given, cast in stone, and that's it. Whether there's a probability of exceeding the thresholds of the criteria, they don't care about that.

DR. WALLIS: It should be in the PRA.

DR. APOSTOLAKIS: It should be in the PRA. That is what I'm saying.

DR. WALLIS: It should be in the PRA.

DR. APOSTOLAKIS: But right now it is not. And all this discussion this morning about delta CDFs and delta LERFs and cumulative risk changes, and all that, that we'll make decisions, we'll evaluate what the licensee submits using 1.174, I don't think you can do that.

CHAIRMAN SHACK: It's even more difficult, George, because you have a probability of violating acceptance criteria, but you are really interested in the probability of damage.

DR. APOSTOLAKIS: That's correct.

CHAIRMAN SHACK: And your acceptance criteria typically is set far enough from your probability of damage --

MR. SIEBER: With margin.

MR. RUBIN: And so will the revised acceptance the criteria. You would still have PRA success, and where we would be able to assess the impact using a 1.174 approach is where, as Dr. Sheron pointed out at the very beginning. The changes to the plant push into areas where, as Jennifer pointed out again, that the success criteria changes, so that you need two out of two trains.

The PRA will model the changes plus the timing changes for the HRA actions, and you will see an actual risk impact based on the unavailability -- it's just a straight Boolean -- unavailability of one or two trains. So you can calculate it. If you push it far enough to change the acceptance criteria, the risk calculation will fall out of the process. Here you're getting a little less confidence of meeting what were originally very conservative acceptance criteria for large break LOCA. There may be slightly more oxidation, maybe some clad perforation.

But in PRA it is severe accidents-based. You have a coolable geometry. You have an intact vessel. It may be a slower reflood, but you have success in risk-based.

DR. APOSTOLAKIS: So these changes here,

if they are reasonably small, are already acceptable because we know that the margin is very large? They are not subjected to any 1.174 criteria or anything else. This is a different regime?

MR. RUBIN: It's a different regime.

DR. APOSTOLAKIS: That's what you're saying. Unless the change is so dramatic that the success criteria in the PRA are affected --

MR. RUBIN: Yes, sir.

DR. APOSTOLAKIS: -- in which case the redundancy is the factor.

MR. RUBIN: Right.

DR. WALLIS: There must be an intersection somewhere. I mean, if you reduce your probability of success here to 30 percent or some value, it begins to affect the PRA, but I don't know where that is.

DR. APOSTOLAKIS: It has to be dramatic enough to change the success rate here.

DR. WALLIS: Well, I don't know how dramatic it has to be. You're saying you want to reduce it from, say, 95 percent to 70 percent, I think is mentioned in the documentation. And I don't know whether 70 percent is a big enough dramatic change to affect the PRA or not.

DR. APOSTOLAKIS: I don't know either. I

don't know either, but the argument that these guys are --

DR. WALLIS: But I think you need to make the connection --

DR. APOSTOLAKIS: -- advancing is that this is large enough --

DR. WALLIS: But you need to make the connection. You need to tell us that, if I had reduced it to 50 percent, then it would have affected it.

DR. APOSTOLAKIS: It would be nice to have that.

DR. WALLIS: I would like to know that because, otherwise, it's all words. You say it's not big enough, so it's all right.

DR. APOSTOLAKIS: But, remember now, they are only looking, as far as I understand in the calculations, that the uncertainties in the calculation are sound. I think Bill alluded to that. There are uncertainties also in the 2200 and the 17 percent.

DR. UHLE: Right, yes.

DR. APOSTOLAKIS: These are very conservatively chosen.

DR. WALLIS: But if you look at the

outputs from LOCAs, you could say, gee, we want a 70 percent assurance if 2200, and if you run a hundred runs, you're going to get some where it goes up to 2500 or 2600.

DR. APOSTOLAKIS: Right, but what I'm saying is even the 2200 is not the actual damaged --

DR. WALLIS: That's right, but there will be some that go up to 2600. Now how much can we tolerate going up, creeping up to higher and higher temperatures?

DR. APOSTOLAKIS: The argument right now is that this probability is very low.

DR. WALLIS: But that's just a word.

DR. APOSTOLAKIS: If it becomes a little bit larger, it's still very low.

DR. WALLIS: That's words, George; it doesn't mean anything to me.

DR. UHLE: Words don't mean anything to you?

(Laughter.)

DR. APOSTOLAKIS: On the other hand, you know, that's how you build systems. It would be nice to have that, though. I'm not objecting.

DR. WALLIS: Is it nice or is it something essential?

DR. APOSTOLAKIS: I don't know about essential, because it depends very much on what the margins are here, and the margins are pretty large.

DR. UHLE: I mean, at this point the way we look at it is that you have a deterministic calculation. So if a licensee wanted to uprate power, and they're shown that their non-safety systems are highly reliable and they're only going to run with all trains injecting, you know, they may be able to uprate power at 10-20 percent, and they do that, and they meet it deterministically. Okay?

All right, is that enough? Is industry happy with that? Well, no, not really, because there is a probability that all trains of the LPSI won't be available. So then in the risk evaluation that's where that is going to pop out. If the risk is shown to not meet the success criteria in the risk standpoint, then the uprate wouldn't be allowed.

So, again, it's a blending. It is a backstop. There is a risk backstop to what they are proposing here, but then there is also a deterministic backstop for the risk because there are chances that what they are proposing to do doesn't affect the success criteria and the risk calculation. Again, the risk calculations are much, the success criteria are much broader than -- again, above 1500, that's core damage. So there's margin there.

I mean there is this concept of exactly what is the probability of exceeding or getting core melt or breaching the vessel. I mean that's been generally unquantifiable. It is a matter of engineering judgment that we're comfortable with the safety of the system.

DR. APOSTOLAKIS: No, I'm not disputing what you're saying. I mean you're stating facts. What I'm saying is or pointing out is that there seem to be two separate --

DR. UHLE: Yes.

DR. APOSTOLAKIS: -- regimes right now --

DR. UHLE: Yes.

DR. APOSTOLAKIS: -- where we do certain things here --

DR. UHLE: Uh-hum

DR. APOSTOLAKIS: -- and then other things in the PRA.

DR. UHLE: Right.

DR. APOSTOLAKIS: But at which point, as Professor Wallis just said, at which point significant changes on the right affect changes on the left we don't know.

DR. UHLE: Right.

DR. WALLIS: Why don't you risk-inform these acceptance criteria?

DR. KRESS: This is the whole argument that we've had for years about the connection between design-basis-based and risk-based. You're not going to make it. I guarantee there's no way to make this connection. You just have to have a faith that your design-basis-based renders the risk to the right level.

DR. APOSTOLAKIS: Yes, but why can't I make it? I mean, they just told me --

DR. KRESS: You can only make it in this sense: The design-basis-based results in some sort of a design and operation mode of a reactor. Then you can take that and put it in your PRA and see whether your risk is acceptable with the probabilities. That's the connection; it's the PRA.

There is no way to say, all right, if I change design-basis-based a little bit, what does it do to my PRA? You just can't do that, unless it changes the design of the plants somewhat.

DR. APOSTOLAKIS: We're talking about different things, I think.

DR. KRESS: It either has to change the

design of the plan or the success criteria. That's the only way; that's the only connection.

DR. APOSTOLAKIS: There is a probability that I will violate these criteria.

DR. KRESS: I know, but these are arbitrary choices.

DR. APOSTOLAKIS: I know. Now if I had distributions on the righthand side for the degrees that it will take to create the damage, and so on, then I could do it. But right now these are fairly arbitrarily set up --

DR. KRESS: That's right, and that's the nature of design-basis-based. I don't see any way we're ever going to make a direct route between these --

DR. APOSTOLAKIS: But you were raising the question this morning about cumulative risk. So you're talking only about when something dramatic happens here, so the redundance is changed --

DR. KRESS: So that it affects anything in the PRA. I'm assuming that the PRA is a realistic representation of risk. If the design change or the operational change, changed flow rates or power, or whatever, affects my PRA, then I'm going to capture it in the PRA.

DR. APOSTOLAKIS: What doesn't this affect your PRA?

DR. KRESS: It might.

DR. APOSTOLAKIS: It affects the success criteria.

DR. KRESS: It may if it affects the success criteria.

DR. APOSTOLAKIS: Yes, yes.

DR. KRESS: But you have to look.

DR. APOSTOLAKIS: All I'm saying is that --

DR. KRESS: We have to look at that.

DR. APOSTOLAKIS: Yes. That's all I'm saying.

DR. KRESS: I mean, when you make a change, you have to say, does this affect my success criteria or does it affect any of the reliabilities or does it affect the frequencies? You have to look at that.

DR. APOSTOLAKIS: But, you see, the success rates in and of themselves are --

DR. KRESS: They are pretty broad, yes.

DR. WALLIS: Well, how about the thermal-hydraulic codes? This licensee now is allowed to submit a methodology; submits a new thermal-hydraulic code. This has no affect on the PRA at all?

DR. UHLE: No.

DR. WALLIS: That's crazy.

DR. UHLE: If this new methodology were to be very, very accurate and the uncertainty was very low, and that allowed them to uprate power more than they could have or take out a pump or something, the success criteria on the PRA side with the uprate in power would, of course, change. The success criteria is not usually --

DR. WALLIS: I understand -- the issue is, do you melt the fuel?

DR. UHLE: Right, but --

DR. WALLIS: It seems to me there's got to be something in the PRA and something in the acceptance criteria --

DR. UHLE: Right.

DR. WALLIS: -- which are reasonably congruent about answering the question, do you melt the fuel?

DR. UHLE: Right, and when you propose to change the plant design, you've uprated power. In a deterministic way, I'm using, say, I'll use the code TRACE as the example, as the best estimate code. That shows that you are below 2200 and you're fine, and you can uprate the power by, say, 20 percent or whatever, or 10 percent.

Then you change your plant. You go and you update your PRA, and you are using a different tool to generate your success criteria. Now there are requirements or the PRA focus as far as the quality of the PRA and are the success criteria valid, but, in general, they'll run and they'll say, well, now, at this power uprate I need to have both my LPSIs working.

DR. WALLIS: Well, what does the PRA say about the thermal-hydraulic predictions? It must be there somewhere.

DR. UHLE: It's reflected in the success criteria. How many pumps do I need to have --

DR. WALLIS: How many pumps has nothing to do with whether or not the thermal-hydraulics is working out until the temperature--

DR. UHLE: Yes, yes, it does, because they've run --

MR. ROSEN: That's the way it's done now.

DR. APOSTOLAKIS: Well, that's the issue I raised.

DR. WALLIS: It's not a good way to do a PRA.

DR. APOSTOLAKIS: There should be a margin quantification.

MR. ROSEN: No, what the PRA success criteria say is that, for example, with respect to the 2200, they derated that, and the 1600 number you used before is pretty good.

DR. UHLE: Yes.

MR. ROSEN: Say, if the success criteria, if under this circumstance or this set of circumstances we don't go above 1600, we'll consider that success. Okay, now what do we have? What options have we got to hold the plant under 1600? Well, we've got this set of pumps, three pumps, let's say. Any two of them will keep it under 1600. So, therefore, our success criteria is having two out of three pumps available.

DR. WALLIS: The 1600 is predicted from the same thermal-hydraulic --

DR. UHLE: No, no.

MR. ROSEN: No.

DR. UHLE: It's different.

MR. ROSEN: Typically, it's much more simplified and conservative.

DR. UHLE: Right.

DR. APOSTOLAKIS: It's not a core damage

frequency. It is the frequency of exceeding the criteria that have been imposed. That's really what it is. It's not a core damage frequency for calculating --

DR. WALLIS: Let me suggest that if the PRA had the proper thermal-hydraulics in it --

DR. UHLE: Then we wouldn't need it.

DR. WALLIS: -- you wouldn't need this stuff at all.

DR. UHLE: Exactly, exactly.

DR. WALLIS: We wouldn't need this stuff at all.

DR. UHLE: I agree.

DR. WALLIS: That's the way it should go.

DR. UHLE: It's not there.

DR. APOSTOLAKIS: Or if these guys had the proper PRA, we wouldn't need the PRA.

(Laughter)

DR. UHLE: Yes, it's the PRA guys' fault.

MR. ROSEN: If the fuel guys are as conservative as the PRA people.

(Laughter.)

DR. UHLE: That's right, but I mean your concern is one actually between SPSB -- that's the PRA branch -- and Reactor Systems. We talk about that:

Is your success criteria valid? This goes back and forth, and I think the answer is looking at the PRA quality initiative and making sure the success criteria is, in fact, valid enough for the application.

DR. APOSTOLAKIS: This issue will come back as we review the framework for future licensing for reactors because the uncertainties there are much larger. You see, you have started already with what is a design basis. So everybody is comfortable with that. Twenty-two hundred, 17 percent, 1 percent, great; don't ask about success criteria; this came down from the mountain.

(Laughter.)

But now in future reactors you don't have these. Now you have huge model uncertainties all over the place.

DR. KRESS: Now don't be too sure, George.

DR. APOSTOLAKIS: What?

DR. KRESS: Don't be too sure. The framework document is proposing a set of design-basis accidents.

DR. APOSTOLAKIS: Not yet.

DR. KRESS: Oh, yes. Oh, yes, they are.

DR. APOSTOLAKIS: No, no.

DR. KRESS: They certainly are. Yes, you had better read that more carefully.

MR. SIEBER: But this situation is not unique to Appendix K or 50.46. PRAs have success criteria that are digital, that are either you made it or you didn't.

MR. ROSEN: That's exactly right.

MR. SIEBER: And you have to change the whole concept of how you're going to do that if you take this uncertainty that meeting a given success criteria will result in a good thing, if you know what I mean. You know, the closer your calculated number gets to the limit, the more uncertain you are that you are successful, but that's not taken into account in the PRA. You either make it or you don't.

MR. ROSEN: We don't have probability distributions on success criteria. We do not.

DR. KRESS: That's because you overwhelm the uncertainties with the two train versus three trains.

MR. SIEBER: That's right.

DR. KRESS: It just overwhelms the uncertainties.

MR. SIEBER: That's right.

DR. WALLIS: You are just reinforcing my

view that you shouldn't really have design-basis accidents with separate acceptance criteria. You should have a really good thermal-hydraulic model of uncertainties put into the PRA and make decisions based on that.

DR. KRESS: Yes, and if you did that, you would put uncertainties on these success criteria, and that's where it would show up.

DR. WALLIS: Yes, but they would be realistic acceptance criteria.

MR. ROSEN: Now you're talking like a real rationalist.

DR. APOSTOLAKIS: Why do you guys say that the framework has designed-basis accidents? They just say that between --

DR. KRESS: No, no, it's important.

DR. APOSTOLAKIS: -- ten to the minus three or ten to minus five, we will define the DBAs, but they can define them.

DR. KRESS: I know, but that is a way to define them.

DR. APOSTOLAKIS: No, they take a frequency -- yes, there are consequences, and they disarrange the whole DBAs.

DR. KRESS: You could have determined

these --

DR. APOSTOLAKIS: But they don't tell you what they are.

DR. KRESS: No, no. Oh, no. That's right. But they're going to have them. They're going to have them.

DR. APOSTOLAKIS: That's where the action is, yes.

DR. BONACA: You mean they're going to choose them in a different way than in the past.

CHAIRMAN SHACK: We had better get off the advanced reactor framework and back to 50.46.

(Laughter.)

DR. UHLE: No, I'm very comfortable just sitting here listening.

CHAIRMAN SHACK: Onward.

MR. SIEBER: Why don't you move us ahead?

DR. UHLE: All right. Speaking of moving ahead, although we're still back on success criteria, again, it is staying the same for the less-than-break size and the greater-than-break size. This is we're going to be less proscriptive. When we say "coolable geometry," coolable geometry was really specified with the 2200/17 percent.

At this point in time NRC doesn't have any more information in front of it to say that we're going to increase or decrease these values in any way. So in the Reg Guide we will say that, unless the licensee were to present data and substantiate why they could increase the value of 2200 and 17 percent, we're going to stick to 2200 and 17 percent.

Now there is fuels research going on. Ralph Meyers in the back --

DR. WALLIS: Wait a minute. When does this business later on come about? There's no need to report until your PCT is 300 degrees --

DR. UHLE: Yes, yes, I'm getting there.

DR. WALLIS: You are going to get there?

DR. UHLE: Yes, I will get there.

DR. WALLIS: Because that is a tough change. Are you going to get there?

DR. UHLE: I promise. I promise.

DR. WALLIS: I couldn't understand how you were going to stick to 2200 and yet let them not report until they went 300 degrees above that.

DR. UHLE: Because it's not as bad as it sounds on that page, but I guess we're moving on because you're okay with -- or you're at least aware of what we mean by coolable geometry.

DR. WALLIS: We won't really know what you mean until we get the Reg Guide in June.

DR. UHLE: What we mean right now is 2200/17 percent.

Okay, documentation, we talked about that. That's, again, talking --

DR. WALLIS: You flipped over something that said "50 degrees"?

CHAIRMAN SHACK: You've flipped over the preliminary analytical results.

DR. UHLE: Yes, yes. That's because Research had asked politely if I could take the slide out, and I'm sorry, Norm, I forgot to do it. That's my fault, all right?

(Laughter.)

So, yes, we have done some preliminary calculations

CHAIRMAN SHACK: Threw a little blood in the water.

DR. UHLE: Yes, there we go. That's all I'm saying.

Because this is the question that you had, reporting requirements. Right now in the Reg it says that, okay, a licensee has got an analysis of record. That's in its FSAR.

DR. WALLIS: That's a minus delta PCT?

DR. UHLE: No. No, no, no, that's a bullet.

DR. WALLIS: Oh.

MR. SIEBER: It's a long bullet.

DR. UHLE: Yes, it's an improper use of a bullet. I apologize.

CHAIRMAN SHACK: It's an EN dash.

DR. UHLE: It's Ralph's fault.

(Laughter.)

Okay, at any rate, back to this. The analysis of record is what's in the FSAR. It has been reviewed and approved by NRC. It is the licensing view of what the peak clad temperature is of the plant if a limiting break were to occur.

However, licensees do things on a cycle-specific basis. They change their peaking factors; perhaps a pump derates. There's some other configuration changes. They are allowed to make those changes. They don't have to come in every day and report to the NRC what the PCT is. Again, the calculations are quite onerous, and that's a little too burdensome. That wasn't defined to be necessary to ensure safety.

So a licensee is allowed to change things in the plant without telling NRC up to 50 degrees.

Now that's an absolute value. So if they are to find an error in their code and they are to change it, and it actually decreases the PCT, well, they can do that and not reanalyze, provided it's not up to 50 degrees.

Every year, annually, they report these changes.

DR. WALLIS: That's 50 degrees from some acceptable --

DR. UHLE: From the analysis of record. So if they're down at 1200, they can only go --

DR. WALLIS: So it's not a cumulative thing? You can't keep getting it? You can't keep getting 50 degrees?

DR. UHLE: No, that's right. It's just from your analysis of record.

CHAIRMAN SHACK: And it's plus or minus.

DR. UHLE: Plus or minus, yes.

CHAIRMAN SHACK: If you go to 1150, if you're at 1200, you have to report it.

DR. UHLE: Yes, and if you've got an error in your code and it decreases PCT to 25, and then you have a change, and so you want to increase your peaking factor a bit, and that goes up to plus 25, you've got to report. Or "26" I should say because it's greater than 50 degrees, because it's the absolute value.

What it is saying here, what it is doing, is that we need to know -- we want the analysis of record to reflect the plant. It is not talking about, are you close to 2200? It is simply saying, "I have an analysis of record that reflects the plant." NRC and the public knows what the PCT of that plant is. So when it starts to deviate too far from the plant, we want a new reanalysis, and NRC would review and approve that analysis to re-baseline.

So there's also a requirement in the Reg that a licensee keeps track of where they are with respect to the acceptance criteria. So, again, during this time, if this plant was at 2190 and it had an error in the code and they changed and estimated, and that was over 2200 or exceeded 17 percent oxidation, they have to come in to NRC immediately. So there's always this focus on, make sure you're meeting the acceptance criteria. However, the analysis is only required -- they have to contact us in 30 days if it's 50 degrees. Otherwise, they have to contact us --

DR. WALLIS: So there's no requirement -- only on delta PCT if it's over 2200?

DR. UHLE: Right, right.

DR. WALLIS: Even if it's a delta of one, they still have to report it?

DR. UHLE: Yes, right.

DR. WALLIS: Okay.

DR. UHLE: And the other acceptance criteria, that goes back to the sump, the sump of long-term cooling. They would have to contact NRC. That's the regulatory connection there, where anything in the ECCS acceptance criteria, if anytime during the cycle they think they are violating the success criteria, they have to come in to contact immediately.

DR. BONACA: Supposedly, if you have a small increase that's below 50 degrees and that adds up to over 50 degrees, then --

DR. UHLE: Yes, then they have to come in within 30 days and schedule a reanalysis.

DR. APOSTOLAKIS: What is the typical peak cladding temperature that is calculated?

DR. UHLE: Typical?

DR. APOSTOLAKIS: Yes.

DR. UHLE: I mean it ranges. I mean there are some plants that are up at 21-something. There are some plants that are at 19.

MR. ROSEN: For large-break LOCA.

DR. UHLE: Yes. It's a range.

DR. APOSTOLAKIS: So a plant that is at

21 --

DR. UHLE: Has 50 degrees.

DR. APOSTOLAKIS: Has 50 degrees?

DR. UHLE: Yes.

DR. APOSTOLAKIS: And we still believe there is a high probability that there will be no damage?

DR. UHLE: Yes.

MR. ROSEN: But that plant that is at 2100, say, for peak clad temperature for the large-break LOCA may be down at 1500 for the small-break LOCA.

DR. UHLE: Uh-hum.

MR. SIEBER: The big differential for large-break LOCAs is between boilers and pressurized water reactors. Boilers typically have lower temperatures.

DR. UHLE: Right.

MR. SIEBER: You know, 2200 is not a real number. That number is probably 2300 or something like that. There's margins put in there. During the ECCS hearings I think --

DR. APOSTOLAKIS: I'm a little surprised that, even if the margin is 200 degrees and you take away -- I mean, you can do things without reporting up to one-quarter of that.

DR. UHLE: Uh-hum.

MR. SIEBER: That's interesting.

DR. UHLE: It's a deterministic idea.

DR. APOSTOLAKIS: It's still the probability is assumed to be very low.

CHAIRMAN SHACK: Below the acceptance limit, the licensee owns it.

DR. UHLE: Yes.

DR. WALLIS: It's not just deterministic because you can --

DR. APOSTOLAKIS: No, not completely because he does not report it.

DR. WALLIS: It's large-break LOCA with realistic calculations plus uncertainty, and you can submit all of the runs, and some of the runs can be above 2200 as long as your 95th percentile is below 2200. So some of them are going over at an absolute minimum.

DR. UHLE: I mean the analysis of record at this point, when they look at the 50 degrees, these are estimates. These can be estimated any way. It is not a reanalysis. They don't have to be running their full evaluation methodology to get the estimates. But as soon as they exceed 50 degrees, they come in and they contact NRC, schedule a reanalysis.

If this plant is closer to 2200, if the estimates were done with a random number generator, certainly we're going to want the reanalysis a heck of a lot faster than if the plant was sitting down at 1700 and the estimates were generated with an approved methodology. So that's where that works out.

But what we're proposing to add, so when we talked about increasing safety or enhancing safety, is this rule, 54.6 was promulgated back when everyone was focused on large breaks and we had talked about how the local oxidation was primarily a function of temperature in a large-break scenario. What we are adding is a reporting requirement on localized oxidation. So the acceptance criteria is 17 percent, and since we're saying that the more the risk is associated with small breaks, then plants would be able to uprate power perhaps more than they would otherwise.

We are proposing to add a reporting requirement on oxidation, so that they have to keep track of their oxidation. We did the same fraction; the 50 degrees out of 2200 is equivalent to --

DR. WALLIS: That is ludicrous. I mean you know that the zero of temperature is arbitrary, and to take 2200 as being a number that means anything, I think that they --

DR. UHLE: We got that comment.

(Laughter.)

DR. WALLIS: You got that comment from NEI rather than from a professor, but I mean it seems extraordinary. Why don't we use degrees Rankine or something?

(Laughter.)

What really matters is the range of temperature you're interested in.

DR. UHLE: This is what it is at this point. We're looking at public comments.

DR. WALLIS: But you went to MIT and you did this?

(Laughter.)

DR. APOSTOLAKIS: She got her humility at MIT.

DR. UHLE: I got my what?

MR. ROSEN: She didn't get a whole lot of it.

(Laughter.)

DR. UHLE: A whole lot of humility. I was a lot worse before I went there.

This is Ralph's fault. See, he didn't go to MIT. He went to Purdue.

DR. APOSTOLAKIS: I get mixed messages here. On the one hand, I'm told that the 2200 and the others are very conservative and the margins are large, a very high probability we will not go over. Then somebody says, "Well, gee, for some reactors the calculations are close to 2100." Then Jack says, "Well, really a failure may occur at 2300." And, yet, the probability is very large that we will not exceed those things, right? There will be no damage. I don't understand that.

And then for 50 degrees change, you can go to 2150 and still the probability is large you're not going to exceed it; don't even report it. All these things, it seems to me, are very confusing.

DR. WALLIS: That's because nobody does quantify the margin. That's what it is.

DR. APOSTOLAKIS: Yes, but the argument, the underlying argument everywhere was not to quantify. I thought the difference was 500 degrees. That's conservative. That's high probability. So, gee, I shouldn't really talk.

CHAIRMAN SHACK: That's a different discussion, though, George.

DR. APOSTOLAKIS: It's a different

discussion? It's always different, though. When is it going to be discussed?

DR. WALLIS: Join the Thermal-Hydraulics Subcommittee.

CHAIRMAN SHACK: Join the Fuels Committee.

DR. APOSTOLAKIS: The Fuels Committee? No.

CHAIRMAN SHACK: Peak clad temperatures damage is really the fuels people.

DR. APOSTOLAKIS: You said that the licensee owns the margin? Not if you require a high probability on anything above. He doesn't own anything.

CHAIRMAN SHACK: In a deterministic world, you are either above or you're below. It's binary.

DR. APOSTOLAKIS: But you can't do anything you like with it. I remember Pietrangelo gave us a whole lecture on that three years ago, was it?

CHAIRMAN SHACK: Can we move on?

MR. SIEBER: You can spend margins.

DR. APOSTOLAKIS: Huh?

MR. SIEBER: You can spend your margin. Leave out the flow limiters. It changes your margin. It changes your PCT.

DR. APOSTOLAKIS: I just don't know how all these things are self-consistent.

DR. WALLIS: They're not.

DR. APOSTOLAKIS: I just don't know.

DR. WALLIS: They're not.

DR. APOSTOLAKIS: Anyway, you have one more slide, Jennifer. Do you intend to go there?

DR. UHLE: Unfortunately, I've got one more.

DR. WALLIS: You have to tell us about the 300.

DR. UHLE: Oh, I thought we were going to get past that.

DR. WALLIS: The 300, I mean you're worried about allowing 50. She's going to allow 300 change.

DR. UHLE: He just did my presentation.

DR. APOSTOLAKIS: Well, without reporting.

DR. UHLE: I'll go to the next slide now.

(Laughter.)

DR. APOSTOLAKIS: Because it is not design basis anymore.

DR. WALLIS: So if they were at 2150, they could go to 2450?

DR. UHLE: No, because as soon as they go over 2200, they've got to contact NRC right away.

DR. WALLIS: Oh, okay. Okay.

DR. UHLE: Okay, all right.

CHAIRMAN SHACK: If they're 17, they can go to 2000.

DR. APOSTOLAKIS: That applies to the 50 degrees, too, right, Jennifer?

DR. UHLE: Yes.

DR. APOSTOLAKIS: Jennifer?

DR. UHLE: Yes?

DR. APOSTOLAKIS: That applies to the 50 degrees as well, right? The moment you go above the criteria, you have --

DR. UHLE: Yes, yes, yes. That's in the rule. I mean it's just that you have to come in --

DR. APOSTOLAKIS: Yes, yes, okay.

DR. UHLE: I mean, as you soon as you see that, you've got to contact NRC immediately and take immediate action to come into compliance with 50.46. That's what the Reg says, which is, you know, what does that mean? Shut down I would think is the most severe interpretation of that or --

DR. APOSTOLAKIS: Is this, by the way, what you meant by inconsequential changes in risk?

DR. UHLE: No, that's tomorrow.

DR. APOSTOLAKIS: That's different?

DR. KRESS: The purpose of these numbers is just to be sure that they're not going well beyond their licensing agreement, that's all.

DR. UHLE: Yes, exactly.

DR. KRESS: They still have to meet all the criteria.

DR. UHLE: Yes.

DR. APOSTOLAKIS: Yes, but why 300 and not 600? I don't understand that.

DR. KRESS: Well, it's arbitrary almost. I mean --

CHAIRMAN SHACK: It's a rule.

DR. UHLE: It's a rule. It's arbitrary.

(Laughter.)

Don't say that.

DR. APOSTOLAKIS: Excuse me. After the rule is approved, then it's a rule. When it's a draft rule, you have to have an argument.

MR. SIEBER: These calculations are done when you're getting ready to refuel and you are doing your fuel pattern work. That's when you do your Appendix K analysis. The reactor is running on an analysis that was done at the previous refueling. So it isn't some big panic, like you're going to have shut down or something like that. Generally, what you do is you rearrange the fuel, put in additional burnable poisons, and balance out the flow structure with flow-limiting devices and unrodded locations or you do whatever you have to do.

The only time you get caught here is if somebody discovers an error in the code, and every year you have to report all the errors you find. You may find an error that will take you beyond the 50 degrees. I don't recall that ever happening, but it's possible.

CHAIRMAN SHACK: Well, this is a reporting requirement, George. Let's just keep things in focus here. It's not quite the substance of the rule.

DR. UHLE: Right, but if that error pushed you over to 2200 or any of the acceptance criteria, 17 percent, long-term cooling --

DR. APOSTOLAKIS: Actually, this really demonstrates how the staff used the difference between DBAs and other accidents. So it's important.

DR. UHLE: Yes, between here and here, yes.

DR. APOSTOLAKIS: It's really important. It's not just something to dismiss.

DR. WALLIS: Now you're not going to talk about the 20 percent on CDF; let someone else talk about it?

DR. UHLE: No, no, no.

DR. WALLIS: But it's also a reporting requirement.

DR. UHLE: That's Mark Rubin.

DR. APOSTOLAKIS: That's somebody else.

DR. WALLIS: Is that somehow related to this 300? Is 300 degrees concurrent with the 20 percent of the CDFs?

MR. ROSEN: Do you have any words to say about 300, Jennifer?

DR. UHLE: That I'm done talking about it.

MR. ROSEN: Done?

DR. UHLE: Yes.

MR. ROSEN: I didn't hear anything yet.

(Laughter.)

DR. UHLE: Dr. Wallis was gracious enough --

DR. WALLIS: Is there any rationale for 300?

DR. UHLE: Yes, it's greater than 50.

DR. WALLIS: Now come on. No, give us something better than that.

DR. UHLE: It was engineering judgment

that the staff who looked at this rule was comfortable with.

DR. WALLIS: Well, you can't concoct something other than just appealing to engineering judgment?

DR. UHLE: At this point in time --

DR. WALLIS: You can't invent something like probabilistic arguments or something?

DR. UHLE: But you wouldn't believe me anyway.

DR. WALLIS: Well, at least it gives some kind of rationale.

DR. UHLE: Okay, at this point we're going out for public comments. We're going out for public comment on what's offered by 300 degrees. I mean, in general, you can get 300 degrees by changing the draft size in your dispersed flow film boiling model. That's also an effect, that what does 300 degrees allow you to do? We were comfortable with 300 degrees.

DR. WALLIS: If you're going to go out for public comment, you can't just pull out a number. You've got to have some reason. Otherwise, your credibility is shot. They're just going to believe that the NRC grabs numbers out of the hat. You've got to have a reason.

DR. UHLE: I will take that into advisement, under advisement.

DR. WALLIS: Oh, come on. Be reasonable.

DR. UHLE: I'm telling you the truth, that it's greater than 50. Why is 50 selected?

DR. WALLIS: Okay, why is 50 selected?

DR. UHLE: Fifty was what was -- people were comfortable with 50.

MR. SIEBER: It's a nice number. That's all they had.

DR. WALLIS: That's how you do reactor safety, what someone's sort of comfortable with?

DR. UHLE: That's regulation, sure.

DR. SHERON: Graham, we started this back in the seventies when Long Tsen Tan picked 95/95 for DNBR. Okay? And the question is, why 95? Because somebody used it. Okay?

DR. WALLIS: But, see, the problem is --

MR. SIEBER: But this is a reporting requirement.

DR. WALLIS: -- you say you're comfortable. Why should I be comfortable with it? I mean you may be comfortable with anything you want to be, right, six mattresses on top of a pea, but I need to be made comfortable somehow.

MR. SIEBER: But it's just a reporting requirement.

DR. WALLIS: Explain to me why I should be comfortable.

DR. UHLE: This is what -- again, whenever they exceed the acceptance criteria, they have to report to NRC immediately and take action to come into compliance. What this is allowing them is to make changes to their plant without getting it reviewed and approved first. They come in annually -- hold on -- they come in annually and report these changes. So at that point in time NRC has the opportunity to take a look and see what they're doing and take action, if necessary.

MR. ROSEN: We understand all that.

DR. WALLIS: We understand all that.

DR. UHLE: Okay. So what you're saying is the 300 degrees. Three degrees is something we feel comfortable with that can happen before --

DR. WALLIS: We don't care about your comfort. I'm interested in my comfort.

MR. SIEBER: What are you comfortable with, Graham?

DR. WALLIS: I'm not comfortable with

anything unless there's a reason for it.

MR. ROSEN: Well, she can take it under advisement and let's move on, Graham. We're not going to get a better answer. So let's just move on.

DR. WALLIS: Okay, we'll move on, I guess. Well, I'm disgruntled.

(Laughter.)

DR. UHLE: Yes, we are used to that.

MR. ROSEN: Uh-oh. Uh-oh.

(Laughter.)

DR. UHLE: It's part of your charm.

MR. ROSEN: We're in trouble now.

DR. UHLE: It's part of your charm.

Okay, wait a minute, wrong direction. I don't want to go back there. We don't want to go back. No, we're going forward. Regulatory review, this has also been touched on, so I can go really fast.

We're going to be reviewing the evaluation models used in the greater-than-TBS range. We're going to be focusing on the models that are of extreme importance, and the scope and the breadth of the review would be less than what is used in the less-than-TBS, looking at the idea that the probability of this break is much smaller.

This doesn't necessarily mean a whole lot to you in a quantified sense. We will be putting this together in a Regulatory Guide, and of course you guys would --

DR. WALLIS: That doesn't change much. If you look at the sensitivity of peak clad temperatures, a whole lot of things, it really does depend only on a handful of them mostly, up to 90 percent or something.

DR. UHLE: Right.

DR. WALLIS: So concentrating on the most important parameter is a very reasonable thing to do.

DR. UHLE: Thank you.

DR. WALLIS: So I think you ought to present it that way, rather than some sort of arbitrary thing. Put it in a perspective.

DR. UHLE: I didn't say it was arbitrary.

DR. WALLIS: No, but give a reason.

DR. UHLE: On the Regulatory Guide? No, I said that we're focusing on the highly important phenomena.

DR. WALLIS: But, then, that implies that there are a few which are important, and then there is real evidence that if you look at how all these things affect PCT, there are a few which you must do.

DR. UHLE: Yes, right, dispersed flow film boiler in front of them.

DR. WALLIS: It's not just a judgment.

DR. UHLE: Level swell -- yes.

DR. APOSTOLAKIS: It's a different world.

DR. UHLE: Yes. We're in violent agreement. Okay, so we will be providing more details on what exactly we mean by this, what models we would be focused on in the Reg Guide that you will have the opportunity to see.

So that is the end of my presentation. I'm not sure if it is the end of Professor Wallis' presentation or not.

DR. APOSTOLAKIS: Now the reason why you keep some of these requirements for beyond the TBS region is because of tradition, isn't it? Historical --

DR. UHLE: I think it goes back to the uncertainty argument, the defense-in-depth argument. We have a break size that we're postulating, and we want to have extra assurance that if there was a break larger than this, that the core would stay in a coolable geometry and, therefore, containment would not be --

DR. APOSTOLAKIS: What would be so bad if you decided to take what you're proposing to do for the above-TBS breaks and did it everywhere? Why would you feel uncomfortable with that? Forget about the extra stuff you are putting for small breaks up to TBS.

DR. UHLE: It's a matter of, I mean, part of it goes back to the regulations saying "high probability." What we are proposing for the analysis in the greater-than-TBS is providing you with assurance that you're not exceeding the criteria and, therefore, not worrying about losing coolable geometry at a level --

DR. APOSTOLAKIS: But you would still do the --

DR. UHLE: -- that is less than at the less-than-TBS. It's boiling down to the level of assurance you have.

DR. SHERON: George, let me try it.

DR. APOSTOLAKIS: So it's a matter of confidence?

DR. UHLE: Yes.

DR. SHERON: There's nothing that says we couldn't have approached this the way you propose, which is to say, why put a TBS; why not just let people analyze the entire spectrum in the same way?

We had about six months to put this rule together. One of the groundrules we set when we started this was we were going to start with -- we weren't going to create any new information. We weren't going to develop any new information. We were going to have to do this with the information that was at hand, if we were going to make that kind of a schedule. The other thing we weren't going to do is plow any new ground from the standpoint of any areas that we felt would require a lot more defense, justification, evaluation, and analysis.

There's nothing that says down the road we couldn't go back and try and do more and ultimately come up with a rule change that did this, but we think that is a much longer-term effort. It is going to require more work, more justification. Looking at the questions we're getting here just on this, we would have to --

DR. APOSTOLAKIS: If some of the questions that Dr. Wallis has raised and some that I raised were answered in a reasonable manner, then it seems to me you wouldn't need TBS. You would do this for the whole spectrum. You would do a best estimate calculation, quantify the uncertainty, and judge whether you like it or not. I mean, if you want high probability, you will do that.

Why would you have to impose a single-failure criteria? Just to feel better? I mean you have the PRA to tell you what is going on there. That's classic PRA, in fact, because you are failing a particular component.

DR. SHERON: That's risk-based, not risk-informed.

DR. APOSTOLAKIS: Huh?

DR. SHERON: That's risk-based, not risk-informed.

DR. APOSTOLAKIS: Yes.

CHAIRMAN SHACK: If you really believe those frequencies, George --

DR. APOSTOLAKIS: What? No, excuse me, you can't say that. We are risk-informing everything. You can't put it down like that.

CHAIRMAN SHACK: Can I interrupt for a second? Tony Pietrangelo would like to say a few words, and he's going to leave before lunchtime.

DR. APOSTOLAKIS: Well, it's after lunch already.

CHAIRMAN SHACK: We'll break for lunch after Tony is done. So that will give you an incentive.

MR. PIETRANGELO: Dr. Shack, thank you very much. I had requested time yesterday with Michael to address the full Committee and then, to my chagrin, this morning learned that I will be out of town when the full Committee is here. So I really appreciate the opportunity to jump in here.

There's been one interaction with the staff and industry on this development of this rulemaking packet. That was in August, and the purpose of that meeting was to provide input to the regulatory analysis, both safety benefits and potential cost benefits of a revision to 50.46.

Since that meeting, from the first draft that was put out to the draft that came out in mid-October, we have seen some very positive changes in the package. For the first time that I think that I recall, safety benefits are mentioned in the Executive Summary. There had been no mention of safety benefits in any of the SECYs on this heretofore.

I think the staff listened at the August meeting. One of the questions that came up there was the applicability of the general design criteria to the beyond-design-basis reason. I think they took care of that in this latest package.

In the previous package you needed an

amendment request to do anything subsequent to a revised break size, and now there's some flexibility there to not have to come in with an amendment request for anything.

So those are all contextually very good changes and I think headed in the right direction. However --

(Laughter.

MR. ROSEN: Why was I expecting that?

MR. PIETRANGELO: Let's go back to what risk-informed regulation is supposed to do. By definition, it's supposed to focus resources and attention on things that are safety-significant. You use risk insight; you use operating experience and apply that in the regulation.

So when you are looking at this package, to me you need to ask yourselves, does this rule make me do that? The driver for this rule change was, in laymen's terms, big pipes don't break as often as little pipes. There was no probabilistic risk assessment used to support the technical basis for this rule change. It was operating experience. This is loosely based on the expert elicitation that's been conducted over the last several years. In fact, I think this rule could benefit more from the insights that came out of that expert elicitation than it currently does.

The 14 inches, one of the owners' groups has submitted comments to the staff. There may not be much difference in the benefit one can get from 14 times two than what they're currently limited by. That's a different issue than for today.

What this rule change does, for up to whatever the TBS is -- for today's discussion, 14 inches -- you do the exact same thing you're doing today, the same methodology, the same everything, the same acceptance criteria. Then from the transition break size up to the double-ended guillotine break of the largest pipe, you get to use something more realistic. That is, to me, what this rule should be focused on. That is what is different from what people are doing today.

That is why I asked Dr. Uhle to put up this last slide again. There's one paragraph in this rule that speaks to the difference between what you do today and what you will do up to 14 inches and what you will do differently for beyond the transition break size. The details are going to be left in the Regulatory Guide.

That is really what changes when 50.46 is revised. I think that is the key part of this rule --

DR. WALLIS: So, Tony, until we see the Reg Guide, we don't really know the implications of this.

MR. PIETRANGELO: No, no, no, that's not the point.

DR. WALLIS: No?

MR. PIETRANGELO: I don't argue with putting the details in the Regulatory Guide. That's perfectly fine. I think details should be kept in the Regulatory Guide.

DR. WALLIS: But they might turn out to be very restrictive.

MR. PIETRANGELO: Well, we'll comment on it. We will go through the regulatory process and do that, but we will wind up, hopefully, with something reasonable to do for that spectrum of breaks. I'm confident we will reach something.

DR. KRESS: Did I hear you say that the 14-inch size may not be that beneficial to the --

MR. PIETRANGELO: I think one of the owners' groups has submitted comments to that effect, the Westinghouse Owners' Group.

DR. KRESS: And probably if one made more use of the expert elicitation on frequencies, one could justify going to a smaller level?

MR. PIETRANGELO: I believe so.

DR. KRESS: But maybe not all the way down to six inches.

MR. PIETRANGELO: The SRM from the Commission said start at -- it didn't say "start at ten to the minus five." It said, "Take ten to the minus five," and, by the way, you still have to demonstrate mitigation capability all the way up. You could have just done that and said, as long as I'm demonstrating mitigation capability, all this other stuff, heavy load, seismic, the other uncertainties that are dealt with there, not use that as a starting point and then doubled it and then did it times two.

DR. APOSTOLAKIS: It seems to me that it's not just a matter of relying more on the expert judgment. An equally important element here which I think is what Tony is driving at is, what difference does it make to the safety of the plant if I keep the current requirements for sized breaks up to the TBS and I relax them in some way or change them beyond TBS? Does it make any difference? That was a question I asked Debbie O'Brien. What if you eliminated the TBS completely and you just did best estimate?

MR. PIETRANGELO: They could have done that, but they asked the Commission in their paper that they sent up in March whether there should be regulatory requirements up to the double-ended guillotine break, despite the low frequency, and the Commission said, yes, you should have regulatory requirements.

DR. APOSTOLAKIS: Yes.

MR. PIETRANGELO: So they're perfectly complying with what the Commission told them to do.

DR. APOSTOLAKIS: Okay.

MR. PIETRANGELO: As Dr. Sheron said earlier, this is supposed to be an enabling rule. It doesn't make any changes in and of itself. But what I think should occur is that you would have to come in and say, okay, here's my new evaluation methodology for the beyond-design-basis spectrum. By the way, the new design basis would be up to the TBS. Okay?

DR. APOSTOLAKIS: Uh-hum.

MR. PIETRANGELO: From the TBS to the double-ended guillotine break, it is not design basis anymore, but it is still part of your licensing basis because it's required by regulation.

That kind of leads me to my next point: How have we, as licensees and the industry and with the NRC, evaluated changes to our plant since we got licensed in regulatory space? We've used 50.59. It looks at increases in probability of consequences. We changed the rule in the late nineties and made those questions much more explicit. There's no reason why those questions aren't good for this.

Now when you consider that PRA wasn't even used as the basis for any of this and that it's not in our current licensing basis, why do I have to take another five pages of codifying what was in Reg Guide 1.174 and add a few more bells and whistles and now make that the basis for any change that I consider subsequent to that?

DR. APOSTOLAKIS: Are you saying it is redundant or it does harm?

MR. PIETRANGELO: I'm saying that it has nothing to do with the basis for this rulemaking.

DR. APOSTOLAKIS: So it's redundant.

MR. PIETRANGELO: Okay, and if you're going to make the kinds of changes that the staff -- like a power uprate, you are coming in with an amendment request, just like you do today for any other power uprate. There will be guidance developed on all the applications that stem from this new break size, particularly those that require NRC review and approval. Others are going to be very minimal. We can use the existing change control processes of the place. We can evaluate it to see maybe there is some other criteria we need to put in there that would address these kinds of things.

But if I was going to put what I thought was a key part of this, the details about my new ECCS analysis in a Reg Guide, I've already got all the risk stuff in a Reg Guide, Reg Guide 1.174, as well as specific other Reg Guides. Why am I going to drag all that stuff into this rule? There is nothing specific to redefinition of large break LOCA or a new break size, to any of that change control stuff that's in the back of this rule.

DR. WALLIS: Because, you see, the PRA doesn't capture these PCTs and things that Jennifer was talking about.

MR. PIETRANGELO: The PRA wasn't the basis for it.

DR. WALLIS: It wasn't.

MR. PIETRANGELO: Neither will the other --

DR. WALLIS: But that's the basis of 1.174.

MR. PIETRANGELO: Neither will the other

methodology. That's a thermal-hydraulic analysis. That is going to be the -- except it is going to be a little bit more realistic than the current one is.

DR. APOSTOLAKIS: Yes. Are we coming back to this issue of picking the 14 and 20? I would like to understand that a little better. Where are we on the schedule now?

CHAIRMAN SHACK: We've just finished the ECCS Analysis Requirements.

DR. APOSTOLAKIS: Three forty-five?

CHAIRMAN SHACK: Uh-hum.

DR. APOSTOLAKIS: Okay, so there is plenty of time.

MR. PIETRANGELO: Let me add one more thing.

DR. APOSTOLAKIS: Go ahead.

MR. PIETRANGELO: The policy on amendment request, let's say you only had to do both up to 14 and use your other evaluation methodology for beyond 14, and I didn't do any other risk stuff and I had an amendment request that was trying to change something. The current policy is the staff can ask you questions, if they think there is some risk-significant impact, on that amendment request, even though I meet my design basis and licensing basis requirements.

That's how power uprates are done. They are asking you all sorts of risk questions on power uprates, even though you are showing that you meet all your deterministic requirements, design basis and licensing basis. So that policy is already in play.

Again, I think this has been a major -- and when the Committee started this morning, you went right to the risk stuff, and you will do that again tomorrow. You have already done it. You have done it in 1.174. So why do it all over again? And it works. It has been practiced by the staff in hundreds of amendment requests. So I just don't see why there was a need to put all that stuff in here, and that the focus of this rulemaking should be on the analysis requirements for the beyond design basis up to the double-ended guillotine break. That would make it an enabling rule.

I think there's a lot of stuff that is in the current regulatory process. Look at it again to see if it is still sufficient, but that will address all the other potential changes that will come out of this.

So, again, I appreciate the opportunity to weigh-in here because I can't do it next week. Thank you very much.

DR. KRESS: I would add one point about: 1.174 is a sort of voluntary type of an approach.

MR. PIETRANGELO: So is this.

DR. KRESS: Yes, but it doesn't seem inappropriate to me to have in this rule something that says you will conform to 1.174. You're not objecting to that, are you?

MR. PIETRANGELO: Not at all.

DR. APOSTOLAKIS: He objects to five pages.

MR. PIETRANGELO: If an amendment request is submitted, and it uses risk-ins, and it uses PRA, you should use 1.174.

DR. APOSTOLAKIS: But I think most of the questions were raised because I at least don't think that the changes here will affect the PRA because here you are eating away margin. The margin is not in the PRA.

MR. PIETRANGELO: Not necessarily. I mean that is why it was important to put the safety benefits piece in this. The sump issue, we would be doing it a lot different if this rule change was in effect. We have learned next to nothing from what we have been doing on sumps and applied it here. It is the same principle for our risk-informed and our realistically conservative alternative in GSI 191. It is a newer evaluation methodology. We don't know enough to make it a little less conservative. This we do. We have been doing this for 30 years. I think this will be a better example.

DR. WALLIS: Well, I agree; you are certainly in a much better position to do this than to do the sumps.

MR. PIETRANGELO: Right. Right, but it is the same approach. It's the same approach, Dr. Wallis.

DR. WALLIS: I agree.

MR. PIETRANGELO: There was no PRA used over there either.

DR. WALLIS: I agree there's lots of overlap in the approach.

MR. PIETRANGELO: Right. Thank you.

CHAIRMAN SHACK: Are we going to reschedule things from tomorrow onto today and finish it all today?

MR. SNODDERLY: Yes, I think it would be a good time to talk about what you want to do with the rest of today and tomorrow. One thing I would like to suggest is that I think two issues, two major issues have been discussed this morning that I think maybe we ought to try to come to some type of -- at least to elicit an opinion from all the members on it by the end of today. Of course, we want to hear from Drs. Sears and Hochreiter.

DR. APOSTOLAKIS: There are also these conforming changes.

MR. SNODDERLY: Right, we definitely want to get through that. But I'm saying as far as --

CHAIRMAN SHACK: But those are simple. Those are short, I would think.

MR. SNODDERLY: I think what we are saying, right now it looks like we are done up until 3:45 on the schedule. So what of what we have covered up until what is now up to 3:45 on the schedule do we want to do? I would like to make two suggestions.

One is that, at the August 17th meeting, I thought one of the most interesting discussions took place between a member of industry and Dr. Uhle, and Tony brought it up a little bit here, where we say right now I have to do my design-basis large double-ended guillotine break analysis, and I am going to replace that now with the design-basis transition break, to the transition break size. And I am going to have another analysis for beyond-the-transition-break size, which Dr. Uhle has kind of discussed.

But then, also, the rule talks about the defense-in-depth analysis. I don't really think we have really discussed that very well so far this morning.

So I think we should make sure we understand what we are replacing those analyses on because I think that is where a lot of the controversy is going to be in the Reg Guide because industry is saying that that is where the burden is going to be. That is where I think industry will say, "Look, do we want to take our resources and spend them on doing a lot of this reanalysis for defense-in-depth and the beyond-design basis, beyond-the-transition break size, or do we want to put it someplace else?

So I think we need to understand clearly what the staff -- and, of course, we understand that they are in the process of writing the Reg Guide, but I believe that they have some more preliminary thoughts that maybe they can share with us. So I want to make sure we feel comfortable with where they are on that today.

MR. ROSEN: So we are going to talk about analysis requirements for beyond-the-transition break size? That's one suggestion.

MR. SNODDERLY: I think Jennifer covered

that this morning --

MR. ROSEN: Yes.

MR. SNODDERLY: -- but I just want to make sure that --

MR. ROSEN: Well, maybe, but we didn't say anything and some of us didn't have a chance to weigh-in.

DR. APOSTOLAKIS: We had statements of fact. Under TBS you do this; above TBS you do that. What I don't understand is, what difference it makes. Just saying, "I feel better because I do more for sizes under TBS," I don't know that I feel better. I would like to understand because that would affect, also, the choice of the TBS.

MR. SNODDERLY: Yes, and that is what the Westinghouse Owners' Group --

DR. APOSTOLAKIS: I mean if it's just about feeling a little better, don't you think that's --

MR. ROSEN: We are not going to have a discussion now. We are going to schedule a discussion for this afternoon.

DR. APOSTOLAKIS: Yes.

MR. ROSEN: I have some things that I would like to say.

MR. SNODDERLY: We have the parties here.

MR. SIEBER: Beyond the transition break, you are allowed to use additional --

MR. ROSEN: We have approximately two hours.

DR. APOSTOLAKIS: I know what you are doing.

CHAIRMAN SHACK: We can have more time for discussion this afternoon.

DR. APOSTOLAKIS: Yes, but can you bring some of the presentations tomorrow to today or is that illegal?

MR. SIEBER: I don't know that he can do that.

MR. SNODDERLY: No, we can.

DR. APOSTOLAKIS: We cannot?

MR. SNODDERLY: We can.

DR. APOSTOLAKIS: Can we finish by ten o'clock tomorrow then?

CHAIRMAN SHACK: Well, presumably, we wouldn't have time for discussion. I should have had the discussion today and hold those presentations until tomorrow. The people who are planning it --

DR. APOSTOLAKIS: Well, the way we are going we are going to finish by 10:00 a.m. tomorrow anyway.

DR. WALLIS: Well, could we hear more about margin?

DR. APOSTOLAKIS: If I can extrapolate --

DR. WALLIS: Could we have a discussion about margin here because I thought the discussion of safety margin was very weak in the document? It is a bit like hand-waving.

DR. APOSTOLAKIS: Sure.

DR. WALLIS: Could we ask the staff to speak more about margin this afternoon?

MR. ROSEN: Okay, so those two things, margin and requirements for analysis at break sizes larger than the TBS.

DR. APOSTOLAKIS: The what again?

MR. ROSEN: Discussion about margin and a discussion about break sizes larger than the TBS.

CHAIRMAN SHACK: What's unclear about the analysis?

DR. APOSTOLAKIS: The analysis itself is not that clear.

MR. ROSEN: It's not that clear to me. I mean I don't have --

DR. APOSTOLAKIS: Okay, so we discuss that. But what's unclear to me is what difference it makes when I change the requirements from one to the other.

MR. ROSEN: That's the whole point, is that if we don't know what the requirements are for the analysis beyond the transition break size, how can we say that they are different? We have no insight.

I have some particular insight into what kind of requirements one should have on breaks, for analysis of breaks larger than the transition breaks.

DR. APOSTOLAKIS: Okay, now you've got your subject for the afternoon. I think we need some free time.

CHAIRMAN SHACK: Well, actually, I thought one of the other issues that we would want to discuss is the TBS itself.

MR. ROSEN: Yes, okay. Fair enough. Yes, the break point and threshold.

DR. APOSTOLAKIS: Do you mean the selection?

CHAIRMAN SHACK: The selections.

DR. APOSTOLAKIS: Absolutely.

CHAIRMAN SHACK: But at least clarify exactly what it is.

DR. APOSTOLAKIS: All these things are related.

MR. ROSEN: You were on the panel, weren't you?

CHAIRMAN SHACK: No.

MR. ROSEN: No? Okay, but you --

DR. APOSTOLAKIS: No. Otherwise, he wouldn't be sitting there.

CHAIRMAN SHACK: I wouldn't be sitting here.

MR. ROSEN: Right, that's true.

DR. WALLIS: I think it is up to the staff to make us feel comfortable with their decision. They agonized for several weeks about the choice of TBS. They are now comfortable. I think it is up to them to make us feel comfortable.

DR. APOSTOLAKIS: All these things are related in my mind. I mean the choice is affected by the requirements that you are imposing below and above and what difference it makes to the safety of the plant. So all these things are one subject, and I think it would be a good idea to discuss them this afternoon.

CHAIRMAN SHACK: Okay, but how do we want to organize this discussion? The staff is just going to be present for a discussion?

DR. APOSTOLAKIS: Yes.

DR. WALLIS: Maybe we could put five of them up there and have them answer questions.

(Laughter.)

MR. ROSEN: How about if we have them walk around?

DR. APOSTOLAKIS: I think we are doing fine. We can ask them questions.

DR. BONACA: I would suggest we finish Part 50.

CHAIRMAN SHACK: Yes, first.

(Members of the staff talk amongst themselves.)

MR. SNODDERLY: Excuse me. For the transcriber, we need to have one conversation.

CHAIRMAN SHACK: Okay, we are going to continue with today's agenda. At the end of the presentation on the scheduled items for today we'll have a general discussion which will last a little longer. We will also hear from Drs. Sears and Hochreiter, and then we will have our discussion.

We will have the presentation of the different viewpoints and inputs, and then we will continue the discussion, focusing, since people want to hear more about these analyses beyond the design basis or beyond the transition break size and the choice of the transition break size.

DR. APOSTOLAKIS: So you're not moving any of tomorrow's presentations?

CHAIRMAN SHACK: I'm not moving any of tomorrow's presentations forward. We will just stay with the agenda, and if we end early today, we end early today.

DR. APOSTOLAKIS: Fine. And you can be a little more generous with the breaks.

CHAIRMAN SHACK: I can be more generous with the breaks.

(Laughter.)

You can come back from lunch at 1:30, George.

(Laughter.)

(Whereupon, the foregoing matter went off the record at 12:27 p.m. for lunch and went back on the record at 1:34 p.m.)

CHAIRMAN SHACK: I think we're ready to come back into session, and we're going to hear about some other conforming changes to 10 CFR Part 50, if we're going to make these changes to 50.46.

MR. FISCHER: My name is David Fischer, and I'm in NRR's Mechanical and Civil Engineering Branch.

What I'd like to do is to describe for you the other changes to regulatory requirements that are being considered to conform with this new transition break size, some of which are rule changes.

There are a number of other proposed rule changes in the package that are more administrative in nature that I do not plan to discuss. I plan to focus on the more technical, conforming changes that stem from the designation of this new transition break size.

This slide shows some of the regulatory requirements that licensees may want to change based on the new transition break size. Changes to some of these regulatory requirements require rule changes. Others will require license amendments, and others may be done by licensees under 50.59.

For example, many tech specs limiting condition for operations, allowed outage times, and surveillance requirements are based on the double-ended rupture of the largest pipe in the reactor coolant system. More specifically, the transition break size might be used to relax emergency diesel generator start times and load sequencing.

Containment isolation valve closure times might be lengthened based on the transition break size. ECCS accumulator set points might be adjusted based on the transition break size. Licensees might also propose to eliminate automatic actuation of containment spray or delay spray actuation because of the smaller break LOCAs.

These types of changes will require a license amendment, and some of them could actually decrease risk at the plant and improve safety.

The new transition size could be used to define equipment qualification requirements. However, it should be realized that the main steam line break is oftentimes more limiting than a double ended guillotine break in the largest pipe in the reactor coolant system in terms of establishing the most limiting EQ profile.

Changes to the EQ profile that a specific piece of equipment would need to be qualified to might be done under 50.59.

The in-service inspection requirements, in-service testing requirements and repair/replacement modification requirements of 50.55(a) might be relaxed based on the scope requirements of the ASME code. For example, the code requires that pumps and valves needed to mitigate the consequences of a design basis accident be tested and inspected in accordance with code requirements.

Changes to the in-service testing requirements for a piece of equipment that is only needed to mitigate breaks larger than the transition break size could be done under 50.59.

Similarly, the test acceptance criteria in a license --

CHAIRMAN SHACK: What kind of equipment would that be?

MR. FISCHER: Possibly an accumulator. I really can't think of anything that's sole --

CHAIRMAN SHACK: Just for that?

MR. FISCHER: -- just for that. So there may not be a lot they can remove from the scope, but they may be able to make like was discussed earlier adjustments to the accumulator set points and some of these other tech spec type changes, but those would require a license amendment.

Changes like if there were a flow rate varied to an ECCS pump and that was specified in a procedure, they could change that under 50.59. So there are different things that they can do, and there are different change control methods.

We're not proposing a new change control mechanism, but we recognize that there are different mechanisms you have to go through to change different requirements. If it's a tech spec, you have to get a license amendment.

But we are proposing some rule changes, and I'll come back to that.

It should be noted also that the rule, the proposed rule, contains high level requirements that no new degradation mechanisms be introduced and the likelihood of detecting RCS boundary leakage or degradation not be reduced. So the in-service inspection requirements, repair/replacement requirements, relaxations for those would be limited. And that is consistent with the assumptions made as part of the expert opinion elicitation process.

Did I get that right?

DR. APOSTOLAKIS: Yes.

MR. FISCHER: Okay. Now, I'd like to focus on a few of the conforming rule changes the staff proposes based on this new transition break size.

Based on a conceptual draft rule, which we put out on the public Web site in early August, the staff got some feedback from industry during an August 17th meeting and in some letters from the owners group at NEI, and they told us some of the types of changes they were interested in seeing in the proposed rule, and that helped the staff focus on some of these particular rules which I'm going to put up.

These five rules here, the proposed rule modifies these five GDCs, which includes the ECCS general design criteria, by removing the requirement for the assumption of single failure and the assessment of the system capability of performance intended safety function for those loss of coolant accidents involving breaks larger than the transition break size.

That is, above the transition break size less margin would be required. The single failure criteria need not apply, and more realistic analyses could be used in assessing system capabilities. However, assessment of system capabilities for LOCAs involving breaks up to and including the transition break size remain unchanged and still must consider or assume the single failure.

The proposed rule would remove the single failure criteria because LOCAs involving pipe breaks larger than the transition break size are judged to be a very low probability and are no longer considered design basis events. Therefore, the additional design redundancy afforded by the single failure criteria does not appear to be justified from the standpoint of providing adequate protection to public health and safety and common defense and security.

Proposed 50.46(a) would require a licensee to assess its plant capability to mitigate loss of coolant accidents involving pipe breaks larger than a transition break size without consideration of single failure to provide safety margins and defense in depth for these lower probability initiating events.

Similarly, the proposed modification to GDC 50 would allow the use of more realistic analysis of the pressure temperature conditions following a loss of coolant accident involving breaks larger than the transition break size. The proposed change would also allow less margin to be included in the assessment of the containment structural capability for these LOCA events which are now considered beyond design basis.

This is consistent with the proposed treatment for beyond design basis LOCAs in the assessment of ECCS system capability, component cooling water, systems and containment systems.

So licensees that implement 50.46(a) would not necessarily have to maintain their current containment design basis for pipe breaks larger than a transition break size.

DR. APOSTOLAKIS: So how would that affect NP? What does that mean?

MR. FISCHER: That means they could use more realistic analysis and they --

DR. APOSTOLAKIS: But would it affect the containment functions, I mean, the sprays?

MR. FISCHER: I believe it would definitely affect the containment sprays when and if they had to initiate containment sprays.

DR. APOSTOLAKIS: Yeah, yeah.

DR. SHERON: George, that was in my -- one of the things in my first viewgraphs, was that we would -- you know, if justified, we would allow manual incorporation of containment sprays. Again, we believe that that provides a safety benefit in the sense that you don't have to initiate it for automatically for all LOCAs and stuff.

The other thing is that if the licensee, for example, were to increase power in their plant because of this, obviously if you, for example, add ten percent more energy in a core from a ten percent power up rate, that's ten percent more roughly that gets released to the containment.

If they were to calculate the containment pressure were to exceed the design basis by some small amount, that would be acceptable. Okay? But, again, this is again given the fact that we believe containments have substantial margin.

DR. APOSTOLAKIS: So the design basis pressure will remain the same, 50 psi or whatever it is. No?

MR. FISCHER: No, they have exceeded. They may not need to maintain the same design basis.

DR. APOSTOLAKIS: So they can submit a license amendment and raise it to 70?

MR. FISCHER: Maybe. I think those details will be worked out in a reg. guide.

DR. SHERON: Well, I think, I mean, they're not going to change the design basis because that's structurally set from the code and everything and the like.

DR. APOSTOLAKIS: There is a widespread belief that, you know, the 50 psi that is assumed now, a failure above that is not real.

DR. SHERON: Oh, yeah. It's probably well over 100 psi. So the point is that even if the design basis for the transition break size or below, okay, that would remain the same.

DR. APOSTOLAKIS: Right.

DR. SHERON: Let's say it's 50 psi. For the beyond transition break size, if they were to, for example, increase power or do something else that resulted in, say, the pressure going to 55 psi, we would allow that provided they, again, did the risk assessment and demonstrated that there was negligible or small increase in risk associated with it, and that they maintained defense in depth and so forth.

DR. WALLIS: How would they do the risk assessment or something like a LERF assessment? You have to have some basis for containment failure.

DR. SHERON: Yes.

DR. WALLIS: So you have to put this 55 psi into some kind of probablistic model of containment failure?

DR. SHERON: Right, or they might be able to make a qualitative argument. I mean, we're not trying to make this so onerous, you know, in terms of analysis requirements that, you know -- in other words, if there's a --

DR. WALLIS: Well, once you relax a requirement though, you've got to put something in its place. You can't just let it relax ad infinitum so that it becomes 56, 57, 58. Where do you stop? There has got to be some --

MR. SIEBER: The code tells you where to stop. It's a pressure vessel so it has to meet the code. It tell you.

DR. WALLIS: Well, maybe the code is 50.

MR. SIEBER: That tells you what the design pressure is. On the other hand, you do have to

DR. WALLIS: I thought you were already above the design pressure.

MR. SIEBER: No, I don't think you --

CHAIRMAN SHACK: No, they are going to allow him to go above the design pressure for the greater than TBS breaks.

MR. SIEBER: Presuming the probability is very small that they would ever do that.

DR. SHERON: Right, and if you recall, we said that we were going to have a late containment failure criteria, and that's where this would probably be factored in.

CHAIRMAN SHACK: But will you have some explicit criteria for that in the reg. guide or is that going to be something they would justify on a case-by-case basis.

DR. SHERON: I don't know.

PARTICIPANT: I think you would probably have some explicit criteria in the reg. guide.

CHAIRMAN SHACK: That would let him go over it by a certain amount.

PARTICIPANT: We defined the design pressure. It would be taking some relaxation in the code equations.

DR. WALLIS: Well, I think until we see the reg. guide we don't really know what you're doing. I mean, this seems to be an elastic regulation where you allow 300 degrees here and maybe 400 and, you know, five psi, maybe ten psi. Until we know what you're doing, we have no idea what the consequences might be.

And there has got to be some realistic justification for these.

CHAIRMAN SHACK: I thought that the containment though, that we have fragility curves, and we haven't quantified these things.

DR. WALLIS: Well, it's up to them to show us.

DR. APOSTOLAKIS: These civil engineers have gotten involved, and these guys do these things, you know, have been doing them.

DR. WALLIS: As long as it's not done in some whimsical way it's fine.

DR. APOSTOLAKIS: No, they actually have

distributions and fragilities and whatnot.

DR. WALLIS: Well, you're telling me. They have not told me that. If they told me that --

MR. SIEBER: That's not the only impact on containment, too. Leak rate goes up as pressure goes up. So some plants may --

DR. SHERON: And it's very likely, too, that there may be other accidents that catch them before they ever get to a much higher power level. For example, steam line break generates similar pressures in the containment, you know, and we're not proposing to put the steam lines under the transition break side or anything.

So they still have to analyze the steam line break, and if you've got ten percent more energy in a primary, you've got ten percent more in the secondary. So they may find that the secondary, that the steam line break may be limiting for them in that respect.

MR. RUBIN: If I could add, I'm Mark Rubin again.

In risk space, slightly or even sometimes more than slightly exceeding the design pressure of a containment won't be a risk significant event, but using the flexibility allowed by the rule change to perhaps change some of the containment response systems or timing of capability will then impact sequences where the pressures will challenge the ultimate capability of the containment. Timing may change to affecting a large release frequency or containment failure frequency, and that's where the change would come into play in risk assessment space.

DR. WALLIS: I thought retaining margin though in part of your words here meant not exceeding some ASME standard. I thought that was where you retain margin. I've got to find the right page, but I thought that was your interpretation of retaining safety margins, was that you stayed within the ASME standards; you didn't relax that.

DR. SHERON: No, not necessarily.

DR. WALLIS: I'll have to find the right page. Not necessarily?

CHAIRMAN SHACK: Certainly for less than the transition break size they're going to have all of the requirements that they currently have.

MR. FISCHER: And there are various ASME service level limits, and we could allow them to go to a higher service level, finish up pretty close.

The staff considered modifying GDC 4 based on a transition break size as defined in 50.46(a), but decided to leave this general design criterion unchanged for the following reasons. GDC 4 as currently written addresses environmental and dynamic effects under normal and accident conditions, including following the double-ended guillotine break for the largest pipe in the reactor coolant system.

GDC 4 contains a provision whereby licensees can exclude dynamic effects from their plant design based on the probability of piping ruptures being extremely low. This provision, however, has historically been implemented by the staff review and approval of a leak before break analysis, as outlined in Standard Review Plan 363.

Absent an approved leak before break analysis for piping larger than the transition break size, PWR licensees would still need to consider dynamic effects. While pipe breaks larger than the transition size will no longer be considered design basis accidents for licensees that voluntarily got 50.46(a), pipe breaks larger than a transition break size will continue to be part of the design basis for the piping, and the requirements of GDC 4 will apply, will still apply to them.

CHAIRMAN SHACK: How many PWRs don't have leak for before analyses now?

MR. FISCHER: I don't know the answer.

Does anyone? I've got somebody coming up from the EDO's office.

MR. MITCHELL: Matt Mitchell and for now from Materials and Chemical Engineering Branch, NRR.

At this time all PWRs have leak before break approvals on their main coolant LOOP piping. So for that subset of piping which would fall under the greater than transition break size regime, you would be talking about all of that piping being covered by existing leak before break analyses.

On the BWR side, however, no leak before break approvals have been issued for any BWR piping.

CHAIRMAN SHACK: Which your break size wouldn't give you much of a leak before break anyway.

MR. MITCHELL: That's a fair assessment, too, yes.

MR. FISCHER: That's really all I had, Dr. Shack.

CHAIRMAN SHACK: Any further questions from the committee?

(No response.)

CHAIRMAN SHACK: At this time we can hear from Drs. Sear and Hockreiter.

DR. SEARS: I'll kick off. I am Fred

Sears. I'm the Director of the Penn State reactor, but I am here as a private citizen, not representing Penn State.

Let me provide you a little bit of my background so you'll understand where my comments come from. For the past 42 years I've been involved with the operation and management of nuclear reactors ranging from ten kilowatts up to about 4,000 megawatts. I've covered PWRs, BWRs, HTGRs, production reactors, research reactors, test reactors, and a few things in between.

I've worked for a vendor, Combustion Engineering. I was their chief test engineer. Worked for Northeast Utility. I was Vice President of Nuclear Environmental Engineering and responsible for licensing, safety, QA, training, nuclear engineering, safety analysis, all those things.

I've been a consultant. I've been a member of the Advisory Committee on Nuclear Facility Safety for DOE, and I've been at Penn State now for seven years and am responsible for operating that research reactor and teaching there.

I've been licensed on a number of reactors. I have been directing operations on others. My area basically is operations testing and reconstruction of events after they've happened and trying to learn from what they are involved.

I was the Vice Chair of the industry degraded core activity for most of the time that it was in existence. I've been involved with design of advanced light water reactors and dealt with nuclear waste. So my perspective is fairly broad. It is mostly from a management viewpoint. I'm not an analyst. Mario can testify to that.

But in looking at what is going on here, I have found myself concerned with that experience, and I'll start off by talking about some words from the former head of our department, Joe Palladino, who later went on to become Chairman of the NRC.

When he taught the introductory nuclear engineering course, which was for graduate students, these were people with physics, chemistry, mechanical engineering backgrounds entering the glorious field of nuclear engineering.

He handed out his first test and most of the class went into shock, and he said, "No comments, and I want to explain something to you." He said, "You're studying to become engineers. As engineers you are responsible for the design, construction, and operation of systems used by the public and your fellow people. You must start with the correct assumptions. You must use the correct approaches. You must have correct math. You must maintain appropriate margins because the health and safety of the public and your fellow beans are dependent upon your actions as an engineer."

That was 40 years ago, and it kind of stuck with me in terms of work that I have done with regard to safety, and as I've observed this effort to bring risk perspectives into the licensing arena, I have found myself seriously concerned.

As we dealt with the aftermath of TMI, we looked at both why TMI was able to survive that event with no releases to the public. We dealt with having the entire industry implement significant PRA efforts on their plants to look for weaknesses and vulnerabilities that had not been recognized before.

And in that discussion we found there was a great deal of robustness and resilience of the existing designs which at many times saved us from significant failure of the cores prior to that, and in that particular case, significant release to the general public.

And we tried to ascertain why were they there. They were there because there was a deterministic design basis. There was an approach of redundancy, diversity, defense in depth, consideration of single failure.

We didn't have a lot of PRA around. There was some obviously, but it wasn't a major tool for our decision making. That came after TMI, where we began to use PRA overall in the industry as a decision making tool.

It assumes that you have a design basis in place. You make significant assumptions about proper maintenance, proper care to what you observe, not allowing degradation of your pressure boundary, not allowing degradation of your instrumentation, having proper training so that the operators know how to respond, changing emergency procedures such that the operators are now observers of what's taking place and verifying that the proper actions take place.

We learned it was not good to have to rely on the operator to take an action. Those were all lessons that were learned, and we had many discussions about whether it was appropriate as we ran the PRAs to reduce the design basis, and the conclusion back then was it was not appropriate; that the thing that gave us the robustness and the resilience was the deterministic design basis, the redundancy, diversity, and so forth.

As I have watched what is taking place and then listened today to the presentations, as an operator I find myself disturbed because I heard things like changing to rely on operator action. That's not a good thing because, as the operator, I should be in the place of verifying the actions that are taking place, not initiating them on my own because then I as the operator -- and I'm a human being -- I'm subject to making errors even in a team environment.

And one of the reasons we design automatic systems is to help avoid that such that the operator is verifying actions rather than taking them.

I heard statements of what we understand today. Well, let me use TMI as an example. What we understood just prior to TMI, and I can tell you from the industry perspective, was that accidents don't happen. TMI proved quite otherwise. Accidents can and do happen, and they will happen despite our best designs, and what we have to do is to work very hard to prevent them, but we also have to make sure we have systems in place which will mitigate them and deal with them.

TMI to the outside public, other than

emotionally, was not a big event because we had a containment. The containment was intact. Those systems worked.

I am concerned that if we relax those design basis events, put them into probablistic space, it will become much like everything else we do when in the process of facing an event, we can always justify whatever we do.

And I've been as guilty as anyone else has of that. Many times I've made wrong decisions on a reactor after the fact, looked at it because at the time it seemed like the thing to do. In the cold, hard light of the day afterwards, you looked at it and said, "You know, I don't think that was so smart. That instrumentation I said that I could modify, when I look back on it, I couldn't modify it or I shouldn't have modified it. I did modify it."

I look at some recent events we've had. How many people could have said prior to Davis-Besse that a well managed nuclear plant under the regulation of the Nuclear Regulatory Commission could achieve the degree of degradation that was viewed at Davis-Besse? I don't think many of us. We would have said it's highly unlikely. We probably would not have said it would happen.

Today I find myself very uneasy with saying something won't happen or that it can't happen because history has tended to prove it will happen almost as soon as we make that assumption.

I'm here today to ask you to think about the aspects that Joe Palladino mentioned, of starting with the right assumptions, using the right methods, using the right math, reaching the right results, and maintaining margin so that for the unexpected things will not go wrong.

The reactors of the '60s often had safety factors, anywhere from 25 to 40 percent for a design of components. Reactors today don't have that safety margin.

You push limits today and you're pushing really hard on it. If you push away the deterministic design basis, I believe you will further erode those margins.

The economy today plays a strong role in the design, the efforts of those people operating nuclear power plants. You've talked about removing the loss of off-site power from LOCA. We've had a loss of off-site power just recently. Palo Verde lost all power. They weren't in a transient for that. They lost all power though. It wasn't in their control, and the fact is the distribution systems which provide the off-site power today often are not in control of the operator of the reactor. So the reliability of having off-site power is called into great question.

Now, I'm not a proponent of ten second starts on diesel generators. I think that destroys the diesel generator, and I would like to see relaxation there, but I think that there are methods of doing that other than throwing out the large break LOCA. I think that if you feel that the advent of best estimates can better be used, there's a good method then of looking at changing the time frame, of changing the accumulators on there.

But to do away with it across the board, I as an operator -- and I will admit I'm no longer operating a owner reactor at this stage, but I still have concerns about it -- I don't think that's a good idea.

I don't want to have to explain to my students how another accident has occurred because the design basis was weakened. I believe we all have a responsibility to prepare for the unexpected, and certainly every accident is unexpected because if we knew it was going to happen, I hope we wouldn't allow it to take place.

We have a responsibility if we really believe that nuclear energy is a powerful contributor to our well-being to insure it is done safely, and that that safety is seen and perceived by the general public. I do not believe that this present effort meets that criteria.

Thank you.

DR. HOCHREITER: Okay. I'm Larry Hochreiter. I've been working in the nuclear area for roughly 41 years. So I'm the junior here. I spent about 26 years at Westinghouse and about seven years now at Penn State, and again, I'm speaking on behalf of myself, not Penn State, and I would like to thank the committee for having us here.

I've been before the committee before, and it hasn't been quite as perhaps nice as this.

MR. SIEBER: It's not over yet.

(Laughter.)

DR. HOCHREITER: I come at this from more of an analysis point of view because the work I did at Westinghouse was in analysis, developing safety analysis methods, doing plant analysis, trying to improve on safety methods, trying to find margin, identify margin, trying to use margin, and the concerns I have with this rule change is the overall concern is, first of all, I think we're trying to fix something that isn't broke. That's the first thing.

The second thing, I really believe that these changes, the proposed changes will result in a loss of margin and a loss of design forgiveness for the plant. And Dr. Sears has already indicated the potential for that in a number of different areas.

I think the plants will be less safe. I think the risk of an accident is going to be higher, and I think it defeats really what the NRC goal should be, which is developing and maintaining a safety culture.

And I teach reactor safety at Penn State, and I'm going to have a hard time convincing my students that there is a safety culture here.

I want to go back to the public perception and nuclear power because, again, this comes out of the course I teach there. Nuclear power is not accepted in general by the public. Okay? If you look at a lot of these surveys -- and I'm not talking about the NEI surveys -- but you look at other surveys, and it has maybe got a 50, 60 percent rating, may depend upon the day of the week, who does the survey, who they talk to, whatever. It's not really accepted widely.

Okay, and the reason for that is because it's viewed as an imposed risk. This is an imposed risk that society is placing on people, and as individuals they feel that, and so they don't really accept nuclear power.

Now, there are other risks, too, that they don't accept, but nuclear power is the one that we're worried about.

Any accident anywhere that happens in the world that's related to nuclear power and nuclear energy, nuclear anything has a negative impact on the perception of the nuclear power program in our country.

And that's difficult to overcome, and the public then loses distrust in our ability to manage nuclear technology. The public does expect us to do everything humanly possible to basically prevent, mitigate any kind of an accident or transient, and what I'm afraid of is that this proposed change to 10 CFR 50.46 basically goes counter to the public expectations of what they expect us to do as people managing this technology.

Now, if we look at the current plants that are operating, these plants were originally designed for 80 percent availability. They're operating anywhere between 92 and 97 percent availability. So we're pushing them hard.

To me this implies that shortcuts are being taken. They're being taken in terms of maintenance, inspection, troubleshooting, asking the "what if" questions. Okay? And we've seen some problems that have occurred because of that.

Dr. Sears mentioned Davis-Besse. I mean, this is a lack of inspection, really poor management on the part of the utility.

But you may not realize that this was a problem that was discovered in the mid-'80s. We knew this was a problem at Westinghouse. We could see this in our plants at Westinghouse. We knew that those structures were under heavy residual stress, and they were cracking.

Okay. Now, we communicated, because we had licensing agreements with the French, with the French on this. The response in France was to replace all the heads. Thirty-six plants, 36 new heads.

Okay. Well, we limped along in this country. We didn't really take a lot of action. We watched the problem.

Well, they watched the problem at Davis-

Besse until they washed it until the head was almost gone.

Indian Point steam generator tube rupture. This was a plant, an older plant. They had done weld repairs on the shell of the generator twice because it had cracked, and then they had a rupture on the primary side, the tubes.

This utility had replacement generators on site for I think about ten years and never put them in. They had to have a tube rupture to put in these generators, and the NRC got a very big black eye about this.

So I'm nervous about how we're pushing our plants, and the concern I have is that with this rule change plants will try to use the margin to increase power, and you are going to decrease safety margins. And you have a greater potential for an accident or an incident, and I frankly don't think we can afford either.

When the rule change occurred for best estimate LOCA, one of the questions that came up, and it was an intervenor question, was what's going to happen with power increases. How is the NRC going to handle power increases.

The response and at that time the thinking was that the power increases would be five to eight percent. We've got plants now that are trying to upgrade over 20 percent. If we relax 10 CFR 50.46, you're going to see higher up ratings in these plants, and I really don't think that's a smart thing to do.

We've also identified new problems when we up rated these plants. We never had axial offset anomalies in PWRs until we started pushing the power in the cores to the point that you were getting substantial nuclear boiling in these cores. It changed the power shape in the core, set off alarms in the core, and it took a year to figure out; at least at Westinghouse it took a year to figure out what was going on.

We have heard about dryer mechanical failures in BWRs, and these are plants that have been up rated. We're simply operating these plants outside of design basis, and we're not recognizing that. So I think we've got to, you know, slow down on this.

Now, when Appendix K was modified, okay, this did give us a basis for doing some of these calculations in a more realistic manner. The current 10 CFR 50.46 requirements will provide a speed limit on power up ratings. You can get margin through best estimate analysis, and people have done this.

But I think that that's still good because you're still analyzing an accident. You're still requiring a robust ECCS system. You're still looking at single failure proof designs, and of course, the full emergency core cooling systems. But if we make changes that are proposed to 10 CFR 50.46, again, we're going to remove the speed limit. This will encourage more plant up ratings, and I think we'll find that we'll have additional problems.

I don't know what these problems will be, but I think we will find we'll have additional problems, and the reason we'll find we'll have additional problems is because we're operating these plants outside their design basis.

Now, as Dr. Sears indicated, a deterministic approach, a deterministic analysis approach, I think, is the right approach to take. I think using the large break LOCA as your design basis, capturing that and keeping that within the design basis frame is the right approach because it makes you have forgiveness, design forgiveness and retain design forgiveness within the plant for things which are unforeseen.

And we have seen a number of problems and issues that have come up that were unforeseen. The concern with the approach that is being presented now with these changes, I think the NRC can be nickeled and dimed to death by the industry, and I think they're going to see a lot more requests for equipment out of service for a longer period of time, operation with degraded equipment, reduced maintenance on safety equipment, extended inspection windows for equipment, reduced testing on safety equipment.

And the argument back to the NRC is going to be that, well, the probability of needing this is very small. Well, I don't agree with that.

They will also argue why spend the resources to maintain equipment that they don't think they need. Okay? I think the message has got to be given to the industry that they do need this equipment. This is their insurance policy. Okay? We don't know what's going to happen in the future, but they've got to design that plant so that no problems do happen in the future.

I think reducing the margins is counter to what the public wants or expects out of us, and I really have a concern about this because we're gaining in public acceptance of nuclear power when we continue to push these plants. If we have a problem, we will lose that acceptance, and then we'll delay any kind of a rebirth of nuclear power in our country for another extended number of years, and I think that's a wrong thing to do.

Now, listening to some of the discussions that we heard today about doing more realistic calculations, extending the diesel start time, this kind of stuff, you can do this now. You have flexibility within 10 CFR 50.46 to do this now.

When I was at Westinghouse, we looked at extending diesel time. Okay? Diesel start time. It just depends on where you want to use the margin in your analysis. Do you want to use it for peaking factors or do you want to use it to extend diesel start time?

When we did the analysis, we found the limiting thing was the containment sprays. In other words, we could have delayed starting the diesels for a longer period of time, but we needed the sprays to keep the containment within design specifications.

So this can be done now. There's no reason it can't be done now. I think the change that was done with the use of the best estimate methodology is the right approach that the NRC used. They required something from the industry. They were willing to relax the specific requirements in Appendix

K in terms of model requirements, providing the industry came in with a more accurate methodology.

And there's a reward system here. If you want more margin, you come in with a more accurate method and you will get more margin. This is the right approach, I think, but giving up margin by changing the rule I don't think is the right approach, and again, I think it is against safety culture, and I do not think this is something that the public would support.

Thank you.

DR. WALLIS: Is this public that you're talking about the general public or would you say it's the technically literature public? I mean people like students in --

DR. HOCHREITER: My students?

DR. WALLIS: -- in nuclear. Yeah.

DR. HOCHREITER: Well, sure. My students wouldn't because they'd get a lousy grade.

DR. WALLIS: You're talking about knowledgeable people, not your --

DR. HOCHREITER: No, I'm talking about the general public.

DR. WALLIS: I think you also should talk about people who are knowledgeable enough to understand what's going on.

DR. HOCHREITER: That's a very, very small --

DR. WALLIS: But they're important.

DR. HOCHREITER: I understand that, but that's a very small number of people.

DR. WALLIS: No, I think it also includes people like people on the staff here. If people on the staff here are uncomfortable with what they're doing, that reflects on the --

DR. HOCHREITER: Well, yes, I would agree with that. No, I was referring to the general public. In the end they're the ones that are going to give a yea or a nay to an increase in nuclear energy in this country.

MR. ROSEN: And you'd discount the surveys that we hear about. The general public is --

DR. HOCHREITER: No, I don't.

MR. ROSEN: -- two-thirds in favor of nuclear?

DR. HOCHREITER: Yeah, look at those surveys carefully. See how many want to build new plants. They don't want to shut down the existing plants because they all want to use their automatic toothbrush cleaners.

MR. ROSEN: So they must be comfortable with their safety.

DR. HOCHREITER: No. They just don't want to change.

DR. SEARS: If I might speak to that, part of the answer comes is do you live next to the plant or not. I don't have any problem living next to a nuclear plant, and during start-up I always lived rather close to them.

However, I've got to tell you that the people living near the plant that are not really knowledgeable live in a fear, and it doesn't take very much to put them over the edge.

We saw that in Connecticut several times when I was there. I've seen it in other places. Just one off-the-cuff comment, not knowledgeable, and everyone is into the fear of it.

MR. ROSEN: Do you think that's true at all sites?

DR. SEARS: For the majority, yes. I will place at Calvert Cliffs they seem to have better reception there than elsewhere, but many other places, yes.

MR. ROSEN: I think you're agreeing that it's variable.

DR. SEARS: It is.

MR. ROSEN: It can be. There are populations around close into plants that really like the plants and feel comfortable with them.

DR. SEARS: Yes. I'd like to speak to how people are responding. As I watched the presentations and have looked at the submittals to the ACRS, I don't get a strong feeling that the NRC as a group is a strong proponent of this change. I see directives having been issued to initiate the change, but I've looked at the wording in various presentations, and in several of them I thought, "Gee, those are the exact words I would have used as my introduction to telling why I disagreed with it." They weren't words that looked like a strong buy-in.

And I don't want to put any words in any staff member's mouth, but that's just the perception. I see it was directed. We sent stuff back. We got clarification. We're taking it down that path.

I know that the industry as a whole wants this as a potential means to reduce cost. There's a tremendous drive to reduce cost in every business, not just the nuclear industry, but I think it can be -- as I said, you can justify at the time you're faced with an issue doing almost anything when in retrospect you will find you sort of wish you hadn't done it.

And I kind of look at this and wonder is this really -- is everyone into it believing that this is the right thing to do, and I don't -- I don't see the evidence that I would see that tells me everyone thinks this is the right thing to do.

DR. KRESS: I don't want to put words in your mouth either, but it seems to me like your major concern with this potential rule is the specter of substantial power up rates; is that a correct statement?

DR. HOCHREITER: The general loss of margin because it's not only power up rates. You're taking equipment out or allowing the plants to operate with more equipment out for longer periods of time.

DR. SEARS: My concern is not with power up rates per se, but more with the idea that equipment will not be available, that you're not going to have the robustness and resilience that we've had in the past.

Power up rates certainly are a part of that. When you've got a system that's only designed with 105 percent at the very beginning of life, you can pencil whip a lot of things, but it's still 105 percent plant, and when you try to do five, eight, 20 percent, I'm not comfortable as an operator. I'm not comfortable as a member of the public behind that.

So power up rate is just one aspect of it. I'm probably more concerned about surveillances and maintenance. We seem to continue to justify taking a train our of service for longer and longer, and we play a lot on the probablistic role that the probability of needing it is very low, but I've got to tell you if I'm the operator and I need it, I need it. The fact that it probablistically I should have had it doesn't hack it for me as an operator.

MR. ROSEN: So you're contesting the basis of 10 CFR 10.65(a)(4), which is the configuration management requirements, as well as 50.46. Because 50.65(a)(4) is what controls the length of time, say that the equipment is out of service.

DR. SEARS: Well, I'm not familiar. I don't remember the specific thing, but I've heard statements here that were specifically aimed at saying you could have equipment out of service for longer. You would not be looking at single failures, and I didn't hear any other reference to another regulation.

MR. ROSEN: I thought Dr. Sheron mentioned that, but anyway, I understand what you're saying.

DR. BONACA: But that regulation allows

for people to take components out of service for maintenance during full power operation, and --

PARTICIPANT: It's restricted though.

DR. BONACA: It's restricted, has set the requirements for risk assessment. It is reported, but you know, it's a step we have taken in the direction of taking components of the service to be in full power, which we didn't do before.

DR. HOCHREITER: I guess I would be against that.

DR. BONACA: Well, you have both discussed the issue of the impact on safety culture, and I think I understand the perspective, but I would like you to expand on that even more. I mean, I guess the sense that this gives you is that this continuing step of relaxation sends the wrong message to the management of the plants, as well as the personnel?

DR. HOCHREITER: I think it sends the wrong message to pretty much everybody.

DR. SEARS: As I've observed it, the negative messages on safety culture go down an organization in fractions of a second literally. I mean it only takes one statement by senior management, and the safety culture begins to go downhill.

In order to maintain a safety culture,

there has to be a questioning attitude continually, every moment, every second from the very top of the house, and there has to be that continual enforcement of that message.

If you talk to management of a utility, quite often they will say, "I always begin my meeting with a discussion of safety." I ran into this during the construction of a unit in the early '80s. They always begin the discussion with how safety was going on the construction.

And the discussion for an hour long meeting took generally about 30 seconds. The next discussion was on schedule and budget, which took 59 and a half minutes. Where do you think the troops thought the emphasis was? On safety? Not on your life. The emphasis was on delivering on time, on budget.

There has to be a continual asking of the question what if, and being done seriously, not just lips flapping, but being done seriously and looking at what could happen with decisions, with maintenance, and everything else and seriously using that.

The utility I worked for, we put in place PRAs. A lot of effort went into it, well before the industry was doing it, specifically for us to make management decisions and to look at what was going to happen with maintenance that was intended and to look at changes.

We looked at extending the fuel cycle, using the PRA, and we made it a requirement that there be a mid-cycle shutdown. Now, that didn't win us any friends within that system, but that was part of the safety culture because we looked at it and said, "We have to reset the failure mechanisms, if you will, of the instrumentation.

If you go for two years, you find you're going way down the curve, and the answer you got at the beginning of life, which really looked great, didn't look so hot later on.

A safety culture, a working safety culture is that continual thing. It is also not saying we're good enough. If you say where we are is good enough, that's not safety culture. You have to be in continuous improvement.

So I don't know if that answers your question, but that's my feeling on it.

DR. APOSTOLAKIS: A lot of the requirements in 50.46, in fact, the whole of 50.46 was done before we could quantify risk, right? And you seem to place a lot of faith in the way it was structured and that the margins are large.

Then we find out with the new technology that there were some holes in that system. So the agency now is forced to pass a rule on station blackout, the ATWS rule, and do all sorts of other things to plug holes that this deterministic system had.

Why then is it inconceivable that some of the other stuff that the system imposed, some of the requirements are maybe not so important? I mean, why do you place such great faith in something that has served the industry well, but has been proven to have had some problems here and there? Why is it inconceivable that some of these margins maybe are not necessary?

DR. SEARS: I did not mean to say it's inconceivable, but we started with a deterministic basis that at a time with no database, they were the estimates of knowledgeable people as to what they thought would bound the events that might take place.

As would be expected, we didn't bound them. We found other events or sequences, and we have remedied some of those. PRA is a tool for finding those weaknesses and vulnerabilities. It doesn't pick up everything because if we've never experienced it, we have a difficult time putting it into sequence.

But what we have been doing is we've been strengthening that deterministic basis both by experience and by suing PRA as a tool and looking and saying where are we as we became more knowledgeable for various loss of coolant events. All of a sudden, surprisingly the small break LOCA became a very significant event that hadn't been looked at originally, and we found in some senses it was more limiting than the large break LOCA.

That's experience. We've learned it. We've incorporated those things. I'm very comfortable with using our experience and the PRA to help us improve. I'm also reasonably comfortable -- I won't say "very" -- with using that same tool to identify areas where maybe we have been over conservative in terms of a time response, but in general, then we have to find a way of analyzing the event.

I don't think we should be going away from that broad paint brush approach that gave us comfort that we had fairly well scoped things. Large break LOCAs define energy requirements in the containment. They end up with pressure. They end up with environmental things. You may find something else that drives the environment worse, but it gives you a scoping to where you can start from, and then you can use experience in PRA to find is it really scoping.

I don't feel that we are terribly wise. We seem to come up with every year something that we hadn't thought about before. I'm with a reactor that's been in operation for almost 50 years. We celebrate our 50th anniversary next year. You would think our procedures and so forth are well shaken out.

Every year, every month we find new things that we hadn't seen before or we find things that people do that we couldn't believe anyone could possibly do that thing. So we keep improving our procedures.

I think the same thing happens with the design basis, is we've got a framework and we're going to continue to tune it, but I don't think it -- you don't take the procedure and throw it away because you find someone isn't following it. You tune that. You add to it. You make it a better procedure, more understandable, more useful.

And I think that's what I see that we should be doing with the design basis, is we've got a framework. We've then got some tools that let us fine tune it and make it better, but we shouldn't throw that framework out.

You know, you talk about how pipes fail. One of the interesting things I noticed as we are talking about the pipes fail, there's an event I'm aware of in which we had multiple double-ended guillotine breaks simultaneously, SL-1. Now, would you anticipate a reactor vessel would raise up multiple feet in the air and sheer all of the pipes connected to it? I don't think you could conceive of that in your wildest dreams, but it happened.

So there's a double ended guillotine break, multiple pipes simultaneously., Is it likely to happen again? I sure hope not. I think we've done a lot of things to prevent it, but no one thought of that happening there.

And that's why I'm really reluctant to move away from that framework. I've had too many experiences as an operator and a reconstructor.

DR. HOCHREITER: I'd like to try to address your question, too. I was involved in the AP600 design, and we used PRA in conjunction with the design basis accident. We would use PRA to look at the set points for some of the equipment in the plant and looking at accidents that were actually beyond design basis in many cases, and looking at the relative worth of one piece of equipment versus another and trying to figure out, you know, which one would give us the best performance.

But we would always go back to the design basis. So we might look at whether one CMT versus one accumulator, you know, two accumulators versus two CMTs, whatever, but we would always go back to the design basis and confirm the behavior of the system with the design basis so that it was basically a two prong approach to showing the robustness of the systems.

The question we had to answer for the NRC, it was actually a Tom Murley question. He was concerned on passive safety systems because what he was worried about was that they might be very good within the design basis space, but if you took a step outside that space, you'd fall a mile.

So we did analysis to show that you would get a general slow degradation of the performance of the system as you would take more components out or you would lose components. And this is somewhat similar to what a current plan is if you would have a loss of one safety system, a loss of one train; then you might lose another train, and so forth.

That made him feel good because there was no cliff effect in the design, but we had to go through that approach, and we did use PRA, but we used it in conjunction with the design basis accident.

DR. APOSTOLAKIS: I'm trying to interpret for my own benefit what you gentlemen said, and I find two main arguments that you're trying to make, and obviously you can correct me. One is the 50.46, since we're talking about it, protects us against unforeseen occurrences, events, processes. It also provides a safety margin. In general you're comfortable with it.

DR. HOCHREITER: Right.

DR. APOSTOLAKIS: Okay. But one can approach both of these concerns, especially the first one, in different ways. For example, again, in the new future reactor licensing frame that the staff is thinking about, the issue of unexpected things happening is addressed by proceeding in a sort of hierarchical manner from the very top release of radioactivity down and so on.

So it is conceivable that one can have a number of approaches to this issue, which is a real one. Nobody questions that unexpected things happen all the time, but the issue of margins bothers me a little bit.

I mean, there is such a thing as too much margin in one area and maybe not much in another, and coming back to a discussion this morning, if we had some quantitative measure of how much margin we had, perhaps then the discussion would be on a more rational basis. Whether I believe this is enough, no, I believe less is enough.

DR. HOCHREITER: Well, that's part of the problem. Until you have a problem, okay, or have an accident or have a transient, you really don't know how much margin you have.

MR. SIEBER: That's true.

DR. APOSTOLAKIS: Or until you quantify it you don't know how much.

DR. HOCHREITER: You can quantify it --

MR. SIEBER: You can't quantify it.

DR. HOCHREITER: -- but you don't know what the precursor will be for the next transient that you can't think of.

MR. SIEBER: Let me try to address that. I think there's three kinds of margin. For example, you can do an Appendix K analysis and come up with a peak clad temperature, 2,150. The limit is 2,200, and so you have a regulatory margin of 50 degrees that you can spend somehow.

In addition to that, the 2,200 has a built in conservatism that came out of the final acceptance criteria rule of maybe 100 degrees, but nobody counts that.

In addition, you end up with margin that's built into the calculation that you do because you cannot do the calculation exactly, and therefore, you make conservative assumptions, but since you can't do the calculation exactly, there is no way to determine what that margin really is.

And my belief is that most of the time it's positive margin, but sometimes it could be negative margin, and so you don't have margin to spend. If you had an accident and didn't have margin someplace else, you're in deep trouble right at that point.

So in my view you really can't quantify all of the margin that you have, and so that's why everybody makes these qualitative statements about the margin that they think they have because they have used engineering judgment and conservative assumptions and so forth, but you don't know what simplified analytical techniques have done with respect to destroying your apparent margin or making it negative.

And so I don't think you can calculate what your margin really is, you know. It's just that simple.

And to say I can relax a regulation because I think we have margin and then use a lot of qualitative statements about the margin, then I think you're making a mistake.

For example, the decay heat curve in Appendix K, you know, is one example. The curve that is now specified in Appendix K is conservative and causes you to overestimate decay heat production by about 20 percent.

That remains in the rule because there is a suspicion that there is a negative margin somewhere in there, that they need to apply that additional conservatism to counteract, and so I think that you have to really be careful when you start calculating down to the last, you know, tenth decimal point and putting it into the probablistic sense, that you aren't chasing yourself around a tree with your own sword.

DR. HOCHREITER: See, this is where I think that the staff has done a very good job because with the revision to Appendix K, you can use your best estimate method.

MR. SIEBER: That's right.

DR. HOCHREITER: You don't have to use the

ANS-71 decay heat.

MR. SIEBER: Yeah, that's true.

DR. HOCHREITER: You don't have to take that 20 percent penalty. You can use the best data out there, but you have to account for the uncertainty.

MR. SIEBER: And you have to do the analysis in a rigorous, realistic and practical way.

DR. HOCHREITER: That's correct.

MR. SIEBER: And I don't think we know enough about some of the thermal hydraulic phenomena that occur to be able to predict down to a one or two percent accuracy or inaccuracy.

DR. HOCHREITER: Well, we're not going to predict down to one or two percent.

MR. SIEBER: Right, and so what margin -- I don't think you know the margin you have.

DR. HOCHREITER: No, but I think we can do a much better job, and I think that's the trend that we've been moving to in doing these more accurate calculations so that you do get a more accurate assessment of the plant performance, the equipment performance and where you are relative to whatever your criteria is.

DR. BONACA: One thing that I would like

to say about margin is that we're all thinking one way, and by thinking of the margin we have for the double-ended guillotine break, the largest break, and that's the margin we think of, but in reality if you think about it, we have all of this equipment which is ready there to shoot when it's needed, and the way it is set in its target, it's always for the large break LOCA, which means it's set to deal with the largest break in the system.

Therefore, all of the water you've got, you're going to just blow it in. It doesn't matter what break size it is going to be. It's going to start. It is going to shoot for what you think. It's your biggest challenge.

And to that degree we're skewing, in fact, the performance of this equipment for an event that probably is going to be the most unlikely event to happen.

We have to ask ourselves the question of if we were able to tailor the performance of the same equipment to a more flexible defense, strategy so, therefore, for the breaks it seems to be more likely, which have occurred or are likely to occur, et cetera, would you really blow so much water in now or retain the water for later so I don't have to go into recirculation?

I mean, these are legitimate questions that are being asked in the context of this rule change, and I'm saying, you know, we learned that the MI for the first time, that the large break LOCA wasn't the biggest threat, but really we have not put into action the consequence of that consideration insofar as the equipment that we have implemented at this point.

I'm not proposing to remove anything. I'm only saying should we have it set still on that target that is the farthest target, unlikely to happen, et cetera, and what is the price we are paying for letting the equipment work the way it is?

For example, I'm thinking about the Millstone 3 plant with the five high pressure injection pumps; that if you have even a medium size break, it will pull out so much water that you're spilling containment much, much more than you need to put in.

Now, that plant has a huge RWSD, 1.2 million cubic feet if I remember, and it could easily deal with any mid-size break LOCA without ever going through recirculation.

Now, will that save the day for some precirculation issues we have today? And yet right now the plant is set to shoot everything it has as if you had the biggest break.

So I think we have to look at what are the opportunities within a change that one could make that would leave still the capability in place insofar as the pumping capability, but reserved in a way that it will give us the most benefit.

DR. HOCHREITER: I was going to say I think you've got some flexibility now with your best estimate method. You can look at optimizing your injection systems, your accumulators. I mean, the CE plants are at 200 psi. The Westinghouse plants are at 600 psi.

All right. Now, CE plants do that so that they get more water in there for a large break, but then they pay the price when it comes to a small break, and the Westinghouse plants are the other way around.

Okay. Well, who's to say that 400 psi isn't better or two accumulators at 600, two accumulators at 200. I mean, we have the tools that we can use to try to better optimize the system if we so choose, and the utility can also choose to use, again, some of its margin to do this optimization.

The same thing with diesel start time. The utility can choose to do that.

MR. SIEBER: Provided they have them.

DR. HOCHREITER: Well, most would. With a best estimate you would.

MR. SIEBER: Some do; some don't. I worked in a plant that didn't.

DR. HOCHREITER: Well, that might be, but I know that the plants I looked at did.

DR. SEARS: I think that from my perspective, again, as an operator, I like the idea of optimizing to the condition, but I don't like it as an operator action because if there's an event that you're called upon, the operator should be verifying that things are occurring, not doing them.

We have the ability at relatively simple cost in terms of software and hardware, if you wanted to optimize behavior to look at the conditions that are initiating and cause pumps to start or stop, now, it requires the analysis. It requires understanding what the event is and what the symptoms are.

I don't have any problem with that type of optimization. The fact is I think it's beneficial because it prevents some subsequent events that may happen if you put too much water in one place ore too high a velocity.

But I think that's a different issue than saying you're going to do away with the full accommodation of those design bases. The design bases were an attempt to bound what was happening in the hope that if you bounded it, then you were able to cover everything under it. Tuning under that is fully within that approach, but I think we need to be very careful of this business of we're going to do away with that requirement. We're going to have it go away because that would almost guarantee you when you do, our experience says it's going to come bite you, and the tuning is a different matter.

DR. BONACA: Yes, but still if your target is large break LOCA with lots of offset power, you have to start your diesel in ten seconds. I mean, there are still requirements --

DR. HOCHREITER: I don't believe so, but it has to be soon.

DR. BONACA: It has to be soon.

DR. HOCHREITER: But I don't think it has to be ten seconds. I really think if the staff is really worried about this situation what they should do is they should run some analysis, and my guess would be it's the containment that's most limiting because your accumulators are injecting in a large break LOCA for 45 to 50 seconds. Whether you have pumps that are injecting or not probably doesn't matter because it probably spills out the break anyway.

MR. SIEBER: Right.

DR. HOCHREITER: So what you really need are the containment sprays.

Now, plants have fan coolers in there. Well, maybe you don't need the containment spray so quickly, but if a plant only has sprays in the containment, well, then you're probably going to need that diesel to start. And you'd probably need it to start for a steam line break, which is something they're not even thinking about changing.

DR. BONACA: One thing they're concerned with, the change also, is this issue about licensees can come in with their own formula or what they're going to do about specifics and express this as a view, and some of the general broader considerations that we have or the need for automatic actions, for example, the importance of them might be lost in the review process because that's supposed to be.

DR. HOCHREITER: One of the things I was picking up and looking at some of this information is this sump recirc issue, and it's like you're trying or someone is trying to argue out of having to have such a rigorous design basis so that you can extend the systems out, in other words, be pulling suction under the RWST for longer periods of time so that you don't have to go to a recirc. Okay?

MR. SIEBER: Sooner or later you do.

DR. HOCHREITER: I was going to say that issue has to be fixed, period, and it should be totally independent of the design basis. You have to go into the plants and somehow fix that issue. I don't have an answer, but it has got to be fixed. You can't guarantee long-term cooling without it.

DR. NELSON: I understand. I just was expressing the concern that that issue -- you know, we both were working together in the power plant, where, you know, the issue, in fact, the big issue was not this component failed. If everything worked, that was the concern because the RWSP was small enough that if it really worked, you had to go to recirculation in eight seconds -- in eight minutes. And so, yeah, there was a time --

DR. HOCHREITER: That was a pretty small RWST.

DR. BONACA: It was a small RWST and they had, you know, high pressure injection from head injection that just devoured the inventory in no time. So I'm saying that --

DR. HOCHREITER: Well, again, the best estimate LOCA should give you some relaxation.

DR. BONACA: But I'm saying that, you know, some of the issues are pretty complex in the sense of, you know, again, nobody ever thought about that until they got to requesting that issue.

DR. APOSTOLAKIS: You seem to be happy with the margin that is provided by 50.46 as it is now. You also seem to be happy with the possibility of using best estimate calculations.

DR. HOCHREITER: Yes.

DR. APOSTOLAKIS: Mr. Sieber says you cannot quantify margins.

MR. SIEBER: Sometimes.

DR. APOSTOLAKIS: Well, so it comes down to having a great faith in the existing regulation, it seems to me.

DR. HOCHREITER: Well, remember we --

DR. APOSTOLAKIS: And I don't understand the basis for that faith.

DR. HOCHREITER: We have tons and tons of experimental data that we have used to assess these codes. We spent over $1 billion running experiments to assess these codes. So if we did our job right, we should have some degree of confidence in these codes. If we did our job right as engineers, we should have designed these tests reasonably well so that they represent the transients that we would expect the plant to have.

DR. APOSTOLAKIS: And I don't doubt that, but again, you seem to be saying that don't touch it because --

DR. HOCHREITER: Yeah, why through it away?

DR. APOSTOLAKIS: -- it protects us. Well, you can reduce the margins and still use the codes. I mean, it's not -- it protects us against the unexpected.

At the same time, we have found over the last 30 years that it did not protect us against all unexpected things because we were forced to pass rules about certain things.

So why this great faith? Again, I don't want to use "inconceivable," but it stands to reason that there may be too much here and maybe too little somewhere else. Why is it so sacred?

And, again, the arguments you gave me

earlier were essentially we have to be conservative. Well, we all want to be conservative. We all acknowledge that there may be unexpected things. The question is how much, and I don't understand why you think --

CHAIRMAN SHACK: And at what price.

DR. APOSTOLAKIS: What?

CHAIRMAN SHACK: At what price.

DR. APOSTOLAKIS: And at what price? Exactly.

So why do you think that what we have now is enough. In fact, it's so good that we can't even touch it. That's where I get lost.

DR. SEARS: If I may answer that, let me phrase it in a different way. The existing design basis has demonstrated a strong robustness and resiliency both to actual events that we've had, and when we found weaknesses, loss of off-site power and other things, we have then modified, if you will, the requirements. We have continually improved our understanding of the models, and we have continually improved our probablistic risk assessment usage and have not identified any significant, major flaw in that.

As a matter of fact, the PRAs have

demonstrated that, in general the systems as designed, with that general design criteria and implementing things we've learned are, indeed, a robust and resilient system.

That provides to my mind a great deal of confidence that that is producing that type of system and that as we learn more in the future and find new events, whether they be a new physical event, a new management event, a new maintenance event or something else, I have reasonable comfort that that basis is providing that margin and that robustness.

If you start to back away from events that we look at and we say we think this is a bounding event, if we start to come under that, then I do not know how far you go and where you stop, and that's where I find myself becoming very uncomfortable in terms of doing it.

DR. APOSTOLAKIS: Yeah, I believe that's the case. I think that's the same argument that you used against any amendments to the Constitution. Once you start changing it, you don't know where to stop, right?

DR. WALLIS: This is what Larry talks about reduction of margin, I think, too.

DR. HOCHREITER: Well, I was going to say we did cut the design basis. We didn't change the design basis, but we changed how we analyzed design basis.

DR. APOSTOLAKIS: I understand that, and you're absolutely right.

DR. HOCHREITER: And we did that on the basis of improved knowledge and so forth. So to say that we --

DR. APOSTOLAKIS: It's really how much margin and how do you protect yourself against --

DR. WALLIS: So maybe you could help, Larry. You talk about you're nervous that the margin has been reduced too much, right?

DR. HOCHREITER: Right.

DR. WALLIS: And the staff's argument for this change in the rule has really three legs. One is this frequency thing in the 1.174. One is defense in depth, and one is retention of margin. They talk about a principle that sufficient safety margin should be maintained. You know, this is a principle. They're going to do it.

They maintain that they're maintaining margins. You maintain that they're not, and I have to decide who's right. How do I judge? What could I possibly use as a crutch or anything to help me decide who's right?

You say the margin is being whittled away too much. They say we're maintaining it, but nobody gives me any rationale or fact or logical process to judge by. So what should I do?

DR. APOSTOLAKIS: That's why I asked if we were able to quantify --

DR. HOCHREITER: That's why you should listen to us.

(Laughter.)

DR. HOCHREITER: That would be a first start.

DR. WALLIS: Is your guess supposed to be better than their guess? Is that what I see?

DR. HOCHREITER: I guess.

DR. SEARS: Could I give you a practical example? Again, where I worked, we were using PRA as a decision making tool trying to address the very issues that you are bringing up. What's good enough?

We put in place our own safety goal. The NRC had been struggling with safety goals for core melt, large releases, and everything, and they weren't coming to fruition.

We as a management tool put that in place as part of our procedures, and we used that then to look at modifications and other activities to find out did it change the predicted frequency of events. If it did change it, was it positive or negative? Did it challenge the safety goals we had established?

We ended up with a whole series of design changes to lower out frequency of events because the units, as we analyzed them didn't meet our own internal goal.

We also used it to go to a major battle with the NRC when they asked us to make some changes on a BWR that increased our risk, which we didn't think were right. So we utilized it in both directions, but we put in place a tool for us to make that decision.

DR. WALLIS: Was this a tool that measured margin or did it measure sort of sort of core damage frequency?

DR. SEARS: We basically reached a decision in terms of core damage and of early release that we said we believe in our limited view this was an acceptable --

DR. WALLIS: But didn't address this question of margin.

MR. ROSEN: No. It addressed delta CDF.

DR. SEARS: But we used that as a marker.

Where were we with respect to that? If we were above that, then we had to take action. The corporate policy said we had to go take action to bring ourselves to increase our margins.

DR. WALLIS: Maybe the NRC should be arguing that LERF and frequency of pipe break and all of that stuff is enough. Forget margin. We won't even talk about it because that's not the basis for our decision, but when they start saying that it's the principle, then I have to have some argument.

DR. APOSTOLAKIS: It's the principle of maintain sufficient margin, not maintaining the margin. Sufficient margin.

DR. WALLIS: Who me why it's sufficient.

DR. HOCHREITER: Yeah, it's very difficult to define "sufficient."

DR. APOSTOLAKIS: It's sufficient when we say it is.

DR. WALLIS: But as soon as it's a tool for judgment, there has got to be some rationale.

DR. APOSTOLAKIS: Absolutely.

DR. HOCHREITER: Some of the examples that were cited today, I mean, are achievable now under 10 CFR 50.46. It really just depends upon how you want to do the analysis, and you should be using a best estimate tool to do the analysis.

One of the things that really bothers me is that when you go to these breaks above the transition break, okay, now you're taking things out of the system or you don't have to consider loss of off-site power, you don't have to consider single failure. Okay?

DR. APOSTOLAKIS: Let me give you another example.

DR. HOCHREITER: Well, wait a minute.

DR. APOSTOLAKIS: I'm sorry.

DR. HOCHREITER: Now, that's your worst situation. So why would you eliminate those things for that worse situation?

The thing that bothered me more is that you now would be analyzing this at some nominal tech spec value, and I don't really know what that means.

DR. WALLIS: You obviously are eliminating it for your worse situation because if you don't do that, you don't get anything.

DR. HOCHREITER: Well, yeah, apparently. So to me there's a very large disconnect between the way you're going to do the analysis for the breaks above this transition break and the way you're going to do the analysis for the breaks that are smaller, and the ground rules and the acceptability for the analysis for the larger breaks, I mean, I don't think they've thought this through. I don't think they've had the time to think it through, and I would be very worried that they're going to get themselves into a situation where you don't have a database to judge the adequacy of a model or whatever core coolability means or anything.

Right now we have a very -- at least I do -- have a very crisp idea of what core cooling means in a coolable geometry. It's a rod bundle. It may be a little squirrely, but it's a rod bundle. Okay?

MR. SIEBER: It's intact.

DR. HOCHREITER: Yeah, it's intact. It's in sort of one piece. Okay?

You start looking at some of these transients that go to high temperatures, and you don't have to go much above 2,200 degrees, and you don't have a rod bundle anymore. I'm afraid they're going to have a problem with this.

DR. WALLIS: When it comes to the reg. guide, they've issued some sort of hopeful statement. Is that what you're saying?

And when they get to the details, they're going to have a problem with it?

DR. HOCHREITER: Yes, I think they are, and I think whoever tries to apply this is going to have an equal problem.

MR. SIEBER: Well, if you're going to give away --

DR. HOCHREITER: And I don't think it's necessary. This is an unnecessary exercise, and I think we're yo-yoing the staff, and I think we're going to wind up yo-yoing the industry for an unnecessary exercise.

The way 10 CFR 50.46 is specified now with the allowance of best estimate methodology, you get credit if you do a better job, and this is the way the incentive should be. Leave the design basis alone. Leave the requirements and the criteria alone. Improve your methods. You get margin.

MR. SIEBER: That's true.

DR. APOSTOLAKIS: That makes much more sense.

DR. HOCHREITER: Well, that's where we are. WE don't need to change a thing.

DR. APOSTOLAKIS: Just as a final comment from me at least, I remember someone once saying that, well, you love it.

DR. BONACA: I like your statement that it is a final comment.

MR. ROSEN: Yeah, we're sure this is a final comment.

DR. APOSTOLAKIS: From me, from me.

MR. ROSEN: Promises, promises.

DR. APOSTOLAKIS: Is the cost of the containment one of the more significant costs in building a plant? No?

MR. SIEBER: It's up there.

MR. ROSEN: And it's much more robust than what it gets credit for.

DR. APOSTOLAKIS: Yeah, why according to prevailing belief, I guess, it would withstand maybe pressures up to 130, 150 psi.

DR. HOCHREITER: That's failure, failure.

DR. KRESS: It's PWR, with large, dry containments.

MR. ROSEN: Large, dry containment failure pressures.

DR. APOSTOLAKIS: And what's the design pressure?

MR. ROSEN: Fifty-five, 56, 60.

DR. APOSTOLAKIS: So why? It is not over designed or you don't think so.

MR. SIEBER: No.

DR. APOSTOLAKIS: So you can be over conservative an waste money here and there, you know, by just being too prudent. See, that's a fundamental problem with this, that there is no way of quantifying how much is enough.

I agree with Professor Wallis. I have two complete reviews, and I have now to look at your face and the other guy's face and say, "Well, I go with him."

DR. HOCHREITER: Thank you.

(Laughter.)

DR. HOCHREITER: I think you've got to look at the containment more generically though because there are this leakage requirements that you've got to meet.

MR. SIEBER: That's right.

DR. HOCHREITER: There's testing requirements that you have to meet as well.

DR. KRESS: And there's equipment qualifications.

DR. HOCHREITER: I mean there's a reason why there's more margin in containment.

DR. APOSTOLAKIS: Until the Zion and Indian Point PRAs were done, given a core melt the assumption was that there will be release. It was the first PRAs that showed that it's about one in ten that the containment will fail because we looked more carefully.

The experts looked at it. They studied it. They said, "Well, for heaven sakes, you know, this is going to fail."

So there is a message there, it seems to me. Now, before the Zion PRAs, let's say in 1977, if anybody had said let's do something to reduce the margin of the containment, maybe we would have heard the same arguments. "Oh, no, the containment," this and that.

And then you do more analysis and you realize that, yeah, you have a hell of a lot of margin that maybe you can afford to reduce it a little bit.

So you know, there are examples on both sides. I mean, you can be overly conservative at a great price. I mean, if it was just being conservative I wouldn't care, but --

DR. BONACA: Well, you can be less conservative at a great price, too. I mean, I come from a town --

DR. APOSTOLAKIS: That's why it's a dilemma.

DR. BONACA: -- in Hartford where in 1972 because of the seven inch snowfall the civic center roof collapsed. Thank God everybody had gone home. Okay? And I'm only saying that that is an example. And then when they investigated that, there was, you know, a lot of discussion about the refinement they had gone through in the --

DR. APOSTOLAKIS: That's why it's a difficult problem.

DR. BONACA: I agree with you on that.

DR. APOSTOLAKIS: I mean otherwise we would always be conservative or always be optimistic.

CHAIRMAN SHACK: Any more final comments before we take a break?

DR. APOSTOLAKIS: Yes, we should take a break.

CHAIRMAN SHACK: Take a break and come back at 3:30.

Thank you very much.

(Whereupon, the foregoing matter went off the record at 3:11 p.m. and went back on the record at 3:34 p.m.)

CHAIRMAN SHACK: Before we broke there was some question this morning that we wanted to hear a little more about the transition break size and that choice and perhaps some additional question on the analysis methods and I just wanted to check with the committee. It seemed to me that it was clear that there were questions on the transition break size so I was going to hold that one second. We have an awful lot of analysts here, so do we have any more discussion we need on that? George?

DR. APOLTOLAKIS: One final comment.

CHAIRMAN SHACK: One final comment?

DR. APOLTOLAKIS: If we were to identify the major difference between below TBS and above TBS, what would that be? Would it be the absence of a single-failure criteria. That's really the key.

DR. KRESS: Absence LOOP is just as significant.

DR. BONACA: Just as big.

DR. APOLTOLAKIS: Absence of --

DR. KRESS: You don't have to coincident.

DR. APOLTOLAKIS: So those two.

DR. KRESS: Those two are the major ones.

DR. SHERON: I think what's going to happen is --

DR. APOLTOLAKIS: And the reliance on equipment that is tested -- only safety related, not all equipment, right?

DR. SHERON: I was going to say that my

feeling is, is that when a licensee does an analysis, for beyond the TBS break size using best estimate methods nominal boundary and initial conditions and so forth, I think what ultimately you're going to see is that the small break is probably going to become the driving peak clad temperature. In other words, you're not going to be large break limited any more and when you start taking advantage or if a licensee decides to take advantage of that margin by either increasing the linear heat generation, increasing -- you know, for peaking factors so they're not peaking factor limited any more what they may stop seeing is that the small break is actually going to limit them.

DR. KRESS: And it would probably be in the 17-percent oxidation.

DR. SHERON: Yeah, it's possible, yeah. Yeah, so I think that's really what the major difference is going to be if a licensee goes to use it, if that helps.

DR. APOLTOLAKIS: Okay, so beyond TBS, small LOCA will be the --

DR. SHERON: No, if you go to 50.46A as -- if you use that option, okay, to analyze your plan and to take advantage of the margin that you might gain, what you'll see --

DR. WALLIS: What do you mean by margin? You mean margin in terms of degrees?

DR. SHERON: The large break will probably not become the limiting parameter, the 2200 degrees.

DR. WALLIS: So by margin you mean the difference between the temperature you calculate and 2200. Is that what you mean by margin?

DR. SHERON: Yes.

CHAIRMAN SHACK: Your allowable limit.

DR. SHERON: Yes.

DR. KRESS: And the 17 percent.

DR. WALLIS: Or the 17 percent.

DR. SHERON: Yeah, I think what will ultimately -- if licensees start to use that, take advantage of that, I think what will drive it then will probably be the small break or possibly other limits like DNBR or perhaps the steam line breaks.

DR. WALLIS: So 2200 is retained and the and in the document everything just became coolable geometry and 2200 was thrown away from beyond that.

DR. SHERON: Yeah, but let me explain because there's this thing about, that, you know, all of a sudden it's coolable geometry like, you know, we're going to just let the core partially melt or something. That's not the case. What we're saying is that today, the only way we know how to define coolable geometry is 2200 degrees and 17 percent oxidation.

DR. KRESS: That is the definition.

DR. SHERON: Right. What we are doing in the beyond TBS, okay, is saying that if a licensee wants to come in and provide a technical basis, defensible basis with data or whatever, that says for whatever reason they can go above those parameters and still show that they can reflood the core and cool it in a coolable geometry, we will review that and if found acceptable, we would accept it.

DR. WALLIS: And the coolable geometry must mean without damage and without release and all sorts of stuff. We've got to define this coolable geometry in a meaningful way.

DR. BONACA: I thought what Hochreiter said, that it looks like a bundle.

DR. WALLIS: And has it released any --

MR. LANDRY: Graham, it's Ralph Landry again. We still mean by coolable geometry something that looks similar to a rod bundle, the same kind of thing that Larry Hochreiter was saying, we don't mean core on the floor as a coolable geometry. Now, even in today's LOCA analysis, and we say coolable geometry as being a rod bundle. That rod bundle though will still be ballooned, can be ruptured under a large break LOCA today and still meet the 2200, 17 percent limits. We're still saying that.

Coolable geometry would be something that resembles a rod bundle. They may be ballooned, they may be ruptured, but it's not core scattered all over the bottom of the reactor vessel, rubble.

DR. WALLIS: No, but you can't say it's neither an elephant nor a mouse. It's got to be something in between. I mean, what is acceptable is going to be 2200?

MR. LANDRY: Today, what Brian has just said is that from what we understand today, we have to define coolable geometry outside of the rule itself ad meaning 2200 degrees Fahrenheit, 17 percent oxidation. Now if the licensee --

DR. WALLIS: It's a default value sort of thing.

MR. LANDRY: If a licensee has other data to demonstrate that they can use 2300, 2400, some other percentage oxidation, then --

DR. WALLIS: What would be the criterion for determining that it still looks like -- sufficiently like a rod bundle?

DR. KRESS: If the clad has ductility.

DR. WALLIS: If it has what?

DR. KRESS: If it has ductility, then this is --

DR. WALLIS: So it still has ductility.

DR. KRESS: I think that's the main criteria and I don't think you're going to achieve that with a small break LOCA.

DR. WALLIS: The clad is still intact and it has ductility.

DR. KRESS: If it has ductility, it's still intact.

DR. WALLIS: If it's still intact and it has ductility.

MR. LANDRY: The 17 percent and 2200 degrees will give you sufficient ductility in the cladding that you can reflood it without shattering the cladding.

DR. KRESS: The small break LOCA is going to almost invariably get you to that 17 percent limit, that's my feeling.

MR. LANDRY: That is --

DR. KRESS: And I don't know how they're going to use any margin at all. If the small break LOCA is going to be the thing that determines, then they're going to hit that 17 percent limit without -- they'll have to have a pretty substantial ECCS to keep from having that.

MR. LANDRY: That is why under the new rule we wanted to put not only reporting requirement on temperature, but a reporting requirement on change in maximum local oxidation. Now, you have to remember that those numbers are the sum of the absolute values of, so that whether you agree with the .4 percent or you think it should be .5 percent or whatever, we don't want to argue the exact number. But our feeling was because under these conditions you can sit at a moderately high temperature for an extended period of time with these smaller breaks, that not only does temperature have to have a reporting requirement but also change in local oxidation because we're recognizing that you can oxidize considerably more under these conditions.

DR. KRESS: Yeah, there's some question in my mind as to how good the 17 percent is for the small break LOCAs, so I have a little bit of a issue --

MR. LANDRY: But that's a different question.

DR. KRESS: Because is really wasn't derived with the conditions of the small break LOCA in mind. It was derived on the basis of --

MR. LANDRY: But you have to also remember that at this point in time, research has an extensive fuel performance program underway.

DR. KRESS: Yes, that's right. And so you may come out with a different value than the 17 percent.

MR. LANDRY: That information, from what we have been told, will not become available until September of 2005. So we did not want to preclude the work that research is doing by changing those numbers at this point.

DR. KRESS: So that may impact what we think is coolable geometry depending on what kind of results you get for that.

CHAIRMAN SHACK: But the rule doesn't build those in unlike the current rule. I mean --

DR. KRESS: No, it just says coolable geometry. I think that's a good thing to do.

DR. SHERON: We don't know what coolable geometry is but we'll know it when we see it.

DR. KRESS: You'll know it when you see it.

DR. SHERON: Is that a good way to put it?

DR. KRESS: I think that's really a good

idea.

DR. WALLIS: This is another vague thing, it's like --

DR. SHERON: No, no, it's not Graham. What we're saying is that right now, we don't know of anything other than 2200 because, you're right, if I don't have a ductile cladding when I reflood the core, then if I shatter the clad, I've got a pile of pellets somewhere, all right. If a licensee is going to say I've got a pile of pellets somewhere, then they're going to have to show where those pellets go and why those pellets can still be cooled and are not going to continue to melt and go down and form a, you know, whatever. And that's going to be an impossible job.

DR. WALLIS: So a pile of coolable pellets would be acceptable if you could show they could show they could cool it?

DR. SHERON: If they could predict.

DR. KRESS: They'd have to have a lot of data and experience.

DR. SHERON: Right, if they could predict that they could always cool it or had high confidence that they could predict and you know that's not going to happen.

DR. WALLIS: I have no idea what's going

to happen.

DR. SHERON: Right, now --

DR. KRESS: What's going to happen is they'll stick to the ductility.

DR. SHERON: All we're saying is that if a licensee, for example, ran some experiments, maybe they have some other -- on their cladding or something and --

DR. KRESS: In the plant.

DR. SHERON: Yeah, and maybe they come up and they say we can live with 2300 and we have some data that says we can go to 2300, we're not going to preclude that. All we're saying is we want to leave it open that if a licensee can come in and provide some data. We'll look at it and we'll review it, and if they can show that they can still cool the core, then we'll accept it.

DR. KRESS: That's what we used.

MR. SIEBER: But to do that, you'd have t go back through all the 1970s FAC data to see if it's consistent, I would think.

DR. SHERON: Oh, you mean from the --

MR. SIEBER: From the hearings.

DR. SHERON: -- from the hearings?

MR. SIEBER: Yeah.

DR. SHERON: I think we'd probably have to take that data into account, I still have to make sure that we're not -- you know, that it's consistent with that data.

DR. KRESS: Were we going to talk about the selection of the --

CHAIRMAN SHACK: Steve has a comment he wants to make.

MR. ROSEN: Yeah, the Commission has asked the staff to consider risk informing 50.46 and the staff has done that for just let's focus for a moment on PWRs, pressurized water reactors for greater than 14 inches, those are the less risk significant breaks. There were larger breaks but they're less risk significant because they're the product of probability and consequences is lower for those breaks because of the probability is quite low. So for those we end up with two regions at breaks of 14 inches and everybody agrees, I think that for the breaks that are smaller than that which are the likely breaks, we're not going to change anything. So the focus is on the larger breaks, the breaks larger than 14 inches in PWRs.

Then you start to argue about what do we do for those bigger breaks. Let me offer you a possible way to think it through, which comes from my experience of dealing with 50.69, where the analogy, I think it's almost perfect that we in 50.69 divided the population of components into those that are risk significant than those that are not. And it turns out that 90 percent of the component turned out to be not risk significant or low risk significant and only 10 percent of the components were judged to be risk significant and for those we said, well, we're not going touch any of the requirements. We'll just do a safety related components have always required.

For the other 90 percent we said, well, we'll do less. Well, what's less? And that turned out into the famous treatment arguments, how are you going to treat the non-risk significant. And we chased each other around and around the flag pole for quite a long time on that. We ultimately concluded, I think that it really didn't matter much because that's the -- there wasn't much risk in that population although there were a lot of them, there wasn't much risk in that population.

So it was left in that case, to the licensee to determine how to treat those components. Usually standard industrial treatment was good enough. Clearly licensing was not going to take those components out of the plant but -- and he wanted them to run. And he wanted them to be functional, to meet the functional requirements so it would be done in a way but with less documentation. There would be less assurance of that functionality than there would be but the functionality would still be there.

DR. KRESS: I see --

MR. ROSEN: So by analogy now, for the breaks that are larger than 14 inches which are less risk significant. Can we not find a way to agree that for those breaks there must be some way to do the analysis that we can all agree on that's less stringent than for components that are risk significant because the outcome is not likely to matter very much because the risk is low for those components.

DR. KRESS: There's a weakness in your argument.

MR. ROSEN: Okay.

DR. KRESS: And it goes like this; the contribution to risk of having given break size and design basis accident is not the risk of that sequence in a PRA. This contribution to risk is how it effects the plant's design because you have to accommodate it and I don't see any connection -- I don't see that I can add -- a priori say that break sizes above 14 inches have less contribution to risk. Just because they don't have any risk to the LOCA sequences, they might have risk to all of the other sequences because the plant has to accommodate them, therefore, they're accommodating other sequences similarly.

So I don't think a priori you can make the statement that those sequences, that those break sizes above that have less risk to them, have a less risk significance. That's the weakness I see in your argument.

MR. ROSEN: I don't follow your argument, Tom. I respect your right to make it but I really don't understand it.

DR. SHERON: Let me give you my classic example that I've used and that is that a licensee decides to adopt 50.46A. Somewhere down the road they go down in the basement of the plant. They found out they got some spalled concrete, okay, on the containment. So the wall is a lot thinner. And they go, "Oh, but I've just reanalyzed my LOCA and in the best estimate now, my peak containment pressure is only 40 pounds and I can go do an analysis and I can show that I don't need a 55-pound containment any more, I need a 40-pound containment because I've got a lower mass and energy release, et cetera, et cetera. That is not necessarily acceptable because when they do the risk assessment, they have to go and they have to look at up through late containment failures, okay, and say have I changed the late containment failure probability because I now have a weak point in my containment. Only if they can show that they have not effected the risk associated with late containment failure, would that be acceptable. Otherwise, they'd have to go in and fix that concrete.

MR. ROSEN: So coming back to Tom's argument, you have to analyze the effect on all the sequences.

DR. KRESS: That's right.

MR. ROSEN: And I agree with that, I don't disagree. Maybe it's just a question of talking it out. I think that's so and I think even though, I don't think that changes my result in my logical argument.

DR. KRESS: I think the risk analogy is real good. I think your statement about how to think about it is still okay.

MR. ROSEN: Okay, and I would agree with your point that when you come to my argument and the penultimate statement in my argument is, now, okay, then the outcome is not likely to matter much for all the breaks greater than 14 inches in a PWR as long as you consider all the sequences or the whole risk analysis, not just -- don't focus on just one and it was in my mind --

MR. ROSEN: See, that's what you did when you did the risk importance thing with the sequences. You considered all the sequences and we considered all operating modes and that was why we had an expert panel because the PRA didn't include all that and the expert panel would get the results from the PRA and it would say, yes, but we're going to make that risk significant anyway because even though the PRA doesn't show it, that particular component is important to containment failure or a shut-down risk or something else.

So a number of components ended up in the high risk category when the PRA would only support low risk. So I think you need to say, yeah, for the 14 inch and greater breaks and PWRs you can make an argument, construct a system in which you can do less because the outcome is not likely to matter much as long as you consider all the risks that are dealt with, all the dominant sequences across all the operating modes.

DR. KRESS: Well, I think that’s almost an impossibility.

DR. SHERON: That’s what you’ll hear tomorrow.

DR. KRESS: I think that’s almost an impossibility but I think it’s done in an incremental way when they require the 1.174 process.

MR. ROSEN: I don’t agree it’s impossible but I agree --

DR. KRESS: What they’re doing is they’re controlling the effect on risk by doing the 1.174 process.

MR. ROSEN: Right.

DR. KRESS: And I think in essence, in principle it amounts to about the same thing you’re talking about and I -- you can’t a priori to start say all right, I’m going to change my treatment of the above TBS and say now what’s that effect on the rest. You cannot do that. You just cannot make that judgment but you can control its effect on the risk if you use the 1.174 process. That’s why I’m insisting on that being as part of the rule. You can’t make any judgment on what effect you’re having on risk ahead of time. That’s our whole problem. Now, you can determine what effect you have on risk due to the set of sequences called LOCAs, but that's not the whole risk.

MR. ROSEN: No, you have to consider all the risks, all the risks and that's the job of the expert panel and the staff. Now you're not going to get it perfect. What we've learned in writing one of these things, when I say "we", the people who are doing that, is you learn more every time you analyze another system. You get another set of insights. And so it's an interim process. It's a learning process. But at no point is there -- is there a -- it's under control, the risk is under control as you're doing this. And I think the same thing can be said about an approach like that for 50.46.

MR. BARRETT: Could I ask about the implications of that proposal, this is Richard Barrett with the NRR, in terms of how it would differ in the way in which we would like to approach it because I'm not sure I fully understand what you're proposing. If you -- if you went to a 50.69 like process, and you took these technical requirements in 50.46 and treated them or gave them the regulatory treatment that 50.69 gives you for treatment requirements, I think that's what you're proposing, would it then essentially take away a lot of the staff's involvement in the thermal hydraulic calculations as well as the staff's involvement in decisions that are made down the road, for instance, changes in the design, vis-a-vis, our proposal?

MR. ROSEN: I don't think it necessarily would do that because in 50.69 what we're talking about was individual components -- decisions about individual components and in 50.46, we're talking about more significant matters than that. And so I'm not sure -- I know I'm not advocating that you take 50.69 like processes and just blanket and print them on 50.46. I'm simply saying that in general terms, one should think about the 50.69 process which said for the non-risk significant breaks, or non-risk significant components, re non-risk significant breaks in 50.46 that to do too much puts all the emphasis where there is the less risk and that's backwards.

And so just that's the whole message, how you do that, which is what you were getting into, is up to -- should be up to this staff. And I had maybe an argument between the staff and the industry about how far to go on pulling and tugging about how far to go, but recognizing that the 50.69 process shouldn't be imprinted 100 percent on the 50.46 process, just the general concept.

MR. BARRETT: I guess what's got me thinking about this is that when we started down the road of the 50.69 process which was piloted at South Texas as an exemption.

MR. ROSEN: I'm fairly familiar with it.

MR. BARRETT: I know you are, I know you are. I think what was the key departure in 50.69 was that if you were to use the license -- the risk informed licensing action process, you would have 90,000 risk informed licensing actions. And so you needed -- if you were going to get however many pieces of equipment we're going to go into this risk 3, you basically had to go for a process that put -- that allowed the licensee to exercise a process if they met certain quality criteria for their process and for their PRA.

And so the process that we're proposing here for 50.46A is a very much of a Reg 1.174 type process where each individual decision that a licensee makes unless it's inconsequential. It has to go through a staff review process. And when you bring up the analogy with 50.69, it makes me wonder if you're proposing a processing which a licensee gets the opportunity to make decisions within 50.46A without the staff's input.

MR. ROSEN: No, Rich, I am not.

MR. BARRETT: Okay.

MR. ROSEN: I think the staff should be involved in each of those decisions because we don't have 90,000 of them to make on each, but all I'm suggesting is that the licensee and the staff should understand that to the extent that they use move of their time talking about how to treat breaks larger than 14 inches on PWRs, you're working on the wrong end of the problem.

MR. BARRETT: Well, we tried to -- I mean, the real question is going to be did we -- we think we reflected that in the proposed rule by the reduced analysis. In other words, I think Jennifer said, you know, we're not going to spend as much time reviewing the computer codes, we're just going to focus in on just the major phenomena. We're not going to go into the secondary phenomena like, we're giving credit for non-safety related equipment if it can be shown to perform during the event.

We're not, you know, requiring all of these, you know, conservative assumptions be piled one on top of another, you know, which we felt was reflecting that type of philosophy that because the risk of these -- the probability and the risk from these events are much lower, we don't need to have as rigorous a treatment of them in the regulatory process.

MR. ROSEN: Yes, and I see that, Brian. I think that's right. I'm not going to judge sitting here whether you've gone far enough or too far. I think you have, at least embodied the beginnings of that principle and as you go through the remainder of this discussion and before the rule becomes law, and before that is actually implemented, you just need to keep that in focus.

DR. BONACA: I think I want to say that I'm concerned beyond transition break size, still I want to see demonstration that the capability of the system exists and I believe that already the single failure increased the criterion not being applied, no power consideration applied. I believe still that the method should be consistent with what they're doing best estimate. Now, I agree that the review of the staff to not to be a total problem but the expectation should be on your part that the work still, it's a proper, this is yes, model and the proper modeling of the transient. I would expect that you would expect that.

DR. SHERON: We don't envision the

licensee, I mean, are going to go out and develop all brand new best estimate models that have to go through this rigorous review. They've already got best estimate models. Okay? And we expect that they will probably just use those models.

DR. KRESS: Let me give you another view of this. I think in essence what we're doing is taking something out of design basis space and putting it into what we generally call severe accident space. You already deal with severe accident space in a way that's consistent with what I hear you saying now. You're treated with -- you don't have to -- you use conservative approaches, you use defense-in-depth. You use accident management. You use sort of best estimate type analysis to deal with it.

I think that's what you're saying. We're just changing our design basis face. We're moving part of it into severe accident space and you're going to treat it in a consistent manner that you've treated severe accidents in the past.

DR. SHERON: I would even use the word severe accident because --

DR. KRESS: I know but you've moving it out of the design basis space.

CHAIRMAN SHACK: This is truly a defense-in-depth consideration.

DR. KRESS: A defense-in-depth, that's the way I look at it. I look at it as defense-in-depth.

DR. SHERON: We're still requiring that even up to the doubled ended guillotine that it doesn't produce any core melt.

MR. ROSEN: And I think the analogy of 50.69, this discussion in 50.69 was about functionality. Even though it's not risk significant, we still want these things to function. We want the pump to start if it's a pump that starts now. We want it to run and meet its objectives and the only thing we're changing is how much you have to do to prove to use a priori, the assurance of that -- that that will be happening and how you have to do that. That was what was changed in 50.69 and that made all the difference. That made everything come together for the licensee on the value of 50.69 and perhaps that will be important in the 50.46 issue as well.

I'm not sure, I just don't have as good a view of it. I mean, it's in the future.

DR. BONACA: But I believe that you said this morning, Elizabeth, right?

DR. UHLE: Jennifer.

DR. BONACA: All right.

DR. UHLE: Queen Elizabeth, I'll take.

DR. BONACA: All right, I believe you said it's not part of the design basis, but part of the licensing basis, right?

DR. UHLE: It is -- I mean, the way we're looking at it it's part of the licensing basis of the plant. We say design basis of the plant, the design basis accident in the standard review plan definition.

DR. KRESS: You're creating a new category.

DR. UHLE: You could say that.

MR. KELLY: What it means is you're not going to have to have safety grade equipment to take credit for the -- I mean, that's the big difference between being here at the design basis accident, you have to use safety grade equipment.

MR. ROSEN: There's a whole lot of safety grade equipment in the plant that works just fine, non-safety grade equipment that works just fine.

MR. KELLY: I know that.

MR. ROSEN: And that was the same argument we used on 50.69.

DR. KRESS: Most of the equipment is also used for the design basis accidents, so they're already safety grade anyway, some of them.

MR. ROSEN: The cold feedwater train is not safety grade.

MR. KELLY: This is Glenn Kelly from the staff. I spent some time working on 50.69 as well as 50.46A and I just wanted to maybe compare a little bit between the two because while there are some similarities, there are also some very significant differences in their application. Under 50.69 as Dr. Rosen said the equipment has to continue to be functional. That's not true under 50.46A.

It may be that it turns out that for the breaks beyond the TBS that it's going to allow me to take equipment entirely out of service, valve it out of the plant, literally cut it out of the plant possibly.

MR. ROSEN: Not without your approval.

MR. KELLY: Well, if they could show that it was -- it had an inconsequential -- if they could show that valving, cutting out an accumulator had an inconsequential effect on risk and didn't effect my defense-in-depth arguments or things like that, then they might potentially be able to do that. I might have a hard time swallowing that if I was going to be reviewing it but, I mean that's a potential thing.

MR. ROSEN: It's up to you, Glenn.

MR. KELLY: Under 50.69 you have the -- we had a peer rate where we had low uncertainty and initiating event frequencies we're talking about, we understood things that were -- events that were being mitigated by these Category 3 pieces of equipment. We had a well-founded basis for the frequency of events. We do not have such a situation for 50.46A. There are very large uncertainties associated with what reality is as far as what is the frequency of those extremely large breaks.

50.69 had continued to consider single failures, loss of off-site power, and as I mentioned the design basis actions here could only take credit for safety grade equipment when you were doing your Chapter 15 analysis. Here we would not prefer breaks beyond the TBS, we're not considering single failure, we're not considered loss of off-site power and I'm taking credit for all reliable systems in the plant, not merely those that are safety grade. So while there are a lot of parallels between the two, I think that as you probably realize, there are many, many more flexibilities available to you under 50.46A than you have under 50.69.

DR. BONACA: I thought the first statement you made about the ability of removing a C tank for example, being consistent with your original SRM that you received. I believe the original SRM said that you would have to keep the equipment that you have in the ECCS system and in fact, restore it. This information shows that, you know, your estimations have changed.

MR. KELLY: We've had a series of SRMs on 50.46A.

DR. BONACA: I understand.

MR. KELLY: And I believe in our latest understanding of what's being proposed is that the potential would be for a licensee to remove it with the understanding that if -- without having to go through the backfit rule, if circumstances change or analysis things said otherwise, they'd have to go put it right back in the plan if something came up that showed that they shouldn't have taken it out.

DR. SHERON: We don't think any licensee is going to physically go in and tear stuff out of their plant. As Glenn said, I can envision, for example, a plant with four accumulators, you know, perhaps demonstrating that they can mitigate up to the double-ended guillotine with say three accumulators, okay, and they may not even say I'm going to valve out that accumulator, but what they may do is they may want to, for example, propose a tech spec that says at any given time they can have one accumulator out of service, okay, and still be okay.

MR. ROSEN: And then you can say in the tech spec, you could say, sure for 30 days or something like that. I mean, you can set time limits or any other constraints.

DR. SHERON: Well, we'd have to have a basis. I mean, if they showed that you know, they met all of the Commission's rules and regulations with three accumulators, I don't know what basis we would have to say that they could -- unless there was some other accident, some other event, that from a risk standpoint you needed that accumulator for.

MR. ROSEN: You'd have to consider all the sequences.

DR. SHERON: Exactly, exactly.

MR. SIEBER: But it would have to be a design basis event to require them to have it.

DR. KRESS: No, they can require them based on substantial improvement in risk.

MR. SIEBER: And usually with accumulators, it's either a level problem or a pressure problem and it just drifts out of the tech spec range and then it's inoperable.

DR. SHERON: At the risk of delving into an area I probably don't want to right now, but adequately protection, which is the finding we have to make, we define that as meeting the -- it is assumed you have adequate protection if you meet the Commission's rules and regulations and there is no undue risk, all right. It's two criteria, all right?

We normally just use the first one, which is if you meet the Commission's rules and regulations, we assume then you meet the adequate protection standard. We had a situation a couple years ago with Callaway on the electrosleeving issue where they met all the Commission's rules and regulations but with regard to the material they used for the electrosleeving, the nano-crystalline nickel, it turns out that stuff started to fall apart, okay, when you got at severe accident temperatures. And so the concern was, is that if I had a severe accident, I would lost the steam generator integrity that was being insured by these repairs and I would basically have now a larger early release.

And when we looked at it we said, even though they meet all the Commission's rules and regulations, there may be a under-risk and we agonized over that. We ultimately allowed Callaway to put the electro-sleeving in and it was based on the fact that they had a very low, I think it was early release probability, core melt and their overall risk was low enough. My understanding was that Beaver Valley was also prepared to use the electro-sleeving, but they had a much higher core melt. And we just kind of said we didn't think they were going to pass that test of undue risk and they never came in.

There was a Commission paper sent up which I think was referred to earlier. I think actually Peitrangelo talked about it, yeah, which said that if the staff believes that there is a risk issue even though someone meets all the Commission's rules and regulations, we can -- you know, we can not approve something.

DR. KRESS: I'd be very disappointed if you couldn't.

MR. SIEBER: Well, the basic equipment set you use to mitigate a small or medium LOCA is pretty close to the same as what you use for a large break LOCA except for set points and flows and so the equipment -- you're saying no?

MR. KELLY: No. This is Glenn Kelly from the staff. One example is for small breaks aux feedwater is a very important one or you pour small breaks on a pressurized water reactor, your RHR pumps only provide you with a benefit under long term cooling and once you've gotten a recirc if you have to go into the piggyback mode to provide flow.

In a boiler, where you can depressurize, basically, any of those systems that can provide adequate flow will be helpful but for large breaks your -- probably your HPCI and RCIC would not provide adequate flow to handle that and you'd be depending on your RHR pumps only for providing you with adequate flow for the core.

MR. SIEBER: Thank you.

MR. ROSEN: I've had my say.

CHAIRMAN SHACK: Do we want to move onto the transition break size and the discussion of that a little bit more?

DR. APOLTOLAKIS: Oh, discussion, I thought the frequency.

CHAIRMAN SHACK: Well, the frequency, yes, a discussion of the frequency, George, is what I had in mind.

DR. APOLTOLAKIS: Not the presentation.

CHAIRMAN SHACK: The presentation we've already had.

DR. APOLTOLAKIS: We did, when?

DR. WALLIS: We had the change of frequency presentation.

CHAIRMAN SHACK: This morning.

DR. APOLTOLAKIS: What is it tomorrow? I thought you were moving up --

CHAIRMAN SHACK: Tomorrow is risk informed evaluation of the acceptability of plant modifications.

DR. WALLIS: Well, couldn't we discuss why six inches is not acceptable?

CHAIRMAN SHACK: Yeah, I think that -- that was your question, George, was we wanted to go over the basis for the 14-inch break size again in a little bit more detail.

DR. APOLTOLAKIS: Yeah. Okay, I have some questions. I have lots of questions. But we're going to meet -- well, it's up in the air now, I understand but we were planning to meet on November 16th. We're still planning to?

CHAIRMAN SHACK: Yeah, that was to discuss the -- you know --

DR. APOLTOLAKIS: The expert opinion.

CHAIRMAN SHACK: -- the expert opinion. At the moment, you know, let's assume we can believe the expert opinion. We'll take that --

DR. WALLIS: We'll never believe it, we can accept it.

CHAIRMAN SHACK: We can accept it.

MR. ROSEN: For the nonce but --

CHAIRMAN SHACK: You know, with the expert elicitation in hand, what do you do to choose a break size?

DR. APOLTOLAKIS: Ah, okay, let's go to that. Nobody else has a question, right? Well, you know, I read this paper that's SECY 04-0060 and it's interesting. As I said -- well, I guess the fundamental question is if the experts -- first of all, the distribution of the expert opinions in my mind does not reflect the expert-to-expert variability. You guys took the meeting -- but that's for November 16th. It does not reflect that.

So then you looked at the distribution and you said, okay, the medium value -- and I wish I could find it, the median value for PWR is 5 or is it 8? Where the hell -- are you taking that down? Where is -- can you help me here?

DR. SHERON: I thought the median value at the 50th percentile was about 4.8 inches, 5 inches, approximately five inches diameter at the 50th percentile.

DR. APOLTOLAKIS: And then if you took the 95th percentile, you got something slightly larger. I think that's where the 8 came from, right?

DR. SHERON: Right.

DR. APOLTOLAKIS: And then you said, well, there are kind -- a lot of uncertainties here so let's make it 14.

DR. SHERON: Well, what we said is that there's two sources --

DR. APOLTOLAKIS: And also the surge line.

DR. SHERON: Yeah, we said there's two sources of uncertainty in this. One is the uncertainty in the expert elicitation process itself.

DR. APOLTOLAKIS: In the sense that the experts may be biased or the processing method may suppress some of the uncertainties.

DR. SHERON: Yeah, I mean, this is -- it's based on a lot of opinion. And the second source was the fact that there were a number of failure mechanisms, potential failure mechanisms that were not considered explicitly by the expert elicitation panel. And so the question was how do you account for those and how much do you add on to account for those? I'm going to be honest, it was a judgment. I mean, the staff, we talked about it, we debated you know, with a number of people in the room about what made sense. Like I said, ultimately when we looked, we said that -- when we looked at the largest pipes that were attached to the primary systems, we said that does provide some sort of a physical bound, you might say.

Okay, we could have picked -- like I say, when we first did it, we went in there and we said 12 inches, you know, and then we said no, because we have one plant that has a larger surge line that's two inches bigger and we said if we make it 14, you know, that covers for a mechanistic --

DR. APOLTOLAKIS: What's so special about the surge line?

DR. SHERON: Nothing it's just the largest pipe that's attached to the primary system, okay.

CHAIRMAN SHACK: And there's quite a discontinuity. You know, it would be one thing if one pipe was 12 inches and the other was 14, but I mean, you go from 12 to --

MR. SIEBER: To 30.

CHAIRMAN SHACK: -- to 48 or something like that.

DR. SHERON: Exactly, a 30-inch, 36-inch pipe, so --

CHAIRMAN SHACK: It's a big difference.

DR. SHERON: Right, and again, it's a judgment call, you know, in terms of how much margin do you tack onto this to account for those two sources of uncertainty.

DR. APOLTOLAKIS: And I understand that.

DR. SHERON: As well as the concern, you know, which I had which is this thing called regulatory stability and that is that you know, if somewhere down the road we said the Office of Research will periodically re-evaluate the data base and decide whether or not there's any reason to change this transition break size, or at least -- I'm sorry, their break size versus frequency curves, you know, you don't want to have that hanging over a licensee's head that somewhere down the road they're going to have to go back in and change everything that they did because we decide we're going to change that number by a couple inches or one or two inches.

And we felt that when you add up those three factors, okay, you know, we felt that 14 inches was a reasonable number for the Ps. For the Bs, the 20 inches but we also recognize that they have -- they basically turn all their small breaks into a large break anyway, all right. And they don't really -- we don't really see that they're going to get any great benefit from this. I mean, if you look at it right now, all the BWRs are able to operate their plants without having to get this rule.

DR. APOLTOLAKIS: I have a related question. I understand how you approached it when you made the 14, let's say this is from one direction. From the other direction, I guess, it would be useful to see what the consequences of 12 versus 14 are. What difference would that make?

MR. ROSEN: Well, it's only one plant that has 14, right?

DR. SHERON: Yes, South Texas.

MR. ROSEN: Right, so we're only talking about the consequences to one plant.

DR. APOLTOLAKIS: Well, 10 then, 10 versus 14, what difference would that make in anything?

MR. LANDRY: Ralph Landry from the staff. Thermal-hydraulically, I don't care if you have a 10-inch break, an 11-inch break, 11-1/2-inch break, 12-inch break, it makes no difference because you're in this area where you're at about one square foot which is if you remember Jennifer's slide, and she's not here to defend herself now, the one square foot, is about where you have the minimum on PCT versus break size. So whether we're -- one square foot is 13.37

inches diameter. So it doesn't matter whether you're at 10 inches, 11 inches, 12 inches, 14 inches, you're down in this range where you're at the minimum PCT.

DR. WALLIS: It makes a difference to PCT. It doesn't make a difference to zone of influence. It makes a difference to zone of influence for -- it makes a difference to some things. It doesn't change PCT. It changes the zone of influence for the sump problem.

MR. LANDRY: Yeah, slightly.

DR. APOLTOLAKIS: Is there anything else that's effected by it? I mean, if everybody says that it doesn't make any difference in anything --

DR. WALLIS: Does it change the containment pressure?

MR. LANDRY: No, I don't mean it doesn't make any difference in anything, George. What I'm saying is as far as --

DR. APOLTOLAKIS: That's what I'm trying to understand.

MR. LANDRY: As far as the thermal-hydraulic calculation on the reactor coolant system, it doesn't matter whether you're talking about 10 inches or 12 inches.

MR. ROSEN: All right, let's concede the

point --

MR. LANDRY: This is too fine tuned.

MR. ROSEN: The difference between 10, 12 and 14 isn't worth talking about but the Westinghouse Owner's Group point is that they think the six-inch number is the right number. Am I correct?

DR. SHERON: Yes, they thought that and they also --

MR. ROSEN: So let's talk about that, the difference between 14 and 6.

DR. SHERON: Don't get me started on that because they also thought that they shouldn't have to do any analysis of ECCS above six inches, okay.

MR. ROSEN: Well, the whole point is to get you started. I want to hear what you think.

DR. SHERON: Well, I mean, I called them up. I called up the Owners Group chairman and I told him, I said, "You know, you're not taking into account any uncertainty whatsoever". You know, the sources of uncertainty I just talked about, I said, "You haven't considered it". I said, "The Commission itself said that you still have to mitigate up to the double-ended guillotine. How are you going to do that if you don't even want to analyze out there". So you know, this is part of the problem. I get worried when I see a letter like that because to me it doesn’t really reflect in my mind, I’ll use the word safety conscious thinking, okay.

To me it was more or less, you know, give me the smallest break that I can get by with, okay, and I’m not going to worry about anything bigger, all right, and I didn’t think that was very responsible, okay. So I mean, I just don’t accept what they put in in front of us.

MR. ROSEN: So your points were, can’t do six inches because it doesn’t consider uncertainty.

DR. SHERON: They didn’t provide a basis. You’ve got to remember one thing.

MR. ROSEN: Your basis --

DR. SHERON: You’ve got to remember one thing, the industry has not submitted one shred of evidence to support this rule change whatsoever. They have gone, they have said, "Gee, you know, we really would like you to change this", you know, and they wrote in these letters that said, you know, we’re going to get all the benefits and everything but they have not provided any information to us whatsoever on pipe breaks or anything like that, all right, that will help us in terms of defining, for example, what a transition break size is, so the staff did what they could with the information they had.

CHAIRMAN SHACK: Brian, if I look at the elicitation, I get seven inches, one time I have 10^5 at 11 inches I have one times 10^6 and at 14 inches I have 2.4 times 10^7. You know, so do I need a factor of 10 or do I need a factor of 40?

DR. SHERON: That's the judgment call, okay? How much margin do you put on it to account for these sources of --

CHAIRMAN SHACK: Can you enlighten me on the judgment that said I needed 40 rather than 10? I mean, I agree that you need more that one. You know, we'll grant that. So we start at 7 and work our way up.

DR. WALLIS: You raise it, 10 to the --

MR. TREGONING: Bill, let me -- this is Rob Tregoning of the staff. I want to follow up on Dr. Apostolakis' question about the elicitation results and uncertainty and one of the differences between SECY 04-0060 and information subsequent analysis that we've done of the elicitation results since that SECY paper which the staff has had the benefit of seeing, we've done a lot of different aggregation schemes to try to aggregate expert opinion differently to account -- using different measures to account for not only uncertainties within individual experts but variability among the panel. And depending on how you decide to interpret those results, you can get very large differences in the effective break size that you have at 1E minus 5 failure probability.

And what NRR decided to do or what the staff decided to do is they realized that there's some uncertainty there and there's -- it's still an issue that needs to be decided, what's the best way to aggregate these results. And by -- one of the side benefits for selecting the break sizes that they did is it removed from consideration any of those uncertainties because all the aggregation schemes are well encompassed within 1E minus 5 using the break sizes that they've chosen. That wasn't the central reason that those break sizes were chosen. There was, again, consideration for regulatory stability. There was, as Dr. Sheron has mentioned, there was consideration of the fact that you have physical pipe sizes that represent these limits. That was certainly a consideration. And there was also consideration placed for these other risk contributors that weren't explicitly considered in the elicitation, like the rare water hammer event but more specifically the seismic event. I think of all those other considerations, that's the one that the staff is most concerned about, you know, what happens when you have the relatively rare seismic event in the face of degraded piping. That's a very real question.

DR. APOLTOLAKIS: Well, haven't we really done a lot of research on seismic risk?

MR. TREGONING: Seismic risk --

DR. APOLTOLAKIS: Didn't we analyze these things?

MR. TREGONING: For undergraded piping, no doubt but --

DR. APOLTOLAKIS: All this money went to undergraded piping.

MR. TREGONING: Most of what we've done has been on undergraded piping, yes.

DR. APOLTOLAKIS: Interesting, interesting. So now you're saying that there's more information. Are we going to see that information? I mean, the document I received was dated October something.

MR. TREGONING: Well, we've -- unfortunately we've presented a lot of this information at prior ACRS meetings and we'll revisit it again on the 16th. And it's certainly part of the

NUREG that's nearly finished as we speak, so there's a lot -- and again, unfortunately you're handcuffed a bit with the SECY paper because there's been a lot more work done since that SECY paper which has gone into the staff's decision making process on this.

DR. APOLTOLAKIS: Now, one other thing and I didn't hear anything about it and I know that people get upset when they hear the words is in this SECY paper, again, much is made of safety culture which later on is dismissed and in light of Davis -- and at the same time it says that the experts took into account the beneficial effects of the various programs we have at the plant.

Okay, and then they pass judgments like failures of larger pipes due to safety culture effects are expected to remain relatively constant in the future, but then they say, the only caveat to this general conclusion is that the LOCA frequencies developed by the elicitation could be significantly degraded by a safety deficient plant operating philosophy. Now when I read that, I'm wondering is the choice of 14 inches covering this, that you guys went well above the expert stuff and shouldn't there be a little story about it? I mean, the experts themselves are telling me that the LOCA frequencies could be significantly degraded by a deficient safety culture.

So am I missing something that went on and it’s not written on this SECY or is it something we haven’t thought of or what do we do? I know it’s extremely annoying for people who worry about pipes failing to have to consider safety culture. It’s irritating but you can thank Davis-Besse for that. I don’t know, I have no idea how one takes that into account but I know we have to say something.

MR. TREGONING: I can tell you about what was done in the elicitation. I can’t speak to how that was considered in the development of the TBS. But we asked about safety culture and keep in mind that the objective of the elicitation was to develop generic frequencies, not plant specific frequencies. So when you develop generic frequencies and you consider the generic safety culture that’s what we asked the experts to do, to consider the industry at large. We also asked them to consider what sort of perturbations could you get from a plant to plant basis with a deficient safety culture and some of the experts said, "Hey, we expect the LOCA frequencies might increase by a factor of 100". And Davis-Besse is a good example of that. I mean, I was part of the structural integrity calculational analysis team to look at the probabilities of large break LOCAs and they were much higher than anything we're predicting in the elicitation.

And there's good reason why they're much higher -- they were much higher than that because of some significant --

DR. WALLIS: What probability should you assign to this kind of factor from 100 from very poor safety culture? Should you dismiss it or should you say we should be conservative and give it a lot of weight? What should you do?

MR. TREGONING: I think that's why, again, it's not a single-leg stool.

DR. KRESS: I think you use the generic numbers and try to figure out how to control safety culture some other way yeah because there's not that many plants that are going to have bad safety cultures. Deal with -- well, that may be true but you deal with it another way, I think.

CHAIRMAN SHACK: Just thinking about it, I mean, I would argue that safety culture is probably most likely to have an impact on things like failures from nozzles, pressurizers, things that are difficult to inspect. The good thing about a pipe is that probably before it gets to the double-ended break, you're going to have a good sized leak coming out of it and the one thing that you probably don't violate is your tech spec on leakage. So, you know, I would think the biggest impact of safety culture would be on things like, I could see blowing our pressurizer nozzles and things like that, where if you don't have a good safety culture, you might miss those but those will be fairly --

DR. WALLIS: What about manways, could you very quickly fix the manways and --

CHAIRMAN SHACK: The manway is another one that's a little bit trickier.

DR. APOLTOLAKIS: But this is exactly the kind of discussion I'd like to see in one of these documents because if you argue that way, that means you have considered it. If you'd say, no, it's somebody else's problem, you're vulnerable. These are insights that would be useful to see because you can't avoid that.

Another thing I would like to see for example, since we're taking credit for the programs, has anybody done any sensitivity analysis or what if one of the inspections of the piping is deficient or they don't do it? What's going to happen? Maybe nothing. I don't know. I think these things are robust enough that they can survive things, like that but I think you are strengthening your argument by saying that you have considered this.

MR. ROSEN: Oh, yeah, I agree with that but I would come back to what Brian said about the going from 6 to 14, that can cover a multitude of sins, I mean, a broad reach like that in terms of conservatist and so what's your view about the safety culture argument with respect to going from six to 14?

DR. SHERON: I think as Bill said that, you know, if you're going to worry about a pipe, it's probably going to be piping that is attached to the primary system. Remember you're right, you've got leak before break piping, okay, for the main coolant pipes and so forth. It's the attached piping, the Iconel 600 piping, et cetera, and the like that a licensee may, for example if you want to talk about safety culture, doesn't -- you know, they neglect and don't do an inspection, okay, or they don't do a good inspection and the like.

So if you say that's the piping that's most likely -- if there's going to be a safety culture effect, that's the piping that's most likely to fail, then the 14-inch number covers all that piping. We're saying is we've got it covered.

DR. WALLIS: How big is the manway then, how big are these manways we've been talking about?

MR. ROSEN: A lot bigger than 14 inches.

DR. SHERON: They're a lot bigger.

DR. WALLIS: They're the ones that might be effected by safety culture, sloppy tightening of bolts and stuff like that, rushing to finish the job without properly checking what you're doing and --

DR. APOLTOLAKIS: And we're not talking only about pipes by the way, right? We discussed it this morning. Yeah. Well, the vessel is included, I heard. Isn't the vessel part of this?

MR. BARRETT: The vessel is included in the expert elicitation but the vessel is not mitigated by 50.46.

MR. SIEBER: Right.

MR. BARRETT: 50.46 covers everything up to the double-ended guillotine break of the largest pipe in the system.

DR. APOLTOLAKIS: So who covers the vessel?

MR. BARRETT: The vessel, basically we have requirements in place to --

DR. APOLTOLAKIS: Make sure it doesn't

fail.

MR. BARRETT: -- to protect the vessel from things like --

DR. SHERON: Inspection requirements.

MR. BARRETT: -- inspection requirements, pressurized thermal shock.

DR. APOLTOLAKIS: So we don't have anything that --

MR. BARRETT: There could be breaks in the vessel that would be covered by 50.46 if they were small enough such as the --

DR. SHERON: We looked at breaks on the bottom for example, not as design based, but I mean, from the standpoint of you know, can the plant stand an instrument tube failing and the answer is, yes. Okay, can it withstand a lot of instrument tubes failing, no. At some point, you know, you can't make up the leak rate.

DR. APOLTOLAKIS: Anyway, my comment is that it would be very helpful if you could somewhere in the document in the SECY or somewhere a discussion of how --

DR. SHERON: We will do that in our statement of consideration.

DR. APOLTOLAKIS: Well, wherever it is

appropriate. Oh, you did that already?

DR. SHERON: Well, we're developing the statement of considerations, okay, which describes the basis for what we're doing and we can certainly embellish that.

DR. APOLTOLAKIS: Yeah, I think you can add something there to that effect and the discussion we had here, I think is a good starting point that, you know, one of the reasons you are conservative is all these things.

DR. SHERON: Well, I mean, the other reason, too, I'll be quite honest with you, and it is that, you know, I mean, when I got involved with, you know, we're going to change 50.46, it was like, oh, you know, we're going after one of the Agency's sacred cows here. All right, and I knew -- you know, you know right away it's going to invoke a lot of emotion, all right, as you can see just from this meeting. Okay?

I would much rather -- if I'm going to err when I'm picking a transition break size, I'm going to err on the side of conservatism, at least initially, all right. If I've got a choice between trying to defend eight inches versus 14 inches, okay, I'll be quite honest with you, I feel a lot more comfortable with the 14 inches at this stage right now, given everything I know, everything I don't know and the like. All right, it's just the way we are. Okay?

That's the best way I can describe it. That factors into our thinking, okay. If we're going to err, we're going to err on the side of conservatism initially at least, okay? We realize we can always go back down the road at some time in the future and revisit this rule. There's new information and the like, we have more time to think it through and everything, we may decide that there's a better number, okay? But given the fact that the Commission was asking us to do this in six months, we didn't feel that we could do it justice if we had to go in and try and rationalize something smaller, so when you're working towards a bit of a deadline, you know, you do want to just say I'm going to cover myself and do it conservatively.

DR. BONACA: But in any event, I mean, all you can rely on is what has been presented to you and then go and add considerations to what really was not in the basis of the elicitation process. I mean, there are a lot of things excluded, a lot of issues that were not really considered.

DR. SHERON: Correct.

DR. BONACA: I mean some people, like members of the public would think that you err in the non-conservative direction with 14 inches.

DR. WALLIS: Can I ask you --

MR. ROSEN: Any emotion at all those members of the public would consider it an error in judgment.

DR. WALLIS: This elicitation, it's quanticized, it's not a continuum of pipe sizes. There are pipe sizes, the 12-inch pipe is the -- then you go to the main loop piping. There's nothing in between. So how do you have a --

CHAIRMAN SHACK: You can envision breaks in between.

DR. WALLIS: But there are very different kinds of breaks. There are very different kinds of breaks from the snapping off of an entire pipe. There's a different phenomenon, so I'd expect there would be steps in these codes, it's not a continuous code. So stopping at a place where you have a step like -- might make a lot of sense.

DR. SHERON: That was part of our thinking, yes.

MR. ROSEN: But it's more continuous than you think. For instance these manways can be cocked.

They can come -- a couple of bolts can come loose and they can leak a lot and look like a 10-inch break or a 16-inch break perhaps.

DR. WALLIS: They bend out and --

MR. ROSEN: Well, they don't bend but they leak, they can leak grossly.

MR. SIEBER: The bolts stretch.

MR. ROSEN: I can imagine, you know bolts being --

CHAIRMAN SHACK: A bolt that isn't tightened enough will certainly give you leakage. I mean --

MR. ROSEN: Or several set bolts or -- I mean, you can envision mechanisms --

DR. WALLIS: I can see that, and the main loose piping it's a little harder for me to see.

MR. SIEBER: It's truly a leak before break.

MR. ROSEN: I'm sorry?

MR. SIEBER: It's truly a leak before break kind of mechanism that goes on with manways, you know. You stretch a few bolts, you know.

CHAIRMAN SHACK: I get a bad torque wrench and I over torque all the bolts.

DR. WALLIS: All of them and once you lose one, you've lose the next and --

MR. SIEBER: It zips.

CHAIRMAN SHACK: Well, I mean, they're normally set up to be redundant. If you have random failures then you know --

DR. WALLIS: If you've torqued them all to the limit then --

CHAIRMAN SHACK: It's looking for that sort of common mode failure like a miscalibrated torque wrench is the one that comes to mind.

DR. SHERON: But keep in mind, too, that even if the manway did catastrophically fail, okay, we still have requirements that say although it's a more relaxed analysis, that we would still expect that the ECCS system would perform and mitigate the event. So it's not like we're on the edge of a cliff.

MR. SIEBER: Right.

DR. APOLTOLAKIS: Related to that, there is a footnote that I'm trying to understand a little better. "The rule would not apply to future design approval so standard design certifications or to any plants which construction permits are issued after the effective date of the final rule".

DR. SHERON: Right.

DR. APOLTOLAKIS: It would not apply to

future design approval or standard design certifications.

DR. SHERON: Yeah.

DR. APOLTOLAKIS: What does that mean?

DR. SHERON: Can’t do it.

DR. APOLTOLAKIS: Okay.

DR. SHERON: They’re certified by rule. Okay, we’d have to go through a whole -- we’d have to open up the whole rulemaking process again. We discussed that, okay.

DR. APOLTOLAKIS: You mean --

DR. SHERON: For the certified designs.

DR. APOLTOLAKIS: 54, is it?

DR. SHERON: The question is, is you know, you take -- I mean, you might say fine, we really need to think this through for a plant like a pebble bed or an ACR 700 or something but for a plant like ABWR, okay, or the CE System 80 plus, you know, in general we don’t see why this wouldn’t apply except that they’re certified, okay.

CHAIRMAN SHACK: But they could apply for an exemption, couldn’t they?

DR. SHERON: they could apply. They’d open up the whole process, I understand. And I’m not going to claim to be the expert on the Part 52 but --

DR. APOLTOLAKIS: I guess I'm missing something.

DR. SHERON: But when I asked that -- when I asked that very question, I got --

MR. ROSEN: Is that the same analogous argument that the anti-Constitutional amendment people who say, if you ask for a constitutional amendment about XYZ, you open up all the Constitution for discussion. Is that the argument you're making or you're repeating? If you apply for an amendment for a certified plant, you've now opened up the whole certification?

DR. SHERON: That was what I was told.

DR. APOLTOLAKIS: But wait a minute, wait a minute, wait a minute, this is a voluntary option, right?

DR. SHERON: Yes.

DR. APOLTOLAKIS: So if the owner of the certified design chooses to use it, cannot use it?

DR. SHERON: My understanding is they can't use it.

DR. APOLTOLAKIS: That's what I don't understand. I mean, it's a voluntary thing.

DR. SHERON: I'd have to get our rulemaking people here to explain it. How about tomorrow. It's a legal thing.

DR. APOLTOLAKIS: Oh, okay, okay.

DR. SHERON: If you want, I'll take an action. I'll see if I can get someone tomorrow to explain it. I asked that question and I got put in my place real quick. You can't do it.

MR. ROSEN: We'd like to have the answer. I would be certainly willing to ask them to come down and tell you and I'll listen.

DR. SHERON: Okay, we'll see if we can get someone here tomorrow and just give five minutes to explain that.

CHAIRMAN SHACK: Sure, I mean, because it certainly seems applicable to the System 80 plus.

DR. APOLTOLAKIS: Yeah, I don't understand that.

MR. ROSEN: It seems illogical but I know it doesn't have to be logical.

DR. APOLTOLAKIS: Would this have any impact on future plants?

MR. ROSEN: I think that's what was excluded, too.

DR. SHERON: No. As a matter of fact, if you remember the Commission's SRM, I think they told us in the long term we needed to --

MR. SIEBER: Come up with a similar rule.

DR. SHERON: -- consider a similar rule for future plants.

MR. SIEBER: Right.

MR. ROSEN: But 50.46 would not apply to future plants, right?

DR. SHERON: 50.46, well, right now, 50.46 does.

MR. SIEBER: If it's a light water plant.

MR. ROSEN: 50.46A?

DR. SHERON: No, 50.46A does not apply to future plants, but I can't tell you -- I mean, after we do an evaluation, we may decide it's perfectly applicable. We just don't -- we just haven't done it yet.

MR. ROSEN: Right, but a priori, without knowing what the plant is, you --

DR. SHERON: Exactly.

DR. APOLTOLAKIS: So again, maybe I'm dense, what if you forgot about the TBS and you did what you -- the provisions that you have now were beyond TBS, you apply to all breaks, what would you lose? What is it that makes you want to have a TBS up to which you have all these extra requirements? Say you continue, for heaven sakes, with the risk analysis.

DR. SHERON: I'm going to give you my opinion and then I'll let any of the staff talk, but my opinion and my concern is, is that when you look at the large break and the small break analysis, okay, there's a lot of conservatisms that we currently apply to the large break analysis, okay. I don't think there are nearly as many conservatisms that are inherent in the small break analysis at this time. It's basically decay heat, okay, peaking factor, but you know, a lot of the stuff that we assume in the large break is not there for the small break so I'm not convinced that you have the same degree of margin, you might say for the small breaks that you do for the large breaks.

Using the conventional 50.46, okay, in this less smaller than TBS range, okay, preserves a lot of those margins, okay, that are helping us with the small break, all right, infinite decay heat, maximum peaking factor, those type -- you know, single failure, okay, those are providing us some additional margins for the small break, okay, that give us a little bit more between say you know, what you calculate versus where you get in trouble.

DR. WALLIS: Infinite decay heat doesn't

mean an infinite amount of heat. It means --

DR. SHERON: I'm sorry, infinite burn-up, infinite burn-up, decay heat assumed with infinite burn-up.

MR. ROSEN: There aren't many heat exchangers that can deal with that.

DR. APOLTOLAKIS: So the small LOCA right now under the standard 50.46 does not -- yeah, he wants to talk about it. Let me ask a question of Brian first.

DR. SHERON: Sure.

DR. APOLTOLAKIS: The small LOCA is not analyzed under 50.46.

DR. SHERON: Yes, it is.

MR. ROSEN: All break sizes.

DR. SHERON: All break sizes are.

DR. APOLTOLAKIS: So why are you saying then that's it not as conservative? Now it will be conservative, the analysis?

DR. SHERON: No, what I'm saying is that it --

DR. APOLTOLAKIS: I will be the same analysis, won't it?

DR. SHERON: No.

DR. APOLTOLAKIS: No.

DR. SHERON: Ralph, why don't you --

DR. APOLTOLAKIS: It's the same as before, isn't it?

MR. LANDRY: George, if I may, you analyze all break sizes under 50.46 at the present time.

DR. APOLTOLAKIS: Right.

MR. LANDRY: But what Brian is saying is many of the things that add a lot of conservatism under Appendix K for the large break, are less important for the small break such as the critical flow model that you use. When you get into the smaller breaks, the flow -- the models have less impact than they do on the large break.

DR. APOLTOLAKIS: Right.

MR. LANDRY: But the decay heat is still the big player.

DR. APOLTOLAKIS: But this is not going to change.

MR. LANDRY: That's -- it's not going to change as long as you stay with the Appendix K approach but we are -- we kept in 50.46A, the option of using a realistic analysis. Going to the realistic analysis is going to buy you a lot more in the small break as it does in a large break. Realistic analyses versus Appendix K has been estimated by some people to be as much --

DR. SHERON: You'll have two trains available. You won't assume a single failure --

DR. APOLTOLAKIS: Because under conservatisms.

DR. SHERON: Because you won't assume those conservatisms, those -- you know, in a small break analysis done under a 50.46A approach.

DR. APOLTOLAKIS: But we heard this morning that, I mean, okay, you use the terms high probability that the criteria would not be exceeded for the ones that are up to TBS, and then some acceptable probability that the other stuff -- that the criteria would not be exceeded beyond TBS. And I guess what I'm thinking is that if you guys decide on what this acceptable probability was, then you could apply that approach to all of the breaks.

DR. SHERON: Well, you'll still have your frequency problem that you know, the frequency of a failure plus a single failure, plus a loss of off-site power is very small for a large break LOCA because you've got all that frequency of -- you know, the low frequency of the large break LOCA. It now is not necessarily so negligible for the small break LOCA, so if you're just looking on your design basis, you know, your design basis ought to include the events that you sort of think can happen.

DR. APOLTOLAKIS: But remember now, this is not the only rule in the books. You still have risk to consider, 11.74, all this stuff. I mean there are many ways of approaching the issue of different frequencies, aren't there?

DR. BONACA: Unless you change the rule.

DR. APOLTOLAKIS: Well, I'm trying to think, why can't I just say I will have one approach for all breaks.

DR. WALLIS: We do already.

DR. SHERON: You can do that, George.

DR. APOLTOLAKIS: The new approach.

DR. SHERON: You can to that, okay?

DR. APOLTOLAKIS: The new approach and maybe have a different probability of acceptance for some events that are more frequent than others. Or have one probability of acceptance but if the initiating event is more frequent for small LOCAs, then you need a bigger margin to meet that overall probability. So then you are achieving the same thing with a single rule. Why do I have to assume coincident loss of power, single failure? I mean, all that stuff I can account for in the probability, can't I?

DR. SHERON: Can I give you simple answer?

DR. APOLTOLAKIS: Absolutely.

DR. SHERON: Six months. We made a conscious decision. We said that if we're going to go off and really -- because one of the things we had heard, okay, was that perhaps we should be approaching this from the standpoint of wiping the slate clean. Namely, if you were going to develop an ECCS rule today, okay, forgetting about 20, 30 years of history with this thing, how would we formulate a rule and we may very well formulate it that way, but we would not be able to craft it and get something in six months.

DR. APOLTOLAKIS: I appreciate that.

DR. SHERON: And that's really what drove us to the form of the rule today.

DR. WALLIS: I think it's sensible to take one step at a time. You do this and then you find out that something has happened as a consequence that you didn't expect, then you can --

DR. SHERON: Well, I think you --

DR. APOLTOLAKIS: Well, look, guys, I'm not blaming anybody or anything. I'm just trying to understand what is going on.

CHAIRMAN SHACK: Well, George, just look

at it this way; suppose you're in the business of conserving margin the way our friends our this morning. You know, you give it up in the large break LOCA because you're paying a high price for it, you know. To account for it, you're doing things that you don't like to do, like fast starting your diesels and things. I think you pay less of a penalty in the small break situation for having that extra margin. And so, you know, why give up margin if I'm not going to get a whole lot for it.

DR. APOLTOLAKIS: There are always competing reasons here and goals but there is something to be said about having, you know, a simple elegant regulatory system.

CHAIRMAN SHACK: Those of us are just muddling through.

DR. WALLIS: But that's not what the Commission does.

DR. APOLTOLAKIS: Well, that's why this committee has 11 members, right? But well maybe, you know, next time we meet with the Commission, I can ask them, although we are not asking questions. We're speaking when spoken to.

DR. KRESS: If one looked at reg guide 1.174, and looked at the Delta CDF one times 10_5 which is allowed for most plants now by the criteria, most plants could accept a delta CDF of 10_5 and if one said that all break sizes above the transition had frequencies of 10_5 or less which is what we're saying, then if you assumed each one of those went directly to core melt, then they're acceptable by 1.174 just to remove them all together without any treatment. Except, 1.174 says we want to maintain defense-in-depth, so I view the extra things you're asking them to do to deal with the break sizes above the transition are mostly defense-in-depth in 1.174 space and so defense-in-depth, in my mind, has never been quantified how much is necessary and how much is sufficient. It's a judgment call and I think they made reasonable judgments.

DR. APOLTOLAKIS: Well, let me make a counter-argument.

DR. KRESS: Okay.

DR. APOLTOLAKIS: I'm already applying defense-in-depth because I have decided to work with the frequency of the LOCA only, right? I know that what matters is CDF but I'm a conservative guy. Forget about all that, I zero in on the frequency of the LOCA. I'm already applying defense-in-depth.

DR. KRESS: A little.

DR. APOLTOLAKIS: And then I become a rationalist and I'm saying you know, I really don't want this frequency to be greater than a certain number, okay, and I want certain margins and all that. You tell me that smaller breaks are more frequent than larger breaks, therefore, you have to have some mitigating functions there to bring the whole thing to the frequency that I want. So I don't see any -- I think the fundamental reason is what Brian said. I mean, you can't do all these things in --

DR. BONACA: I think they show defense-in-depth is very important because I'll tell you, I mean, this elicitation process okay, when there is very little data, doesn't give me the level of comfort that I would have if there was more information and data supporting this data base, so really there is a big question mark in my mind about -- you know, and I am comfortable when we go from eight to 14 inches, because we begin to move in that direction and there is something there that says, yes, I have a defense-in-depth, and slap something on to compensate for the fact you know, the solicitation process is convincing but --

DR. APOLTOLAKIS: But defense-in-depth is not absent when you are dealing with breaks beyond

TBS. They're not dropping defense-in-depth. They're still doing things.

DR. BONACA: I understand that.

DR. APOLTOLAKIS: It's just that they're not imposing these very conservative conditions, you know, thou shalt also assume that there is no power, you know, very drastic things. It's not that they're, I mean, defense-in-depth is everywhere.

DR. WALLIS: Defense-in-depth was originally in there and considering that you had to consider the biggest pipe break in there.

DR. APOLTOLAKIS: And it's already there. Anyway, I mean, I understand now.

MR. ROSEN: Well Bill, I believe we're done.

DR. WALLIS: We're done.

DR. APOLTOLAKIS: Two minutes before 5:00, we're done.

CHAIRMAN SHACK: Yeah, can we just go around the table to get some input on what we might be thinking about for a letter?

DR. APOLTOLAKIS: Do you want to do it today or tomorrow?

CHAIRMAN SHACK: Well, I was thinking today just because tomorrow everybody is going to --

MR. ROSEN: Well, we're not done, we have tomorrow, right?

CHAIRMAN SHACK: Right.

MR. ROSEN: In which we're going to hear some very important things, I think, the process, right?

CHAIRMAN SHACK: Okay, if you're not ready to comment, we can wait.

MR. ROSEN: No, we can comment except withholding those on process because tomorrow we'll hear about it. It's up to you.

CHAIRMAN SHACK: Yeah, I'd just as soon tonight start thinking about a letter if anybody has any comments. We're finished for the day.

(Whereupon, at 4:57 p.m. the above entitled matter concluded.)