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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

January 25, 2006

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on January 25, 2006, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

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JOINT MEETING OF

THE SUBCOMMITTEES ON

REGULATORY POLICIES AND PRACTICES AND

THERMAL HYDRAULIC PHENOMENA

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WEDNESDAY, JANUARY 25, 2006

The meeting was convened in Room T-2B3 of Two White Flint North, 11545 Rockville Pike, Rockville, Maryland, at 1:30 p.m., MARIO V. BONACA and GRAHAM B. WALLIS, Co-chairmen, presiding.

PRESENT:

WILLIAM J. SHACK Chairman, Regulatory Policies
GRAHAM B. WALLIS Chairman, Thermal Hydraulic
GEORGE APOSTOLAKIS Member
MARIO V. BONACA Member
RICHARD DENNING Member
THOMAS KRESS Member
DANA A. POWERS Member
WILLIAM J. SHACK Member
MICHAEL SNODDERLY Designated Federal Official

I-N-D-E-X

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

(1:33 p.m.)

I. OPENING REMARKS

CO-CHAIR SHACK: The meeting will now come to order. This is a joint meeting of the Advisory Committee on Reactor Safeguards Subcommittees on Regulatory Policies and Practices and Thermal Hydraulic Phenomena.

I am Bill Shack, Chairman of the Subcommittee on Regulatory Policies and Practice. Also is attendance is Graham Wallis, Chairman of the Subcommittee on Thermal Hydraulic Phenomena

Members in attendance are George Apostolakis, but he's not here; Mario Bonaca; Richard Denning; Tom Kress, who is not here yet; and Dana Powers.

The purpose of this meeting is to review the staff's proposed regulatory guide in support of a voluntary alternative rule that would allow licensees to implement a redefined large break LOCA and associated risk-informed ECCS 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 Federal Register on January 10th, 2006.

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

We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting. We'll now proceed with the meeting. And I'll call upon Tim Collins of the Office of Nuclear Reactor Regulation to begin.

MR. COLLINS: Thank you, Mr. Chairman.

II. INTRODUCTION

MR. COLLINS: My name is Tim Collins. And I work in the Division of Safety Systems in NRR. And I am heading up the staff's efforts to pull together a reg guide supporting the 50.46 proposed rule. That rule, of course, is dealing with risk-informing the ECCS performance requirements.

The staff has met with the Committee on several occasions to discuss the rule, but this is our first meeting to go over the reg guide. And before we get into the detailed presentations, I would like to just go over what we anticipate our interactions with the committee will be over the next year because I think we'll probably be here several times. Then I will give an overview of the staff's presentations. And then the staff can go on and get into the details.

This table here is a summary of what we anticipate our interactions with the committee will be. After today's meeting, we would expect to be back again later in the spring, in April or May. And at that meeting, we would plan to discuss any changes to the reg guide that we think are necessary as a result of our seismic studies.

At that time, I think that we would probably want to also discuss the impact of comments that we receive on the rule. The rule is currently out for public comment. The comment period closes on the 8th of March. So if we get significant comments that look like the rule is going to be impacted, we would also have to incorporate that in the reg guide.

CO-CHAIR WALLIS: Can I ask you about the rule? On the first page, it seems to say that the rule only applies to current reactors.

MR. COLLINS: That's correct.

CO-CHAIR WALLIS: And if you build a Westinghouse PWR in the next five years like the old design, it has to go back to the old rule.

MR. COLLINS: That's correct the way the rule is written right now.

CO-CHAIR WALLIS: It seems a bit strange.

MR. COLLINS: Well, it's that I think that is a specific area we have asked for comments from the public on as part of the rulemaking. Should this be applied to other --

CO-CHAIR WALLIS: If you build in the future, why shouldn't it apply? It's the same reactor as you already have. I think it would apply to it.

MR. COLLINS: I think that's a good comment for the rule.

CO-CHAIR WALLIS: I just wondered why you put it in the rule. But, anyway, that's all. You didn't. Somebody else did.

MR. COLLINS: We all had a hand in it.

CO-CHAIR SHACK: I mean, what was the rationale for that, though?

MR. COLLINS: Well, I mean, I sit there trying to figure out why in the world you do that in the first place.

MR. RUBIN: Yes. I don't --

MEMBER BONACA: Wasn't there a provision that you would be able to step back from these changes in case new information, et cetera? I think that would be the reason why.

MR. RUBIN: This is Mark Rubin from the staff. At least one reason, the validity of which can certainly be debated, is that the advance designs that are currently on the plate were certified by rulemaking themselves. And so they are sort of frozen and that I don't think any of them would be precluded from coming in and implementing this rule, but without changing the design certification rule that certifies the plants, they're kind of sort of frozen in sort of a time warp, so to speak.

CO-CHAIR SHACK: I mean, I can perfectly understand that, but this seems to even preclude the guy coming in and asking to go under. I mean, I can understand that you would now want to make it so that the licensee would have to come in and ask since it's already certified under the old rule, but --

MR. COLLINS: That would certainly necessitate a rule change, subsequent rule change.

CO-CHAIR SHACK: Yes.

MR. COLLINS: Okay. As far as the schedule goes now, if we came back in April and May to a subcommittee meeting with the balance of the reg guide, then we would be looking for a letter from the full committee in May or June supporting us sending the guide out for public comment.

CO-CHAIR WALLIS: If we today have trouble with the guide being compatible with the rule, you have a choice of changing the rule or changing the guide or changing both.

MR. COLLINS: Yes. The rule is out for comment right now. The guide hasn't even gone that far yet. So everything is up for change at this point.

So if we could get the guide out for comment in June, it would then be out in the summertime for gathering comments. Then in the meantime, we would be resolving the comments that we had received on the rule. And we would hope to come back to the committee in September with the final rule. And we would be looking for a letter from the committee on the final rule in the September time frame. Okay?

Then we would be gathering and resolving comments on the reg guide in the September-October time frame. And we would expect, then, to come back for a subcommittee meeting in November to discuss comment resolution on the reg guide.

And then that would be followed by a request for a letter from the full committee in December to release the reg guide for trial use. That's assuming that the rule, of course, goes out.

CO-CHAIR WALLIS: That will be the last letter I sign, right?

MR. COLLINS: The last letter you sign? Okay. So it looks like we could be having a lot of interactions over the course of the next year.

Now, as far as today goes, this slide is a snapshot of the part of the table of contents that -- I think the table of contents came with the reg guide when we sent it to you. Okay?

I didn't include the element number one, the first part. Those are basically a lot of boilerplate and a lot of background information. And we didn't think we were going to discuss any of that at this meeting. The format and content are typical of that which is used for any risk-informed reg guide. And it's based on reg guide 1.174.

So today our presentations are going to focus on element two, the engineering analysis; and element three, the implementation performance monitoring and reporting. We didn't put together a specific presentation on element four. We think the other presentations spill over into that area anyway.

The specific presentations that we plan to make are on ECCS analysis and containment analysis and then on the risk-informed integrated safety assessment process. That presentation covers most of element three as well as the risk assessment parts in element two.

But there are also two subtopics in the engineering analysis which we didn't really think warranted full-blown presentations, but I'm going to summarize our thinking on those so that we've covered all the different topics. And that is 2.1.4 is radiological consequences and 2.1.5, changes in break frequency and uncertainty. And that's what I was going to go to right now. Okay?

With regard to radiological consequences, we concluded that the existing guidance really didn't need to be modified for a plant that wanted to adopt 50.46(a). And that's based on the following considerations.

First, the LOCA source terms have already been more realistically defined in the alternate source term rulemaking. And we really didn't want to get into trying to redefine the source term again. Okay? And, secondly, well, because they are more realistic, we think you can use them in both the DBA and the non-DBA LOCAs.

And, secondly, the containment leak rates that are used in the dose assessments are not derived from any mechanistic analysis. You use tech spec values. And then you confirm that by your containment testing.

So the changes that are calculated in the containment pressure for non-DBA LOCAs really have no impact whatsoever on the dose calculations. Okay? So the guidance that's out there for both the term that goes into the containment and the leak rate that comes out of the containment applies to non-DBA LOCAs as well as DBA.

MEMBER KRESS: I was under the impression that part of that rule was that you kept the pressure at the calculated LOCA value for 24 hours, then reduced it to one-half that value. I don't --

MR. COLLINS: You can do that. Well, that's my next point, as a matter of fact. I'm going to use that example in my next point.

MEMBER KRESS: Okay.

MR. COLLINS: There's a caution in the guidance that we provide. And it says you have to be careful that if you make a change to the plant, it could invalidate some of the underlying assumptions in the existing guidance. And the example is just what Dr. Kress is referring to.

I mean, in the current guidance, the containment leak rate can be reduced after 24 hours. And the basis for that is the effectiveness of containment sprays in reducing containment pressure.

So if a licensee in using the flexibility that 50.46(a) would provide decided they wanted to modify the use of containment sprays, then that could invalidate that assumption and they would have to change their radiological assessments to make sure that it was consistent with both the intent of the guidance as well as the actual plant configuration. So there's a caution in the guidance particularly aimed at those types of possibilities. Okay?

CO-CHAIR SHACK: Now, most of these consequences that we're calculating here are done typically for design basis accidents, but you're going to require them even for the non-design basis LOCAs?

MR. COLLINS: Yes. When we looked at the SRM, the Commission said that we were supposed to be providing mitigation capability up to the double-ended break.

And ultimately what you're trying to protect against is dost. I mean, you're trying to protect the public from being over-dosed. So we thought it wouldn't make sense to exclude a calculation for that event.

MEMBER DENNING: How does the break size affect the calculation? I mean, in reality, it would, but --

MR. COLLINS: I don't think it has much effect, in fact. We really don't think that people will have to do much in the area of their radiological assessments if they adopt this. Pretty much what they have now is pretty much the same as after they adopt 50.46(a). Okay?

As regards the changes in break frequency, this is section 2.1.5. This section is really addressing the question of whether or not the expert elicitation estimates of LOCA frequency continue to apply to a plant after they start making plant changes.

When the expert panel developed their frequency estimates, they assumed or they did it based on their understanding of the way plants had historically operated in the United States. And they noted in their report, as a matter of fact, that their estimates were dependent upon that.

And so if a plant comes in under 50.46(a) and starts making changes which lead to operating conditions that are significantly different from what we have seen historically, it raises the question of how applicable are the estimates that the expert panel came up with.

And so we wanted to add this guidance as a flag that we need to look more closely at this. I mean, the fact of the matter is we don't have a way to correlate small changes in operating parameters to changes in LOCA frequency.

So we can't put guidance out there which says "Here are the limits on how far you can go in changing a parameter." We wouldn't have had to use an expert panel in the first place if we could do all of those correlations.

But at the same time, we think it's important that this not be forgotten in the reviews that licensees do and in the reviews that the staff does.

So if a licensee decides they want to make some dramatic changes to their plant, maybe big changes to their chemistry program, -- who knows? -- different change to their flow rates, temperature, operating temperatures, this will serve as a flag that we're going to have to look at that more plant-specifically. And it's something that we're just going to have to work out on a case-by-case basis because we don't know how to provide generic guidance on this sort of a thing.

But at the same time, we think it's important enough that we've got to stop and look at it if things start changing dramatically.

CO-CHAIR WALLIS: I think you also said that there could be new evidence, there could be evidence of some new mode of failure or something, there could be something which makes you change your break frequencies.

MR. COLLINS: Yes.

CO-CHAIR WALLIS: I think you have something in the rule or somewhere there, the regulation, which says, in that case, you can go back to the old system, where there were not a lot of plants to take advantage of the --

MR. COLLINS: That's correct. That's correct.

CO-CHAIR WALLIS: So that's also in there?

MR. COLLINS: Yes, that's also in there.

CO-CHAIR WALLIS: Which means that a plant that changes, wants to make changes to take advantage of the new rule, has to bear in mind that it might have to sometime change back again --

MR. COLLINS: There's a risk involved.

CO-CHAIR WALLIS: So it's not going to take away equipment presumably. It's just going to change the way it's operated.

MR. COLLINS: Yes.

CO-CHAIR SHACK: Yes. That's a question that I had. How much equipment is uniquely associated with the double-ended guillotine break or is it just you're changing operating and design parameters for a whole bunch of other set of equipment?

MR. COLLINS: How much equipment is uniquely associated?

CO-CHAIR SHACK: Yes.

CO-CHAIR WALLIS: It also may be nothing.

MR. COLLINS: Right, yes.

MR. DINSMORE: This is Steve Dinsmore from the staff. I think one way to answer your question is a long time ago we tried to figure out what people might change, which is one way of addressing your question. And we spent a long time trying to do that.

And in the end, we decided that it wasn't a good use of our time because it was very complicated. And it might be very plant-specific.

So we were directed and we eventually wrote I think a rule, which doesn't really require you to know beforehand what is going to be changed. So I don't think we can really answer your question. We couldn't quite get it out of the --

CO-CHAIR WALLIS: I think it is changing some points more than changing hardware. Isn't that what is involved? And it's changing power level of the reactor, which isn't changing the ECCS at all necessarily. I mean, it's not changing the hardware.

CO-CHAIR SHACK: Well, one of the other concerns I had was whether the testing that you you would continue to do for your current design basis LOCA would, in fact, cover the equipment that you would need for the beyond design basis LOCA.

MR. DINSMORE: We did have lots of those types of conversations. And the net result is we decided --

CO-CHAIR SHACK: You can't answer that question generically.

MR. DINSMORE: Yes, sir.

MEMBER DENNING: Let me ask a question in the same vein. And that relates to allowed outage times. Would it be likely that allowed outage times would be significantly affected? I can see some equipment now that is there that wouldn't really be needed for smaller size breaks but which might be really necessary for the large breaks in that you might have allowed outage times that are very large. Am I just not understanding?

MR. COLLINS: Oh, it's possible, but it should be caught in the risk assessment, the importance of that equipment. And the whole idea of the risk-informing the decision-making process is to put a risk check on exactly the type of situation you're suggesting.

It's to allow flexibility where it's not risk-significant and to preclude flexibility where it is risk-significant. That's the ideal of the risk-informing the decision-making process. So hopefully we do it right.

CO-CHAIR WALLIS: Now, if it's called further risk, if you now go to, say, 70 percent probability that the system will work, is that going to appear in the PRA?

MR. DINSMORE: This is Steve Dinsmore. I think that 70 percent is a thermal hydraulic parameter. So it wouldn't --

CO-CHAIR WALLIS: It must. I mean, if you're going to back off on whether or not your system will work and meet the criteria for not damaging the core. So hydraulically it's going to appear in the PRA, too.

MR. DINSMORE: Well, we would say that the 70 percent -- if you have 2 trains running or one train running your 70 percent, if you meet his criteria, that's all it would be in the PRA. We wouldn't put one and a half trains or we wouldn't put the reliability on one and one-half trains in the PRA.

CO-CHAIR WALLIS: Well, the probability of it working with all of the trains can now be 70 percent.

MR. COLLINS: I think Ralph Landry is going to talk about that during his presentation. I don't think that is the correct interpretation.

CO-CHAIR WALLIS: There are some other discussions we have had about this matter and other matters, like power uprates, where it seems to be a disconnect between the thermal hydraulic criteria and the PRA.

You have to artificially put something into the PRA in order to take account of, say, containment over-pressure issues or something because it's not already taken care of. A proper PRA would take care of the risk. And you wouldn't have to then insert it afterwards in some special way.

I mean, the thermal hydraulic stuff that we worry about should already be in the PRA. Otherwise, it's sort of two different worlds.

MR. DINSMORE: Well, the PRA is a binary model. It's either it works or it doesn't.

CO-CHAIR WALLIS: And 70 percent probability or 95 apparently. Is that going to be in there?

MR. RUBIN: Well, I think the fact that there is some disconnect is a valid comment, but if we look at the way the basic risk-informed criteria was developed, I think that was acknowledged by the developers as well as the committee which reviewed it in looking at the subsidiary goals of defense-in-depth and maintaining margins.

Typically the margins area might look at some confidence interval or reliability of system or competence at meeting some criteria, but that doesn't mean you would model it that way in the PRA. In the PRA, you would be modeling the as-built systems with the component reliabilities that experience in modeling would derive for those systems.

So I think your observation is a very correct one, but intentionally some of that disconnect was built into the risk-informed decision process. And I think when Dr. Landry discusses how his criteria are used, you may gain some additional insights on that.

CO-CHAIR WALLIS: Well, I was asking about this question. I don't think he has enough time. You spoke about margins. Now, the agency has never defined what it means by "margin."

And in the language we got for the guide, it sort of said, "Well, the margins are there to take account of uncertainties." But I thought these uncertainties were going to be taken account by this probablistic statistical method.

What is it that's taking care of the uncertainties: the margins or the probablistic stuff or is it some mixture of the two or is it two different worlds again?

MEMBER DENNING: When you said "probablistic," did you mean realistic with uncertainties, --

CO-CHAIR WALLIS: Yes.

MEMBER DENNING: -- which isn't the same

as probablistic?

CO-CHAIR WALLIS: Well, let's say realistic with uncertainties is a probablistic approach, as I understand it.

MEMBER DENNING: Yes. Okay.

CO-CHAIR WALLIS: You do a Monte Carlo thing and all of that.

MEMBER DENNING: Sure.

CO-CHAIR WALLIS: And then, somehow or other, you do a separate assessment of margins? I don't see how you can assess a margin without doing the probablistic stuff to tell you what is the probability of being over some limit. That's what to me a margin is.

MR. DINSMORE: Well, certainly the PRA methods could be improved. And if they need to be improved to implement this rule, then --

CO-CHAIR WALLIS: You're talking about these different worlds, where the margins somehow take care of uncertainties. But they're also taken care of by statistics. And the uncertainties in whether or not the ECCS will work are taken care of by the probablistic stuff that somehow doesn't appear in the PRA at all, but it's called at some other place. Do you see what I mean? I'm sure you --

CO-CHAIR SHACK: But you could do the large break LOCA analysis without using the best estimate approach. You could just take the credit you get from not having to assume the worst single failure.

CO-CHAIR WALLIS: You could do all of that. Sure, you could.

CO-CHAIR SHACK: And then you just use your conservative analysis.

CO-CHAIR WALLIS: That should be like --

CO-CHAIR SHACK: So then you're using the margins in thermal hydraulics to account against uncertainties. But coming back to Rich's question on the outage, again, the beyond design basis LOCA isn't just risk-informed here. You're also limiting it in another -- at least I thought it was that you still had to mitigate it.

MR. COLLINS: Yes.

CO-CHAIR SHACK: So you had a configuration control. That equipment that you need to mitigate it has to be available, right?

MR. COLLINS: Right. That's correct. That's correct.

CO-CHAIR SHACK: So it's a semi-design basis situation? I mean, you're not looking at beyond design basis just purely in terms of risk?

MR. COLLINS: Right, right. Well, as soon as the Commission said you had to mitigate it, they did that.

CO-CHAIR SHACK: Right. They did that. So there would be limitations on the outages beyond what you would get from just the risk analysis, I think.

MR. COLLINS: Well, that's what that --

CO-CHAIR SHACK: That's what that statement says. And so you're going to have a configuration control.

MR. COLLINS: Configuration control. Right, yes.

CO-CHAIR WALLIS: So this 70 percent takes care of the uncertainties in the calculations. It doesn't take care of the input about the probability of something being in service or not being in service. It doesn't take care of that?

MR. COLLINS: I don't think it does.

CO-CHAIR WALLIS: It could very easily. I would have thought it would. But it doesn't. Again, it's two different worlds. It takes care of the uncertainties in the state of the plant in terms of temperature and things like that, though, these probablistic things, whatever they want to call them. It takes care of the safety of the plant. It ought to take care of it quickly, but I don't think it does.

MR. COLLINS: I don't think we have a neat answer for that.

MEMBER DENNING: We can come back to the same. So let's let him go ahead.

MR. COLLINS: That was the end of my presentation. If there aren't more questions for me, we can move on to Ralph.

III. ECCS ANALYSES

MR. LANDRY: My name is Ralph Landry from the staff. I'm in the Nuclear Performance and Code Review Branch.

I've packaged together the presentations that I am going to give and that Ed Throm is going to give because they're both thermal hydraulic topics: the ECCS analysis and the containment analysis. So we felt that it was best if we put the two together and we moved directly right from one to the other.

Briefly I'm going to go and hit the ACRS presentation history very quickly, then a little bit about the objectives and scope of what we tried to lay out in the regulatory guide, and the approach that we have taken for the ECCS. And then Ed is going to talk about the approach taken for the containment analysis.

Previously we have been to the ACRS on two occasions, in November of 2004 and in March of 2005, talking about the proposed rule and the scope for the rule. We at that those two times said that we were planning to come to you with our proposed regulatory guide to explain further what is intended with the rule and what would be necessary to comply with the rule.

The objectives and scope are very simple: to define the acceptable analysis approaches for breaks up to and including the TBS and for breaks greater than the TBS and to define the acceptance criteria for breaks up to and including the TBS and breaks beyond the TBS.

The analysis methods, we were starting to hit this when Tim was talking. For breaks up to and including the TBS, licensees today have nothing that is new. There is nothing different in the way that we have been doing business for a long, long time.

You can make an analysis that complies with 10 CFR, Part 50, appendix K or you can make an analysis that uses realistic methods and quantifies the uncertainty. And that is pretty well-defined in regulatory guide 1.157, what we find as an acceptable approach.

We haven't defined what constitutes an acceptable approach in great detail. We leave that up to the applicant or the licensee to come in and show what is an acceptable approach for a realistic analysis.

However, we have said that the uncertainty has to be demonstrated at a high probability. And we have said in reg guide 1.157 that a high probability is understood to be 95 percent.

CO-CHAIR WALLIS: Is it time to talk about that now? I've never seen this just --

MR. LANDRY: If you want, but let me get through this part. And then we'll talk about that acceptance.

CO-CHAIR WALLIS: We'll talk about 95 percent at some later time? Okay.

MR. LANDRY: Yes. Let me get through the next. And then we'll talk about the acceptance on both.

CO-CHAIR WALLIS: Okay.

MR. LANDRY: For breaks greater than the TBS, what can the licensee do? Well, the licensee can still do an analysis that is compliant with 10 CFR, Part 50, appendix K. Of course, they haven't gained anything over what they are doing today other than they can now go back and relax a lot of hardware assumptions, which I'll get into in a few minutes.

They can still do the realistic uncertainty determination per reg guide 1.157 or they can come in with another analytical approach. And we haven't defined what that analytical approach is, but I'll have a couple of slides coming up that will say some things that we expect.

What we have said in the rule is that you have to come in if you're using another alternative approach, tell us what that approach is. You don't have to submit the approach, but you have to tell us what it is.

CO-CHAIR WALLIS: That's what you're saying --

MR. LANDRY: And then you maintain the documentation --

CO-CHAIR WALLIS: It's in the rule. That's in the rule.

MR. LANDRY: I'm sorry?

CO-CHAIR WALLIS: That's in the rule.

MR. LANDRY: That's in the rule. And you maintain the information on your approach available so that we can come in and law-audit it, look at it if we want to.

But we have also said that the uncertainty determination can be done at a much lower level, what we have called a reasonable level, versus the high probability level that we say for the below TBS.

CO-CHAIR WALLIS: Do you want to talk about the use of probability at all? The rule says very clearly the criteria is that after any LOCA, the core geometry changes must be such that it remains amenable to cooling. It doesn't say anything about probability.

MR. LANDRY: Right.

CO-CHAIR WALLIS: It says "must" be such that it remains amenable to cooling. It doesn't say anything about probability at all. How did you ever get this to be a probability? The rule is very clear.

MR. LANDRY: In the statement of considerations and --

CO-CHAIR WALLIS: Something must be.

MR. LANDRY: In the statement of considerations and in the regulatory guide,we have discussed a realistic calculation with uncertainty.

CO-CHAIR WALLIS: I'm sorry, but also GDC 35, it says, "ECCS must be supplied at such a rate that clad damage that could interfere with continued cooling is prevented." These are very clear statements. How did they ever become some 70 percent of probability or something?

MR. LANDRY: Or 95 percent.

CO-CHAIR WALLIS: It is a very clear statement in the rule itself.

MR. LANDRY: Why would they become 95 percent?

CO-CHAIR WALLIS: Well, I would ask you that, too. I don't see that's ever been justified.

MR. LANDRY: Let's get back, then, to what does the uncertainty mean --

CO-CHAIR WALLIS: So I'm not saying you're wrong. I'm just trying to get you consistent in the statements, which are very categorical, something "must" be. And then you suddenly say, "Well, it's all right if it's only 70 percent."

MR. LANDRY: No.

CO-CHAIR WALLIS: I don't understand how those are --

MR. LANDRY: Graham, let me get back to it now.

CO-CHAIR WALLIS: Okay.

MR. LANDRY: Because there's continued misconception of what does this uncertainty mean, calculating a peak cladding temperature -- let's just use that as the metric right now -- with uncertainty at a level of 95 percent simply means that your calculation has captured the highest peak cladding temperature that you could calculate to a probability of 95 percent.

CO-CHAIR WALLIS: But it means that --

MR. LANDRY: It says nothing about the other five percent.

CO-CHAIR WALLIS: -- reactors, that on the average five of them won't.

MR. LANDRY: No, no.

CO-CHAIR WALLIS: Yes, it does.

MR. LANDRY: No. It doesn't say that. It says that you have captured the highest peak cladding temperature that would be calculated at the 95 percent level. There's a five percent probability that you have not calculated the highest temperature. It says nothing at all about that five percent. It doesn't say --

CO-CHAIR WALLIS: It says --

MR. LANDRY: It doesn't say --

CO-CHAIR WALLIS: -- 95 percent --

MR. LANDRY: Just a minute, Graham. Just a minute.

CO-CHAIR WALLIS: -- will meet the criteria.

MR. LANDRY: No, it doesn't.

CO-CHAIR WALLIS: That's what you --

MR. LANDRY: No, it doesn't.

CO-CHAIR WALLIS: -- what you end --

MR. LANDRY: It says you calculate the temperature at an uncertainty level. So that means the temperature you have calculated at a 95 percent probability level is the highest. It says nothing about what that other five percent is.

And let me go on. If you calculate a peak clad temperature of 2,190 --

CO-CHAIR WALLIS: Right.

MR. LANDRY: -- 95 percent value, there's a 5 percent probability that you could calculate a temperature higher than 2,190.

CO-CHAIR WALLIS: That's right.

MR. LANDRY: It could be 2,190.1.

CO-CHAIR WALLIS: All you know is that --

MR. LANDRY: It could be 4,000. This probability is --

CO-CHAIR WALLIS: It is not profound as it was to meet the failure criteria.

MR. LANDRY: No, it doesn't say

"criteria."

CO-CHAIR WALLIS: Of course, it does.

MR. LANDRY: No, it doesn't.

CO-CHAIR WALLIS: That's what you're going to do eventually.

MR. LANDRY: It's the probability that your temperature that you've calculated is not the highest temperature.

CO-CHAIR WALLIS: I know that, but then you're going to go on and say it's less than some --

MR. LANDRY: Now you're going to compare that with the criteria.

CO-CHAIR WALLIS: Right. And this is a less than. So all you're doing is bounding whether or not it meets the criteria.

MR. LANDRY: What you are saying is that there is a 95 percent probability that the temperature which you have calculated, which is less than your acceptance criteria, is the peak that would be calculated.

CO-CHAIR WALLIS: Right.

MR. LANDRY: It says zero about the other five percent probability, where that temperature falls.

CO-CHAIR WALLIS: Right.

PARTICIPANT: Except it's higher.

MEMBER POWERS: Let me just be sure. I thought I was following you. It is a 95 percent probability that the peak clad temperature is less than or equal to what you calculated?

MR. LANDRY: Correct. It says nothing about the other five percent probability.

MEMBER POWERS: It could be a tenth of a percent, could be --

MR. LANDRY: It could be 1,000 degrees higher. You have no information about that.

CO-CHAIR WALLIS: But then you have criteria. So there's 95 percent probability of meeting that criteria. You've reduced that from what you just did.

MR. LANDRY: No. You've got a 95 percent probability that I have the highest temperature.

CO-CHAIR WALLIS: What is the probability of meeting the criteria, then, if it's less than that criteria?

MR. LANDRY: I don't know. It's at least 95 percent.

CO-CHAIR WALLIS: At least 95?

MR. LANDRY: It's at least 95 percent.

CO-CHAIR WALLIS: What we have shown is

it's about. What you have shown is it's at least 95 percent.

MR. LANDRY: It's at least 95 percent.

MEMBER POWERS: I'm not sure whether I'm following what the debate is. He calculates a peak clad temperature and says there's a 95 percent probability that the true peak clad temperature is less than or equal to the number I've calculated.

MR. LANDRY: Correct.

MEMBER POWERS: You compare it against a criterion that says yes, you're less than this criterion.

MR. LANDRY: Ninety-five percent probability and less.

MEMBER POWERS: You calculated a number. The criterion is here.

MR. LANDRY: Yes.

MEMBER POWERS: It is a 95 percent probability that the true peak clad temperature for the hypothesized accident is less than this.

MR. LANDRY: Correct.

MEMBER POWERS: You don't know what the probability is. It's less than the criterion.

MR. LANDRY: Right.

MEMBER POWERS: It's at least 95 percent

probable that it's less --

MR. LANDRY: Yes, correct.

CO-CHAIR WALLIS: I agree with that entirely, but the only clear statement you can make is that the probability of meeting the criteria is at least 95 percent.

MR. LANDRY: Correct, yes.

CO-CHAIR WALLIS: And I'm saying if you have 100 reactions and this is a bounding one, you can say, "Well, at least 95 percent of them are going to meet the criteria." You can say that is a sole equivalent statement.

MR. LANDRY: Yes.

CO-CHAIR WALLIS: Is that really what you want to make as a statement about safety?

MR. LANDRY: That's what I'm --

CO-CHAIR WALLIS: Based on 100 reactors.

MR. LANDRY: But, Graham, that's all an uncertainty analysis allows you to make.

MEMBER DENNING: I think that there is a difference, though, Graham. I think that one of the things that isn't discussed here is the difference between variability and epistemic uncertainties. And I think that if you get into the 100-reactor argument, you're discussing potentially variability, rather than phenomenological epistemic uncertainties.

I think that you can only look at it from that reactor -- I don't think you can say five percent of reactors are going to be above it. What you can say is five percent of realities.

You know, we don't understand this universe exactly right. In five percent of the universes out there, you don't meet the criteria.

MEMBER POWERS: In five percent of the universes, none of the reactors --

MEMBER DENNING: Exactly.

MEMBER POWERS: -- would meet the criteria.

MEMBER DENNING: That's exactly right.

MEMBER POWERS: In 95 percent of the universes, they do. And that's the distinction that's being brought here. And in the world of epistemic uncertainties, a 95 percent confidence is a heck of a confidence.

PARTICIPANT: Well, I think you owe it, especially since it's 95/95.

MEMBER DENNING: Now, let's talk about that.

CO-CHAIR WALLIS: I wonder where that --

MEMBER DENNING: Are we going to get to

the 95/95 --

CO-CHAIR WALLIS: We can now if you'd like.

MEMBER DENNING: Can we get to that now because it isn't clear to me when the agency decides it's going to use a 95 percent probability and when it's going to use a 95 percent probability with a 95 percent confidence. And I was wondering if you can address that.

MR. LANDRY: That we have specifically not addressed, Rich, for a reason. Because the minute you start specifying probability and confidence, you have now prejudiced the statistical methodology that you must use. You have taken statistical methodologies and thrown them out because they cannot return the confidence level.

Response surface analysis can only return probability. It can't return probability and confidence level.

CO-CHAIR WALLIS: I am not sure you can ever determine probability exactly without an infinite amount of data. You probably --

MR. LANDRY: There are some people that want to argue how many runs you have to make to really --

CO-CHAIR WALLIS: If you want 95 percent probability with 100 percent confidence, you've got a large amount of data.

MR. LANDRY: Right.

CO-CHAIR WALLIS: You've got to specify confidence. Otherwise they're meaningless data.

MR. LANDRY: But we as an agency did not want to specify confidence when we wrote the original change to the rule in 1988.

CO-CHAIR WALLIS: Plus, it doesn't mean anything.

MR. LANDRY: In 1988, Graham, this was done deliberately to not specify confidence because at that point, the mindset was you have to do a response surface analysis to determine uncertainty. And response surface cannot return a confidence.

So, rather than prejudice the methodology used, we very specifically said probability only. We did not specify a confidence.

CO-CHAIR WALLIS: Then there is not certainty on that probability. Must be.

MR. LANDRY: We don't say anything about the confidence level.

CO-CHAIR WALLIS: As you know, there is no way that with a finite amount of data, you can get an exact probability of anything.

MR. LANDRY: No.

CO-CHAIR WALLIS: You can toss coins 50 times and get half of them heads. It doesn't mean to say that when you toss 100, you're going to get the same number, same proportion.

MR. LANDRY: But there's nothing in life that's 100 probable --

CO-CHAIR WALLIS: No. I'm just saying --

MR. LANDRY: -- except death and taxes.

CO-CHAIR WALLIS: You can't define something which is meaningless.

CO-CHAIR SHACK: But if I'm doing my estimates in the 95th percentile by order statistics, it makes a very large difference whether I specify a confidence level or not.

MR. LANDRY: Yes, it does. If you're going to use our non-parametric method, such as order statistics, and you're going to calculate a 95/95, then you have to make 59 calculations. You have to have a population of 59 to have a 95/95 value.

CO-CHAIR SHACK: Yes, but I want to do 95/50 because you only asked for 95.

CO-CHAIR WALLIS: That's right.

MR. LANDRY: Well, if I want -- here we're talking about a realistic uncertainty level of a suggested number of 70 percent. Now, that's not a hard number. We're suggesting 70 percent. If we want to do that, my preference would be the calculation would have to be at a high confidence level but relaxed probability level.

If I were going to do a 95 percent confidence calculation at a 70 percent probability level, all I have to have is 9 calculations to satisfy those criteria using order statistics because the relationship is confidence is equal to one minus the probability range to the end.

CO-CHAIR SHACK: I sort of figured you picked the 70 percent because for most of the kinds of distributions we're talking about, the average is somewhere around the 70th percentile. And so this is really kind of like taking the average.

MR. LANDRY: Then we could argue 70 percent is a C. We could argue 80 percent. If I wanted to do a 95/80 calculation, I would have to have 13 calculations.

CO-CHAIR WALLIS: Now, this is predicting that the thing would work at 70 percent. Seventy percent of the time it is going to work.

MR. LANDRY: No, no.

CO-CHAIR WALLIS: It has a 70 percent probability of it working.

MR. LANDRY: This doesn't mean 70 percent.

CO-CHAIR WALLIS: You're taking a 70 percent probability of it working.

MR. LANDRY: This is 70 percent probability that you have captured --

CO-CHAIR WALLIS: But it works.

MR. LANDRY: Seventy percent of probability that you have captured the peak cladding temperature.

CO-CHAIR WALLIS: Take all the uncertainties and --

MR. LANDRY: Just a minute, Graham. Just a minute. Keep in mind also the peak cladding temperature is the highest temperature achieved on the hottest rod in the hottest assembly in the core.

CO-CHAIR WALLIS: That's something else.

MR. LANDRY: It's not saying anything about the whole core. This is the one point in the core that is the hottest.

CO-CHAIR WALLIS: I see this the same as manufacturing. You have, say, uncertainty in the heat transfer coefficient. You put it into your computer. And it predicts various values.

MR. LANDRY: Yes.

CO-CHAIR WALLIS: It's the same thing as having an uncertainty in the tolerance in the screw that goes into some sort of an automobile. You know, it is an uncertainty, and it goes into the final product. The final product works or it doesn't.

Now, you're saying that I should buy a product that has a 70 percent chance of working? That's very difficult for me to understand.

MR. LANDRY: No. We're buying a product that has estimated a value at the 70 percent probability level.

CO-CHAIR WALLIS: If you wanted to stall, say, what is the probability of this watch working? They say, "Well, we've run a computer program. And 70 percent of the time it works." Are you going to buy it? That's the kind of thing you have to explain to the public.

I'm not saying you're wrong. But I'm saying you cannot simply out of the air say "70 percent." It looks awful.

MR. LANDRY: We are suggesting 70 percent as a metric for a reasonable probability.

MEMBER DENNING: Why is that a reasonable probability? I mean, it's scarcely more than 50/50.

And I would make the argument that it ought to be 95 percent that you're taking tremendous credit for these higher break sizes, for not having to do single failure criterion. You know, already there is a tremendous benefit there. And I don't see why -- I mean, that is not even a one sigma, you know.

MR. LANDRY: Yes.

MEMBER DENNING: And so in 95 percent, we have talked to that as being exceptionally high. It isn't really that high, particularly when you realize that people tend to underestimate uncertainties when they're looking at epistemic uncertainty.

MR. LANDRY: Yes.

MEMBER DENNING: So I don't see a reason why we wouldn't want a high probability but that we're given a lot of credit associated with these other relaxations for it.

MR. LANDRY: It's a valid argument, Rich. I don't disagree with it entirely. We are on the staff attempting to say something that we feel is reasonable. And this is not even out for public comment yet.

If the committee would like to make comment, we would be more than happy to hear your argument for a different probability level. And it is a very valid argument to say a higher probability than 70 percent because we are relaxing so much on the requirements of the equipment to mitigate.

So that's not a bad argument, but we would entertain and listen to different views. This is going to be for public comment. What do you as members of the public feel is adequate or reasonable?

MEMBER KRESS: If you had a value for the frequency of the large break LOCAs above the transition break size, you could almost say from a risk standpoint that you don't need any mitigation.

CO-CHAIR WALLIS: That's right. That's right.

MEMBER KRESS: So did that factor into your assessment that 70 percent probability for the mitigation is a reasonable thing because from a risk perspective, you don't really need anything?

MR. LANDRY: No.

MEMBER KRESS: That didn't factor into it?

MR. LANDRY: We were trying to take a studied reasonable approach that if this is an event that is of a very low probability, what would be a reasonable approach to the analysis and the acceptance of the analysis?

MEMBER POWERS: I'll point out that in the same exact struggling for the source term, another set of people came up with 75th percentile, instead of 70th, I mean, virtually the same number.

I don't know the rationale by which they came up with that, but they came up with almost the same number when the requirement was to come up with a reasonable. A reasonably conservative number is what they were looking for. And they came up with exactly the same number.

The ideology has never been explained to me. And I'm sure I wouldn't follow it if it were.

MR. LANDRY: I know we will continue to argue this point, Graham.

MEMBER POWERS: As far as I have been able to ascertain, there is no engineering mechanism to pick that input.

MR. LANDRY: There is no engineering mechanism that I am aware of that would define what is the appropriate reasonable --

MEMBER POWERS: Conservative is just not defined in --

MEMBER KRESS: Don't you think it ought to be?

MR. LANDRY: It's a judgment call that this is a reasonable and rationale approach.

CO-CHAIR WALLIS: You see, the problem the public has is this sort of thing that you're talking about. This is a safety thing. So it's something you have to relate to some everyday thing, something like a life jacket.

Now, your life jacket in a canoe has to really work because the canoe is very likely to tip over. A life jacket in the Queen Mary, too, really will never be used because it's very unlikely to ever have accident. Therefore, the life jackets on the Queen Mary, too, only have to be 70 percent effective.

MEMBER KRESS: How about the Titanic?

CO-CHAIR WALLIS: It doesn't seem to make sense to the public.

MR. LANDRY: The Titanic sunk. Everybody knows that.

CO-CHAIR WALLIS: You have to explain it. So you can't just say it. You've got to explain it clearly, justify it.

MR. LANDRY: We'll try to work on --

MEMBER KRESS: That's why I was saying that probability has to -- the LOCA in the first place has to enter into the judgment.

CO-CHAIR SHACK: You're saying for those, a realistic analysis is good enough. And I would say a realistic analysis is about 70-75 percent. Maybe it is because that --

MEMBER KRESS: Because it ain't going to happen anyway.

CO-CHAIR SHACK: -- in my distribution, that is about the average. And the average is the realistic value. So to me --

MEMBER KRESS: That's one. That's one.

CO-CHAIR SHACK: That's my rationale for coming out somewhere around 70-75 percent because that really is the realistic value.

CO-CHAIR WALLIS: There's no consumer product and certainly no safety product which would ever be marketed with a 70 percent probability of working.

MEMBER POWERS: But that's not --

MR. LANDRY: They are not advertised.

MEMBER POWERS: It's not what they're advertised and it's not what they're doing here. They're saying there is a 70 percent probability that you will not exceed this rather mild --

MEMBER KRESS: For sequences that have a very low probability frequency in the first place.

CO-CHAIR WALLIS: You know what I would like to see? I would like to see -- the real thing is core damage. That's what's in the rule. Maybe you can say a 70 percent probability of 2,200 means 99 percent probability of not damaging the core. Then I understand what you're saying.

But if 70 percent probability of 2,200 means 70 percent probability of not damaging the core, that is not consistent with what it says in the rule. So you haven't made that connection for me at all.

MR. LANDRY: We'd better move on past this slide or we're never going to get --

CO-CHAIR WALLIS: I'm sorry. If you need all day, it's clear. I'm very sorry to hold you up, but I think it's an important issue. And you know that, too.

MR. LANDRY: We have argued. We have discussed this before in various other presentations, not just on this rule, with the Commission. I'm sure we'll keep going on it.

CO-CHAIR WALLIS: You see, now you're equating coolable geometry with this.

MR. LANDRY: Right.

CO-CHAIR WALLIS: And so there's no margin apparently to --

MR. LANDRY: Let me read my slide. Okay. The acceptance criteria, which we are reiterating in the reg guide, is that for breaks less than or equal to TBS, you stay with the current criteria.

And for breaks greater than the TBS, we said that there are only two criteria, that you must maintain a coolable geometry and that you must provide long-term cooling. But we have stated in the regulatory guide that today the understanding of the staff is that a coolable geometry is a PCT less than or equal to 2,200 degrees, maximum local oxidation less than 17 percent, and hydrogen generation equivalent to core-wide oxidation level of one percent.

CO-CHAIR WALLIS: So the core might actually only be damaged to 25, and it's irrelevant. We've defined it this way.

MR. LANDRY: We've defined it this way. Now, what we have said is that should a licensee not want to use those criteria, you can come forward and propose alternative criteria. But if you're going to propose alternative criteria, you have to give us a statement or the purpose of the proposed criteria. And then you have to give us a basis for your criteria, including your database.

The assumptions, you have to give us an uncertainty analysis on that database. You have to provide a validation and assessment, but you don't have to submit this material. As with an alternative approach to the analysis or breaks greater than the TBS, where you maintain the material, you simply tell us what you have done and you maintain the material, here also simply tell us what your criteria area. And you maintain available for staff inspection all of this supporting information.

This is to allow proposition of some other alternative criteria for what defines coolable geometry. Now, the staff today, we don't have that information or we are not aware of a strong justification for another definition. If somebody has one, we would be --

CO-CHAIR WALLIS: You all should be realistic about core damage now. Twenty-two hundred, does that mean there is a one percent chance of the core being damaged if you go above 2,200 -- it doesn't matter how long you're there for for one thing -- or is it 50 percent chance or is that really a very conservative bound?

MR. LANDRY: That's a very conservative bound.

CO-CHAIR WALLIS: Well, when we say 70 percent chance of meeting 2,200, that might mean 99 percent chance of avoiding damage.

MR. LANDRY: You mean --

MEMBER POWERS: At least my particular understanding of the 2,200 level criteria was that if you go up to 2,200 and spend any significant amount of time there -- and "significant" can be a fairly short period of time -- you will absorb enough oxygen such that when you cool that core down, the clad will be embrittled. And you are very likely to shatter the core.

A shattered core has been deemed difficult to cool. Now, by far, there is no demonstration of that. The break-up of the core is likely to be coarse enough that it may be coolable, but it would be difficult to assure that it's coolable.

CO-CHAIR WALLIS: Well, I guess my point is that --

MEMBER POWERS: Getting to 2,200 in itself, you could -- I mean, as far as damaging the core itself just by temperature, you would sit there for all eternity and it would not be anything you would get -- it's a very, very slow release of --

CO-CHAIR WALLIS: But it has embrittled it. So when you finish it, you --

MEMBER POWERS: When you cool it down, the cold ductility of the clad is nil or essentially nil.

CO-CHAIR WALLIS: What I guess I am asking for is to make a bridge between some percentage probability of getting over 2,200 and some probability of real core damage.

Let's see if I can sort of link to the PRA because if the core damage really switches on at 2,200, you would want to avoid it with I think a higher probability than 70 percent.

CO-CHAIR SHACK: But if it doesn't happen any more frequently than 10^{-5}, you're total risk is still pretty small.

CO-CHAIR WALLIS: That is also true.

MR. LANDRY: If it is 10^{-5}, then you have another probability of exceeding that at 10^{-2}.

CO-CHAIR WALLIS: I might as well say I don't care. I'd just say --

MR. LANDRY: On top of that, you have a 10^{-7}.

CO-CHAIR WALLIS: Why cool it all above TBS if the probability is so low?

MR. LANDRY: Because on the structure.

CO-CHAIR WALLIS: I feel as if you've sort of got two legs and you're doing a split here.

CO-CHAIR SHACK: Right. Let me understand this. Do we work on a Napoleonic code here or common law when it comes to this? That is, do you have to prove that they're wrong when you go out and inspect or do they have to prove that they're right?

MR. LANDRY: We haven't defined that, but what we have said is this is our understanding of coolable geometry today. If you want to, take an alternative approach. That's fine with us.

But you have to have a rationale for that alternative approach, and we have to have a basis, a strong basis, based on data, not just we think it would be better to use this. You have to have a basis for your alternative approach, but you don't have to submit it to us.

CO-CHAIR SHACK: No. When they come here with a code, you beat them up. Now, when you're going out there and inspect, what are you do?

MR. LANDRY: We are going to go out and say, "We want to see all of this documentation that supports the basis for your alternative criteria." And we will inspect it with a critical eye.

We're not with the intent of "This is wrong. We're going to shoot it down. We're going to look for everything we can to shoot it down." We want to go and inspect it and see, do you have a strong technical, rational experimental data basis for what you are suggesting? If it's supportable, okay.

MEMBER DENNING: I think the burden of proof question is really a good one, Bill, because this is such a difficult area to develop a really convincing analysis for. I think you ought to put the burden of proof on them, not on the inspectors or staff, to say, "No, you're wrong." It ought to be they ought to be able to really demonstrate why they're right.

MR. LANDRY: Okay. Well, we're trying to do that, Rich, because we're trying to say that if you want to propose this alternative, you have to have all this there, but --

MEMBER DENNING: Well, why isn't it then you propose it to us? You're not doing that. And it's obviously, at least from somebody's perception, easier to do that, I think.

MR. LANDRY: It's another comment to make. That's a valid comment. Have we not gone far enough in demanding submittal?

Okay. For the ECCS analysis for breaks greater than TBS, a little bit ago, when we started talking about the relaxed probability, we talked about some of the reasons for relaxation. And some of those are the assumptions that are being relaxed in the analysis requirements.

You no longer have to use a locked reactor coolant pump rotor in the analysis, but you do have to use the proper coast-down resistance for the pump from an applicable homologous curve. And you don't have to use off-site power. You can have off-site power that is available. You don't have to use the loss of off-site power assumption, which means a great deal because now you don't have to consider diesel start time because you don't need the diesels.

You don't have to consider you have lost the entire train of ECCS. All the trains are available. You don't have to take the worst single failure in the near analysis approach.

CO-CHAIR WALLIS: That makes sense to me. That makes sense to me. It's just like saying when you brake your car, you don't have to assume that one of the brake lines isn't available. But you still expect the brakes to work.

MR. LANDRY: Correct.

CO-CHAIR WALLIS: Take away all of these conservative assumptions, but then you expect the system to work. I think that would be a defensible position.

MR. LANDRY: Okay. And we have also said that you can use non-safety-grade equipment in the mitigation of the event, but if you're going to do that, you have to maintain that equipment as available.

And if you're going to take credit for non-safety-grade equipment, you have to be able to show that that equipment can operate under the conditions that it will be exposed to post-accident.

You can't take credit for a pump operating when it cannot withstand the relative humidity, temperature, pressure conditions that it will be exposed to. You can only use accredited equipment when it can be shown to be capable of operating under the conditions appropriate.

MEMBER POWERS: Well, if I tested something, a piece of equipment, under the conditions of the accident, some of them would fail and some of them would not fail. When I do that test, what confidence level do I have to have that will be able to survive under the accident conditions?

MR. LANDRY: We haven't put any requirements on confidence levels of survivability. We could go back to the PRA and say, "According to the PRA, what are the availability and operability of this equipment?"

MEMBER POWERS: The PRA can't tell you.

MR. LANDRY: And if it says one percent, you know, use an extreme. You can't take credit for this.

MEMBER POWERS: The PRA can't answer that question until they get the results of my experiment. Okay? I mean, they have to have a success criterion to plug in. And what I'm asking is, what kind of a number should I give them?

I mean, if I run a pump under the steam and temperature conditions, it's very likely to succeed. And I guarantee you if it didn't succeed, I would run a second pump until I got one that survived.

Now, how much of that data do I have to report?

MR. LANDRY: We haven't made any judgments on that.

MEMBER POWERS: Don't you have to?

MR. LANDRY: I don't know if the PRA people could help me out on that, but --

MEMBER POWERS: They can't. Until they have my experiment, they can't hep you.

MR. LANDRY: No. I'm sorry, Dana, but we haven't. We haven't discussed if a piece of equipment were going to be credited, what kind of statistical database has to be available for that piece of equipment.

CO-CHAIR WALLIS: It seems to me it should be treated the same way you treat the heat transfer coefficient.

MEMBER POWERS: That is what I was thinking. That is what I was thinking.

MR. LANDRY: There really does need to be a database available because we're not talking about a plant going out and adding a non-safety-grade pump simply to use. We're talking about a plant that is already in existence that has all of its hardware. And they have had testing of all of their equipment. They maintain their equipment.

What has been the testing history of the equipment? Does that support use of this non-safety-grade component?

MEMBER POWERS: There's a great deal of the testing of environmental qualification that consists of getting one to work.

MEMBER KRESS: I was assuming that's what that meant, that it had to undergo the same EQ requirements that a safety-grade pump would. That's how I interpreted it. Is that the wrong interpretation?

MR. LANDRY: No because then you're making it a safety-grade pump.

MEMBER KRESS: No. I'm making it go through the same EQ.

CO-CHAIR WALLIS: Is it the accident that makes it not work or is it something wrong with the pump itself that makes it not work?

MR. LANDRY: Well, I used a pump. If it's an electric motor --

MEMBER KRESS: Yes. It could be --

MR. LANDRY: If it's a motor-driven pump --

CO-CHAIR WALLIS: If it's away from the accident, I would expect it to work.

MR. LANDRY: Well, yeah.

MEMBER POWERS: A lot of these things are in an unusual environment.

CO-CHAIR WALLIS: Most pumps work. The pump in my basement works thousands of times without being a problem at all. I expect a reactor pump to work even better. What is the problem?

CO-CHAIR SHACK: I think it is commercial-grade equipment. It is designed to work under these conditions. It has not gone through the full EQ program to demonstrate it.

MEMBER DENNING: Well, there is a question of environmental conditions. You know, we --

CO-CHAIR WALLIS: Is that the problem? Is that the problem?

MEMBER DENNING: I think it's environmental conditions. Would it really survive the special environmental conditions, which it hasn't been tested for?

CO-CHAIR WALLIS: But it would be nice to put it into the probablistic analysis, incorporate it in there.

MEMBER POWERS: But understand you cannot do that without doing my experiment.

CO-CHAIR WALLIS: But, then, how do you get a heat transfer coefficient? You do experiments, too. It's subject to the same problem.

MEMBER POWERS: No. We just look up the heat transfer coefficient.

CO-CHAIR WALLIS: Oh, you've established --

(Laughter.)

MR. LANDRY: We've said in the rule and in all the materials supporting that FAR analyses for breaks greater than the TBS, all that must be done is to tell us what methodology you've used.

But you must maintain for inspection the documentation that supports your analysis, analytical model requirements, the model methodology code description, and on down.

These are the typical supporting documentation that we would require be submitted today under the current 650.46.

CO-CHAIR WALLIS: Did it say they would finalize this thing with RELAP 5 and the code outputs are all in the drawer somewhere? Isn't that the sort of thing they would say?

MR. LANDRY: Then they would have to maintain their user guideline materials. They would have to maintain the model description manuals and so forth. Yes, they have to keep those there.

CO-CHAIR WALLIS: Under what circumstances would you go and look at them?

MR. LANDRY: We haven't defined those circumstances yet.

CO-CHAIR WALLIS: It seems funny. There is no entree that you have. There's no sort of way that you can justify when you do or do not take action, it seems to me, here.

MR. LANDRY: We have tried to be careful

to not specify in the regulation or the supporting documentation what would trigger an inspection and audit. We're keeping that still at staff's description there.

CO-CHAIR WALLIS: If the public is looking over your shoulder and you're looking after the public interest in assuring nuclear safety, what do you say to them when you say there is something available there which we or might not go and look at? How do you assure them that everything is okay?

MR. LANDRY: We'll have to make that judgment when we get a submittal and we determine that this methodology --

CO-CHAIR WALLIS: What's wrong with having them submit it?

MR. LANDRY: Burden.

CO-CHAIR WALLIS: Then you have checked it off and there is some kind of a -- so you can assure the public that "Yes, we have looked at it, and it's okay."

MR. LANDRY: We simply just made the decision that since the probability of the event is so low, that that was not a necessary burden to add on, that we would simply require that the material be made available or kept available so that if we want, we can go and inspect it.

CO-CHAIR WALLIS: That's a bit funny because I just bought a ladder so I can escape from my house in a fire. And I think it's been sort of tested and so on.

The probability of that is very small. If you're looking for statistics, the probability of my having to escape my house is probably times small, but I still want to make sure that someone has validated the design and all of that.

MR. LANDRY: Did you require that they submit the database to you? It's available.

CO-CHAIR WALLIS: I'm trying to protect you in a way from going out there and putting yourself in a position where the newspapers get a hold of it or something and people start looking for a rationale that you have to supply to the public, not just to us, because I think we can probably understand your rationale.

MR. COLLINS: Excuse me. This is Tim Collins. We have to go back to what the Commission was trying to accomplish in the first place when they wanted to go forward with this rulemaking.

I mean, it was their decision that they wanted to focus our attention on the more risk-significant events. And following the work of the expert elicitation panel, which indicated that these large break LOCAs are of such low probability, the Commission said, "Okay. Let's not spend a lot of time and effort looking in this area." So all this stuff we're talking about is beyond the TBS, the extremely low probability initiating events.

And we were basically instructed by the commissioners to cut back on what a licensee needs to do in this area. Okay? And so all the stuff you're seeing here are ways we think we can cut back without cutting into the major risk contribution or the contribution of risk from these events to start with, --

CO-CHAIR WALLIS: I understand what you're doing.

MR. COLLINS: -- which is driven by the initiating event.

CO-CHAIR WALLIS: But if I go back and talk to my friends and professional colleagues and students about what is going on here, I have to be able to explain to them why it makes sense to them.

I think that you are so focused on satisfying the Commission. I hope somebody is explaining it in a way that is going to satisfy the other people.

MR. LANDRY: We're not only trying to satisfy the Commission, Graham. We're trying to be reasonable in what we're asking.

CO-CHAIR WALLIS: Yes. I understand that, too. I think that's important.

MR. LANDRY: We're trying to be consistent with the probability of the event.

MR. COLLINS: Yes. The primary answer to explaining it to anybody is that we believe the initiating event probability is so low for these large break LOCAs, they don't warrant a whole lot of special protection. And if the people can't accept that, then that's the issue right there. It's not this other stuff.

MEMBER KRESS: Then you have to answer the question, how do you know it is so low? Then you say, "Well, we got a bunch of experts together. And they told us it was low."

And I'm a member of the public. When I hear that, I sort of "I can understand it. I agree with it. We have no other option."

MR. COLLINS: Somebody has got to make those decisions somewhere. Okay? And the Commission has made that decision. At this point we're trying to implement it as we understand it.

Now, if the public has a significant problem with that, the rule is out there for comment. So the public can let us know that they don't want to go that way.

MEMBER KRESS: Well, except your public when you go out for comments is rarely the public.

MR. RUBIN: Well, even with the low expectation, the frequency of this challenge, the Commission guidance and the way the staff has formulated the rule and the acceptance criteria is with the expectation of success if this low frequency challenge were to occur given the available equipment and the changes they make to the plant to implement 50.46(a).

So based on the thermal hydraulic calculations that Ralph is talking about, it is our expectation that adequate core cooling will still occur.

CO-CHAIR WALLIS: That's exactly my trouble. I believe that. I think that is a very good goal. I like it in the rule. But, then, does 70 percent meet that? I don't think so. Expectation that it will work with a 70 percent probability is not much confidence, is it? It's not.

CO-CHAIR SHACK: There are not many other 10^{-5} events you design for.

CO-CHAIR WALLIS: Yes. But, you see, he just said that, even then, you expect it to work.

MEMBER DENNING: Well, let's move along because there are other areas we want to criticize.

MEMBER KRESS: That was my comment about the expert opinion, that the way you offset that is by how an expectation is going to work anyway. And that's where I have the problem with the 70 percent also.

MR. LANDRY: Okay. With regard to the documentation and the analyses provided above the TBS, you're saying that you must still maintain good quality assurance practices. You must have QA that's consistent with appendix B. That applies to the analytical model, its development, assessment, and application.

So, to summarize the analysis, except for breaks up to and including the TBS, you have to follow all the rules currently in place. For breaks beyond the TBS, you may use the current analytical methods or an alternative, but the documentation relative to the analytical methodology used must be maintained for staff inspection.

We have allowed considerable relaxations in assumptions on equipment for breaks beyond the TBS. And we're still insisting, though, that there has to be good quality assurance practice that is followed.

If there is no more on the ECCS, I'll let Ed Throm come up and explain the containment to you.

CO-CHAIR WALLIS: You have a very short section on safety margins in the guide. There's a section about so long and three or four inches on safety margin.

It sort of doesn't help me at all. It's that the safety margins are there to compensate for uncertainties. I thought that was what you were doing in the statistical methods.

I didn't really see how your discussion of safety margins helped at all. It didn't seem to define anything which was meaningful to me. Is that going to be clearer in the future?

MR. LANDRY: If that is what you would like clarified, we'll take that back and look at it further.

MEMBER DENNING: Let me make a comment in the uncertainty section, too. I didn't think that this 2.1, 2.1.1, .2 uncertainty -- I didn't see a major distinction between the uncertainties that were code uncertainties and then the rest of the paragraph.

And I thought that you might want to say something about variability. I think that, really, what you're doing is you don't allow credit for variability. I think --

MR. LANDRY: Right, right.

MEMBER DENNING: So I thought you might help that section a little bit by discussing variability and then --

MR. LANDRY: Okay, Rich. I'll take that comment back and look at it further.

IV. CONTAINMENT ANALYSES

MR. THROM: Good afternoon. My name is Edward Throm. As of January 8th of this year, I moved over to the Nuclear Performance and Code Review Group, basically reactor systems, out of the Containment Group. So I am kind of wearing two hats right now until I train someone to kind of take over and pick up on some of the containment work.

You know, the first thing I would like to point out is that containment response analyses are not only directed at LOCA. We also look at main steam line breaks and feedwater line breaks.

CO-CHAIR WALLIS: Excuse me. Excuse me. What are we looking at for papers here?

MR. THROM: It should be following Ralph's?

CO-CHAIR WALLIS: Does it?

MR. THROM: Page 13.

CO-CHAIR WALLIS: Page 13 says "Risk Assessment Reporting Requirements." That's pretty clever. We don't have Ralph's? We don't have Ralph's. So that's the only thing I have. Okay. Thank you.

MR. THROM: Ralph did have the handout. Do you have them now?

CO-CHAIR WALLIS: Yes.

MR. THROM: Okay. I wanted to point out that the containment response analyses are not only done for LOCA. They're also done for main steam line breaks. And feedwater line breaks have been considered. Traditionally they have been shown not to be a significant actor within the framework, but, you know, through trial, through the process.

We don't typically look at them because they are not limiting, but, even as a result of the rule change, the licensees will still have to look at the main steam line break as far as containment pressure responses go. And there will be no change in that based on the current way we do business in the conservative guide.

Basically these analyses are done to demonstrate that the pressures and temperatures remain within design limit. And, of course, they're used to evaluate the safeguards equipment, whether it be sprays, coolers, ice condensers, the ice weight, and BWRs, the suppression pool temperature performance.

Also, diesel loading times, when do you need some of these safety-grade systems to be available? So it deals with how long does it take to get coolers started? How long does it take to get pumps started for sprays or RHR systems, for suppression pool cooling?

That's part of what goes into looking at the containment analysis as well as what I call auxiliary system performance. And that basically deals with the heat exchangers and how they are modeled, how much water is going to them.

CO-CHAIR WALLIS: Could I ask you now about this "demonstrate pressure and temperature within design limits"? Does that apply to a LOCA when the ECCS works or does it apply to this 5 or 30 percent, whatever they are, cases where it doesn't work, may not work with some probability?

MR. THROM: I will try to address that

when I get to the later-on presentation about what might be done as far as the analysis goes. I could step to it now.

CO-CHAIR WALLIS: How does it handle a case where the core gets embrittled or is that beyond DBA?

MR. THROM: That would be beyond where I think we're trying to go in this thing. The way containment analyses are done today -- let's just take as an example there -- is there is a little bit of an opposite swing between the analyses. When they do the core ECCS analysis, their objective is to make sure that the heat stays in the reactor vessel because that is the worst thing to do. So I want to look at the containment response.

I do a similar type of calculation for the blow-down of the fluid from the reactor system, but I do my analysis to make sure the energy and the mass get released in a conservative faster fashion.

So in today's environment, even if people are doing a statistical LOCA approach, when they're going and looking at containment, I think for the most part, they're still staying with their currently approved methodologies, which would be basically the double-ended guillotine break, with mass and energies calculated based on the guidance in the regulatory guide.

CO-CHAIR WALLIS: It doesn't bring in a hydrogen probe or something like that?

MR. THROM: No, it does not. In today's environment, what is typically done in the containment response is the energy from the hydrogen, the one percent hydrogen, is put into containment as well as the hydrogen itself is a non-condensible because it is going to infect the heat transfer coefficient to be a conservative analysis.

Ultimately, you know, containment analyses are used to determine whether or not the ultimate heat sink is adequate for its job of ultimately removing the heat from the reactor.

Other purposes for containment response analysis are equipment qualification, temperatures, and profiles, to go back to the question we had previously, because it's a thing that we would allow in containment, too, was to be able to credit non-safety systems.

I would think that the current equipment qualification envelopes that have been calculated to date based on the large double-ended guillotine break in using the guidance from the reg guide -- and there's also NUREG 05-88 -- is basically the guideline the staff uses for equipment qualification.

We have temperature, pressure profiles that any of this equipment could be matched again. You know, what do you have? Basically, the only thing that is probably really available that is not safety-related is in those plants that don't have safety-related coolers, which either rely on ice condensers or rely on sprays as their mitigation and cooling system.

You know, you would probably be hard-pressed to look at those coolers and say they could operate in above-boiling temperatures that you would probably see in containment for, you know, beyond the transition break, large double-ended guillotine break.

What we're trying to do is say we would not be adverse to looking at whether or not there was something there that could operate. And, of course, we would have to have confidence that it would operate.

I think we would look at it the same way we look at equipment qualification. It might be necessary for a particular licensee to go back to a manufacturer and get some bench testing done to see whether or not his feeling on the equipment is adequate, but we don't want to basically just throw it out out of hand and there might be something in some specific design where someone does have something that he could take credit.

It might very well be that things are progressing at such a rate that I could credit maybe 10-20 minutes worth of operation for a system that I typically wouldn't. But we want to leave it open that we be receptive to listening to an argument in that area.

Another thing that is done for containment response analysis is for pressurized water reactors, there is a minimum containment pressure for ECCS performance that is calculated.

This is an opposite calculation to the peak pressure. It goes into the back pressure that is basically used in the ECCS analysis. You know, you want to have a minimum pressure because it makes the core response a little bit worse. So it's another calculation that gets done that influences the way you want to handle your containment analysis as you go through this process.

CO-CHAIR WALLIS: Are you going to take containment pressure credit for NPSH for BWR or are you going to do something similar?

MR. THROM: That's a different --

CO-CHAIR WALLIS: Do we also do a minimum containment pressure analysis?

MR. THROM: Yes. But this analysis is used for the ECCS performance. And that's basically to look at what the containment back-pressure is and how it impacts the reflood rate.

CO-CHAIR WALLIS: Because when you really need the containment is after you have had some damage to the fuel, isn't it? That's when you really need it.

MR. THROM: Yes.

CO-CHAIR WALLIS: That's when you want it to work.

MR. THROM: Right, although the objective, first-line objective, is to prevent damage to the fuel.

CO-CHAIR WALLIS: But the containment doesn't do that.

MR. THROM: No, no. It's the defense-in-depth.

Okay. The containment criteria and guidance are found basically in for the general design criteria. It's general design criteria 16, which essentially says containment should be a leak-type barrier against the uncontrolled release of radioactivity and that the containment design condition is important that safety not be exceeded as long as the postulated accidents require. Okay?

Now, I'm pointing that out because the next three, actually the containment heat removal only addresses LOCA and containment design base, GDC 50, addresses containment design basis for LOCA. Okay? So we do look.

That's the reason we still look at the main steam line break, is basically because of GDC 16. One would think that a plant going to 50.46(a), if he were doing his LOCAs up to his transition break size with the containment, he's still going to be limited in terms of what he can do because he still has to analyze the main steam line break.

The guidance that we use, again, it's in the standard review plan. It's 6.1.1.1(a) if you're an atmospheric or subatmospheric containment, (b) if you're an ice condenser, and (c) if you're a BWR. That defines the way we look at the containment analysis itself.

CO-CHAIR WALLIS: Is there anything different? I couldn't find it in the reg guide about below transition break size and above transition break size --

MR. THROM: It's there.

CO-CHAIR WALLIS: -- frequence of the containment? I couldn't find anything.

MR. THROM: I'll go over it, but it basically parallels what Ralph has just basically said. We think up to the transition break, the current methods that are being used are most likely applicable. And it's what people would use.

We'll leave it on this slide. I point out one of the potential issues with going to a smaller break. Okay? And that's in the minimum containment performance calculation. There's a rather prescriptive methodology that's in the guidelines that most of the utilities use about the use of the Tagami heat transfer coefficient.

Tagami is a bunch of data that was developed I think in 1964. And what is essentially described is you start with a fixed heat transfer rate I think of about 8 btu per foot^2 hour degree at the start of the transient. And then you look at the time until you get to the end of blow-down.

And you look at the containment volume and the energy. And you do a calculation to come up with a number that says between time zero, when the break occurs.

And when I get to the end of the blow-down, I ramp the heat transfer number up to this calculated number, which is a function of one over the blow-down time.

That data in this application has typically been used for double-ended guillotine breaks, where the 1/t is something like 30. If I get into breaks that are much lower than that, maybe the 10-14-inch break, the blow-down time now becomes possibly 100 to 200 seconds, which now means that particular guidance has to be revisited to determine -- but I've also got a different energy release characteristic. It's just something we point out that we have to be a little bit careful on just blindly going in and saying, "And that's the right thing to do." We would probably have to revisit that.

And there would be nothing in the way we do business that we would not listen to an alternative way of trying to do this conservative back pressure calculation. You know, reg guides are a way of doing business.

But I wanted to point out that, you know, there is something that we may have to go into a little bit further when we look at this particular part of the containment response and the analysis licensees will be doing under 50.46(a).

CO-CHAIR WALLIS: It looks like a very crude method.

MR. THROM: Oh, it is. You know, the containment testing was done from 1960 to probably 1975. Methodologies were pretty well put into place back in those days. And they've done us very well.

You know, the methods are understood to be conservative. There's been a long history of looking at the codes and comparing them to a large amount of test facilities.

And basically they show 00 their nature tends to over-predict what is going on, which is basically what I am going to cover here right now.

This is looking at the containment for breaks up to the TBS. We think the current approved computer models and guidance are most likely applicable. These models are based on lumped parameter approaches.

For the most part, large dry containments are analyzed as a single volume. Ice condensers have multiple volumes, but there again, the lumped parameter approach for the most part because they need to look at making sure steam goes through the ice condensers, in boiling water reactors, you have, again, mostly a lumped parameter approach, but more than one node, the dry well, the suppression pool, and the wet well.

But within the framework of looking at the containment response and how heat structures are behaving in general, the breaks have always led to a well-mixed containment environment. That's why the lumped approach is good. The establishment of stratification is generally not an issue. And the containment is well-mixed. So these single wallings tend to work fairly well.

The other thing that is not in force is --

MEMBER POWERS: It seems to me that in a lot of the recent more advanced reactors, we have had questions about stratification in the containment because of steam condensing up in the dome region and just leaving behind hydrogen. I mean, it seems to me that the rises in the ACR 700 because of their water cool certainly rises in the AP1000.

MR. THROM: Again, the PWR analyses to date have always considered the fact that shortly after blow-down, these sprays come on.

And essentially that situation is over.

In these passive designs, you've got two things. You've got in like ESBWR, you're going to have smaller pipes. In the AP1000, the issue was not so much the issue with the early part of the transient, where, again, they had large things, but it was basically when you got to their ADS 4, would you be able to argue that the dynamics of the jet break was still sufficient to say that "I really thought that the well-mixed environment and, you know, the possibility of the stratification was remote"?

And under that review, you know, we looked at the Froude number of the jet coming out of that break size and concluded that that was still a fairly good argument that we could entertain to say that there was no need to really be considerate about a large amount of stratification.

Does that answer your question?

MEMBER POWERS: Yes.

MR. THROM: Okay. Again, the way we do calculations today, we use conservative initial conditions. We tend to look at the maximum tech spec pressure you could be operating at. We tend to look at the maximum temperature in containment and basically look at a low relative humidity because that increases the amount of noncondensibles that you assume are there in the first place.

Typically there is a conservative treatment of the break flow and the heat structures. And what I mean "break flow," I mean that's the mass and energy that is coming out of the break.

This is probably more pronounced in the long term; i.e., after blow-down, where the stored energy in the reactor coolant, piping, steam generator, fuel, and everything else tends to be released to containment in a rapid fashion, more rapid than it would be if you were trying to do what you would call a realistic estimate of how those things were released. Of course, we look at single failures and loss of off-site power when we look at the engineered safety systems.

Now, again I have to point out in this avenue that when I first started looking into developing a reg guide, it was not clear to me where the transition break might come out. But just on the discussion we have just had with Dr. Powers there, there is a point where those assumptions may break down. Okay?

And we would expect -- and I think it is in the reg guide -- that a licensee who wanted to use his currently approved code would have to look at the breaks he's looking at and be able to put forth an argument that the well-mixed assumption was being maintained for these breaks.

If you're going to ask me to guess at what it might be, I would guess in the six to eight-inch range is where I would probably think. I would be concerned as to whether or not the dynamics were adequate.

But no, I haven't done any calculations to verify that one way or the other. There is nothing in my mind very early on to say we might not be looking at three-inch breaks, in which case -- you know, we're not talking about analyses that should challenge the containment design. But we're looking at implementing some regulatory requirements. And we have to have some confidence that what is being done has some technical merit to it. Okay?

CO-CHAIR WALLIS: The very small break, the steam goes up to the top, doesn't it?

MR. THROM: Yes. You would expect it to, yes. You know, you could also look at just the situation where small breaks in what -- below the operating DEC in compartments, you have to be a little bit cautious about the way you look at the way the calculation were originally done, where if you had a break in a compartment that may have a door in it, because it was a large double under break, no one ever considered the impact of the door. There is a point where you can get to a break that is small enough that might be in a compartment, although we don't require people to put the break anywhere under 50.46(a).

But, again, just to make sure I was trying to cover all of the bases, you know, I had to say something about what could happen if the breaks got really small.

The acceptance criteria that is used would be the same acceptance criteria today. And the structures withstand the peak pressure calculated without loss of integrity.

CO-CHAIR WALLIS: This is the peak pressure calculated?

MR. THROM: For the transition break.

CO-CHAIR WALLIS: Without core damage?

MR. THROM: Yes. Okay? And also that the containment remains low leakage barrier against the release of fission product as long as accident fission is required.

As was pointed out earlier, that is not done as part of an analysis. That is validated through the appendix J leak rate testing, where you do leak rate testing to assure that the containment is a low leakage barrier. You know, it's not done through analysis.

The other point Dr. Kress brought up earlier is the 24-hour number. What is typically done in licensing space for consequence analysis is we say the leakage is at the design basis leak rate for 24 hours.

Then after 24 hours, if the containment analysis response shows that the pressure has been reduced at least 50 percent, then we give you credit for reducing the leak rate after 24 hours.

If we get into the transition breaks and they don't do that, well, then, you know, they're going to have to look at something potentially different. Okay?

And this will go basically a lot to the implementation because in a lot of plants, it's the sprays that satisfy the general design criteria 38 for the rapid reduction of what is going on.

So how sprays will come into the fold we'll have to look at. And, of course, it's going to be a decision a licensee would have to make, you know, how we wanted to handle what it was going to be possibly doing in looking at its safety --

CO-CHAIR WALLIS: Now, in terms of LOCA, isn't it the big LOCAs that challenge the containment the most?

MR. THROM: Yes.

CO-CHAIR WALLIS: They're the ones you're going to change the rules about?

MR. THROM: Yes.

CO-CHAIR WALLIS: They're the ones we need to be concerned about?

MR. THROM: Right, but still the rule --

CO-CHAIR WALLIS: The only thing I can see that is different now is that with the big break, if it should happen, there would appear to be more chance of core damage given the condition of the build, not that it's going to affect CDF much at all.

If you did have the big break, then a big break with core damage is now more likely because you're being less conservative about your ECCS system. That's what is happening with this new rule.

MEMBER DENNING: Well, if I may, I would like to now make an argument as to why we shouldn't do anything to change the design basis of the containment. And that is that the value of the containment is not related to LOCAs or fission product release in the LOCAs. The value of the containment is to maintain integrity in severe accidents.

Historically we have developed a design basis of containment before people knew anything about severe accidents. Now we analyze severe accidents. What we see is strong containments are really important to the mitigation of severe accident processes like the 15 psi spike, hydrogen spike, that occurred at TMI.

So regardless of whether or not large break LOCAs are of high probability or low probability, they're really irrelevant. The real question is, are we going to do something here? Are we going to allow something that would reduce the effectiveness of the containments? And that is definitely the wrong way to go.

If we see any vulnerabilities in PRA, it's that there were some containments that were going through this large break LOCA kind of approach that did not build strong containments.

Now, I don't know what people are going to do that could affect -- you know, given this relaxation, is there anything they're going to do? They're not going to take tendons out of the containment or things like that.

But I don't know. I don't know what

they're going to do, but the principal value that I see of that containment is to protect us from severe accidents. And I don't see any logic by which we would allow a reduction in the strength of that containment in any sense.

Now, if we do go this pathway, then I do think that we want to have some very specific criteria on LERF and the examination of LERF and the effect of this on LERF, which I don't think people are thinking about at the moment. But I don't see any reason why.

I mean, it's a surrogate. It's what gives us a strong containment that is what really protects us from the severe accidents. If we're doing it all over again, what we really ought to have is severe accident criteria for the design of containments, but we're not going to do that.

MR. THROM: Right. Maybe, you know, first of all, a rule for outside the DBA or beyond the transition break says containment integrity must be shown. Okay? Now I'll cover that on the next slide. I think we can get there. And that is for breaks beyond the TBS.

Since they're the large double-ended breaks essentially that we're accustomed today, the tools we use today should be appropriate. What we think we should allow people to do is now because of the understanding of the frequency of the break, let them do a realistic treatment of the break flow in the heat structures and also not include single failure, let them take credit for off-site power, and apply if they can non-safety-grade equipment, and do that analysis.

The acceptance criteria is still the containment, has to be able to withstand those pressures without loss of integrity based on ASME code limits.

And basically the way that would be done is the engineering people would go to their standard review plan, 3.8.1 if it was concrete containment and 3.8.2 if it was a steel containment. Essentially one would expect that if you used your current methodology and did a realistic assessment, the analysis would show that you had more margin to that design value.

But we're not going in saying as a result of any of these analyses, my belief is that is not the intent, is to go in at any time and say as a result of adopting 50.46(a) and looking at better estimates of the large breaks, that we would say that that is the ability to degrade containment.

And I think maybe if you would want, the engineering staff can give what they're trying to do in terms of looking at this analysis and making sure that we stay the course on containment integrity. It's clearly called out in the rule.

MEMBER DENNING: Well, the question -- I had a number of questions. First of all, is anybody really asking for this relaxation? And if they are, what are they thinking they're going to get from it? I just want to make sure that whatever they do, it's not something that decreases the strength of the containment in severe accident regimes.

MR. COLLINS: This is Tim Collins from the staff. This question came up in our internal deliberations. As someone suggested, what if we had a situation where somebody was doing a steam generator replacement and they cut a hole in the side of containment?

When they patch that hole, can they have a degraded containment as a result because they have adopted 50.46(a)? We said, no, that is not an acceptable approach.

The regulation itself says that we need to maintain the structural integrity and leak tightness of the containment.

MEMBER DENNING: When you say the

"structural integrity," they still would have adequate structural integrity, just at a lower peak pressure. I mean, in this patch, for example, I don't understand why they couldn't patch the containment in a containment that currently can stand 50 psia, why the patch area might now only be 25 psia. That's ridiculous or gauge. But is there a reason when they went in and patched, why they couldn't patch it at a lower level of total structural capability?

MR. COLLINS: Is Hans still here?

MR. ASHER: Yes.

MR. COLLINS: I think that is a code question.

CO-CHAIR WALLIS: -- risk arguments on containment. We found out with the AP600, you could almost make a case it didn't need a containment at all, just use risk calculation.

MR. ASHER: I am Hans Asher with the Division of Engineering. Yes, we deliberated quite a bit at one time. We did think about can you give any more relaxation in the containment design itself?

And after a number of arguments and the meetings that we have been through, we decided we are not going to do that. We are going to hold the containments in the same kind of way. Either beyond

TBS or within TBS, the acceptance criteria will be the same. Okay?

Now, regarding degradations, we are going through a number of studies with Office of Research regarding the effect of certain degradations; for example, removal of three tendons from a containment and what effect it would have on the capacity of the containment, the argument capacity. I'm not talking about the leak type individual part, on argument capacity.

And we are finding -- at least this is the preliminary finding at this time -- that certain degradations can be tolerated. And still containment can take -- its capacity cannot be compromised very heavily, maybe two percent, by the time you take out three tendons from the containment. Okay?

Based on that, the existing criteria that we have in the standard review plan will be of the same kind of a robustness as we had before. It won't be changed. I understand your question that in case the beyond LOCA pressure decreases, can the licensees degrade the containment just to cope with that? And my answer to that is, no, they cannot do that.

MEMBER DENNING: Why are we opening the door? Who is asking? I certainly understand the benefits in the ECCS area and diesel generators and that kind of stuff. I don't understand where the perceived benefit is here.

And then the thing that worries me is obtaining that benefit, are they going to do something that is going to make us less robust against severe accidents?

So why do we feel the necessity to reduce the -- you know, to provide more margin here?

MR. ASHER: I don't know. It is an indirect result of changing 50.46(a) route, the containment risk, structural risk particularly. I mean, even if the pressure comes out a little higher because of certain other things that are being considered, along with realistic considerations and everything else, they are also there to meet the requirement of the standard review plan, which is ASME code more or less. So it does not change our premise.

What you are thinking about, I have thought about at the time you are deliberating in these areas. And I don't think we want to allow more degradation in containment because of this change in the criteria. There is no way to change. You won't allow that to.

MEMBER DENNING: Well, it looks to me like one could with no loss of value to the utilities just say here for breaks beyond the TBS, same criteria as previously.

MR. ASHER: Yes. That is exactly what it says right now.

MEMBER DENNING: In fact, you feel that is what it says right now?

MR. ASHER: Right.

MR. THROM: Well, the acceptance criteria is the same. The argument is whether or not the analysis procedure should be allowed to be changed.

MEMBER DENNING: Yes. The acceptance criteria is the same, but the peak pressure is going to be lower. So that it would say I don't need as strong containment.

Now, what they're going to do about that that would reduce the containment strength, I don't know except there is --

CO-CHAIR SHACK: Well, I assume they're going to upgrade their power to --

MEMBER BONACA: That's a possibility.

CO-CHAIR SHACK: I mean, I don't think they're going to degrade the containment, but they're certainly going to take advantage of that additional margin.

MEMBER DENNING: Margin, yes. Well, see, I'm not sure. As far as peak pressure in a dry containment, I don't think it's affected by the power level. You know, it's sort --

MR. THROM: I don't know.

MEMBER DENNING: I mean, I don't know. I mean, it would be difficult. You know, I would be very careful what I say because I don't know.

MR. THROM: We're talking one or two psi here, you know.

MEMBER KRESS: That's necessarily true, what you're saying.

MR. THROM: Well, I would appreciate your comment that we really should go back and revisit it. I think it's as much an issue of trying to perceive how the industry would want to implement this part, as much as anything else.

For example, it might be that they might want to stay with basically what they have been doing in the past. You know, again, we're just trying to look at, again, being a lower probability event, is it appropriate to maintain that additional level of conservatism in the analytical procedure? That's kind of what we're trying to address.

MEMBER DENNING: Right. And if large type break LOCAs were all that was to it, then I would agree. I mean, who cares?

MR. THROM: Right.

MEMBER DENNING: But it's not. It's really severe accident.

MR. THROM: But, again, as I said, they still have to also look at the main steam line break. Okay? And a number of plants when it comes to the peak pressure, you're hard-pressed to tell who is going to be the dominant guy.

You know, what is going to happen is basically you may see the shift from the LOCA in some plants to the main steam line break as being the one that defines the ultimate challenge to the containment.

So, you know, we need to balance that and really consider your comments about what could conceivably happen or maybe the guidance needs to be made more clear that, you know, it's not the intent to use this as a means for degrading containment because of a calculation.

I think in a real world, we would be hard-pressed to say that we were able to do those analyses of sufficient, you know, quality to say, yes, you could make a good engineering judgment on it.

CO-CHAIR WALLIS: I tend to agree with what Rich said. All we really care about is the severe accident. And what we care about is if we've got to focus on all of these design basis accidents and then allow the licensee to make changes in the plant, this may change what happens in some of these things that we really care about, which is the beyond design.

MEMBER KRESS: Yes, but one of the main reasons, if you remember our letter, that we went along with this whole thing of changing the break size was that if they were going to make changes in the plant, --

CO-CHAIR WALLIS: Yes.

MEMBER KRESS: -- then they would have to do it using reg guide 1.174. And the comment that I have there is it only looks at CDF and LERF and the defense-in-depth and other things.

But I was under the understanding that you were also going to add a criterion on additional containment failure probability. I don't know if it's in there or not, but I'm still looking for that.

But that's the only reason we went along with it is because it would be treated just like a change to the licensing basis. And, you know, it would have to have the appropriate PRAs and uncertainty analysis and defense-in-depth considerations and so forth.

CO-CHAIR SHACK: Well, we're running late here. Can we stop here?

MR. THROM: Sure.

CO-CHAIR SHACK: And then we'll --

MR. THROM: I was just at a summary slide. I've said it all. So I don't think there's any need to rehash it. Thank you.

CO-CHAIR SHACK: We were due for a break a little while ago. Let's take one but be back at 20 of.

(Whereupon, the foregoing matter went off the record at 3:25 p.m. and went back on the record at 3:41 p.m.)

CO-CHAIR SHACK: Let's go back into session. Mr. Dinsmore is going to tell us about the risk-informed integrated safety performance assessment.

MR. DINSMORE: Yes. Thank you.

CO-CHAIR SHACK: We got through the noncontroversial parts of the reg guide.

MR. DINSMORE: Yes. I guess I'm ready for this.

V. RISK-INFORMED INTEGRATED SAFETY ASSESSMENT

MR. DINSMORE: My name is Steve Dinsmore. I'm at the PRA Branch in NRR. And I'm going to discuss today the RISP process, risk-informed integrated safety performance, from here on out always known as RISP since I can't say that very quickly.

In order to fully appreciate how RISP works, you have to understand the process which is used within. So this discussion will also cover the change process which RISP has used to support.

MEMBER DENNING: Is this the first application of RISP? I haven't seen it before.

MR. DINSMORE: Yes, sir. It's brand new.

Here are the topics that I am going to discuss. If you are so inclined, you can look at those, but before I start, I would like to identify the three different mechanisms that licensees use to make changes to their facilities.

Which mechanisms they use depends on what they're going to change. The first mechanism they use is their own internal processes to evaluate different changes. And the licensee applies these mechanisms to non-regulated balance of plant equipment, for example, to decide what change to make.

The other two mechanisms are listed on

this slide and are used on regulated equipment. And that is the 50.59 process and the 50.90 process. 50.59 is essentially a screening evaluation that identifies changes to regulated equipment that are of minimal significance.

Now, licensees evaluate, document, and implement these changes without interactions with the NRC staff. Instead, every two years, they submit a summary of all such changes that they made in the previous two years.

Now, the last mechanism is 50.90, which is a traditional license submittal and review processes. Licensees submit a description of their change and evaluation of the change and a request for the NRC to review and approve the change. Licensees cannot make these changes unless and until the NRC authorizes the change. Now, those are important because the RISP process has interfaces with all of them.

So an overview of the RISP process. The rule says, "A licensee who wishes to make changes to the facility or procedures or to the technical specifications shall perform a risk assessment."

Normally rule language will kind of more specify the change; for example, to say "Changes to the facility or procedures as described in the FSAR."

This rule does not, initially did, and it was removed. So it's not an oversight that it doesn't say that.

Essentially what this means is that the RISP process should be applied to every change that the licensee makes, regardless of which mechanism they're using to make the change.

The risk assessment has got a couple of pieces to it. The pieces are essentially out of reg guide 1.174. The assessment that they do must demonstrate that all plant changes satisfy the acceptance criteria in the rule; that is, that there is an acceptable change in risk, defense-in-depth is maintained, adequate safety margins are maintained, and adequate performance measurement programs are implemented. And, of course, in order to do this, the risk assessment process must include quantitative and qualitative risk analysis tools.

CO-CHAIR SHACK: Okay. Steve, can I just ask a question --

MR. DINSMORE: Sure.

CO-CHAIR SHACK: -- before you get in here?

MR. DINSMORE: Of course.

CO-CHAIR SHACK: Why can't he just use 1.174 and 50.59?

MR. DINSMORE: Well, because the rule requires him to -- well, to use risk in 50.59, we need to do something. That is not the way that they use 50.59 right now.

MR. RUBIN: If I could just jump in? This is Mark Rubin from the staff. 50.59 currently impacts design basis, safety-related aspects of the plant. And this is a much broader application that touches on both safety-related and non-safety-related, specifically directed towards changes to the definition of large break LOCA.

So currently 50.59 would allow changes to be made where there are small impacts on the probability and consequences of "design basis accidents only." Here it's a much broader perspective.

And I apologize for interrupting, Mr. Dinsmore.

MR. DINSMORE: Yes. I think the short answer is the rule as set up requires that you use risk and 50.59, which is a little --

CO-CHAIR SHACK: I mean, as I read the rule, it says you submit a license amendment, which I could do under 1.174, or the paragraph X.6.

I guess you're right. The rule also says you can't use 50.95.

MR. DINSMORE: No.

MEMBER POWERS: Yes. It says 50.59 is not applicable.

CO-CHAIR SHACK: And I guess I didn't understand exactly why I couldn't have it set up so that I did it the same old way I did before. I used 50.59 and 1.174. I'm still not understanding why absolutely they're coupled now. Why do I have to make 50.59 risk-informed, which is --

MR. DINSMORE: Well, because that is the way the rule was written. The decision was made to do that.

CO-CHAIR SHACK: Okay.

MR. DINSMORE: Luckily, that is going to be a lot of my responses because the rule is somewhat new. And we are following the rule to the letter.

MR. RUBIN: Again, I would just emphasize that this characterizes the -- 50.46(a) will characterize requirements in an area that goes beyond the new design basis of the plant because you are changing the design basis LOCA. Traditionally 50.59 addresses design basis accidents.

CO-CHAIR SHACK: But if I want to do a 50.59 change that has absolutely nothing to do with

50.46(a), do I still have to submit a RISP?

MR. DINSMORE: Yes. Well, you have to adopt 50.46(a).

CO-CHAIR SHACK: Suppose I have adopted 50.46(a).

MR. DINSMORE: In the adoption submittal, you have to submit your RISP.

CO-CHAIR SHACK: Okay.

MR. DINSMORE: And to do 50.59 once the submittal has been approved, you have to use that RISP.

CO-CHAIR SHACK: No matter what I am changing?

MR. DINSMORE: Right.

MR. COLLINS: All changes. Once you bought 50.46(a), every change you make to the plant has to go through your RISP. That's what the rule says.

CO-CHAIR SHACK: I think I quite appreciated that.

MEMBER BONACA: Any change, even on --

MR. COLLINS: Yes, any change. And it goes beyond what used to be covered by 50.59. I mean, changes that previously you didn't have to consider relative to 50.59 now you have to make a risk assessment of. I mean, that was a significant change that the Commission made to the rule that we sent up. They sent it back and said, "No."

Any change you make, whether it is described in the FSAR or not, has to go through your RISP, a very important point.

CO-CHAIR WALLIS: Now, you are maintaining defense-in-depth. I've never been quite sure what that meant because if you change the large break LOCA definition, you are changing defense-in-depth. But how much change in defense-in-depth is now allowable?

MR. DINSMORE: Maybe the words should be "The philosophy of defense-in-depth is maintained."

CO-CHAIR WALLIS: Philosophy is an easy thing to maintain. It's the practice.

MR. DINSMORE: I am actually not sure what is in the rule, but the intent was not to maintain the current defense-in-depth but to maintain some.

CO-CHAIR WALLIS: We don't have a defense-in-depth meter.

MR. DINSMORE: No.

MR. RUBIN: Maintain sufficient or adequate defense-in-depth.

CO-CHAIR WALLIS: I see what you mean.

MR. DINSMORE: So, anyway, in order to be able to demonstrate that these things are the criteria meant for all plant changes, of course, the process must include the risk analysis framework for evaluating defense-in-depth, a framework for evaluating safety margins, and performance-monitoring programs.

CO-CHAIR WALLIS: That would be very interesting. It really tells you how to do it.

MR. DINSMORE: You mean the defense-in-depth and the safety margins?

CO-CHAIR WALLIS: The safety margins and tells you how to evaluate them. Is it going to be clearer than we have been before about what we mean by "safety margins"?

MR. DINSMORE: If the licensees are able to come in and develop a framework for evaluating safety margins that's better than what we have, we would be happy to.

CO-CHAIR WALLIS: Well, is that what we were talking about earlier? I mean, is this 2,200 and the degree to which you are below it? Is that a safety margin?

MR. DINSMORE: I think so. Well, one way to maintain safety margins is if you design pressure and your containment is 150, your ASME is 50, if you want to accept the max pressure greater than 50, it has to be far enough below the --

CO-CHAIR WALLIS: But if you're below that safety margin with less probability, what does that do? I don't think this has really been addressed.

MR. DINSMORE: Well, some of these things haven't been completely worked out. But we're trying to put the framework in place and move forward in the hope that as we move forward, we will be able to fill in the details.

All right. As I said earlier, in order to adopt 50.46(a), each licensee must submit an application to the NRC. The NRC will review and, as appropriate, approve the application. And, among things, the application must contain the stuff that we have already talked about twice, actually.

One thing --

CO-CHAIR WALLIS: You have really intrigued about what a non-PRA risk assessment is.

MR. DINSMORE: Well, 50.69, if you have a lot of equipment, 50.69 is the special treatments requirements. If you have a lot of equipment -- well, you do have a lot of equipment that doesn't show up in PRAs and you need to evaluate the risk significance of that equipment, there is a methodology to evaluate whether it's -- I mean, it's not quantitative.

And, actually, I'm going to try to avoid defining those two terms, but there are things definitely at one end and there are things definitely at the other end. And then there's kind of stuff in between that we haven't quite pigeonholed yet.

MR. RUBIN: This is Mark Rubin again. I could just direct you to both the ASME standards and the draft standards that are being issued. They are non-quantitative risk assessment methods included in both standards that are not traditional PRA, quantitative PRA, techniques, such as seismic margin, the five analysis, things of that nature.

No one is attempting to infer those are traditional PRA techniques, but they are certainly risk assessment but not a probablistic quantitative risk assessment technology.

MEMBER DENNING: I want to be careful about the word "quantitative" because they are quantitative. And one of the things I objected to I didn't get to mention is back under element two, "Engineering Analysis," you talk about the importance of qualitative analyses. And I just don't see the value of qualitative analyses here.

I mean, we can call it semi-qualitative or crude or approximate analyses, but things that are qualitative, I just don't see how you can make regulatory judgments.

MR. RUBIN: That's a good point. I think the point that staff is trying to make here is that they don't generate the traditional PRA metrics of a delta CDF and a delta LERF. And we can certainly clarify the language here. Thank you.

CO-CHAIR WALLIS: So what is different? I thought what you meant was estimating CDF by a non-PRA method, which didn't make any sense to me.

MR. DINSMORE: No. Using non-PRA to support a decision.

CO-CHAIR WALLIS: Ah. Because risk assessment to me implied PRA. They're one and the same thing.

MEMBER DENNING: They aren't. PRA is our definition an event tree, fault tree analysis. There are other ways to do risk assessments, Markov methods and stuff like that, that would definitely fall under certainly a non-PRA because PRA nowadays is fault tree, event tree analysis.

CO-CHAIR WALLIS: Does it end up with a CDF?

MEMBER DENNING: Oh, yes, it certainly can end up with a CDF. But not everybody has to wind up with CDF.

CO-CHAIR WALLIS: See, I always thought PRA is any methodology of probablistic risk analysis, a generic term. If you're using probability stuff to evaluate risk, you're doing PRA.

MEMBER DENNING: You can say that, but I think that the world has made PRA equal to an event tree, fault tree analysis.

CO-CHAIR WALLIS: Has done. Okay. So it's a subset of risk analysis.

MEMBER DENNING: Yes.

MR. RUBIN: A good example might be seismic margins analysis, which will give you success paths for safe shutdown but without some additional work will give you direct risk metrics.

MR. DINSMORE: Okay. Once we've approved an application to adopt 50.46, this will authorize the licensee to use risk to support future licensee-controlled and 50.59 changes. This is a lot different than what we do in reg guide 1.174.

So, therefore, we expect the NRC staff review of the risk process in the initial application will concentrate almost exclusively on the ability of the proposed process to support 50.59 changes because we do not prior review and approve this. And this type of use of risk assessments is not included in 1.174.

In 1.174, the risk assessment supporting each proposed change is evaluated by focusing staff review of the specific part of a risk assessment used to support the change. And this risk process has to be used every single change that the licensee desires to make in the future.

Even the phased approach plan which we're working on is in process, cautions that a one-time staff review and approval will only be applicable for redefined application. So this is one of the difficulties that we're dealing with, how we can get an analysis description of processes and everything that we can approve for generic use on any changes which are undefined future changes.

Finally, the risk must also be used to support all future applications made under 50.90. Review of the risk process and results during review of these applications can be performed pretty much as we do current risk-informed application, although we recognize that it is going to be a much higher volume of them if every one of these applications has to come in with a risk-informed part.

Now, although risk really is only one of the four principal evaluations, the other being defense-in-depth, safety margins, and performance measurement, really, a large part of the success of the risk process will be dependent on the risk assessments.

The two important aspects of risk assessments are the scope of the assessment and the technical adequacy. Now, this slide talks briefly about the scope and the next one about technical adequacy.

Here again, because the risk must be used to evaluate every future change, every initiating event and operating mode must be somehow addressed in the risk assessments.

As many initiators and modes as necessary should be addressed with a PRA. The rest can be addressed with non-PRA risk assessments. We have taken necessary and defined it using the discussions of the Commission's phased quality approach again. And that is that initiating events and operating modes that could change the regulatory decision substantially should be quantified with the PRA.

So that will allow us to identify those changes which you are going to need a PRA for. And the rest of the changes we would allow them to use on non-PRA risk assessment.

The proposed reg guide provides three alternatives for determining if the non-PRA risk assessment is sufficient to support any specific decision. And those would be realistically estimating the change in risk. If the risk would be estimated, I guess you could get into discussion of whether that is really a PRA estimate or not. But you might be able to estimate it without event and fault trees.

The second alternative is to demonstrate that any increase in risk caused by the modification will not affect the regulatory decision in a substantial manner.

A good example of this is, for example, if you did a bunch of screening analysis on your flooding, for example, and you're going to make a change and you go through and determine that that change isn't going to affect your screening analysis. And, therefore, you can conclude that it's not going to affect your decision.

And the last one is demonstrating that it cannot be reasonably concluded at all, really, that risk is actually changed. For example, again, one of the better examples is changing the instrumentation used by the operators to respond to some sequence where they've got all different types of instrumentation available. And so just having changes to this one instrument might not affect risk at all.

Then the other part of risk is the technical adequacy. The technical adequacy of both the PRA and the non-PRA assessment used by each licensee must be sufficient to support the risk-informed process. In the submittal to adopt 50.46(a), each licensee should provide a description of the measures essentially to provide a description of the measures taken to assure the technical adequacy of the risk assessments.

Now, reg guide 1.200 together with approved standards provides an acceptable approach for assessing the technical adequacy of the PRA risk assessments. In the draft reg guide, at this point in time, we're starting that you should at the very least expect to resolve all pere reviewer comments and you should identify the key sources of uncertainty as part of your demonstration of technical adequacy.

Now, evaluation of the technical adequacy of non-PRA risk assessments is still being studied and evaluated, although, again, from 50.69, we might get some stuff to work with.

Now, it might be that, rather than evaluate the technical adequacy of the risk assessments for some initiators in operating modes, the authorization to use the risk to support 50.59 changes may be limited.

So we're aware of that possibility, too, that if certain types of initiating events -- let's just say "shutdown." If it shut down, you have no way of determining the risk. Then we might say, "Well, if you're going to make changes that affect shutdown," you can't use 50.59, but that's just an example. That might not be a very good example.

MEMBER BONACA: At some point, it would be useful if you could make an example of this PRA versus no PRA risk assessment, particularly where you talk about initiators and modes of non-PRA methods that would be used for other scopes. It would be useful if there was an example.

MR. DINSMORE: Well, I guess I tried to talk about, for example, the fire screening -- not the fire. It's a screening analysis. It depends on what you call the non-PRA method. If your PRA method has to produce an estimate of event, there are others which kind of say, "Well, the likelihood of this sequence" --

MEMBER BONACA: If you have this fire analysis, it's because you do not have an adequate fire PRA.

MR. DINSMORE: You do not have a fire PRA that might be good enough to support some decisions, yes.

MEMBER BONACA: Okay. So what you're talking about here is dealing with inadequacy in the PRA model? All I'm trying to say is that if you have a PRA model and it is complete enough, anything which is significant would be in the PRA model. But what is not significant is not in the PRA model.

So, really, what you are doing is doing this to allow for limitations in the PRA that you have to deal with with a non-PRA approach. That's what you --

MR. DINSMORE: Yes. We're providing an opportunity to adopt the rule and to start making changes without a phase IV type of PRA.

MEMBER BONACA: Yes. Okay.

MR. DINSMORE: Is that --

MEMBER BONACA: I understand now. I understand better. Okay. Because just the logic wasn't there, but, of course. All right. So when do you move it back to help?

MR. DINSMORE: Well, as always, we have been trying to move forward as much as we can within the constraints that we have without -- I mean, there was a discussion about requiring the licensee simply to go out and do full-scale level III, fully reviewed. And the decision was that that wasn't really --

MEMBER BONACA: I don't think you need to be that prescriptive. I'm talking about if you have elements that could be addressed in the PRA by some improvements in the PRA, this should be a means of encouraging licensees to use it. They get a great benefit from adopting this rule.

They might as well invest some money to do the improvement and not be able to do a level III PRA for the sake of it. Is this in the file now? Is this is the PRA? So that you don't have to go after these qualitative evaluations.

MR. DINSMORE: Well, if the evaluation was pretty much completely qualitative or non-risk-informed, then they might -- in this situation, when they come to adopt 50.46, we might say that "Well, you can't make any changes, including 50.59 changes, on stuff which could affect this equipment which you don't have a good PRA for." That would give them an incentive to improve those models in that area.

MEMBER BONACA: Yes. All right. Anyway, I understand now.

MR. DINSMORE: We would prefer that they all did these expensive PRAs, but as long as they don't really need them, I guess --

MEMBER BONACA: Well, you know, you commented that the risk assessment is not based on PRA. And, really, it's a judgmental evaluation. It's we're trying to really make up for inadequacy in the risk assessments, simple as that.

MR. DINSMORE: Yes. We're also trying to use whatever tools they have available. And then if they can't, if the tools aren't good enough, then they would have to make a submittal essentially.

Now we'll get to the controversial part. Okay. There are two different regulatory change control mechanisms included in the rule, which is the 50.59 mechanism and the 50.90 mechanisms. And eventually there are two different change criteria, which are also discussed in the next two slides. Is this the right one? Yes. Okay.

The first one is changes made under 50.59, which, again, is changes that they make internally. They do their review. And they do an evaluation. And they make the change.

The proposed rule states that licensee may make changes to the facility without prior NRC approval when the increase in the estimated risk is minimal compared to the overall plant risk profile. Again, I guess that's 95 percent rule language.

The minimal compared to the overall risk profile is rule language. It's a new word that we had to deal with. We considered for a short time not quantitatively defining minimal just to leave it as minimal, like it is in 59. But we decided this would be a worst case situation.

We decided that quantitative guidelines are needed to define minimal because the proposed rule includes consideration of the change in risk in every decision. It provides quantitative guidelines for non-minimal or totally acceptable risk increase. And although changes in risk for many facility changes may not be quantifiable, some will be, although there might be a small number.

So we've got a situation where we have quantitative limits up here that you can't exceed. We have kind of this gray area in the middle that's minimal. And we're going to start getting numbers that are very low. The question is, which one of those very low numbers is below minimal?

So essentially we thought, "Well, we're going to have to come up" -- well, the easiest way, most systematic thing to do is just to come up with a guideline and say, "Well, if your real small number is less than that, we'll consider it to be minimal."

Here again reg guide 1.174 doesn't provide any guidance about when a proposed risk-informed change does not need to be approved or reviewed and approved by the staff.

So we started off at the -- now, the guidelines at 1.174 essentially say, "Well, this is an acceptable increase in risk if the other things are met, of course. There's always defense in this one.

But this an acceptable risk increase. This is an acceptable increase in risk. If the staff gets this number and it's less than this number, the staff can spend its time determining the adequacy of the analysis used to develop the number and not do a lot of consideration of whether the number is low enough.

Now, in this case, the staff is not going to have the opportunity to review. Well, it's going to review early on a generic analysis. And then that analysis is later going to be used to develop this number.

So one of the first considerations with the selected value for minimal should be less than the reg guide 1.174 guideline acceptance criteria. That was pretty much the only hard and fast rule we had.

The staff is proposing the following guidelines to define when a quantifiable risk increase is minimal, which we simply reduced it by an order of magnitude below the very small guidelines for any plant, which is less than 10^{-7}, less than 10^{-8} for LERF. And then we had this extra --

CO-CHAIR WALLIS: How does this relate to what Ralph Landry was saying? I mean, we've got a large break, which is not going to be mitigated as well as before. It's going to meet the acceptance criteria maybe by 70 percent probability and serve 95 for an event which is likely with 10^{-6} or something.

Surely that affects the CDF in proportion to how well the ECCS works, which is related to his acceptance criteria, doesn't it? Yet, I don't think that's in the PRA.

MR. DINSMORE: We probably could put -- well, you need two trains. And if you get 2 trains, you've got a 70 percent, you've got a 30 percent change that's not enough.

CO-CHAIR WALLIS: It's in the thermal hydraulics. It's not in the trains. It's in the --

MR. DINSMORE: Right. But the only option we have to put stuff in the PRA is to deal with the logic of trains. You could put a lot of the stuff in the PRA, but if you don't have a really good reason for the number to go in, we would prefer to not kind of fuzzy up the PRA.

MEMBER KRESS: This shows up in the success criteria.

MR. DINSMORE: That's the two trains, yes.

MR. RUBIN: If that's the key to do a basic PRA, you need to develop the success criteria using the thermal hydraulics, of course. And, as Mr. Dinsmore pointed out at the very beginning of the presentation, it's binomial. You know, it's yes or no. One train is successful. One train is not successful.

And we take the output to our thermal hydraulic analysts, who say, "We have high confidence that one train will be successful" or, in fact, "need two or three trains."

As far as the selection --

CO-CHAIR WALLIS: The problem is when you do the thermal hydraulics, you get a probablistic thing that one train may be successful with certain probability.

MR. RUBIN: Right.

CO-CHAIR WALLIS: It's not as if it's yes or no. You put that right into the PRA. I mean, it's a probability in --

MR. RUBIN: Theoretically you could. It's not state of the art. And currently methods have not been developed. And the standards do not include incorporation of thermal hydraulic success path uncertainty as part of the methodology.

It's certainly an area that is potentially fruitful for development but is currently not state of the art. In fact, to get around the lack of that analytical treatment, PRAs traditionally -- we use a success criteria that you have high confidence in in a best estimate sense. And your point that it's not quantified is a very valid one, but, again, that is typical PRA methodology.

You need a starting point. And that is success criteria.

CO-CHAIR WALLIS: Well, I'm just thinking that it may well be that what Ralph Landry was talking about may actually have the effect of changing the CDF by more than 10^{-7} per year. But it won't show up.

MR. DINSMORE: You mean by reducing it from 95 percent to 75 percent?

CO-CHAIR WALLIS: Changing the rule from 95 to 70 could actually change the CDF if it led to changes in the file. But it wouldn't show up in the PRA. Well, you'll consider that, I'm sure. But you've got some time.

MR. DINSMORE: There's a couple other considerations that went into this 10^{-7}, but unless you want to hear them, I'll move on.

CO-CHAIR WALLIS: I notice you only change things in PRA by factors of ten. Yet, you're talking about one percent down on the bottom there.

MR. DINSMORE: One of the considerations was to say that if you looked at the 10^{-6} from 1.174 as a 95 percent limit and you applied the normal error factor as factors of 3 to in PRA, you get 3 times 10^{-7}. So we actually had a 3 times 10^{-7}.

CO-CHAIR WALLIS: Well, that's the square root of ten. Is that what it is?

MR. DINSMORE: Well, it's kind of one-third of --

CO-CHAIR WALLIS: Square root of ten.

MR. DINSMORE: Yes. Okay. Risk metrics. For changes under 50.90, which is what they submit, licensees must always submit a request for a license amendment if they can't use 50.59. And every request for a license amendment will need to include a risk assessment that demonstrates that the total increase in core damage frequency and large early release frequency are small and that the overall risk remains small. Of course, this is also risk language that we were given to work with.

We simply combined this total increase with the fact that you had to apply RISP to every change in the facility and came up with this second bullet that every change to the facility that increases or decreases risk should be included in the total change in risk estimate.

For those of you who have been involved in these discussions for a long time, that means this is 100 percent bundling. Everything has to be bundled. Nothing can be excluded. There are a lot of pluses and minuses to that. But that is what is out there in the rule for comment.

Small increases here again is defined by 1.174. And that the overall risk remains small is also covered by 1.174 sliding criteria as they move up into high CDFs and LERFs.

Now, this is an unusual calculation. So

we gave some consideration to how we could actually do this. In some ways, it's easier. This guideline is easier than the other risk-informed applications because in this case, the total increase in CDF and LERF can be estimated by tracking the change to the overall CDF and LERF caused by all changes.

So you don't have to figure out anymore, well, which set of changes came from this application and which came from that application and try to do something. You would just monitor your total CDF.

MEMBER DENNING: You know, I'm not sure that's true that there is that linearity there because I think you can make some changes that have bigger or smaller effects.

I think you have to look at your beginning state and your end state and see what the change is. I'm not sure that you can take the deltas from them. I'm sure you can. I know I have done examples where that is not the case, where it's not just the linear summation subtractions of CDFs and LERFs.

MR. DINSMORE: Oh, no. That's not --

MEMBER DENNING: You have to look at beginning state and end state.

MR. DINSMORE: Okay. That's kind of what that first bullet was supposed to mean. You have a

CDF when you start. And then 250 days later, you have another CDF. And the total change is the difference between those two.

MEMBER DENNING: Okay.

MEMBER KRESS: The problem with that is that not all changes have the same uncertainty. And this sort of eliminates the question of, does it affect the uncertainty?

MR. DINSMORE: That's correct. There are simplifications and complications involved in this.

MEMBER KRESS: Equal delta CDFs are not always equal.

MR. DINSMORE: That's correct.

MEMBER POWERS: I can see that as a headline now.

MR. DINSMORE: I'm glad to see your headline.

CO-CHAIR WALLIS: Well, it's just talking about CDF here. It's not generalizing that theory.

MEMBER KRESS: The headline will.

MR. DINSMORE: One of the greatest difficulties with this approach, though, is that some changes to the PRA that change the overall CDF and LERF aren't made to reflect changes to the facility, but they're going to improve the model or the method used in the model. And that will cause --

MEMBER KRESS: The model used in this correlation, instead of a McAdams correlation.

MR. DINSMORE: That we see is --

CO-CHAIR WALLIS: It's the old argument about probability. You have exactly the same plant. You changed your analysis. So the probability has changed.

MR. DINSMORE: Right.

CO-CHAIR WALLIS: So nothing has really changed about the plant itself.

MR. DINSMORE: Yes. That is the greatest difficulty we have with this process. If you didn't do that, then you could take the ten-year and minus from the first one. And you --

MEMBER KRESS: If you don't allow that, though, it sort of puts a damper on improving the PRA.

MR. DINSMORE: Yes. Well, we didn't intend not to allow. We just are recognizing when it's --

MEMBER KRESS: You don't know when it's one or the other.

CO-CHAIR WALLIS: You only improve your PRA when the risk goes down.

CO-CHAIR SHACK: It is an incentive to

remove conservatisms, right. Yes.

MR. DINSMORE: It certainly is an incentive to start with a very good PRA.

CO-CHAIR SHACK: Why not start with a very conservative one?

MR. DINSMORE: Well, even if it went -- that might be. We haven't thought about it. Yes. But there might be a lot of ways to separate the effect of improvements from facility changes.

But we think, at the very least, the changes to the LERF are the CDF and LERF caused by improvement should be -- when they update their PRA to improve it, they should do that separately from when they --

And we had a discussion about your proposal of adding up the changes. And that's kind of where this last bullet comes from, that the quantitative guideline should not be interpreted as being overly prescriptive.

So all we really need is a reasonable estimate. We're not saying you need to calculate it out to five decimal places. All we need is reasonable assurance that the total change is small.

And in some cases, you might be able to add them up and subtract them for a while and then --

so this is a new process. It just kind of falls out of the rule language.

CO-CHAIR WALLIS: This is interesting. We were talking about increases in risk, but one of the major arguments made for bringing in this rule was that it would actually decrease --

MR. DINSMORE: Increases means increase or --

CO-CHAIR WALLIS: -- risk benefits from bringing in the rule.

MR. DINSMORE: Yes.

CO-CHAIR WALLIS: So you could say that, actually, the criterion should be that the risk-benefit should be bigger than a certain amount.

MR. DINSMORE: Increases actually in this case means both increases --

CO-CHAIR WALLIS: There is no benefit to having a risk-benefit. I'm not giving you any credit any --

MR. DINSMORE: Yes. Well, that's --

CO-CHAIR WALLIS: Is it because everything is bundled? Is that the idea?

MR. DINSMORE: No. It --

MEMBER KRESS: The bundling does that.

CO-CHAIR WALLIS: Oh, yes. I think that

is what we were trying to do.

MEMBER KRESS: Yes.

CO-CHAIR WALLIS: So you gain in one thing, and then you bounce it off against something else.

MEMBER BONACA: It would increase the risk of this balance by --

MR. DINSMORE: Qualitative? This is actually a very good way to get them to implement safety improvements because it --

CO-CHAIR SHACK: Buy CDF you can burn somewhere else.

CO-CHAIR WALLIS: A power uprate, yes.

MR. DINSMORE: Now, I am going to get a little complicated because I didn't think we were going to get this far, actually.

(Laughter.)

CO-CHAIR WALLIS: This is a backup slide now?

MR. DINSMORE: Well, these are also. Defense-in-depth. We haven't done much with defense-in-depth since what was in reg guide 1.174, as opposed to some of the other earlier things. We still don't have any really good guidance to do it.

This last bullet here might cover

something that was being discussed earlier about essentially late containment failure. The first red bullet is in the rule itself. It says, "Reasonable balance is provided among prevention of core damage containment failure early and late." That is actually some new words and consequent mitigation. So that --

MEMBER KRESS: I like those words. I wish I knew what the quantitative criteria was. I don't know what reasonable balance is. And does it involve the uncertainties?

MR. DINSMORE: Yes.

CO-CHAIR WALLIS: I think it's highly unlikely that any change will have any significant effect on these red bullets which is noticeable.

MEMBER BONACA: The second one, what does that bullet mean?

MEMBER KRESS: It certainly could change. Suppose using the smaller LOCA size affects your containment sump blockage calculation. That could certainly affect your ability to use the sprays and save your containment. You would get a higher initial containment failure probability or if you wanted to reduce the spray's effectiveness in some way because now you would only have to cool for a medium size LOCA to a large break LOCA. I think there are some things that you could do to --

CO-CHAIR WALLIS: Well, let us pursue this a bit. I mean, suppose that doing away with the large break or changing the above TBS rule allowed the plant to have a greater probability of some blockage in some way. How would that figure in to all of this?

MR. DINSMORE: Well, there's --

CO-CHAIR WALLIS: The sump blockage problem is with the large break, isn't it?

MR. DINSMORE: Well, there's a number in the PRA which would be blockage of the sump. And that number would show up the probability of blockage of the sump. And that number shows up in the ability to mitigate a large break LOCA, which would still be in the PRA, of course.

CO-CHAIR WALLIS: Nothing would have changed.

MR. DINSMORE: No. Well, you might. Assuming that whatever change you made to your plant would increase the probability of the sump blockage given the large break LOCA, then that number used in the PRA as the probability of the sump blocking for a large break LOCA would go up a bit. And that would flow through to --

CO-CHAIR WALLIS: Well, there isn't the

idea here that if the large break LOCA is less likely or very unlikely, then you don't need to worry so much about sump blockage with large break LOCAs?

MR. RUBIN: Well, this is Mark Rubin again. Hopefully before a plant would implement this rule, the majority of the sump blockage concerns would have been resolved.

It's both the medium and large size LOCAs that contribute to a blockage potential. And so the new defined break size still would cover the debris generation that would be of concern.

Right now some failure probability due to blockage is a basic event, I believe, in some PRAs quantified very low. Obviously, we have all come to recognize that there are concerns that require revisiting and updating and rectification of that concern.

But let's say that we do get to the point where the basic generic issue has been resolved but a plant does propose something that has potential to introduce a new blockage mechanism. Yes, we would expect that to be incorporated into the model and considered.

CO-CHAIR WALLIS: I guess I'm looking for a larger effect. I'm looking for this rule in some way to take the pressure off the sump blockage problem because the large break LOCA is so unlikely. And that is the one which produces the huge amounts of debris that somehow the sumps wouldn't have to have such an enormous screen because they wouldn't have to be designed for the large break LOCA. I'm looking for that sort of thing.

MR. RUBIN: It has the potential to change the design basis challenge. So if the rule --

CO-CHAIR SHACK: The rule says that you have to be able to mitigate --

MR. RUBIN: You have to be able to, right. That's correct.

CO-CHAIR SHACK: -- in order for the sump to be able to handle a large break LOCA.

MR. RUBIN: Yes.

CO-CHAIR WALLIS: With 70 percent probability.

MR. RUBIN: No.

MEMBER DENNING: Not 70 percent probability.

MEMBER POWERS: Is the requirement just to mitigate? Then all you have to do is have the spray operation.

MEMBER DENNING: Well, I hope that isn't

what it means. I assumed it meant that would prevent core damage. I think that's the meaning. I understand what you're saying, but if you're correct, then we've got other complaints to think about the rule.

I mean, the intent of the rule is that for large break LOCAs reasonably analyzed, you would not get core damage.

CO-CHAIR SHACK: Get core damage. The core will remain coolable.

MEMBER DENNING: The core will remain coolable, I should say.

CO-CHAIR WALLIS: Yes. But if the realistic analysis of the sump says that it won't work, then it wouldn't be changed in any way, would it?

MEMBER DENNING: Right. But a realistic analysis of the sump is certainly less challenging than a conservative analysis of the sump. Right? I mean, I'm not sure exactly how we do either today. But a realistic analysis of the sump could be --

CO-CHAIR WALLIS: Well, the totally conservative might say all the debris goes to the sump.

MEMBER DENNING: Yes, right.

CO-CHAIR WALLIS: And you would say, "Well, the realistic one would be the smaller amount."

MEMBER BONACA: Could I understand the second red bullet to say that "Defense-in-depth is maintained provided" -- and then you introduce the concept of, you know, redundancy and dependence in regard to their provided commensurate with respect to frequency. I mean, is it quantitative expectation?

MR. DINSMORE: These would only be used if the risk analysis indicated that the change was acceptable. If the risk analysis indicates it's not acceptable, you wouldn't get down into this area probably.

So I really can't answer you.

MEMBER BONACA: I don't understand what it means to maintain something and then to develop the judgmental criterion here that I don't understand how it's going to be implemented. You know, do you have --

MR. DINSMORE: We've been having difficulty in practice implementing. These words I think are pretty much from 1.174 as well.

MEMBER BONACA: I understand that, but the point is that, you know, is it true that it is maintained? In the context of that bullet, I don't understand it.

MR. DINSMORE: It probably is in the eye of the beholder as you go through each individual proposed change.

MEMBER BONACA: I guess it is work in progress?

MR. DINSMORE: Well, we have been using these definitions for years.

MEMBER BONACA: I'm trying to understand here how --

MR. DINSMORE: They have been difficult to use.

MEMBER BONACA: -- defense-in-depth is maintained.

MEMBER KRESS: I'm really intrigued by the first red bullet. You know, if you look at a BWR, it may have a 10^{-6} CDF and a conditional containment failure probability of .8, which gives it, you know, something like close to 10^{-6} overall containment probability frequency.

But if you look at a PWR, it might have 10^{-5}, but a .1. So you end up at the same place with the two of them. But the balance is entirely different between the CDF and the condition of containment failure probability.

MEMBER DENNING: But there's something else there, Tom, which I noticed it as inconsequent mitigation. So that in your BWR example there, although, you know, you've got low conventional core damage, you have high containment failure. But you have a high consequent mitigation.

MEMBER KRESS: I'm really intrigued at how they're going to put all of that together in some sort of acceptance criteria. That's my point.

MR. DINSMORE: I think this is the acceptance criteria.

MEMBER KRESS: I would have said that --

CO-CHAIR WALLIS: Well, if you have a containment probability of .8, there really is no reasonable balance at all. It's almost one. And so it's not really doing much at all there.

MEMBER KRESS: Well, some of these BWRs have about that level.

CO-CHAIR WALLIS: Yes.

MEMBER DENNING: But they get a lot of mitigation through the suppression.

MEMBER KRESS: That's right, maybe at a low CDF.

MR. DINSMORE: Maybe part of the thing is that if you're -- this has to do with changes, right?

So if your current BWR is .8 and you're going to change something to make it .9, people might get upset, where --

CO-CHAIR WALLIS: It doesn't make any difference. It makes very little difference, really.

MR. DINSMORE: Well, it --

MEMBER DENNING: Who cares?

MR. DINSMORE: All right. I withdraw. These things we have been around for years --

MEMBER KRESS: You're saying if it's already an acceptable balance, then we ought to accept small changes.

MR. DINSMORE: Well, again, if it was .8 and went to .9, people might react. And if it's --

CO-CHAIR SHACK: I think that what it amounts to is that in the future, you're not going to let them do that.

MR. DINSMORE: Right.

MEMBER KRESS: Right. That's for sure. You know, I'm more concerned about the ones we have now.

CO-CHAIR SHACK: No. You have what you have, but in the future, you will maintain a reasonable balance.

MR. DINSMORE: And if you have a

conditional probability of 10^{-2}, maybe you can get it up to 5 times 10^{-2}.

MEMBER DENNING: You know, I think we agree with the second blue bullet, though, I think as far as that is something that you can do that provides some assurance to defense-in-depth. The others under that need more work or they're so difficult to generically come up with real criteria.

CO-CHAIR WALLIS: And that full spectrum of accident sequence is being everything, not just design basis.

MR. DINSMORE: The last bullet might have been pretty quickly put together. So I did the general concept. So I'm hesitant to -- in this reg guide, we are not going to be able to explain how to use these things in the foreseeable future.

CO-CHAIR WALLIS: That industry is going to get very nervous about how you're going to interpret all of these things.

MR. DINSMORE: Well, they have been around for a long time, and we have been managing to move stuff through. So I think this is one of their smaller concerns.

Safety margins. Again, I'd really rather not dwell a lot on this because it's pretty much right out of 1.174. And whatever difficulties were there, we have maintained.

Here are somewhat slightly new things, the risk requirements during operation, the risk is actually required to be maintained up to date and reflecting the actual design and operation of the plant, although I jumped. As I said, I hadn't really prepared these slides.

So a performance-measuring program should be integrated. Well, the rule requires you to have performance-measuring programs. I believe that we can maybe rely a lot on the performance-measuring programs that are also already in place is kind of what the first bullet says.

The licensee must periodically reevaluate and update the risk assessments. They're not really required to change the PRA every time they make a change to the plant. And so periodically they're going to have to update the PRA to address modifications that haven't been put in. And sometimes to determine the impact when airs are nonconformances or these other things are identified.

MR. SNODDERLY: Steve, so a low-power shutdown standard comes out and is approved by the NRC. Does that mean that I have to now implement that if I want to continue to --

MR. DINSMORE: No, but you may want to implement it and come in and say, "Hey, this is our low power shutdown. So please give us relief from doing submittals for things we change during low power and shutdown because now we can do it on our own."

CO-CHAIR WALLIS: I think we sometimes have been given advice that the ACRS should not advise on process. If we get into too much of the details of the process, we may simply say, "We'll leave it to you."

Some of this is going to get very much into the details of the process, how you evaluate all of these things. And it may well be the ACRS simply trusts you guys to do it right.

MR. DINSMORE: Well, we accept and appreciate any comments that are --

MR. SNODDERLY: I think this whole thing -- but I'm also thinking about it in terms of the Commission's based approach to the PRA quality eventually, right? The idea is at the end of phase II, we'll be someplace and phase III eventually. So I'm trying to picture how this dovetails with that.

In other words, standards are going to be coming out. And eventually the idea was that folks would adopt those standards. So it's not clear to me.

Does this require that if I want to, as these standards come out, I have to adopt them within a certain time or --

MR. DINSMORE: No.

MR. SNODDERLY: No. So --

MR. DINSMORE: What will happen is that when the standards come out and you do your PRA according to the standard and you submit to us, either you could submit to us for review to use in 50.59 or you wouldn't have to, but when you come in with a 50.90 application that has some impact, it would simplify that analysis.

So they run in parallel, but there's no conflict between them.

MR. RUBIN: Mark Rubin again. If they don't adopt the shutdown standard, it may limit changes they can make to the plant under this rule. And it would certainly limit the changes they could make under 50.59 because we wouldn't have any assurance that they have a methodology in place to demonstrate to themselves that would be a low, low impact change that would affect shutdown conditions.

MR. DINSMORE: Actually, the bullet with the most impact on this slide is the last one, which means, for example, if they write up that they are a 10^{-5} limit and they discover an error in their PRA and that pumps from above the limit, they have to do something to come back down. That's essentially what it means. It's a pretty hard hook.

CO-CHAIR SHACK: Well, 10^{-5} limit, without a full-scope PRA, are they going to be able to get to a 10^{-5} limit? They're going to be at a 10^{-6} limit, right? Because they won't know where they are on that axis. Are you going to let them do that in a qualitative, non-quantitative, whatever it is, assessment?

MR. DINSMORE: We allow the --

CO-CHAIR SHACK: There's a big incentive for them to go full scope to get that order of magnitude in delta CDF.

MR. DINSMORE: If we're convinced that the total CDF is less than 10^{-4}, we allow them to use the 10^{-5}. The degree of convincing can be discussed. But, for example, if they don't have a very good seismic analysis but they're in a very, you know, not --

CO-CHAIR SHACK: I was thinking more of fire and shut. Seismic I can understand the argument better than I can fire and shutdown.

MR. DINSMORE: It's a valid concern.

CO-CHAIR WALLIS: So you let them use 10^{-5} and you're quibbling about 10^{-7} in this?

MR. DINSMORE: Well, the 10^{-7} is that we wouldn't see it. That original idea was to allow them to do stuff that wasn't going to change risk at all. And these we had these problems with the numbers, which you can come up with numbers.

And so 10^{-7} according to what their discussions are, most things won't change risk at all. So it's not really a problem. There might be a couple of them.

Then the last slide, -- I guess I'm behind here -- the rule requires these periodic PRA reevaluations, again, because they don't really have to update their PRA with every change.

Then when we added reporting requirements, which are actually similar to the ECCS reporting requirements -- and this is actually in the rule. I'm not sure if that is the exact language, but as part of the PRA update the licensee shall report the change to the NRC if the change results in significant reduction. There is no real definition of "significant reduction." Again, reg guide 1.174 doesn't give us any guidance.

And we simply proposed the following guidelines to open up the discussion. The significant reduction is if the overall CDF or LERF estimate increases by 20 percent. And here increases means increases. We weren't worried about that going down.

Essentially, what this stuff means is that the licensees made some changes to their model that had a fairly significant impact on the results. And, like the ECCS criteria, it gives the staff the opportunity to decide whether they want to look and see, "Hey, you know, these are pretty unexpected changes. We might want to look and see what is going on."

CO-CHAIR WALLIS: Look in the other direction, too. On the plant is a CDF.

MR. DINSMORE: Decreases.

CO-CHAIR WALLIS: If it suddenly comes back and says, "We calculated, and it's now 10^{-6}," you might want to find out why.

MR. DINSMORE: We had that discussion, but the concern was if it increases. But yes, that is a valid comment. We'll take it. And that's it. I guess I'm a little late.

CO-CHAIR SHACK: It just seems like when a guy buys into this, he buys into a lot.

MEMBER DENNING: I don't want to buy into this much. I mean, this actually sounds burdensome to me, although I'm not sure what the alternative is. I read it as burdensome. And everything else seems to me toward decreasing burden. Am I wrong?

MR. DINSMORE: It is definitely a different class than a normal risk-informed application. It puts you in a different world, yes.

CO-CHAIR WALLIS: It would be interesting to see if there are any applications.

MR. DINSMORE: You have to ask industry. I'm sure they would be willing to --

MEMBER POWERS: And how much has industry seen this?

MR. DINSMORE: They have seen the proposed rule, which includes the statement of consideration. In this process, the statement of consideration includes all of this. We put it all in there.

So they haven't seen a reg guide, but the guidelines and everything are in there, in the statement of considerations, which they have seen.

CO-CHAIR WALLIS: What's going to be interesting is what kinds of changes in the plant actually get facilitated by all of this.

MR. DINSMORE: PWR power uprates is the

only one that we know of, yes.

CO-CHAIR WALLIS: That seems to be the one which stands out the most.

MR. DINSMORE: But, again, we have no idea. Maybe I should have rephrased that earlier. We couldn't figure it out. It was going to be a very complicated process. And we were told, "Well, don't try to figure it out. Just make sure that the rule will cover anything which is proposed."

MEMBER DENNING: Are we into a discussion period now?

VI. GENERAL DISCUSSION-INCLUDING FUTURE INTERACTIONS

CO-CHAIR SHACK: We're into a discussion period, yes.

MEMBER DENNING: Well, I guess part of that discussion period ought to be areas where we would like to see more the next time they come. This certainly has to be one. I think we need to look into this in more detail, this last part of it.

You know, I know what I don't like and the things I do like in the front part, you know. But on this one, I'm still somewhat baffled as to how it's all implemented, how burdensome it is.

And then the thing that I was hoping was that we were finally going to see some real meat on the how do you do the margins and how do you do the defense-in-depth analysis?

And obviously there's not any more thought on this beyond 1.174.

CO-CHAIR WALLIS: That's my concern. All of this seems to be still pretty vague. If I were industry, I would not really know --

MEMBER DENNING: What I am buying into.

CO-CHAIR WALLIS: -- what the rules were for me, what I really had to do to satisfy some of these qualitative sort of statements. Presumably if they have an incentive, they'll try it and see what happens. That's really sort of experimental.

MEMBER KRESS: As a framework, without noticing, without really putting real numbers on all of that, but as a framework, it looks like they covered the bases pretty well.

MEMBER POWERS: Yes, Tom, but I'm not sure we really want to experiment with our licensees.

MEMBER KRESS: Well, that's --

MEMBER POWERS: I mean, I think you'd better have at least some idea of how you're going to implement it. For instance --

MEMBER KRESS: I agree.

MEMBER POWERS: When we think about defense-in-depth, they're going to have to wrestle with exactly the same things the committee wrestled with. And they're going to have to come down.

You've got three choices. You can be a structuralist. You can be a rationalist. Or you can be AC/DC. And AC/DC just doesn't cut it. Inevitably you're driven to the structuralist point of view on that one because the rationalists demand the level of uncertainty analysis that can't be done. And so why not admit that you're a structuralist?

I mean, there's nothing wrong with being a structuralist, even if it is Thirteenth Century.

CO-CHAIR WALLIS: I think you can use a structuralist method. You yourself don't have to make a commit to be one thing or the other.

MEMBER POWERS: Well, that is, of course, true, but -- and, similarly, I mean, not to be -- I mean, I am not too critical with what they have written down up there. I think they have given to PRA that which is the PRA. That's the redundancy and diversity area. That's the thing that's PRA's strength. And they're really only worried about the structural aspects of the plant.

And so you become a structuralist and do what they did. In fact, they did that. They were structuralists in their second blue bullet. So you might as well just admit it, that you're going to do that. And you're in good shape as far as existing plants.

Now, when you go to the more advanced plants, then you may want to rethink your commitment to structuralism.

CO-CHAIR WALLIS: How can structuralists implement a risk-informed change?

MEMBER POWERS: Very easily.

CO-CHAIR WALLIS: I thought, then, you had to be risk-informing. You were supposed to permeate everything. And then you had to be somewhat of a rationalist.

MEMBER POWERS: Well, the structuralist gives to the risk analyst that which they do well, which are the diversity and redundancy areas. What they don't give to them are the decisions on independence of barriers and the existence of containment because they're making the argument that until the PRA can do the type of uncertainty analysis that the rationalists demand, we have these things.

The structuralist is basically a dying breed if PRA improves, but they're not improving in that area.

MEMBER KRESS: The problem that I have, a problem I have, with structuralists is it tells me, for example, I have to have a containment. It doesn't tell me how good it has to be.

MEMBER POWERS: No, it does not.

MEMBER KRESS: And that's where I fall back on being an AC/DC. I've got to know how good it's got to be, which leads me to the --

MEMBER POWERS: Well, no. You have to go to the next structuralist argument, what if it won't?

MEMBER KRESS: Yes.

MEMBER POWERS: Okay? And that will tell you how good you want to be.

MEMBER KRESS: Yes. But the question of how to quantify the effect of what if I am wrong is the rationalist approach. In order to put some quantity on that --

MEMBER POWERS: You become a phenomenologist then.

MEMBER KRESS: Yes, you do.

MEMBER POWERS: And, actually, the structuralist argument on how good the containment has to be is not very demanding. For instance, you look at TMI. We got up to the design pressure only during the hydrogen spike. Okay? So they're not very demanding there because then you're relying on the next level of defense-in-depth, which is emergency response. Okay? And so you're buying time.

So, actually, the structuralist argument --

MEMBER KRESS: The structuralists have ever gone along with ice condenser containment, for example, or maybe a Mark I?

MEMBER POWERS: Yes. I think in the end, the structuralist buys those because he is looking at -- he's just not very demanding.

CO-CHAIR WALLIS: The structuralist would accept the transition break size.

MEMBER POWERS: Yes.

CO-CHAIR WALLIS: He wouldn't say, "What if we're wrong? We ought to consider all breaks"?

MEMBER POWERS: Yes, he would. He would, but --

CO-CHAIR SHACK: It seems to me this rule has taken into account defense-in-depth in that sense. You know, you are required to mitigate the large breaks.

Some of these other things, I mean, I don't think anybody is doing to propose changes that remove the containment. I don't think they are going to propose changes that exceed the design pressure of the -- I think a lot of this is sort of philosophical discussion.

I'm kind of worried about the practical things of tracking these risk changes, sorting out risk changes due to the changes in the models and changes in the real risk and --

MEMBER KRESS: Who does the tracking? Who keeps --

MEMBER POWERS: Well, where do you want to look and see if it is making a practical impact, Bill, is can you use this to argue you don't have to do the integrated containment leakage test.

And nobody is going to come in and change out containment that is already built, but can you come in and say, "I don't have to do" -- because we're coming up on time when those things have to be done. I mean, I think it starts next year, doesn't it?

MEMBER KRESS: Ten years, isn't it?

MEMBER POWERS: Yes, it's about ten years.

CO-CHAIR WALLIS: It's also risk. When you cut a holding containment, how well do you have to repair it?

MEMBER POWERS: Well, if you take Turkey

Point as an example, not too well.

MR. SNODDERLY: I think the structuralist would say, "What if you are wrong and there are some degradation mechanisms that we didn't consider and we want to do the integrated test to see if those exist in those areas that we can't visually inspect or somehow test otherwise through the integrated test?"

And the rationalists would have to say, "Do I think I have covered the uncertainties to address all of those degradation mechanisms?"

And if you think that the rationalist did a good job, you say, "Eliminate the test." If you think that he hasn't, that the uncertainties are such that you need to do some tests so you have some data, you say --

MEMBER POWERS: If I were a rationalist and going to make that argument, I would pursue the tack that you took and then I would also ask, "How much damage do I inflict on the system by doing the test as well?" I mean, I think you would have to do both of those.

MR. SNODDERLY: Right.

MEMBER POWERS: That is going to weigh heavily on our thinking.

MR. SNODDERLY: You are right. I assumed

that there was negligible damage caused by the tests.

MEMBER POWERS: And I suspect that that is the strategy one would take on doing the test, is let's not do the over-test. The over-test is where the damage comes.

MEMBER KRESS: I think, basically, all we're being asked is to once again give our blessing to the 1.174 process. In other words, we're trading small risk increases for reduction in burden. And we have already said that is an okay thing, but you have to have good PRAs to do it.

MEMBER POWERS: I have always preferred to look upon it as trading small increases in risk for an increase in focus.

MEMBER KRESS: Okay. Well, I agree. That's a better description.

MEMBER POWERS: I think that's a better description.

MEMBER KRESS: That's much better.

MEMBER POWERS: And I think it's also --

MEMBER KRESS: Well, now, I think that's overdoing it in this case.

MEMBER POWERS: And I think the committee is on record as thinking that that is the right way to go.

MEMBER KRESS: Have we discussed this enough?

CO-CHAIR SHACK: Any more comments?

(No response.)

CO-CHAIR SHACK: If not, then the subcommittee is adjourned.

(Whereupon, the foregoing matter was concluded at 4:57 p.m.)

CERTIFICATE

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

Name of Proceeding: Advisory Committee on Reactor Safeguards Regulatory Policies and Practices & Thermal Hydraulic Phenomena

Docket Number: n/a

Location: Rockville, MD

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

Eric Hendrixson
Official Reporter
Neal R. Gross & Co., Inc.

PROPOSED 10CFR 50.46A REGULATORY GUIDE

Briefing for ACRS
Timothy Collins, NRR-DSS
January 25, 2006

Schedule for ACRS Meetings

Date	Rule	Reg Guide	Notes
Jan 25		Sub	Non seismic
March 8th	Comment period ends		
Apr or May		Sub	Rule comments and seismic
May or June		Full	Ltr: Send RG out for comment
July-Sept		Out for comment	
Sept	Full		Ltr on Final Rule
Nov		Sub	Comment resolution
Dec		Full	Ltr on RG for trial use

Overview of Staff's Presentation

Radiological Consequences

- Existing Guidance Valid under 50.46a
  - More realistic source term for LOCA already developed in Alternate Source Term Rule
  - Leak rate used in dose calculation is independent of calculated containment pressure
- Proposed plant changes could invalidate assumptions in current guidance,
  - analysis must be made consistent with actual plant as well as intent of regulatory guidance

Changes in Break Frequency

- LOCA frequency estimates used to support 50.46a assumed historical operating conditions
- Significant changes to operating conditions could invalidate applicability
- Significant changes need to be assessed for impact on LOCA frequency

Risk-Informed Integrated Safety Performance (RISP) Assessment for Proposed 50.46(a) Rule

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PRA Licensing Branch
Division of Safety Systems, NRR
US Nuclear Regulatory Commission

ACRS Subcommittee Presentation
January 25, 2006

Topics

- Overview of the RISP Process
- Application to Adopt 50.46a
- Description of Risk Assessment Methods
- Risk Metrics for Changes Under 50.59
- Risk Metrics for Changes Under 50.90
- Change in Risk Calculation
- Defense-in-Depth
- Safety Margins
- RISP Requirements During Operation
- Risk Assessment Reporting Requirements

Overview of the RISP process

- A licensee who wishes to make changes to the facility or procedures or to the technical specifications shall perform a RISP assessment.

- The RISP assessment must demonstrate that all plant changes satisfy the acceptance criteria in the rule:
  - acceptable changes in risk,
  - Defense-in-Depth is maintained,
  - Adequate safety margins are maintained, and
  - Adequate performance measurement programs are implemented.

- The RISP assessment process includes:
  - Quantitative and qualitative risk analysis tools,
  - A framework for evaluating defense-in-depth,
  - A framework for evaluating safety margins, and
  - Performance-measurement programs that monitor the facility and provide feedback during operation.

Application to Adopt 50.46a

- The Commission must approve an application made under 50.90 to adopt 50.46a

- The application under 50.90 must contain a description of the RISP assessment process including:
  - Description of the licensee's PRA and non-PRA risk assessment methods and
  - Description of the methods and decisionmaking process for evaluating compliance with
    - the risk criteria,
    - defense-in-depth criteria,
    - safety margin criteria, and
    - performance measurement criteria.

- Approval will authorize licensee to use the RISP to satisfy 50.46a requirements when making future changes under 50.59 and its internal change process.

- The RISP will also be used to satisfy 50.46a requirements when proposing future change under 50.90.

Description of Risk Assessment Methods - Scope

- The application to adopt 50.46 should include a description of the licensee's PRA and non-PRA risk assessment methods and should:
  - Identify the PRA scope (initiators and operating modes) that will be used and provide the estimated CDF and LERF.
  - Identify the non-PRA methods that will be used for out-of-scope initiators and modes. For each facility change that is evaluated, the non-PRA methods should be capable of;
    - realistically estimating the change in risk if risk will be estimated,
    - demonstrating that any risk increase caused by the modification would not affect the regulatory decision in a substantial manner (for example, by not affecting the results of screening analyses), or
    - demonstrating that it can not be reasonably concluded that risk has actually changed (for example, the qualitative review of potential safety related functions used for 50.69 implementation).

Description of Risk Assessment Methods – Technical Adequacy

- A description of the measures taken to assure the technical adequacy of the risk assessments. An acceptable approach for assessing technical adequacy of PRA risk assessment is discussed in RG 1.200 including
  - Resolving all peer reviewer comments and
  - Identifying key sources of uncertainty.

- NRC approval to adopt 50.46a will limit the changes permitted under 50.59 to those for which the available risk assessments are adequate to demonstrate that any increase in risk will be minimal.

- Any change may always be requested under 50.90, and technical adequacy of supporting RISP analyses will be required to be submitted and will be reviewed by the staff.

Risk Metrics – Changes Under 50.59

- The proposed rule authorizes licensees to make facility changes without prior NRC approval when the increase in the estimated risk is minimal compared to the overall plant risk profile.

- The NRC staff decided that quantitative guidelines defining minimal are needed because:
  - The proposed rule introduces the consideration of the change in risk into every decision,
  - The proposed rule provides quantitative guidelines for (non-minimal) acceptable risk increases, and
  - Although changes in risk from many facility changes may not be quantifiable, some will be quantifiable although very small.

- RG 1.174 does not provide any guidance about when a proposed risk-informed change not need be approved by NRC so a new guideline was needed.

- The staff is proposing the following guidelines to define when a quantifiable risk increases is minimal:
  - Increase in CDF less than 10E-7 per year,
  - Increase in LERF less than 10E-8 per year,
    - And
  - Increases in CDF and LERF are less than 1 % of overall plant risk profile.

Risk Metrics – Changes Under 50.90

- Licensee may submit a request for a licensing amendment when the RISP assessment demonstrates that
  - the total increases in core damage frequency and large early release frequency are small and the overall risk remains small.
- Every change to the facility that increases or decreases risk should be included in the total change in risk estimate.
- Small increase is defined by RG 1.174.
- Overall risk will remain small due to RG 1.174's guidelines that reduce acceptable increases when the overall CDF or LERF is greater than 10^{-4}/yr and 10^{-5}/yr respectively.

Change-in-Risk Calculation

- The total increases in CDF and LERF can be estimated by tracking the change to overall CDF and LERF caused by all changes to the facility since the adoption of 50.46a.

- Some change to the PRA that change the overall CDF and LERF are not made to reflect changes to the facility but, instead, to improve the fidelity of the model or the methods used in the model.

- Changes to overall CDF and LERF caused by PRA improvements should be tracked separately.

- Quantitative guidelines in RG 1.174 should not be interpreted as being overly prescriptive. Therefore, a reasonable estimate of the overall change to CDF and LERF should be acceptable.

Defense-in-Depth

- The RISP must also demonstrate that defense in depth is maintained for all changes, in part, by assuring that:
  - Reasonable balance is provided among prevention of core damage, containment failure (early and late), and consequence mitigation;
  - System redundancy, independence, and diversity are provided commensurate with the expected frequency of postulated accidents, the consequences of those accidents, and uncertainties; and
  - Independence of barriers is not degraded.

- Licensees should retain a level of containment reliability for the full spectrum of accident sequences following all facility changes, even if there is no change in CDF or LERF.

Safety-Margins

- The RISP must also demonstrate that adequate safety margins are retained for all changes to account for uncertainties. With sufficient safety margins:
  - Codes and standards or their alternatives approved for use by the NRC are met
  - Either safety analysis acceptance criteria in the plant licensing basis are met, or proposed revisions provide sufficient margin to account for analysis and data uncertainty.

- The licensee is expected to choose the method of engineering analysis appropriate for evaluating whether sufficient safety margins would be maintained if the proposed modification were implemented.

RISP Requirements During Operation

- Performance measuring programs should be integrated with existing programs where practicable such as;
  - Maintenance Rule (§ 50.65) and
  - Monitoring and feedback programs implemented as part of previous risk-informed regulatory actions.

- Licensees must periodically reevaluate and update the risk assessments (both PRA and non-PRA assessments)
  - Address modifications to the plant, operational practices, equipment performance, and plant operational experience
  - Determine impact on RISP assessments when errors, non-conformances, degraded conditions, or conditions adverse to quality are discovered

- Licensees must take appropriate action to ensure that all modifications continue to meet all applicable acceptance criteria, or modify the facility, technical specifications or procedures so that the acceptance criteria are met.

Risk Assessment Reporting Requirements

- The rule requires periodic PRA reevaluation and, if necessary to address facility changes that have not been incorporated into the PRA, a PRA update.
- As part of the PRA update, the licensee shall report the change to the NRC if the change results in a significant reduction in the capability to meet the acceptance requirements.
- RG 1.174 does not provide guidance on a significant reduction in capability.
- The staff has proposed the following guidance to define a significant reduction in capability
  - The overall CDF or LERF estimate increase by 20% or more
  - The increase in CDF increases by $1X10^{-6}$/year or more
  - The increase in LERF increases by $1X10^{-7}$/year or more

Proposed 10 CFR 50.46a
ECCS Analysis
Containment Analysis

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US Nuclear Regulatory Commission

ACRS Subcommittees
Regulatory Policies and Practices
Thermal-Hydraulic Phenomena
January 25, 2006

50.46a Regulatory Guide

- ACRS Presentation History
- Objectives and Scope
- Approach
  - ECCS Analysis
  - Containment Analysis

Previous ACRS Briefings Regarding 10 CFR 50.46a

- Previous ACRS briefings
  - November 2004
  - March 2005

Objectives and Scope — ECCS Analysis

- Define acceptable analysis approaches
  - For break sizes less than or equal to the TBS
  - For break sizes greater than the TBS
- Define acceptance criteria
  - For break sizes less than or equal to the TBS
  - For break sizes greater than the TBS

Acceptable Analysis Methods — ECCS Analysis

- Breaks ≤ TBS
  - 10 CFR Part 50, Appendix K
  - Realistic with uncertainty determination, Regulatory Guide 1.157
  - Uncertainty demonstrated at high probability level
- Breaks >TBS
  - 10 CFR Part 50, Appendix K
  - Realistic with uncertainty determination, Regulatory Guide 1.157
  - Another analytical approach
  - Uncertainty can be demonstrated at lower probability level

Acceptance Criteria — ECCS Analysis

- Breaks ≤ TBS
  - Current criteria
- Breaks > TBS
  - Coolable geometry
  - Long-term cooling
  - Coolable geometry understood by the staff to be:
    - PCT ≤ 2200°F
    - MLO ≤ 17%
    - Hydrogen equivalent to CWO ≤ 1%

Acceptance Criteria – Alternative

- Statement of proposed criteria
- Basis for criteria
  - Experimental data base
  - Applicability of the metric
  - Derivation of success criteria
  - Key assumptions
  - Uncertainty analysis
  - Limits of applicability
- Validation and assessment of the analysis methodology

ECCS Analysis > TBS

- Assumptions and input
  - Locked RCP rotor need not be assumed, but appropriate pump coast down resistance must be used
  - Offsite power available
  - Worst single failure is not assumed
  - Non-safety grade equipment may be credited, but must be maintained available and be capable of performing credited function under the associated accident conditions

Analysis Methodology (>TBS) Documentation

- Analytical model requirements
- Analytical model methodology
- Code description manuals
- User manuals and guidance
- Scaling reports
- Assessment reports
- Uncertainty analysis reports

Quality Assurance

- Good QA practices consistent with 10 CFR Part 50, Appendix B
- Applies to analytical model
  - Development
  - Assessment
  - Application

ECCS Analysis Summary

- Breaks up to and including the TBS follow all the rules currently in place
- Breaks beyond the TBS may use the current analytical methods or an alternative
- The documentation relevant to the analytical methodology used must be maintained for staff inspection
- Considerable relaxations are acceptable for breaks beyond the TBS
- Good quality assurance practices must be followed

50.46a Containment Analysis

Edward D. Throm

Containment Response Analyses

- Performed for DBAs – LOCAs, MSLBs and FWLBs
- Demonstrate pressure and temperature within design limits
  - Evaluate safeguards equipment performance
    - Sprays, coolers, ice weight, suppression pool temperature
    - Diesel-loading sequence time requirements
  - Evaluate auxiliary systems performance
    - Heat exchangers, service/component cooing water, UHS
- Equipment Qualification temperature and pressure profiles
- PWR – Minimum containment pressure for ECCS performance

Containment Criteria and Guidance

- General Design Criteria
  - GDC 16 - Containment Design
  - GDC 38 - Containment Heat Removal
  - GDC 44 - Cooling Water
  - GDC 50 - Containment Design Basis
- Standard Review Plan
  - 6.2.1.1.A,-.B,-.C - Containment Functional Design
  - 6.2.1.3 - Mass and Energy Releases for LOCAs
  - 6.2.1.5 – Min Pressure for ECCS Performance (PWRs)
    - Possible issue related to use of Tagami for heat transfer coefficient
    - H_{Tagami} at end-of-blowdown ~ 1/time to end-of blowdown

Containment - Breaks Up to the TBS

- Use current approved computer models and guidance
  - Models based on lumped parameter approach
  - Breaks result in a "well-mixed" containment atmosphere
  - Conservative initial conditions (p,T and relative humidity)
  - Conservative treatment of break flow and heat structures
  - Single failure/Loss of Offsite power for engineered safety systems
- Possible need to reconsider models for "small" breaks
- Acceptance Criteria
  - Containment and containment structures withstand peak pressure without loss of integrity
  - Containment remains a low-leakage barrier against the release of fission products as long as accident conditions require

Containment - Breaks Beyond the TBS

- Use current approved computer models
  - Realistic initial conditions (p,T and relative humidity)
  - Realistic treatment of break flow and heat structures
  - No single failure/Offsite power for engineered safety systems
  - Non-safety grade equipment may be credited, but must be maintained available and be capable of performing credited function under the associated accident conditions
- Acceptance Criteria
  - Containment and containment structures withstand peak pressure without loss of integrity – based on ASME code limits
  - SRP 3.8.1 – Concrete Containment
  - SRP 3.8.2 – Steel Containment

Containment Analysis Summary

- For breaks up to the TBS use current codes and practices
  - May need to revisit codes if TBS is a "small" break
  - May need to revisit guidance for PWR ECCS performance

  - Containment pressure and temperature within design limits
  - Leak tight for accident duration

- For breaks beyond the TBS use currents code
  - Without single failure or loss of offsite power
  - With realistic inputs and modeling, may include non-safety systems

  - Containment integrity maintained for breaks beyond the TBS