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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

October 31, 2006

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

MEETING OF REGULATORY POLICIES & PRACTICES

SUBCOMMITTEE

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TUESDAY,

OCTOBER 31, 2006

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The meeting was convened in Room T-2B3 of Two White Flint North, 11545 Rockville Pike, Rockville, Maryland, at 8:30 a.m., Dr. William J. Shack, Chairman, presiding.

MEMBERS PRESENT:

WILLIAM J. SHACK	Chair
GRAHAM B. WALLIS	Vice-Chair
OTTO L. MAYNARD	Member
SANJOY BANERJEE	Member
J. SAM ARMIJO	Member
GEORGE E. APOSTOLAKIS	Member
MICHAEL CORRADINI	Member
THOMAS S. KRESS	Member
JOHN D. SIEBER	Member

ACRS STAFF PRESENT:

ERIC THORNSBURY Cognizant Staff Engineer

NRR STAFF PRESENT:

RICHARD DUDLEY

STEVEN DINSMORE

MIKE TSCHILTZ

RALPH LANDRY

ROB TRAGONING

GARY HAMMER

BWROG REPRESENTATIVES PRESENT:

RANDY BUNT

TONY BROWNING

FRAN BOLGER

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8:32 a.m.

CHAIR SHACK: On the record. The meeting will now come to order. It's the meeting of the Advisory Committee on Reactor Safeguard Subcommittee on Reactor Policies and Practices. I am Bill Shack, Chairman of the Subcommittee. Members in attendance are George Apostolakis, Sam Armijo, Sanjoy Banerjee, Mike Corradini, Tom Kress, Otto Maynard, Jack Sieber and Graham Wallis.

The purpose of this meeting is to review details of the draft final risk inform revision to 10 CFR 50.46. The subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full Committee. Eric Thornsberry is the Designated Federal Official.

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 October 19, 2006. A transcript of portions 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 and speak with sufficient clarity and

volume so that they can be readily heard. Mr. Randy Bunt, Chair of the BWR's Owners Group, has submitted written material for our consideration, has requested time to make an oral presentation to the subcommittee. We will hear from him following the staff's formal presentation.

We've had some substantial discussion of this issue already through the emails. So I think we're just going to go right to the staff's presentation and I'll proceed with the meeting and call Mr. Richard Dudley from the Office of Nuclear Reactor Regulation to begin his presentation.

MR. DUDLEY: Good morning. I am Richard Dudley. I'm the Rulemaking Project Manager for the 50.46(a) ECCS Rule. As you said, the Committee has a substantial history with hearing us. I think we've met with you five or six times before. Our most recent meeting with you was on March 3, 2005 on the proposed rule and we received an ACRS letter on March 14th recommending that we go forward with publishing the proposed rule.

We provided the proposed rule to the Commission on March 29th in SECY-05-0052. The Commission deliberated on the proposed rule for about three months and on July 29th, they gave us a staff

requirements memo. The Commission made some substantial changes to the proposed rule that the staff provided and to the rule as the Committee last saw it on March 3rd.

The most significant, however, of the changes that the Commission made was that they directed us for the risk informed evaluation effort or the program they called the RISP, the Commission directed that the RISP process be applied to all facility changes. Not just the ones in our proposed rule had been enabled or made possible by thte 50.46(a) new rules. The Commission said this RISP should apply to all facility changes since all facility changes have the potential to affect risk at a facility.

We made those changes and other substantial --

VICE CHAIR WALLIS: Could I ask something? I'm sorry to interrupt you, but you seem to be getting into the details. Would you give us some indications particularly for new members as to what the purpose of the rule is and then perhaps we could see if what you propose to do meets the objectives that you've set out? Could you do that for us please?

MR. DUDLEY: Yes. This is a voluntary

alternative rule. Licensees may choose to take this option or not. Basically under this proposal, licensees would be allowed to redefine their large break LOCA with at a level we call the transition break size. The proposed rule takes your LOCAs and divides them into two regions separated by the transition break size or the TBS and LOCAs in the smaller break region up to and including the TBS are design basis accidents and they're analyzed by the existing process, procedures and requirements that we have for design basis accidents.

LOCAs between the TBS and the double ended guillotine break, previously the largest break that would be looked at is design basis are no longer called design basis accidents.

VICE CHAIR WALLIS: Now you're giving me the rule. You're only giving me the rationale for the rule. I'd like to go back a step before that. Why is this the solution to some problem? What is the problem you're solving with the rule?

MR. DUDLEY: I think it was the view of the Commission and others that many of our requirements for emergency core cooling systems established many, many years ago by wise men had through experience over time been shown to be perhaps

a little too much swayed to large break accidents and not quite so much focused on the more frequent small break accidents. And so the purpose of risk informing the ECCS requirements would be to allow licensees to perhaps optimize their emergency core cooling systems more on the more likely smaller breaks and be less dependent, have the equipment less --

VICE CHAIR WALLIS: So the main motivation is the low likelihood of large breaks.

MR. DUDLEY: That's correct, yes.

VICE CHAIR WALLIS: Is that the problem resolving or is it something else?

MR. DUDLEY: It is, yes. The issue is that large breaks are highly unlikely. Yet our facilities have been designed so that their performance and design greatly depend on being able to mitigate this large break LOCA.

VICE CHAIR WALLIS: And this transition break size is one way to address that problem.

MR. DUDLEY: That's correct.

VICE CHAIR WALLIS: And was this the only way you considered or did you consider other ways you might do it or what or did this just get decided as being the solution without much consideration or what?

MR. DUDLEY: There are a number of other

efforts underway. We've changed the emergency core cooling analysis requirements. Ralph Landry might need to help me talk about that, but we've gone to best estimate analysis procedures that also are less -- - allow you to focus a little more on the smaller breaks and not the --

VICE CHAIR WALLIS: The best estimate introduces this idea of probability and with high probability. Right? So probability is already there in the best estimate approach. You have to show that ECCS functions with high probability. That's in the rule now.

MR. DUDLEY: That's the current 50.46, is that correct, with the best estimate option? I believe that, yes.

VICE CHAIR WALLIS: So the motion of probability is already there.

MR. DUDLEY: That's my understanding.

VICE CHAIR WALLIS: Okay. Thank you.

MEMBER APOSTOLAKIS: Well, we keep saying that this will allow the licensees to focus on the smaller breaks. Can you elaborate on that a little bit? How would that allow them to do this? From what I read, they will have more flexibility for breaks above the TBS. Is that the same as allowing them to

focus on smaller, more likely breaks? I don't see that.

MR. DUDLEY: Well, for example, if you started your diesels, if you didn't have to -- I guess the reason you have to start your diesels as fast starts is in order to mitigate the very large break.

MEMBER APOSTOLAKIS: Right.

MR. DUDLEY: Smaller breaks don't require diesels to start as rapidly and if you start your diesels on a slower start schedule or you load your electrical components on a less aggressive loading rate or whatever, you put less strain on the equipment. The diesels could potentially be more reliable and more reliable diesels because you don't start them fast could also give you risk/benefits on other accidents in other areas. So that's --

VICE CHAIR WALLIS: Does this mean that they would not start fast enough for a large break then?

MEMBER SIEBER: Right.

CHAIR SHACK: Or a large break with a simultaneous LOOP.

MR. DUDLEY: That's correct.

VICE CHAIR WALLIS: Yes, but that's a big conservatism. You don't need to assume a simultaneous

LOOP.

MR. DUDLEY: But yet we do for the --

VICE CHAIR WALLIS: But you could take that out. That would help a lot. Take that out.

MEMBER SIEBER: But the answer to the question is yes.

VICE CHAIR WALLIS: Would it? I mean if you take out the LOOP, does that do it as far as the diesels go?

MEMBER SIEBER: You aren't going to be able to code proof for that accident in a timely way.

CHAIR SHACK: We'll have a chance to discuss that with the BWR Owners Group.

VICE CHAIR WALLIS: Okay.

CHAIR SHACK: Because they're talking about break size and --

VICE CHAIR WALLIS: LOOPs.

CHAIR SHACK: -- LOOPs and things like that. But again as I read the BWR NEDO Report here, one of things I would do is I would optimize my immersage (phonetic) diesel loading which we talked about. I would put 1HRHR LOOP in essentially containment cooling mode. I would eliminate my low pressure coolant injection LOOP selection thing. There are a number of things that they've proposed

here and that would be their --

MEMBER SIEBER: You would probably also want to change the accumulator pressure.

MR. DUDLEY: That's another thing you could do.

MEMBER SIEBER: Which would optimize for smaller breaks. I would expect folks to do that. On the other hand, you aren't going to be as good if you ever did get a double ended break as you would the optimized way the plans were optimized now.

MEMBER APOSTOLAKIS: But all these changes would have to be approved separately on a risk informed basis.

MEMBER SIEBER: Yes.

MEMBER BANERJEE: Can I ask a couple of questions though just for clarification? You said the Commission wanted you to do this. When did they ask for this?

MR. DUDLEY: The history of risk informing by regulations goes back many years and there's just sort of an evolution.

MEMBER BANERJEE: No, but this is -- Was this a specific instruction that you need to do this and when was that instruction given and does this Commission feel the same way?

MR. DUDLEY: I can't tell you how this Commission feels because --

MEMBER BANERJEE: So you haven't gone back to them?

MR. DUDLEY: None of these issues have gone to the Commission.

MEMBER BANERJEE: Okay.

MR. DUDLEY: The last information we got from the Commission was July 29, 2005.

MEMBER BANERJEE: This was the instruction?

MR. DUDLEY: This was the instruction of that Commission. This Commission has not spoken nor been involved with these efforts.

MEMBER BANERJEE: Okay, and the second question I had was you said that some new information had come about since the wise men had set up this rule. Can you tell me what this new information is?

MR. DUDLEY: I think it's the experience that we developed over many, many reactor years of operation.

MEMBER BANERJEE: What experience?

MR. DUDLEY: We've seen that small break LOCAs do occur. Large break LOCAs are a much, much less frequent.

MEMBER APOSTOLAKIS: They never occur.

CHAIR SHACK: They never have occurred.

MR. DUDLEY: They have never occurred. It depends on what you call large.

MEMBER APOSTOLAKIS: Much less frequent.

MR. DUDLEY: But certainly the double ended guillotine break has never occurred.

MEMBER APOSTOLAKIS: Correct.

MR. DUDLEY: And so there is that kind of experience.

MEMBER BANERJEE: What about things like Davis-Besse? Did you take those things into account in experience?

MR. DUDLEY: Davis-Besse I believe would have been what? An intermediate break?

MEMBER APOSTOLAKIS: Medium, yeah.

MR. DUDLEY: An intermediate break.

MEMBER BANERJEE: It could have been larger and not an double ended.

MR. DUDLEY: It wouldn't have the double ended guillotine break. I can't really tell you how fast the diesels would have had to start to mitigate that but it wouldn't have been the double ended break.

MEMBER KRESS: Sanjoy, on your first question, the Commission back then instructed the

staff to start risk informing the regulations and they went -- The industry came in and said if you're going to do this we have some we'd prefer you start with and they named two or three and one of them was this 50.46. That's why it seems to be one that they were working on that.

VICE CHAIR WALLIS: The history is that industry kept promising us that they would come up with arguments for changing 50.46 and they never seemed to do so and somehow it turned around and it came from the Commission instead of from industry. Isn't that what happened or am I misrepresenting history? I remember industry coming here and saying we're going to give you the arguments why you should change 50.46 and it never seemed to happen.

MEMBER CORRADINI: I had a clarification. Can I just have a couple more clarification questions? So you said a couple things that I guess, and I'm new too so even newer, much newer than Sanjoy in this, you said the Commission changed some things between what the ACRS saw and issued a letter on in March to what occurred on July 29th. The one thing I reread in the letter of March, it asked what were the risks/benefits of this. Are you going to later address that specifically or we've just kind of run through them in

a very qualitative fashion and those are the risks/benefits, optimizing for small, etc., etc. or are there others that there are?

I'm curious because I'm looking to turn this in a positive way. If this were to come into play, what are the benefits and I heard a few. Are there others?

And then also if you wouldn't mind, you mentioned what were the changes in the rule between the time what was seen in March to what now we see here. That's one thing I guess I need to understand a bit.

MEMBER APOSTOLAKIS: Right. He will address this I hope.

MEMBER CORRADINI: If we ever let them get there.

MR. DUDLEY: I was going to --

MEMBER APOSTOLAKIS: Experienced speakers do this even when they are not allowed --

VICE CHAIR WALLIS: I think there is somewhere in the record the rule and then the changes marked out in red ink. You can get a hold of that.

MR. DINSMORE: To answer your first question, we're not entirely sure what all can be done with this rule which is why we've been somewhat

cautious about setting it up because we were told that we should permit the changes that flow naturally from this rule to be implemented and a number of licensees and owners' groups have come in and they've been giving us suggestions of what they want to do and this is what they think they can do and Dr. Shack had probably the best list on the table when he went through that. So there are many things they could do and we simply don't know. So we've been trying to make sure that the rule itself will be able to accommodate the whole spectrum.

MEMBER CORRADINI: Okay, and then one other --

MR. DINSMORE: I'm sorry. Steven Dinsmore from NRR.

MEMBER CORRADINI: So just one more clarification. So in what was seen in the ACRS, what was seen in the rule in March still had the transition that anything beyond the TBS was not a DBA. That was in the rule as of the March time frame.

MR. DUDLEY: Yes, and that was left in by the Commission and that's still in there.

MEMBER CORRADINI: Okay. Thank you.

MR. DUDLEY: Licensees in the proposed rule and even in the final rule, they still have to

mitigate accidents between the TBS and the double ended break, but the mitigation requirements are much less severe associated with the lower probability of breaks in that region.

MEMBER CORRADINI: Okay, but that clarified my question. Thank you.

MEMBER SIEBER: If that's the case, it's still a DBA then.

MR. DUDLEY: It's hard to say. It's kind of like severe accident in that it's not a design basis accident. It's kind of like station blackout. We have regulations.

MEMBER SIEBER: I get disturbed when you say that. In my mind, the design basis is the rupture of anything other than the reactor vessel.

MR. DUDLEY: Equipment to mitigate the double ended break will still be --

MEMBER SIEBER: It could be size.

MR. DUDLEY: -- considered in the design basis of the facility. Yet if you look at the specifics and the wording in the history it's not considered a design basis access. Yet it will be --- It's just kind of a silly distinction.

MEMBER SIEBER: I would be happier if we could clean that up a little bit because to me it's

still a design basis accident. Your mitigation requirements are less stringent than those at the TBS or below.

MR. DUDLEY: But design basis accidents usually have more severe requirements associated with them.

MEMBER SIEBER: Right.

MR. DUDLEY: So that's why it's awkward to call it a design basis accident. Yet you're absolutely correct. It is still within the design basis of the plant.

MEMBER SIEBER: You aren't going to change the QA category, but you may say I can relax the surveillance requirement with respect to pressure and flow which I think is a degradation that's probably not in our best interest.

MEMBER MAYNARD: Yes, but they're going to have to come back and ask licensee for each one of these changes individually and justify the changes that they make. Mr. Chairman, I'd really suggest that we give them a chance to move on.

CHAIR SHACK: Since we have new members, I wanted to let them explore things.

VICE CHAIR WALLIS: I think we need to go over some of this.

MEMBER APOSTOLAKIS: But Mr. Dudley said something that I think needs clarification coming back to your presentation. The third bullet, Commission approval, you said that there was a change regarding the risk informed part or the Commission changed something. Can you explain that a little bit?

MR. DUDLEY: The proposed rule as the staff prepared it and as the committee saw it had licensees required to for every facility change that historically they would not have been able to make under the existing 50.46, those changes which would now be possible under the alternative requirements were called 50.46(a) enabled changes.

MEMBER APOSTOLAKIS: Right.

MR. DUDLEY: Licensees who made 50.46(a) enabled changes had to run those changes through this risk evaluation process to make sure the delta risk was okay, make sure the defense-in-depth was remained, safety margins were preserved and that monitoring was.

MEMBER APOSTOLAKIS: Right.

MR. DUDLEY: So that was the process and we only applied it in our proposed rule to 50.46(a) enabled changes. The Commission applied this risk informed evaluation to all facility changes.

MEMBER APOSTOLAKIS: What does that mean

"all"?

MR. DUDLEY: All changes, those under 50 -- Well.

MR. DINSMORE: The Commission came back and said it's going to very difficult or impossible to identify changes which were enabled by this rule compared to changes that were enabled by any of the other rules. So you shouldn't treat them differently and essentially you should apply the risk informed processes to all changes in the plant.

There was back --

MEMBER APOSTOLAKIS: How is that different from what we had before with 1.174?

MEMBER KRESS: 1.174 was not mandatory before.

MEMBER APOSTOLAKIS: Well, this is not mandatory either.

MEMBER KRESS: It's mandatory --

MR. DUDLEY: Once you accept that option, it's mandatory.

MEMBER KRESS: Yes, that's the difference.

MEMBER APOSTOLAKIS: Wait a minute. We said the same thing when NFBA-805 was discussed that if you elect to adopt an NFBA-805 then everything you change in the future would be risk informed. So it

seems to me that that was something that was already in place. So that's why I'm having difficulty understanding what the Commission changed.

MR. DINSMORE: Yes. Okay

MEMBER APOSTOLAKIS: I mean they are not allowed to request a change using deterministic methods anymore.

MR. DINSMORE: No, they would have to do a risk analysis on every change that they proposed. One of the discussions which came up, which floated up and down, because there was some confusion on our part as well. It was if they were changing the curb heights in the parking lot, they should do a risk analysis on it. Now it's a simple risk analysis. It has no effect on risk, but the change the Commission made was you're going to apply this to every change in the plant which is a lot different than I have all my change control processes out there. I have 50.59. I have all these different -- And I follow those processes unless I want to use a risk informed application to do something that I might not otherwise been able to do. This was now you have to do it on everything.

CHAIR SHACK: George, let's not focus on this too much because what we need to get to

eventually is the change control process they are now proposing for 50.46 rather than --

MEMBER APOSTOLAKIS: Is this clear to everyone?

CHAIR SHACK: -- this historical one.

MEMBER APOSTOLAKIS: It's not to me.

CHAIR SHACK: It comes back to this thing where they used to track your allowable delta CDF under 1.174 sort by each rule change. It goes back in history. I don't think we want to go back there.

VICE CHAIR WALLIS: I would like to know more about how you define the design basis accident and does the ECCS rule apply only to design basis accidents?

MR. RUBEN: That's correct. This is Mark Ruben from the staff, the PRA group. Yes, the ECCS Appendix K requirements apply only to design basis activities.

VICE CHAIR WALLIS: Can you apply something to beyond design basis accident?

MR. RUBEN: There is a --

VICE CHAIR WALLIS: A changing of a rule that applies to design basis accidents.

MR. RUBEN: There is a requirement in the rule and it was in fact mandated by the Commission

that mitigation capability be available possible for breaks up to the original design basis double and its size. The intent of that was to prevent plants for example from taking out LPCI pumps.

But at the same time, I would like to supplement the question asked earlier on design basis versus not design basis. All the requirements for a design basis accident in safety related equipment needed to respond there is an extensive list of requirements for such equipment. Their quality, how they respond, the assumptions that go into the analysis, that only applies to design basis accidents. Single failure is the one of the major assumptions. Loss of outside power is one of the major assumptions and the analysis acceptance criteria meets generally 90 to 95 percent.

VICE CHAIR WALLIS: I'm going to ask a much simpler question.

MR. RUBEN: Okay.

VICE CHAIR WALLIS: The 50.46, does that apply to design basis accidents?

MR. RUBEN: Yes.

VICE CHAIR WALLIS: Well, does it only apply to design basis accidents?

MR. RUBEN: Yes.

VICE CHAIR WALLIS: So what are you doing saying some of them are now not design basis access and yet putting it in this CC and the rule that applies to the design basis? I don't understand that.

MR. RUBEN: The rule presents alternate criteria for the non-design basis portion of the LOCA at larger sizes just like the staff has some set of requirements for station blackout and that was -- Excuse me?

VICE CHAIR WALLIS: It shouldn't be a rule that applies to design basis. That should be somewhere but I don't see how you can put it in a rule that is itself only applying to design basis accident.

MR. RUBEN: We think it's essential that it be in this rule and the rule is a expansion of the original 50.46 that redefines the size where the design basis accident terminates now at a smaller size. But at the same time, it points out requires the accomplishment of other criteria much looser for the beyond design basis size just like non-design basis accidents as SPO and that was set requirements.

CHAIR SHACK: Okay. One more and then it's time to move on.

MEMBER CORRADINI: So just to walk this through. I want to say it once so I have it. So

Jack, Sanjoy, and what we were asking relative to this, if beyond the TBS it's not a design basis accident, if they choose this alternative, they are then in a mode that everything they do within the plant, not just CCS related, but everything they do within the plant must be risk informed. That is if they choose to do something on a procedure that might be to do with the simulator it must be risk informed, anything within the plant structure. Do I have this correct?

MR. DINSMORE: Yes.

MEMBER CORRADINI: Okay.

MR. DINSMORE: With the understanding that much of the risk, much of these analysis on peripheral stuff, the risk informed is going to be more or less a check or a no.

MR. RUBEN: This is Mark Ruben again. Let me emphasize that because that is a key point here. There are a number of issues, topics, parts of the plant that aren't in the PRA model at all because they have no impact on risk. We expect the -- Certainly in many instances, if not the majority of instances, changes being contemplated by the licensee will have essentially zero risk impact and the screening assessment, a quick check assessment, as Mr.

Dinsmore said a check list, will be sufficient to provide a qualitative basis for that.

CHAIR SHACK: Okay. Now that we've opened this one, let me -- One of the big changes between the last version of the rule and this one is in the last rule you actually had a whole set of criteria for when a change was sort of negligibly small and could be sort of done by the licensee once he adopted 50.46 without a review by the staff. Now all that seems to have disappeared in the current version.

Is the new screening basically 50.59 now and that is the process that you're going to use to distinguish minor changes from significant changes?

MR. DINSMORE: The new screening process on what must be evaluated prior -- Before I get to the slides, the short answer is the new screening process is reverted back to the original current processes to determine what must be submitted and what must not be submitted. So nothing that -- Then there's a caveat, but it's easier if I get to this. It's been reduced substantially and we've taken the greatest --

CHAIR SHACK: It's disappeared as far as I can tell.

MR. TSCHILTZ: This is Mike Tschiltz. I'm the Deputy Director of the Division of Risk

Assessment. I would offer that we have a flow chart and a process in the presentation that would facilitate a better understanding of what we're proposing and if we could focus on that when we get to that slide.

MR. DUDLEY: If I could through with my introduction.

CHAIR SHACK: Why don't you get through?

MR. DUDLEY: We can actually get to the real discussions.

(Off the record comments.)

MR. DUDLEY: And the fourth bullet of the day, we published the proposed rule on November 7th and we had an extended comment period and we also had industry requests for an additional 30 days. The comment period didn't end until March 8, 2006.

We had a number of public meetings on the proposed rule. We had one in February when it was still before the comment period expired so that we could debut the rules so that we could make sure that the public understood with the rules so that the comments would not be misdirected or misinformed. Then we had meetings in June and August of 2006 to discuss proposed resolution of some public comments with the public. We got some good feedback from the

meetings and that and the analysis of other comments that we had we developed our draft final rule language and we posted it on the NRC Rule Forum website on October 3rd.

The draft *Federal Register* notice and the discussion of comments and their resolution was prepared consistent with the language posted on October 3rd and we provided the committee with the draft *Federal Register* notice on October 16th and that's the document, the main document, you had for review. Our current schedule is to provide a final rule to the Commission for their review by the end of February 2007. We will meet later with the ACRS in the spring of 2007 to discuss the implementing of reg guide with you.

We're here today to request an ACRS letter on the final rule. But an issue has arisen since we've provided you with the *Federal Register* notice on the 16th and what has occurred is there is potential impact of some pipe crack indications that were seen at the Wolf Creek plant and because that's early preliminary information the staff has taken the cautious position that we want to review that information and review our position on the seismic analysis that it supports the transition break size

for PWRs to make sure it is unaffected by information that came out of Wolf Creek.

MEMBER SIEBER: Now all those indications are below the TBS, surge line.

MR. DUDLEY: I think some were equal to it. That's correct.

MEMBER SIEBER: Yes, there are three on the surge line. There is one on each of the two pressurizer nozzles, PRVs and safety valves. So whatever you do in rule space applies to those indications. Right?

MR. DUDLEY: Yes. But nevertheless what we're here to discuss with you today would be all the other technical issues.

VICE CHAIR WALLIS: Could I ask you a question about that? I looked at your slides and almost all of them seem to be dedicated to process. What are the technical issues with this rule? All the slides are devoted and a lot of our discussion gets involved with process. That's not really what the ACRS does best. It's these technical issues. So what are these technical issues you want us to review?

MR. DUDLEY: The way we do risk analysis, the way we do the risk informed evaluations. There are a number of technical issues associated with PRA

and other things that we would like feedback on.

MEMBER ARMIJO: Isn't that on your next chart, the agenda where we get into the technical stuff, the discussions on thermal hydraulics, risk analysis, TBS sizes, etc.?

MR. DUDLEY: That's correct, but you know Dr. Wallis is right. We are primarily talking about process issues.

VICE CHAIR WALLIS: It looks as if someone has decided that technical issues have been resolved and now we're doing process.

MR. DUDLEY: Maybe my slide is a little inappropriate. All the other technical or process program issues --

MEMBER APOSTOLAKIS: Is there a place where I could go and find out what kinds of changes would the licensees request for breaks higher than the TBS? That may cause concern from a technical basis or from a technical point of view. I have been unable to find that and I hear, you know, random thoughts like they may request power uprates and that will have the same fact that we don't like that. Is there a place where you guys have thought about it and said if this rule becomes the law, they may come back and request A, B, C, D, and this is how we're going to handle this

because right now, it's a little bit of a mystery to me what kinds of changes the licensees may request if this becomes a rule? I'm sure you have thought about it in your deliberations, internal deliberations, but it's not clear to me in reading the document what could happen.

MR. RUBEN: This is Mark Ruben again. I can provide a couple insights. They may not be fully comprehensive. But the acceptance criteria and the guidance that was developed for the rule was done so with the concept that what was defined as an acceptable change would apply to any potential changes the licensee would want to make and there is criteria on what they have to review, what we have to review and the acceptance criteria or guidelines because it will be in reg guide that they have to meet. So any changes they make to the plant will have some risk impacts. The rule requires meeting some risk criteria. There are thermal hydraulic requirements, meaning some criteria that Mr. Landry can speak to. So pretty much independent of what they do, we expect the rule will provide enough guidance on how to assess its acceptability.

Now if something comes in that we think challenges the ability of the rule to appropriately

control it, then we will certainly move forward and try to identify what the issue is and maybe what kind of addition thoughts should be brought into mind. But at this point, we don't know of any.

VICE CHAIR WALLIS: I think, I'm with George, before you do anything especially something significant like this, you have to evaluate the consequences. That's the basis of mortality. This is what you tell your teenagers. Before you do anything, you think about the consequences.

Now I've made this speech before and the staff has done this before, proposed things without any evaluation whatsoever of what would happen if they did it and I find that a little disconsorting.

MEMBER APOSTOLAKIS: I guess I want to see a couple of specific examples. Mark's point is that we will face that if they ever come and request specific changes.

MR. DINSMORE: They have -- The BWR Owners Group provided us a couple years ago with a long list of stuff that they thought they were going to do. Dr. Shack had a short list. I guess it wasn't BWR Owners Group. So they are these different lists drifting around. We have read all the lists, but we keep coming back to the point that if it's not on the list,

that doesn't mean they can't do it.

MR. DUDLEY: And if it is on the list it may not be acceptable at certain plants. It's a plant specific evaluation also.

MR. DINSMORE: But if you want the list, we can dig up these lists and provide you with the different lists. They are kind of --

MEMBER APOSTOLAKIS: Do we have -- I remember seeing one some time ago.

MEMBER BANERJEE: But without this sort of analysis, how can you evaluate what the impact of the change would be? What are the increased risks associated with it?

MR. RUBEN: This is Mark Ruben. Let me try to answer that and then Mr. Dinsmore should jump in. The answer is you need an assessment methodology as such that is laid in 50.46(a) and it doesn't just include risk PRA type calculations. It also includes some thermal hydraulic considerations for the TH analysis to demonstrate acceptability to meet criteria both below and above transition break size.

We wanted something that would be flexible enough to deal with a wide gambit of changes. We don't know exactly what the licensees will all want to do, but there is one thing I can assure you of. The

day that this rule is put into place, there is no change in risk in the operating plant. It's purely a function of what each plant decides to do and the most -- one of the things, one of the changes is most likely and could have some risk impact is very large power uprates because their ECCS requirements only have to meet the Appendix K requirements below the transition break size.

A number of PWR plants are running very near to peak clad temperature limit 2200 within a couple of degrees, a few degrees, using often conservative methods acknowledged and same for the oxidation limits in Appendix K. The challenge to those limits are significantly a function of break size and by changing the break size you'll get a lot more margin in your calculated core response to reactor response as compared to the current regulatory limits and criteria.

So one of the most obvious actions would be increased power because now you'll drive the peak clad temperature back up near the limit of 2200 degrees but for a smaller break because you have a higher power density, more decay heat, and you've put that into the calculation and for boiler transition break size you meet the current Appendix K

requirements. For above, you meet a looser mitigation requirement that focuses on coolable geometry.

VICE CHAIR WALLIS: That's very useful. Before I can get enthusiastic about this at all, I want to see that it would achieve something desirable. So I have to decide that power uprates are desirable in order to get enthusiastic about this rule. Is that true?

MR. RUBEN: It may be desirable to the utility and some members of the public critique power. We didn't evaluate it against desirability per se. We used the same framework approach as in Reg Guide 174 and as supplemented by the Commission SRM Guidance, namely that small increases in risk are acceptable following the guidelines in 174 that the committee has seen many times and has endorsed.

As far as what you might call desirable changes taken in the spirit that they increase safety and reduce risk, we know of a couple that could do that. I'll give you a couple examples, but it depends on what each licensee wishes to do and wants to submit. But just for sake of an example, there's a change that the BWR Owners Group indicated on the docket for another topical report rulemaking activity related to LOCA LOOP but there's a close correlation

between that effort and this work and one of the changes they had indicated was mentioned by one of the committee members three or four minutes ago which was the alignment of one of the LPCI to pressure support cooling rather than injection and having just one LPCI pump lined up for injection. That will indeed reduce risk.

Another example is the slower start of the diesels that's required to successfully meet Appendix K requirements for a smaller break may not be ten seconds to start and load, come up to speed and load. Everyone knows such requirements and the associated testing does some harm to the diesels rather than promote increased diesel reliability. We've been aware of that for a long time, have made some adjustments requirements that I'm sure the committee is aware of, but at the same time, the slow start, 30 or 40 seconds may be all you need for the new design basis break size and that gives you an opportunity to preLOOP, do a slow start, let the diesel warm a little bit before you lock in the breakers. And we don't have hard data but I think everyone concludes that it's most likely going to produce increased diesel reliability.

MEMBER SIEBER: From a PRA standpoint

though, none of those factors go into the PRA and if you use CDF and LERF as the surrogates and the PRA has a go/no-go success criteria, then there's no change in risk.

MR. RUBEN: Your comment on the reliability of the diesels is correct because we don't have an appropriately sophisticated model to reflect the benefits of the changes that may come from this rule, but that doesn't mean they aren't real and don't exist. But for some of the actual line-up changes and the hardware changes that have been looked at by the BWR Owners Group, they are able to modeled in the PRAs such as the changes in the LPCI alignment and get CDF.

MEMBER SIEBER: It would take --

CHAIR SHACK: But you get a CDF improvement of 1 X 10^{-9}.

MR. RUBEN: Is that what it is, Steve?

CHAIR SHACK: That's what the report says.

VICE CHAIR WALLIS: If it is, it's a plus.

CHAIR SHACK: The RHR LOOP is 4 X 10^{-8}. The optimized EDG loading is 1.2 X 10^{-8}.

VICE CHAIR WALLIS: So a look at improvements in risk which are so minuscule that normally you would forget them.

CHAIR SHACK: The increase in reliability

again if you assume a ten percent increase without really knowing how to quantify it but if you assume that gets you a little bit more. But the change --The people shouldn't get carried away here. The computed changes at any rate are small. Now I'm sure we'll get more discussion in a qualitative sense from the BWR Owners Group that will make a stronger case than that, but the computed numbers at least in this report seem to be pretty small.

PARTICIPANT: Yes.

MEMBER APOSTOLAKIS: And we will get the more detailed discussion, I guess, on this statements in the draft rule that one can have qualitative estimates of changes to CDR and LERF at some point. Right? This is a checklist that you mentioned, Steve. Qualitative estimated of changes to LDF and LERF, I'm always intrigued by that. So we'll have to discuss that.

MR. DINSMORE: Okay.

MEMBER APOSTOLAKIS: Not now. At some point.

CHAIR SHACK: We should just -- Whenever we look at power uprates, we always get computed in delta CDF that are very small.

MEMBER APOSTOLAKIS: -- qualitative.

MEMBER BANERJEE: Now I want to ask Dr. Ruben a question. You said that as a response to this change in the rule we may get requests for larger power uprates because clad temperature and oxidation or whatever is limiting. Can't these things be achieved under the best estimate for less uncertainly methodology that is available today?

MR. RUBEN: I am not the right person to give the full answer. I'll give a little snippet of it and then Dr. Landry will I'm sure will answer it more properly than I do. It's my perception that you can probably do more with this rule than just best estimate a LOCA analysis will give you. Some plants have already implemented best estimate LOCA. It's a small number but some have. So maybe they recovered an ability to have some higher peaking rates, maybe push the power a little bit more. But I think Dr. Landry should answer.

VICE CHAIR WALLIS: Let's see here --

MEMBER BANERJEE: You can defer that until he makes --

VICE CHAIR WALLIS: You can defer that, but these methods used so far have not considered the low probability of large breaks.

MR. RUBEN: Which method, Graham?

VICE CHAIR WALLIS: The best estimate method so far has not considered the low probability of large breaks.

MR. RUBEN: All the current acceptance criteria for design basis accidents assume that the event occurs in the category that it falls into during the staff review. This is a limiting fault event and as such it has to meet the full regulatory requirements. The LPCI (phonetic), right, is in that assessment.

VICE CHAIR WALLIS: Maybe we should examine Mr. Landry on these points later on.

CHAIR SHACK: Yes, let's just move ahead here until we get there.

MR. DUDLEY: Just shortly I'm going to get to the agenda.

VICE CHAIR WALLIS: I think you can skip over lots of the history of stuff and just get on with the technical issues.

MR. DUDLEY: I just want to make it clear that we would like feedback and recommendations from the ACRS on all issues other than the transition break size for PWRs due to some relooking at things we're going to do.

MEMBER APOSTOLAKIS: If we write a letter

this time, when will we know your response to the first bullet?

MR. DUDLEY: We hope to get back to you in December. That would be our hope that we come back to you for hopefully a short meeting and explain to you what we've looked at between now and then and explain to you any changes necessary, if any at all, in the rule that you have before you.

VICE CHAIR WALLIS: This is showing me something. You were going to go ahead with something and then here's an event and you say, gee whiz, maybe we were wrong. We're going to change it. That's telling me something even if I don't know what it was.

MR. DUDLEY: I just think it means that we're being prudent. All right.

VICE CHAIR WALLIS: But it's telling me something about how much you knew before perhaps.

MEMBER MAYNARD: I think what they're trying to do is to see if this falls within what they knew before and already have factored in.

VICE CHAIR WALLIS: That would be good. That's a good point.

MEMBER MAYNARD: I think I know exactly what was found there and I think that when it's all over it's going to turn out to be that it was all

encompassed by the original assumptions in this. But they have to take a look at that and come to that conclusion.

MR. DUDLEY: And so we hope to meet again with you in December to close the loop on this one issue.

CHAIR SHACK: Okay.

MR. DUDLEY: All right. Now with the agenda, Dr. Landry will talk about the thermal hydraulic analysis and the comments necessary that we got on that. Steve Dinsmore will speak to you at some length on the comments related to risk analysis and operational requirements because those were by far the largest group of comments that we received on the proposed rule. I'll speak briefly on the applicability of this rule to future reactors and Gary Hammer will talk to you about how we selected the transition break size for BWRs and how we dispositioned the comments that we received on the BWR TBS.

MEMBER APOSTOLAKIS: So the PWR Owners Group is not unhappy.

MR. DUDLEY: That's our understanding.

Just to summarize the comments in general, most of the comments came from industry

representatives. We had six licensees, two reactor vendors, four industry groups, NEI, the BWR Owners Group, Westinghouse Owners Group and STARS, a strategic alliance of a number of facilities and one NRC employee also made a comment. We also looked during this period at the public comments on the expert elicitation. The expert elicitation developed the curbs that we used to start our development of the transition break size. So we also made sure that none of the public comments on the elicitation were going to cause the curbs to change.

Dr. Landry will talk to you about thermal hydraulics now.

DR. LANDRY: I'll stand up.

(Off the record comments.)

DR. LANDRY: Okay. I only have two slides and based on the discussion so far, that should be good for about an hour and a half. The thermal hydraulic requirements, today 50.46 says that you can analyze a LOCA using either a realistic methodology with uncertainty determination or you can use the prescriptive Appendix K.

VICE CHAIR WALLIS: Let me ask you about this. These requirements have to be met with a high level of probability. That's in the rule.

DR. LANDRY: Okay.

VICE CHAIR WALLIS: Now you're implying this probability to a smaller range of break sizes. So now shouldn't the level of probability now increase because you're neglecting the other ones which previously had less probability?

MEMBER CORRADINI: More uncertain.

VICE CHAIR WALLIS: Uncertainty is taken care by probabilistic methods.

DR. LANDRY: No. Today the rule says that you have to analyze the range of rates all the way up to the double ended guillotine rupture to determine that you have encompassed the worst size.

VICE CHAIR WALLIS: It doesn't say anything about worst. It just says you have to analyze the number of breaks.

DR. LANDRY: And have determined the highest peak cladding temperature.

VICE CHAIR WALLIS: It doesn't say that either in the rule.

DR. LANDRY: I don't have the rule.

VICE CHAIR WALLIS: Maybe I misread the rule, but I couldn't find that in the rule.

DR. LANDRY: This is in the first paragraph of the rule and it says that you can use

uncertainty analysis methodology but you must determine the worst event.

VICE CHAIR WALLIS: We'll look at the rule and see.

MEMBER APOSTOLAKIS: Or you can show for all of them which is the same thing. You can show for a spectrum of breaks that you are below the criteria which is the same thing as the maximum.

(Off the record discussion.)

VICE CHAIR WALLIS: We need the rule. We don't have any staff here. We need the rule. It simply says to make sure the most severe causative loss of coolant accidents are calculated.

DR. LANDRY: Right.

VICE CHAIR WALLIS: It doesn't say they have to meet the criteria. It just says they have to be calculated.

DR. LANDRY: It does say in that paragraph that they must meet the acceptance criteria of paragraph B.

CHAIR SHACK: "The maximum fuel cladding temperature shall not exceed..."

VICE CHAIR WALLIS: But that's after you've done the uncertainty analysis.

DR. LANDRY: That's after you've done --

VICE CHAIR WALLIS: We'll read it with a fine -- We will read it very carefully later on.

DR. LANDRY: You can do an uncertainty analysis approach, a realistic approach, and analyze a spectrum of breaks to determine if you have calculated the worst event.

(Off the record discussion.)

DR. LANDRY: Or you can use the prescriptive Appendix K approach.

VICE CHAIR WALLIS: I think it's been interpreted that way but we're going to look carefully what the rule says. Okay.

DR. LANDRY: Okay. Today, if you're doing an uncertainty analysis approach and you're ranging the break size, you can use the break size as one of your sample parameters in doing the analysis. Traditionally, all analyses for ECCS performance have looked at the large break as one segment and the small break as another.

Looking at the large break the way the rule has been interpreted is that if you're going to encompass the worst event you have to start with the 1.0 double ended guillotine and typically they'll drop down to 0.8 times that area and 0.6. If 0.6 is higher than the other two, then they'll drop down to 0.4

simply to show that they have calculated the worst PCT event. Now --

VICE CHAIR WALLIS: When you calculate them probabilistically --

DR. LANDRY: Now if you're doing them probabilistically, you can still go in and fix the break size, do your statistical analysis around particular break sizes.

VICE CHAIR WALLIS: You can, but you --

DR. LANDRY: Or, Graham, you can range the break size and use the break size as a sampled parameter. That's been done by one vendor and we've allowed that because the rule does not preclude using break size as a sampled parameter. Now if you're going to do something such as a full spectrum analysis using one code to run from the smallest break to the largest break which nobody can do today because nothing has an approved small break realistic model, but if you're going to use a full spectrum analysis, you could in theory use something a selector for the break size for a probabilistic distribution function derived from the results of NUREG 1829.

In theory, you could. Nobody has suggested that and we haven't seen that. But that could be done to weight your analyses towards to the

smaller break sizes. But the current rule still insists that you have to do all the way up to the worst break size.

VICE CHAIR WALLIS: You have calculate it, but how you weigh it is not specified by the rule.

DR. LANDRY: Right.

VICE CHAIR WALLIS: And this rule doesn't say that the highest break size must meet the criteria exactly. The probability comes later on in the rule. So well anyway.

DR. LANDRY: The probability is only in a very --

MEMBER BANERJEE: Really the issue is does the existing rule allow you to take the probability of different break sizes occurring into account.

DR. LANDRY: Yes, there is nothing in the rule today that precludes doing that.

MEMBER BANERJEE: So why do we need to change this rule now?

DR. LANDRY: If you want to gain more margin though, the current rule is under the guidance of the general design criteria. The general design criteria say that you must have these certain assumptions in design basis events. The design basis events have to consider the worst single failure. You

must do the analysis with and without offsite power availability. Today, that means the full spectrum must be analyzed with the worst single failure which is generally offsite power.

VICE CHAIR WALLIS: But you could change those to be probabilistic the way you do it in the PRA.

DR. LANDRY: One of the things that has been done with this 50.46(a) proposal is to change specific general design criteria so that the design basis of that goes up to the TBS. Beyond the TBS, you're no longer a design basis event, so you don't have to use the single failure criterion and you don't have to use the loss of offsite power criterion.

VICE CHAIR WALLIS: So we're not just looking at 50.46. We're looking at these general design criteria modifications as well.

DR. LANDRY: You can't look at one without looking at the other.

MEMBER CORRADINI: Can I? You said this and maybe if you're going to say it again later I'll hold my question.

DR. LANDRY: I only have two slides, Mike. I wasn't planning on saying a whole lot at all.

VICE CHAIR WALLIS: But it's much better.

MEMBER CORRADINI: I'm still very fuzzy as I read the explanation of the rule in one document and the rule itself as to what the staff is expecting the licensee to do above TBS and below DEGB. I'm very fuzzy.

DR. LANDRY: Okay. That means getting back to my slides. Above the TBS, now under 50.46(a) the rule says that anything below the TBS everything you do today still applies. You can use Appendix K analysis or you can use a realistic analysis with uncertainty determination, both of which have to be reviewed and approved by the staff. Above the TBS, you can use Appendix K analysis method, you can use an approved, already reviewed and approved, best estimate with uncertainty analysis method or you can propose another alternative analysis method or you can use another alternative method. The new rule would not require you to submit for review an approval that methodology.

MEMBER CORRADINI: Which one? Any of the three?

DR. LANDRY: Above the TBS.

VICE CHAIR WALLIS: So this could be a one page -- This could be a one page sort of back of the envelope analysis.

DR. LANDRY: Above the TBS you do not have to submit for review and approval by the staff the analysis methodology. We have in the --

MEMBER BANERJEE: -- enough water or something around.

DR. LANDRY: Just a minute, Sanjoy. We have stated in the rule though that you have to identify the method you have used and then the methodology is available for the staff should we determine that we don't understand. You use Code XYZ which we've never heard of or what sheet back of the envelope calculation. We have the option to always come out and audit, inspect and audit, the work that you've done. We can look at what you've done.

In the regulatory guide, we are identifying those phenomena which are important to large break LOCA which we are giving as guidance that should be accounted for in your methodology. Some of those are the old familiar items that everybody loves to talk about. Momentum must be accounted for.

The rule 50.46 or Appendix K states that you have to account for a momentum flux. For a large break LOCA, you have flow reversal. So you have to account for momentum whether it's a mechanical conservation term or you call it momentum

conservation. You still have to do something to account for momentum. So our goal while we're not being prescribed in telling you how you do your analysis above the TBS you're making guidance statements in the regulatory guidance as to what phenomena should be considered and accounted for in your analysis methodology. This precludes using essentially back of the envelope calculation because you're not going to be able to account for some of these factors.

MEMBER CORRADINI: So let me just play this out. So therefore if you had this analysis and you informed the staff and the staff didn't want to audit it but it's there somewhere there would be likely a range of break sizes which would above the peak clad temperature.

DR. LANDRY: There would be a range of break sizes that would be above the design basis event peak clad temperature.

MEMBER CORRADINI: Okay. All right. Then below what so I don't get nervous? Here's where I'm coming from and I'll give you my concern because I'm not sure where it sits; it seems like you're inventing a new category of accidents that are not severe accidents that are not designed basis accidents and I

don't see how they are watched over.

DR. LANDRY: They would be in my next slide.

MEMBER CORRADINI: Okay. Currently, the acceptance criteria are that the PCT must be under 2200 degrees, maximum local oxidation under 17 percent, hydrogen generation equivalent to less than 10 percent of the core-wide oxidation. Coolable geometry and you must provide for long-term coolant.

VICE CHAIR WALLIS: Coolable core geometry is really defined by the above three.

MEMBER CORRADINI: Right, it is somewhat redundant because the above are what we'll define a coolable --

VICE CHAIR WALLIS: The coolable core geometry unless defined, doesn't mean anything to me at all because TMI was cooled and all kinds of things can be cooled.

MEMBER CORRADINI: Everything is going to be cooled.

VICE CHAIR WALLIS: So you must have a better acceptance criteria than coolable core geometry.

DR. LANDRY: We're doing to get to that above the TBS. We're now saying below the TBS all of

these acceptance criteria are the same. Above the Tbs though, we say that you must maintain a coolable geometry and you must provide for long-term cooling.

VICE CHAIR WALLIS: But both of those, the purpose of those is to prevent damage to the core. The release is radioactivity.

DR. LANDRY: Correct.

VICE CHAIR WALLIS: That's got to be the definition. Otherwise it doesn't mean anything. How good does this have to be as cooling?

DR. LANDRY: If you go into the statement of considerations and the regulatory guide, we are defining that the staff, at this point understands the coolable geometry to be this and this.

VICE CHAIR WALLIS: Okay, so what's changed about TBS?

DR. LANDRY: This is to give the option to the industry to come in with data or information which says, "We can go to a higher temperature or we can go to a higher oxidation level and still maintain a coolable geometry.

VICE CHAIR WALLIS: Oh, we have an improved cladding or something that will go to 2500.

DR. LANDRY: Today this is the best information we have. If you go out and you obtain the

data that says you can go to 2700 degrees and 20 percent oxidation and still maintain the cladding in what looks like a cylindrical configuration, come in with the data and show it.

VICE CHAIR WALLIS: Well, if that's valid, why don't you accept it for all breaks?

MEMBER CORRADINI: Say again.

VICE CHAIR WALLIS: If that's valid, why don't you accept it for all breaks? I mean, if there's a certain temperature which the coolable geometry fails, why don't you apply it to all breaks, not just above TBS. If they come back and say, "Our core is good enough for 2500", and they're clearly convincing --

MR. RUBEN: Ralph, can I add something and I'm sure you can answer better? Not meeting the definitive acceptance criteria Dr. Landry has put up there, may be defensible through alternate analysis, processes, or new information as he pointed out but it may also put you in a scenario were you have some about of limited fuel failure, including potentially some small amount of localized melting, but you don't have a major challenge to the core integrity or the vessel integrity.

Now, we currently don't have criteria to

differentiate beyond the criteria he has up there right now. And it would have to be a proposal from a licensee that gave high confidence that even though you exceed those values, the small amount of damage that may occur to the core won't challenge the geometric structure of the core that insures its coolability and won't result in so much relocation of the core that you could potentially challenge the lower head of the vessel. We won't be well away from that point.

MEMBER CORRADINI: So now you're into my regime. Now, I'm getting very nervous because what I just heard was said and I may have misheard, so please correct me, and I want to start with you, Ralph, you're saying that for the moment the guidance on those three words "coolable core geometry" really are the three quantitative numbers above.

DR. LANDRY: Correct.

MEMBER CORRADINI: So what has changed then above the TBS? Has it changed by the way you're interpreting this that those three quantitative numbers are applicable but you don't have to worry about offsite power and you don't have to worry about single failure criterion? Is that what is changing?

DR. LANDRY: Right, you are allowed to --

MEMBER BANERJEE: It sounds like that.

DR. LANDRY: You can do that analysis today assuming you have offsite power available and assuming that all the equipment operates. You don't have to take the single failure penalty.

CHAIR SHACK: Okay, why don't we just define it that way?

DR. LANDRY: That's a huge plus. To the availability of --

MEMBER CORRADINI: So why not just define it that way and leave the quantitative value -- because the next thing I was going to say is, I don't know of any data anywhere that I believe that supplants those three quantitative things and I don't believe the industry is going to invest in any new data to do it, so --

DR. LANDRY: But we were trying to leave that door open.

MEMBER CORRADINI: Yeah, but come on.

DR. LANDRY: We wanted to leave that door open so that if the industry had the data, then they could come in, make the argument --

MEMBER CORRADINI: I understand.

DR. LANDRY: -- and we did not have it in the rule that these criteria were required.

MEMBER CORRADINI: Okay, but --

DR. LANDRY: This is what we're aiming for.

MEMBER CORRADINI: So just to say it again, those three quantitative are assumed below and they --

DR. LANDRY: But they're not in the regulation.

MEMBER CORRADINI: And they're not in the regulation, and in the below single -- loss of offsite power and single failure criteria must not be -- are not necessarily need to be invoked.

DR. LANDRY: That's correct.

MR. TSCHILTZ: And if I could add there that they're also allows to use -- Mike Tschiltz, NRR. They're also allows to use a more realistic analysis and they are also allowed to credit non-safety related equipment in that analysis. That's, I think, the full spectrum of changes from what's in the existing criteria.

DR. LANDRY: You're allowed to credit anything you want up there, anything that's available.

MEMBER MAYNARD: But this is only being allowed because again, you still have to have some level of confidence about coolable core geometry but

it's for the very low probability events. Above the transition break size is supposed to be an extremely low probability event.

DR. LANDRY: That's correct. Os we're not adding onto that low probability event the probability of loss of offsite power and the probability of single failure.

MEMBER MAYNARD: And that's why you would not relax those criteria for below the transition break size because it's not considered as lower probability of --

DR. LANDRY: Right, those are the more probable events.

MEMBER ARMIJO: Okay, so let's say a PWR comes in. They've used all the flexibility you provide above TBS. The best estimate codes, all the tricks in their bag and they come up with a peak clad temperature of 27, 2800 degrees F. Is that still okay?

DR. LANDRY: They would have to show us why it would be okay. To the staff today, no.

MEMBER ARMIJO: So, if that's the case, why don't you just keep those same requirements, peak clad temperature, oxidation, hydrogen and say, "Hey, look, keep those requirements because that defines

coolable core geometry," you've got all this other flexibility and take advantage of that and you should be able to beat that.

DR. LANDRY: We wanted to give the capability to out, get new data, new information and come in here and show us that we don't have to have these very prescriptive limits. That if you can come in with the data, we'll consider it and allow this relaxation.

MEMBER ARMIJO: Do you have any reason to believe that anybody has such data?

DR. LANDRY: No, not today.

MEMBER ARMIJO: I don't think so either. I think it's going to be very tough to show that you'll keep the fuel together.

DR. LANDRY: We were trying to not lock everybody in and we were trying to be flexible.

MEMBER SIEBER: I think if you look at the way the original fact criteria was developed, there's a lot of margin in these numbers.

DR. LANDRY: Yeah, and --

MEMBER SIEBER: The real numbers like 2300 and something and say, well, you know, let's be really sure this is the right number, we'll make it 2200. And that's the way that rulemaking went and --

CHAIR SHACK: Well, that's a debate for another day.

CHAIR SHACK: Well, that's a debate for another day.

MEMBER ARMIJO: Yeah, that will come up again, though.

MEMBER APOSTOLAKIS: Ralph, I have a question about this. It seems to me that things above the TBS you don't define a design basis accident and people can use equipment that is there or not there. Wouldn't you need as part of the acceptance criteria to say something about the frequency of the sequences? Let me tell you what I think about it. I'm looking at the number of sequences now. I am not forced to assume loss of offsite power and so on. So in some of these sequences the power is there. I have other non-safety equipment or so on and I meet the criteria, but I have a bunch of sequences.

And some of these sequences with very, very low frequency almost none of this is available, and then I exceed the criteria. Then are you going to argue that these sequences are so rare that even though you exceed these three criteria, you're still okay? In other words, you bring an additional dimension here to the argument so you will need to

have some sort of acceptance criteria regarding the frequency of the sequence that leads you to violate the criteria. Isn't that true, because you don't have a well-defined sequence now that you are analyzing? So would these be --

DR. LANDRY: But this is going to be --

MEMBER APOSTOLAKIS: I'm sorry.

DR. LANDRY: This is going to be analyzed, George, on a case by case basis. A plant comes in and wants to adopt 5046A. They're not required to do this.

MEMBER APOSTOLAKIS: I understand that. I understand that, yeah.

DR. LANDRY: Do you follow, George?

MEMBER APOSTOLAKIS: I understand that, yeah.

DR. LANDRY: And then in support of it, they come in and say, "Well, we've analyzed this and we've -- up to the TBS," et cetera and above, everything is fine and then we can say, "We want to come out and we want to see your analysis, the risk analysis you've done, equipment availability analysis that you've done, the results of your thermal hydraulic analysis". And we can look on a case by case basis and do exactly what you're saying.

"Have you considered all the proper sequences, yes or no and what are the results"?

MEMBER APOSTOLAKIS: But there has to be something about the frequency itself. You have -- you will do this in the regulatory guide, perhaps.

MR. DINSMORE: I think you have -- this is Steve Dinsmore from the NRR. I think what Ralph's talking about is success paths. He's going to be identifying success paths. Now once we implement the rule, and they go into this risk informed change process, the failure of those success paths coupled with the frequency of having to enter them, will go into the change in risk estimates.

VICE CHAIR WALLIS: Risk has nothing to do with these numbers up here.

MR. DINSMORE: Right, but these are just success paths. This is just saying, well --

MEMBER APOSTOLAKIS: What do you mean by success paths, you assume that the equipment is available?

MR. DINSMORE: Yes.

VICE CHAIR WALLIS: That bothers me. I mean, that's not --

MEMBER APOSTOLAKIS: It may not be. I mean, that's the point. The benefit that you have

from the design basis accident is that the sequence is well-defined. Thou shall assume spectrum of breaks and the largest break perhaps, assume that you don't have outside power, assume single failure, the worst single failure but everything else is available, so the sequence is well-defined and you do your thermal hydraulic calculations.

Now, you're entering a space where the sequence is not well-defined and you're saying, you know, I'm getting rid of all these extra requirements but now I have to consider a spectrum of sequences because sometimes --

CHAIR SHACK: But as I understand the rule, if you credit the equipment, then you're going to put it into your tech spec that it can't be out of service for example, more than seven days.

VICE CHAIR WALLIS: And it can't fail?

CHAIR SHACK: Well, failure is a different -- you know, that comes back into --

MR. DINSMORE: If it fails you can't --

CHAIR SHACK: That's in the PRA space and risk space, but in terms of a definable situation, if you say I'm going to meet this criterion with this equipment, then that equipment has to be available within this technical specification requirement that

you can't have an outage of --

MEMBER APOSTOLAKIS: And I'm done if I do that?

MR. DINSMORE: No, then you have to do your risk analysis to make --

CHAIR SHACK: You have to do your risk analysis.

MR. DINSMORE: -- to make sure that you --

MEMBER APOSTOLAKIS: But there will be some sequences where I violate this criteria, correct?

MR. DINSMORE: Okay, if something fails.

MR. RUBEN: Let me supplement.

MR. DINSMORE: Then you do good, then it goes into the risk analysis as a failure.

VICE CHAIR WALLIS: It doesn't appear in your ECCS analysis though. It only appears in the risk analysis.

MEMBER APOSTOLAKIS: It does not, no.

CHAIR SHACK: Yeah, but the design basis doesn't -- it never fails in design basis space but it fails in the PRA now, too already.

VICE CHAIR WALLIS: But now you're going to say with the new rule nothing fails?

MR. DINSMORE: No, we're going to say if we're going to identify the operating configurations

where the --

VICE CHAIR WALLIS: How do you deal with -- you just -- you get rid of single failure. I understand, that probably is the sensible thing to do. It would be nice to know what some number associated with abandoning it. What are you now going to do about failure? Are you going to assume no failures? Are you going to do a probabilistic analysis of failures?

MR. DINSMORE: But the greater than --

VICE CHAIR WALLIS: What are you going to do?

MR. DINSMORE: But the greater than TBS sequences that they're looking at they can assume there's no failure.

VICE CHAIR WALLIS: There's no failure. They assume no failure. That's a big change.

MR. RUBEN: Let me supplement the answer a little bit if I could. This is mark Ruben again from the Division of Risk Assessment. The evaluation process that Dr. Apostolakis identified is a good process and it's the formation of the advance reactor framework, a licensing basis approach that is pretty much fully risk informed that identifies this sequence frequencies and puts them into various design basis

groups according to the sequence frequencies and has different acceptance criteria.

That is a very different licensing design review approach and we're some years away from being able to implement that. But it would account for the sequence frequencies explicitly. Here we've made a coarser cut based on initiation frequency. So we have two groups and in the second group, even though it's a coarse cut, we believe the initiation frequency is low enough that the requirements -- that the deterministic analysis requirements need not make the traditional assumptions for DBAs single failure and loss of offsite power at T_0 and some other things.

However, we acknowledge that there is some likelihood that those assumptions will not be met if a real event occurs due to failure modes, failure frequencies of various components and to make sure that that doesn't pose an unacceptable risk to the public is the second part of the 5046A criteria which is that as best as we can a realistic risk evaluation is conducted reflecting all the changes they wish to make for the plant and this model will include as Mr. Dinsmore pointed out before, includes the full PRA model with all the failure rates of the systems that are in the PRA.

So looking at you know, nominal PRA model calculations even though the acceptance criteria is analytically run in a deterministic sense, without these assumptions, the safety impact with those assumptions not being met in risk based is calculated and compared to a guideline metric of acceptability.

MEMBER CORRADINI: Can I just run that example? I think I understand what you just said, so let me pretend something. So take a reactor, Zion, Zion is running and now they want to come in with a 25 percent uprate. By what you just said is by this method of calculation, they could find that they are okay above the TBS and yet their CDF could go up by a factor of two or three. Two separate calculations, two separate calculations, one would raise the risk because it's a PRA and one would be acceptable via the TBS. Am I on base here?

MR. RUBEN: Ninety percent. The 10 percent where I would have to scratch a little deeper, I believe the Zion baseline risk is high enough so that if you took it two to three factor increase, it wouldn't meet the risk acceptance guidelines that would be part of this rule, which is 10^{-5} for everything that's done after a licensee adopts the rule.

MEMBER CORRADINI: So the second trigger is not that -- a second trigger is not that this is -- not only is this accepted but they must not hit the risk trigger.

MR. RUBEN: That's correct, and the risk trigger is very, very broadly applied, capturing all the changes made to the plan.

MEMBER APOSTOLAKIS: Steve, when you said the success paths, you mean the thermal hydraulic analysis will assume that the equipment is available.

MR. DINSMORE: Yes.

MEMBER APOSTOLAKIS: Okay, okay.

MR. RUBEN: Okay for the low frequency zone, only for the low frequency where we made that coarse cut.

MEMBER APOSTOLAKIS: Well, above the TBS.

MR. RUBEN: Right, yes, sir.

CHAIR SHACK: Okay, I'm going to take the chairman's prerogative and ask one last question then we're going to move on. The -- my question sort of goes back to Dr. Sieber's question. Suppose we said that beyond the TBS it was still a design basis accident? We were just going to redefine the design basis accident not to have LOOP and not to have single failure but you would still have to bring in a prior

approval for your code and you would still have to meet all the other requirements on the equipment that you need, can we do that?

DR. LANDRY: You still -- you would have to have a rule change to do that.

CHAIR SHACK: Yes, of course, to do that.

DR. LANDRY: Of course, you're in a different space, Bill. You can do any rule change, of course any rule change you want. If that's what --

CHAIR SHACK: It's a different rule change than you're proposing.

DR. LANDRY: -- you want to do, you would still have to have a rule change.

VICE CHAIR WALLIS: No, it's not you. It's the Commission that can do it.

DR. LANDRY: But if you came in and you were successful in having a rule change to permit it, of course you could that.

CHAIR SHACK: Let's move onto Mr. Dinsmore then at this point. The risk analysis is a large part of this.

MEMBER APOSTOLAKIS: Are we following the agenda, Mr. Chairman?

CHAIR SHACK: Yes.

MEMBER APOSTOLAKIS: What does the agenda

say?

CHAIR SHACK: We've had comments on the thermal hydraulic analysis. We're about to have comments on the risk analysis.

MEMBER BANERJEE: Did they get any comments from outside about the thermal hydraulic analysis?

MEMBER ARMIJO: They're going to show that.

MEMBER BANERJEE: Oh, they're going to show the data.

MR. DINSMORE: Okay, my name is Steve Dinsmore. I'm a Senior Reliability and Risk Analyst in the Office of Nuclear Regulation and I'm going to talk to you about the major public comments related to the PRA or to the risk aspects of this change.

I'm going to present a brief summary of these comments that we received and the resolution of some of the comments cause us to make changes to the rule and the resolutions of others did not. So any changes to the rule that were made to resolve the comments are identified in the presentation.

VICE CHAIR WALLIS: When you say public comments, these are comments from industry?

MR. DINSMORE: Yeah, pretty exclusively.

VICE CHAIR WALLIS: Are they all from industry?

MR. DINSMORE: From one --

PARTICIPANT: Almost all, yes.

MEMBER APOSTOLAKIS: This NRC employee, he commented on what? You mentioned an NRC employee.

MR. DINSMORE: His is the last comment in here.

MEMBER APOSTOLAKIS: Okay.

MR. DINSMORE: The major comments that we got were regarding the scope of the facility changes requiring a risk evaluation, identification of changes that require prior staff review and approval, tracking of risk increases, PRA -- periodic PRA updating and reporting, acceptance criteria on amount by which risk increases and these operational restrictions and maintaining that --

VICE CHAIR WALLIS: Go back to my question about the public. So there are skeptical members of the public out there, we know some of them. Presumably they're waiting until you take this step before they come back and comment on it.

MR. DINSMORE: They have not been showing up at any of the meetings that I'm aware of.

VICE CHAIR WALLIS: Yes, but I would

imagine that's what they're doing.

MR. DINSMORE: They also get --

VICE CHAIR WALLIS: And if they're not commenting now, they probably will comment some time. It's obviously, a very commendable thing to do.

MR. DINSMORE: We are surprised as well, but we just --

VICE CHAIR WALLIS: Well, I think they're waiting, they're biding their time is what's happening.

MEMBER BANERJEE: What advantage would they get by that?

VICE CHAIR WALLIS: Because then they can -- you know, then they've got something substantial that's happened they can critique.

CHAIR SHACK: You'd think they'd like to prevent it from happening.

VICE CHAIR WALLIS: Oh, no, they want to show that the NRC has done something unwise but anyway, let's move on.

MR. DINSMORE: You're making me feel nervous here. Okay, from these comments, the first two comments, the scope of facility changes requiring evaluation and identification of changes that require prior staff review and the very last one, operational

restrictions, the industry claim that these were show stopper which meant that if the rule went out without changes to these areas that the industry didn't think it was going to be worthwhile for them to implement the rule. And since this is a voluntary rule, there is some consideration that it would be a waste to put on a rule that they wouldn't implement. So --

MEMBER BANERJEE: What were the points again, the show stoppers?

MR. DINSMORE: The scope of the facility changes requiring a risk evaluation, the identification of changes that require prior staff review and approval and the operational restrictions. There's a slide on each one of these.

MEMBER BANERJEE: Okay.

MR. DINSMORE: Okay, the first --

VICE CHAIR WALLIS: This is backwards, isn't it? You're saying that you want to put out a rule and then you ask industry and they say don't put that out because if you put it out, we won't do anything. It ought to be the other way around. They ought to come in and say, we want to do something because and then you evaluate it and say, yeah, you can because we're going to make changes in the rule. The whole thing seems backwards to me.

MR. RUBEN: Let me give just a little tad of perspective on this. Your comment is extremely well-founded. We were though, directed by the Commission to engage in extensive stakeholder interactions before finalizing the rule to insure that not only were the safety public protection criteria maintained but also to insure that it was a useable rule, one that could be applied and one that would be flexible enough so the licensees might want to apply it. But again, our primary focus was that sufficient safety be maintained as a result of the rule but also, as I said, secondarily, that it be useful for something.

VICE CHAIR WALLIS: But presumably, the motivation was to do something useful from beginning. And therefore, the -- if this were a design problem, you'd make your specifications in terms of utility right at the start, not look for it at the end.

MEMBER BANERJEE: Well, that's why I asked how did this whole process initiate and what I heard is you were instructed to do this by the Commission.

MR. RUBEN: It's a little broader than that. This goes back to 1998 when SECY 98-300 was issued which identified options for going forward with risk informed rulemaking activities and we gave three

options. In fact, the committee was briefed on that many years ago. The Commission decided to choose the options 1, 2, and 3 and 3 was to go forward to see how effectively we could risk inform revise some of the most significant rules. When that effort was started, there was an associated activity to sort of prioritize which of the rules should we give attention to first and two or three were identified. One was combustible gas control, I think 50.48. We've already changed that. And now we're working on this one and so it was early on where the Commission was given some information and the prioritization was an effort by research was that our involvement on where the biggest bang for the buck was to risk inform the rules. This one was identified six, seven years ago and the Commission not only endorsed the staff moving forward with it, they wanted it on an accelerated schedule, so a lot of stakeholder involvement.

MEMBER BANERJEE: So you did not feel that the best estimate, this uncertainty, met the goal of risk informing this rule.

MEMBER APOSTOLAKIS: No, because they still have to make the assumptions so the --

MEMBER CORRADINI: The simultaneous LOOP, the simultaneous double ended guillotine.

VICE CHAIR WALLIS: But that's a separate question, isn't it? Whether or not they make sense to have LOOP is a separate question. You could do away with that for a risk informed basis.

MR. RUBEN: In fact we are, Dr. Wallis. We're working on --

VICE CHAIR WALLIS: This is different than the entire 50.46 we're looking at.

MR. RUBEN: Dr. Graham, we have an initiative underway to do exactly that. There's a BWR Owners Group initiative associated with removing the LOCA/LOOP requirement just as a required concept in general and we're reviewing the topical. We're about halfway done on that effort and we will likely follow it by making a rule change or a GDC change.

MR. DINSMORE: And I guess when industry says something's a show-stopper in this case we look carefully at it. But if we decide that we can't come to an agreement then it would just stop the rule. But we tried to move forward as fast as possible.

MEMBER APOSTOLAKIS: Isn't this an obvious thing, I mean, that they should always do the evaluation prior to implementing the change? I never understood why you have to say that. It's in 1.174. Right?

MR. DINSMORE: But this is every change in --

MEMBER APOSTOLAKIS: And there was already a comment on it.

MR. DINSMORE: The proposed rule required a risk evaluation of all changes to the facility prior to implementing the change which means again if you were going to raise your curbs and your parking lot you would have to do a --

MEMBER APOSTOLAKIS: I see. So it's clear. All right. That's trivial though.

VICE CHAIR WALLIS: It's the all that you're --

MEMBER APOSTOLAKIS: Yes, all.

VICE CHAIR WALLIS: The prior isn't the new thing. It's the all changes that's --

MR. DINSMORE: I should underline both of them, yes. We were aware of that when the rule went out, but the comment that came back of course is this does not credit current change control processes and is unnecessary burdensome and then the final rule that's going --

VICE CHAIR WALLIS: Now wait a minute. In the risk evaluation suppose you raise this temperature from 2200 to 2300 or something, that doesn't appear in

a risk analysis, does it? The risk analysis doesn't have anything to do with these criteria that you have in ECCS rule.

MR. DINSMORE: Many of the risk --

VICE CHAIR WALLIS: Doesn't take account of that.

MR. DINSMORE: Many of the risk evaluations would have been just not applicable, but it would have had to have been done. There was a lot of comments about it. We agree that most of them are going to be very simple, but we still have a paperwork problem of getting it all done.

VICE CHAIR WALLIS: But we've had this before. You have saw two parallels. You have risk which is a very innovative and good thing to do and you have these other systems where you calculate things like 2200 degrees more or less and there seems to be no coupling between them. They're separate things and you can change one completely without influencing the other and sometimes it influences and sometimes it doesn't because the thermal hydraulics and the uncertainties in it are not in the PRA.

MEMBER APOSTOLAKIS: The problem is and I believe the issue came up last June when you guys were discussing the safety margin thing that the

quantitative safety margins are not in the PRA.

VICE CHAIR WALLIS: Right.

MEMBER APOSTOLAKIS: And there seems to be some resistance to doing that, right, judging from what was discussed?

VICE CHAIR WALLIS: But suppose we raise the temperature of the fuel to 2500. What would the PRA -- How would the PRA respond to that?

MR. DINSMORE: Unless it changes success criteria, it wouldn't respond at all.

VICE CHAIR WALLIS: It wouldn't respond at all. It doesn't have a way of responding to it. So your check and balance that Michael Corradini was talking about supposed that you predicted 2500 or something, the risk is going to catch that. Is risk going to catch that?

MR. DINSMORE: It probably wouldn't meet your success criteria for your PRA which is to keep at 2200.

MR. RUBEN: But let me -- This is Mark Ruben again. It would depend on what severe accident criteria the particular PRA included. Sometimes they use the current 2200 limit. Sometimes they use the uncoverary (phonetic) of the core. Sometimes they use time and temperature or two-thirds high on some BWRs

for example. So it varies.

But the PRA bobbling is not changing as a result of this rule. The best that we can currently model the impact of risk of any change including the thermal hydraulic changes because there are TH models in the PRAs. They're by assessment models but they're TH models. We're not changing anything in that and so the actual risk impact due to a higher peak clad temperature as it would impact meeting the PRA success of severe accident failure or success on the path, the eventuary (phonetic) path is properly reflected. So if 2500, you still meet the sufficient core cooling requirements in the PRA, you're right. No impact. If you don't meet them, there's an impact.

VICE CHAIR WALLIS: So you have sort of two parallel criteria for core cooling which sometimes seem on different planes. I think this is one of the problems of the whole regulation. It would be very nice to have one integrated method that did both things properly.

MEMBER APOSTOLAKIS: It's very hard though.

VICE CHAIR WALLIS: I know.

MEMBER APOSTOLAKIS: It's very hard.

VICE CHAIR WALLIS: But ingenious people

could probably devise a way to do it. Some of those guys in famous universities near the coast.

MEMBER BANERJEE: Which coast?

VICE CHAIR WALLIS: Either coast.

MEMBER KRESS: The coast of the Mississippi River.

MEMBER APOSTOLAKIS: We need to collaborate that. Yes, PRA models really, they're redundancy. Their part of defense in depth refers to redundancy. The part that refers to safety margins is not. Indirectly, it is of course. I think Steve answered that. The success criteria determines how many LOOPs you need and so on but in general it isn't. So changes in the margin are not in the PRA.

VICE CHAIR WALLIS: So if you use a different heat transfer coefficient then the light of new research and it turned out the temperatures went up, they wouldn't appear in a PRA at all.

MEMBER APOSTOLAKIS: No, but that's why they have two sets. One is all the equipment is available. Look at the thermal hydraulics. You pass that. Then you start playing with the failures of the equipment and then you have something like 1.174 to handle that. Okay.

MR. DINSMORE: So the final rule, I was

going to say a risk evaluation is required prior to implementing potentially risk significant changes.

VICE CHAIR WALLIS: Independently.

MR. DINSMORE: And a periodic risk evaluation is required to assist the cumulative effect of all changes. Now when we were evaluating this comment and developing the response to the comment, we decided that the goal would be to eliminate redundant regulatory controls wherever possible and to minimize additional requirements to the extent possible.

MEMBER APOSTOLAKIS: Now let me -- This cumulative effect, and maybe, Tom, you can help here, I went back to the Regulatory Guide 1.174 and I also remember the debates we had in this room when we were discussing it. Maybe you were part of it. But I remember explicitly getting a hold of it and saying according to this regulatory guide, they can come every Monday with a new change, proposed change, and it will be evaluated, the change against the criteria of the guide. And somewhere in the guide it says that the staff should also consider the cumulative effect of changes without saying what "consider" means.

Now it seems to me we are going beyond that and we're saying no. The actual cumulative risk is what we're going to use in our decision making.

MR. DINSMORE: We have a slide that directly addresses that issue.

MEMBER APOSTOLAKIS: All right.

MR. DINSMORE: About two slides down. I'm sure --

MEMBER KRESS: I think you're right, George.

MEMBER APOSTOLAKIS: Because the original intent was not to take the cumulative delta risk and compare it to the 10^{-5}. It just said consider and that was left up in the air.

MR. DINSMORE: If we can get through how you --

MEMBER APOSTOLAKIS: Yes. All right. You have a slide. That's fine.

MR. DINSMORE: This slide is still about how you identify what changes are going to require risk informed evaluation prior to implementation and what changes you might have to do with your periodic update. So if we start up on the --

MEMBER APOSTOLAKIS: Excuse me. I understand now we have 50.46(a) and 50.46(b) and you are following that new terminology, so this is indeed (a). (a) was acceptance criteria in the new thing, isn't it?

MR. DINSMORE: The existing 50.46(a) will be renumbered as 50.46(b).

MEMBER APOSTOLAKIS: Right.

MR. DINSMORE: And this will be the new 50.46(a).

MEMBER APOSTOLAKIS: So this is (a) now? This is the new (a)?

MR. DINSMORE: This is the new proposed rule.

VICE CHAIR WALLIS: The new rule is 50.46(a).

MR. DINSMORE: I should have put the (a) in.

MEMBER APOSTOLAKIS: It's there but I'm just wondering whether it's --

MR. DINSMORE: This is the new rule.

MEMBER APOSTOLAKIS: The new rule.

MR. DINSMORE: This is the staff's response to the industry's comment that the scope of the facility changes requiring a risk analysis is way too broad and it would cover everything and we just couldn't deal with it. So the way we looked at it is we started out if the changes -- the question is is the change going to covered by regulations and if it is going to be covered by regulations normally all

regulations have pieces in them with criteria that allow you to make the change without making a submittal. 50.59 is the most famous one. If you go through 50.59 and you pass it, you do not have to make a submittal. Other ones are the fire regulations and all these criteria are along the lines of either the change maintains an acceptable level of safety or it does reduce the effectiveness of the equipment or the procedures.

So industry claimed and we eventually decided that yes if you actually go through one of these change processes and it's determined that you could make this change without prior NRC approval, the likelihood that you're making a risk significant change is very, very small.

So the first thing we decided was people who go through regulatory processes and those processes permit them to make the change without a submittal, they don't have to do a risk analysis on that change. But what happens then if they do need a submittal, they're going to have to make a risk informed evaluation and that's what they would submit.

Now if you start off with the top change governed by regulations, then, no, it's not governed by the regulations. Then the next question would be

if the change affects an SSC within the scope of the maintenance rule. Now we chose the maintenance rule because the maintenance rule examined the nexus between safety and SSCs and it was pretty good at identifying all those SSCs at the plant that you rely on to mitigate all these different initiating events.

So if it's not in the scope of the maintenance rule, then we figured that again it would be a very small chance that anything that you changed on this component would affect safety. So you could go ahead and implement it. If it is within the scope of the maintenance rule, then you should do this risk informed evaluation.

Now the population of stuff that's not governed by regulations but within the scope of the maintenance rule is probably going to include the changes that we were somewhat worried about which is changes that the new rule permitted you to do such that they were no longer within the scope of the regulations, but might affect safety significant equipment. So we're confident that we picked up that population of changes with this little process. If it's within the scope of the maintenance rule, you have to do a risk informed evaluation. Now if it meets the small criteria, the cumulative small

criteria, I guess I should repeat this one when Dr. Apostolakis comes back, if it meets the cumulative small criteria or it does not meet it, then you can't implement it. You would have to either bundle it with some other change which would bring your total back down or you'd have to postpone it. If it does meet the small criteria, then the last question is it meets a very small criteria which is mainly just a reporting required criteria.

VICE CHAIR WALLIS: Now is this small and very small defined in any way?

MR. DINSMORE: Yes, they are defined using the values out of the Reg Guide 1.174.

VICE CHAIR WALLIS: Okay. That's what -- Okay.

MR. DINSMORE: The little chart. Right. And if it meets the very small criteria, you don't even have to put it in the report. You just implement it.

Now on top of all this, every two operating cycles, there's a roll-up of all the changes. They have to bring -- They have to update the PRA to reflect the current operating configuration and design of the plant and they would redo a calculation at that time and then they would come up

with a risk increase which would include everything.

So we thought that the process set up here it relies a good bit on the current regulations because there are places you can rely on them and it simplifies their process and it uses mainly what information is already available to them. So it seems to be a pretty reasonable way to go through.

MEMBER KRESS: Is there any way in this rule that we can treat power uprates differently?

MR. DINSMORE: Unless we put it right in the rule, I doubt it.

MEMBER KRESS: It's because 1.174 doesn't deal very well with power uprates.

MEMBER APOSTOLAKIS: It does not.

MEMBER KRESS: That's about the only thing it doesn't deal with very well and if we could just --

VICE CHAIR WALLIS: It doesn't measure loss of margin in any way at all, does it?

MEMBER KRESS: Well, it says you might maintain margin but it's very vague about what you mean by that.

MR. RUBEN: This is Mark Ruben again. We currently have guidelines and methodology for assessing power uprates and risk space. It's a non-risk informed submittal and we follow Appendix G of

SRP 19 which is we make sure adequate protection is assured. But we do that by essentially doing a 1.174 type analysis and comparing it to 1.174 guidelines and criteria and there's a document, a review guidance document, that was put together by the EPU folks that includes essentially the approach that's used to evaluate EPUs.

The same process will be used here with the new thermal hydraulic and success criteria and operator timing changes that fall out of the implemented change that's now allowed by 50.46(a). So --

MEMBER KRESS: See, the trouble with all of those things is they don't properly address site risk and power uprates is a site risk issue not a reactor design issue and that's the problem I have with it.

VICE CHAIR WALLIS: The problem I have is the only thing that's ever showed up so far in power uprates risk analysis is operator action time. Nothing physical has showed up at all.

MR. RUBEN: I could provide --

VICE CHAIR WALLIS: I wonder if this is going to be the case with this new rule too. Is there anything that's going to show up in the risk analysis?

Risk is supposed to capture things when you've gone too far with the thermal hydraulics or something. Is it going to catch anything? I'm not sure it will.

MR. RUBEN: Dr. Wallis, there have been some rare cases on EPU power PRA evaluations where there have been some minor changes and success requirements like you need an extra feed pump being available and that change in success criteria is put directly into the PRA model and calculated. So you're absolutely right. Virtually all the changes have been timing changes because the amount of uprate they've done hasn't challenged the previous success criteria and required equipment response. If they make additional uprates that now impact the original assumptions and requirements of what success is, that will be directly assessed in the risk evaluation portion. But the changes done to date have resulted in very little significant change in risk or significant changes in success criteria but there have been some.

CHAIR SHACK: Yes, Brown's Ferry had to change the success criteria is the one I can think of.

MEMBER SIEBER: That happens because you don't evaluate margin and if CDF is your criterion, it doesn't make any difference whether it's a little core

or a big one. The source term is irrelevant. So PRAs really don't tell you much about EPUs.

MR. RUBEN: We do look at both CDF and LERF changes.

MEMBER APOSTOLAKIS: But that's just a frequency of release.

MR. RUBEN: You go to a level three now.

MEMBER SIEBER: Right. Doesn't tell you how bad it is.

MEMBER APOSTOLAKIS: Or even a level two, Mark.

MR. RUBEN: Right.

MEMBER APOSTOLAKIS: At level two, you could calculate the quantity released.

MR. RUBEN: Yes.

MEMBER APOSTOLAKIS: But level two minus one step. That's the frequency of a release, any release, as long as it's large.

MR. RUBEN: It's the frequency would be large early release under the definitions we've been using for several years.

MEMBER APOSTOLAKIS: Right.

MR. RUBEN: So the releases that are later than or smaller than that criteria are not reflected in the calculation, but that's the underpinnings of

1.174.

MEMBER APOSTOLAKIS: Correct, but the frequency can stay the same and the large part can increase. Right?

MR. RUBEN: That's absolutely true and there will be a small impact on that from an EPU. We looked at, I believe, it was a Swiss study that actually assessed it quantitatively and it was roughly proportional to the increase in power. But sort of the approach that we're taking is a large release is a large release. It's a very undesirable event and that's why we have guidelines for its increase.

MEMBER APOSTOLAKIS: So the argument then appears to be that the guideline we have is already a conservative thing. That no matter how large it is it's bad. That's why we have a 10^{-5} delta LERF limit.

MR. RUBEN: I don't know if I would call it conservative rather than just say meeting it provides enough assurance of public protection. But the conclusion also was that if we meet these surrogate risk metrics we would meet the safety goals quantitative health objectives as --

CHAIR SHACK: This comes back to metrics of risk informed regulation. Let's move on here.

MEMBER APOSTOLAKIS: Did you want to ask

that?

MEMBER CORRADINI: I just -- I didn't understand what allows you to go left on your branch there to implement where the answer is no. You said it and I guess I didn't write it down.

MR. DINSMORE: Which one? The submittal required?

MEMBER CORRADINI: Yes, submittal required. No.

MR. DINSMORE: That's when you can make this change according to the regulation within making a submittal.

MEMBER APOSTOLAKIS: They're both yes. That's what's confusing. Yes.

MR. DINSMORE: Submittal required, yes. Yes, you need a submittal that goes down. No, you don't need a submittal that goes --

MEMBER CORRADINI: And the reason you don't need a submittal is because?

MR. DINSMORE: Because you fulfilled the acceptance criteria in that regulation to make a change without submitting a change.

MEMBER MAYNARD: Both of those various regulations that control changes.

MR. DINSMORE: Right. Past 50.59, there's

a bunch of them.

MEMBER APOSTOLAKIS: So you enter the diagram up there which says change governed by regulations.

MR. DINSMORE: That's the first question, yes.

MEMBER APOSTOLAKIS: That's one you enter.

MR. DINSMORE: Thank you. It took us months to develop this.

(Laughter.)

MEMBER APOSTOLAKIS: Are there any changes that are not governed by the regulation?

MR. DINSMORE: Sure. Yes, changes to safety significant equipment that's -- or to maintenance rule equipment which some of the secondary side pumps and things like that is in the maintenance rule.

MR. RUBEN: Some of it is very important like some of the old PRAs, start-up feedwater pumps especially the diesel driven ones, if there are AC independent ones out there. They are real important in risk space. Sometimes they're in the PRA model. Sometimes they're not. But on an old, high baseline risk PRAs are pretty important and that's captured by the maintenance rule, but it's not a safety related

system so it has no criteria.

MEMBER MAYNARD: George, I --

MEMBER APOSTOLAKIS: But it captured by the regulations.

MEMBER MAYNARD: George, I would have probably titled that upper lefthand diamond different because I agree. I think all changes are really governed by regulation.

MEMBER APOSTOLAKIS: All changes are governed by regulations.

MEMBER MAYNARD: I think they're talking about the regulations that deal with change as opposed to --

MEMBER APOSTOLAKIS: Right.

MEMBER SIEBER: 50.59.

MEMBER APOSTOLAKIS: The wording could be different. Okay. Where are we?

MR. DINSMORE: This one should go pretty quick. This is the second comment, identification of changes that require prior staff review and approval. The proposed change said if you have it submitted according to your current regulatory requirements or if it increased risk by more than a very small amount, then you had to submit it for prior staff review. The comment was the same, does not create a change process

and is very burdensome.

The final rule --

VICE CHAIR WALLIS: They are all process items, aren't they? They're not technical questions.

MR. DINSMORE: Right. The final rule got rid of it because what determines what you submit is the current change control process. So it was quick. Now we're starting to slow down a bit probably.

This one has to do with tracking of risk increases. The proposed rule said that the amount by which CDF and LERF increased over time must be estimated and tracked. The industry came in and said it should be sufficient to estimate and track the overall CDF and LERF overtime. The final rule is unchanged so that you still need to track the amount by which CDF and LERF increase.

VICE CHAIR WALLIS: What's the difference there?

MEMBER KRESS: In one case, you have to subtract. The difference is you can do other changes that reduce CDF and LERF but those wouldn't be included in.

MR. DINSMORE: No, that would all be in there. The difference is that you have to subtract.

VICE CHAIR WALLIS: So it's a big thing to

ask industry to do really. Come on.

MEMBER CORRADINI: I don't think I get it.

VICE CHAIR WALLIS: I'm kidding.

MEMBER CORRADINI: It can't be that simple.

MR. DINSMORE: The difference is what you're going to submit, what you're going to be looking at. Are you going to be looking at the total CDF and LERF or are you going to be looking at the difference?

MEMBER KRESS: The delta.

MR. DINSMORE: The delta. If you only track the total CDF and LERF and you submit that, let me go through this just a little bit that might help you.

VICE CHAIR WALLIS: It doesn't matter what you submit because you can easily subtract. The question is what do you do with it once you get it. You can subtract too.

MR. DINSMORE: Right.

VICE CHAIR WALLIS: Is the decision based on the total or the increase?

MR. DINSMORE: The decision is based on the increase.

VICE CHAIR WALLIS: So you can easily

subtract. So there's no big deal on this slide.

MEMBER APOSTOLAKIS: Wait a minute. This is not related to a particular request. This says at any point in time you should have the estimate of delta CDF from all past changes and delta LERF. That's what this says and you should know it. If we ask you, you should give us the answer in two minutes.

MR. DINSMORE: And periodically.

MEMBER APOSTOLAKIS: Yes.

MR. DINSMORE: Or periodically, not every second.

MEMBER APOSTOLAKIS: Right. It's not tied to any particular request. It just is a cumulative.

MR. DINSMORE: Right.

MEMBER APOSTOLAKIS: What it doesn't say is what to do with it.

MR. DINSMORE: Right. That's the next slide.

MEMBER APOSTOLAKIS: Okay.

MR. DINSMORE: But the reason it's in the rule it says what we want them to track is the increase over time is because the rule requires an acceptance criteria to clarify for the staff, licensee and public what will be acceptable and what will not be acceptable and the staff has no guidance on what is

an acceptable overall CDF and LERF, but we do have guidance on what is an acceptable risk increase and what is not an acceptable risk increase. So quite simply, we retain the requirement in the rule to estimate the parameters that we have a criteria for.

MEMBER APOSTOLAKIS: So the goal of 10^{-4} for CDF is not considered an acceptable.

MR. DINSMORE: All it does is if your total is above 10^{-4}, your acceptable increased drop from 10^{-5} to 10^{-6}.

MEMBER APOSTOLAKIS: Right. So you don't proceed at an unacceptable -- That's fine. I think that's fine.

MR. TSCHILTZ: This is Mike Tschiltz from NRR. I think maybe a helpful analogy to use here is that you have a checking account with a risk balance in it and once you've made changes that increase risk a certain percentage, any change that you make to the plant following that needs to decrease risk to gain back the balance in your checkbook. So it's not facilitating changes to the facility that would allow them to increase risk to 10^{-4} threshold. There's some incentive there in the rule to make changes that reduce risk as well when you're making changes.

MEMBER APOSTOLAKIS: We can debate that a

little bit later, but the question is whether the acceptability of risk that this rule will promulgate will be different from what's in the regulatory guide that we've been using for eight years now.

MR. DINSMORE: Which brings me to the next slides which is probably the gates of Hades.

MEMBER APOSTOLAKIS: Good. Let's go to the next slides.

MR. DINSMORE: See. I have it all set up for you. Acceptance criteria, an amount by which risk increases. Proposed rule, the amount by which CDF and LERF increase is compared to the acceptance criteria in the rule that states the total increases in CDF and LERF are small and the overall risk remains small. Small is defined using the 1.174 guidelines.

The comment we got from industry was don't put the acceptance criteria in the rule and rely on Reg Guide 1.174 guidelines for controlling risk increases over time. I guess that's what you're discussing here. I'm going to read this a bit I'm afraid.

As with the previous slide, a rule requires acceptance criteria to clarify for the staff, licensees and public what will be acceptable and what will not be acceptable. I'll discuss this comment

that they had in two parts. First, the proposal that we do not put acceptance criteria in the rule. The rule relies on our risk informed framework to permit changes to the facility that would not otherwise be permitted by the deterministic regulations of being replaced. A risk informed process including acceptance criteria must be included in the rule to provide a regulatory footprint establishing alternative regulatory requirements that provide confidence that inappropriate facility changes with significant adverse risk implications are not implemented. So we really do believe you need an acceptance criteria in the rule.

The second part of the comment is to rely on Reg Guide 1.174 for controlling risk increases over time. Reg Guide 1.174 provides a framework establishing a risk informed process and provides guidance on what an acceptable increase in risk is, but Reg Guide 1.174 is always augmented by application specific guideline documents once an application that might be used in multiple sites is identifying. These application specific guidance documents define how the guidelines are to be applied to changes made over time.

In developing this 50.46(a) rule, the

Commission decided to apply the risk informed change control process to all plant changes and eventually we chose the simplest and most straightforward solution to deal with changes made over time and that is to simply apply the acceptance guidelines to all changes made at the facility after implementation of the rule.

MEMBER APOSTOLAKIS: But again, I'll come back to my earlier comment that when we were debating the 10^{-5} for CDF and 10^{-6} for delta LERF it was made very clear to us that these were referring to individual changes not the cumulative changes. And the cumulative changes in CDF and LERF were supposed to be considered by the staff and that was vague. It seems to me this is a significant change now that you have to keep to track of all the changes and make sure that they're below 10^{-5}. Maybe if you do that, then the 10^{-5} should become $5(10^{-5})$. I don't know.

MR. DINSMORE: It is a change in the scope for this application, but each of these application reg guides addresses changes made over time. I have excerpts from them all.

MEMBER APOSTOLAKIS: Addresses means what?

MR. DINSMORE: Addresses, for example --

MEMBER APOSTOLAKIS: There is a 10^{-5} limit?

MR. DINSMORE: Yes. It tells them what changes can be combined or what changes must be combined and compare it to that 10^{-5}. If you look in service testing, it says the cumulative impact of all risk informed IST program changes, initial approval plus later changes should comply with the acceptance guidelines. There's an OMN code case out which allows them to do it on their own actually. The aggregate risk impact of changes to the IST program shall be evaluated by the owner.

MEMBER APOSTOLAKIS: Now when you say "total" here, Steve, what do you mean because I can understand in the ISI for example. Yes, all these are related to a particular program and they are bundled. That's fine. But when you say "total" you mean all changes in the plant no matter whether they are related to 50.46(a) or not?

MR. DINSMORE: The "total" here means total, yes, because --

MEMBER APOSTOLAKIS: It's different though, isn't it?

MR. DINSMORE: It's a different population. We tried -- When we wrote the SECY and sent it up, the SECY said all changes that arise from this new rule. That was our population. That was

very consistent with all these other things. So then the decision was made that that's not how we're going to do it and so we actually sat down again and tried to figure out how can we define populations and it just was atrocious. It was like the tentacle search. We couldn't get anywhere and especially within the schedules.

VICE CHAIR WALLIS: So you're responding to something the Commission decided. Is that what you're doing?

MR. DINSMORE: We're adapting --

VICE CHAIR WALLIS: You said the decision was made. Who made this decision?

MR. DINSMORE: The Commission made this.

MEMBER APOSTOLAKIS: So the Commission is saying that no matter what your CDF is now all changes forever to the plant cannot exceed 10^{-5}.

MR. DINSMORE: They didn't say it that bluntly.

MEMBER APOSTOLAKIS: That's what it means.

MR. DINSMORE: No. Well, they said apply the risk -- All changes that the plant after 50.46(a) has been implemented should be risk informed.

MEMBER APOSTOLAKIS: That's very different from what you just said.

MR. DINSMORE: Well, if you didn't have any population groups, if you just said every single change you can come in on your own and every single change can be defined by the licensee to be whatever it is, has no influence on what he's changed in the past or the future, I don't think that's consistent with 1.174.

MEMBER APOSTOLAKIS: In 1.174, there was an understanding that you will not accumulate so many changes that eventually you reach the goal of 10^{-4} and I understand that. And in fact as you said, as you reach that goal and start exceeding it, it drops down by an order of magnitude. But this is different from saying that now you'll have to go to ISI, to your IST, to the tech specs and everything and find the whole delta CDF, which one, add them up and make sure that's less than 10^{-5}. I mean we keep talking about regulatory stability, but this is a major blow to risk informing the regulations, isn't it?

MR. DINSMORE: I disagree with that, but this --

MEMBER APOSTOLAKIS: You think it's a minor blow.

MR. DINSMORE: I think it simplifies it.

MEMBER APOSTOLAKIS: It changes the rule,

the rules -- the game, not the rules.

MR. DINSMORE: It changes the population of which you're applying this to. It simplifies it in that you don't have to keep track of all your little changes. All you have to keep track of is what you your total CDF is. The ones that --

MEMBER APOSTOLAKIS: Delta CDF, your delta LERF CDF.

MR. DINSMORE: Well, the total because then you can subtract the original one.

MEMBER APOSTOLAKIS: Yeah, but the idea is that you have to keep track of the total delta CDF and total delta LERF and then the way I understand the slide, is compare it to the acceptance guidelines of the regulatory guide.

MR. DINSMORE: Right.

MEMBER APOSTOLAKIS: That's a significant change from the original intent of the regulatory guide, it seems to me.

MR. RUBEN: If I could supplement slightly, the previous version that was sent up to the Commission that resulted in the SRM included these kinds of risk acceptance metrics but as Steve said, restricted just to items that were enabled. But when the Commission came back, they didn't change -- it

didn't request a change to the risk acceptance metrics. What they said was all changes should be incorporated into the risk assessment process and evaluated. So that's what we've done. And they took out a few reporting requirements and things of that nature, but this was explicitly sent up to them and the only change which related to this issue was everything should be included, not just --

VICE CHAIR WALLIS: I'm very surprised. This is making risk informed regulation tougher to do. I mean, I -- did the Commission understand what they were doing when the did this?

MEMBER APOSTOLAKIS: Maybe it's a matter of interpreting their words and I'd like to see the SMR. Do we have it, Eric? We'll get it. Because this is pretty -- in my mind, it's a significant change.

MR. TSCHILTZ: Well, I think, this is Mike Tschiltz.

MEMBER SIEBER: On the other hand, it offers an advantage, you know.

MEMBER APOSTOLAKIS: What advantage is that?

MEMBER SIEBER: Every once in awhile you've got to do some good things that improve your

CDF and that allows you to do some of these other things.

VICE CHAIR WALLIS: Maybe that was the idea.

VICE CHAIR WALLIS: But it seems to me we can't do these things on the fly.

VICE CHAIR WALLIS: Maybe that was the idea that you can decrease the CDF which then lets you increase it somewhere else. That makes some sense.

MR. TSCHILTZ: Yes, you know, that was part of our thinking, to incentivize safety improvements at the plant, not just allow facilities to parse their changes to allow acceptable increases in risk all the way up to the CDF guidelines in 1174. Also the other thing, I think, that was part of the Commission's thinking was that 50.46A is a voluntary rule and the price of entering into this realm is that you basically risk inform the operations at your facility and you risk inform the changes that you make so you're entering into a new regime here for the way you run and operate your plant.

MEMBER APOSTOLAKIS: Well, I mean, Dr. Wallis complained at the beginning that you guys focus too much on process and I am focusing on process now. Regulatory Guide 1.174 has been revised once. It

seems to me that if we want to make such a major change, we should revise it again and have a debate on that and not do it as, you know, as a minor detail when we are revising something else, risk informing something else because that's where it belongs. It belongs to the fundamental framework of risk informing the regulations. And 1.174 has been the major guide that has set that framework. So I don't know that this is -- and I'd like to see the Commission's SRM to see whether they meant something else. Maybe it's a matter of interpretation of what they meant and this is one interpretation. Or maybe, as Graham said, the Commission did not fully realize what they were requesting.

CHAIR SHACK: To move on here, George, you know, I think we've identified the issue and, you know, we can debate the issue but this is what the rule now says.

MEMBER APOSTOLAKIS: I'm objecting to it.

CHAIR SHACK: Yes, right.

MEMBER APOSTOLAKIS: It was clear.

CHAIR SHACK: That didn't require clarification, right.

MR. TSCHILTZ: Just one point --

MEMBER APOSTOLAKIS: And I appreciate what

you're saying. I mean, there is value to what you're saying but I just don't think that this is the way it should be done.

MR. TSCHILTZ: One comment on this though, that the industry in our public meetings on this issue doesn't find this to be an unacceptable approach to them. There's been no feedback that this is unacceptable in any way according to the industry and then --

CHAIR SHACK: Well, they want a total CDF, I heard a different story.

MR. DINSMORE: Well, they want a total but when they --

CHAIR SHACK: Well, and if a total is 10^{-4} that's a big difference between limiting my increase to 10^{-5}.

MR. DINSMORE: They wanted to report the total but --

CHAIR SHACK: We didn't get any comments that --

MR. DINSMORE: As Mike said, during the discussions in all the meetings the industry didn't have a heartache with this. I think they think that if --

CHAIR SHACK: You think they understand

it, right?

MR. DINSMORE: I'm sure at least some of them do. The bundling was very popular and if you keep your bundling and then the change is made to it and --

VICE CHAIR WALLIS: Well, I'm with George. When you risk inform regulations, you ought to know what risk informing means and you ought to meet certain standards. If one of them is RG 1.174, you need to know what that is. You can't interpret it differently when you start risk informing different regulations.

MEMBER APOSTOLAKIS: It makes a big difference in the acceptability because if you keep track of the total CDF, that goes on the horizontal axis of the diagram, right? So for each change, you still have the 10^{-4}, $^{-5}$ but you move a little bit to the right, which really doesn't make any difference because it's a flat line. Only when you exceed the 10^{-4} it makes a difference. However, in your interpretation, it's very different now, because I have a CDF here but now the total delta CDF has to be below 10^{-5}, which is a hell of a difference.

VICE CHAIR WALLIS: Well, you have a curve instead of a --

MEMBER APOSTOLAKIS: I think the industry want a total CDF, because they know you move a little bit to the right but a little doesn't make any difference.

MR. DINSMORE: But they didn't object strenuously to this.

MEMBER APOSTOLAKIS: Well, then we object, I object.

CHAIR SHACK: We'll hear from industry. We can find out whether they object. Let's move on.

MEMBER APOSTOLAKIS: Well, that's not a criterion anyway.

CHAIR SHACK: No, it's not. We're just looking for information, George. We're gathering information. We've gathered some, we're going to gather now.

MEMBER APOSTOLAKIS: Hopefully, we'll speak with sufficient clarity and volume.

MR. DINSMORE: We've got a couple big ones. Maybe I'll go through this one real quick unless there's a lot of interest. This just as to do with -- this just has to do with the different reporting requirements. Originally, in the proposed rule, they should report if there is a significant reduction in the capability and what it's changed to

now is if they exceed this 10^{-5} on total cumulative, they have to report steps in the schedule to bring the facility back into compliance and this essentially gives us the information that we need when we need it, which is if the criteria is exceeded, what are you going to do?

So I'll go fast. This is the last one.

MEMBER APOSTOLAKIS: But again, there is another comment that I want to make here. We spend all this time talking about quantitative part and the periodic updates and so on. However, in the rule itself, there is a major way out of this when I says to the extent that risk assessment methods other than PRAs are used to develop quantitative or qualitative estimates of changes to CDF and LERF in the risk involved, a licensee shall justify the other methods.

So I don't understand how risk assessment methods other than PRAs are used to develop quantitative estimates.

MR. DINSMORE: Well, they could take seismic margins analysis and use that factors to --

MEMBER APOSTOLAKIS: It's not part of the PRA, or qualitative estimates of changes, how can you have a qualitative estimate of delta CDF?

MR. DINSMORE: Negligible.

MEMBER APOSTOLAKIS: Negligible?

VICE CHAIR WALLIS: Less than what?

MR. DINSMORE: Well, if you made a change and you calculated these things and it was, I don't know five 10^{-8} and then they the guy said, "Well, your radiation monitor on the wall might break", is that -- it's going to have a negligible -- I mean, we've seen these. I can't think of one off the top of my head, but we've --

MEMBER APOSTOLAKIS: So PRA then here means specifically --

MR. DINSMORE: fault trees and event trees.

MEMBER APOSTOLAKIS: And when you do margins you don't look at fault trees and even trees? You do, right?

MR. DINSMORE: We have a success path.

MEMBER APOSTOLAKIS: I don't know. I think this business of referring to qualitative estimates of --

MR. DINSMORE: We can try and go back to the ISME standard and see if there's any way to --

MEMBER APOSTOLAKIS: Okay.

MR. TSCHILTZ: I think part of the issue there was that if this would also incentivize

licensees who didn't have a full scope PRA because their qualitative assessments would need to be bounding and bounding and conservative and they would be losing the benefit by not having a full scope PRA that was in accordance with the standard that let them more accurately quantify these risks.

MEMBER APOSTOLAKIS: But the -- I mean, as you know, there has always been a debate about whether you should really reap the benefits of risk informed regulations without a good risk analysis. And I know that Commissioner McGaffigan has said that a good PRA is the price you have to pay to be risk informed and get all the benefits.

MR. TSCHILTZ: And I think this follows along with that philosophy because you're basically going to be penalized by your conservative analysis in there without a full scope PRA.

MEMBER APOSTOLAKIS: No, when you have a conservative analysis, I appreciate that but when you say that some licensees don't have a full scope PRA or they are excluding external events and so on and we still want them to have the benefits, I'm having a problem with that. Why don't they have a good Level 1 PRA? They should. If they want to enter this pace, they should. I mean, we were using these arguments in

1997 and '8 when we were --

CHAIR SHACK: George, we're running late. Let's move on.

MEMBER APOSTOLAKIS: Well, but it's important. I mean, we can't just --

MR. RUBEN: I would just note, the staff certainly agrees with you. The issue that Mr. Dinsmore was mentioning comes into effect where they're Perry bottle goes beyond Level 1 in a complete sense. There are non-quantitative methods that are in the various ASPI standards or draft standards that allow margins for bounding approaches. Whether those are acceptable for an individual application to us is something that we have to judge on a case-by-case basis in the application. But for example, most people use seismic margins and you just have to identify a couple success paths for safe shutdown.

And so you don't have a quantification out of that but you can make some bounding claims through the Kennedy method that we've been applying for a number of times. I think we've mentioned it to you. We can back calculate in an approximate seismic risk contribution. But the uncertainties are very different and the same is true for fire for people who use the fire analysis. It's usually a very

conservative evaluation. I mean, you just add all the numbers together, you get -- you can get a misleading perspective but the methods are allowed in the baseline risk -- excuse me, risk standards.

MR. DINSMORE: Okay, go.

CHAIR SHACK: Go.

MR. DINSMORE: The last issue is operating restriction when in a configuration not demonstrated to meet the ECCS criteria, ease of acceptance criteria for breaks bigger than TBS. And let me take a quick minute and explain that one. PWRs will most likely be permitted to raise power because of the smaller design basis LOCA. Because single failure criteria and the simultaneous loss of offsite power are not required for breaks greater than TBS, it is likely that some facilities may credit both LPCI trains to demonstrate mitigation of the largest breaks.

The question immediately arises is, what do we do about operation when for example, one of the LPCI trains is out for maintenance? Assuming that no other non-safety-related equipment can be used as a LPCI, when one LPCI train is out, that facility would be operating in a configuration not demonstrated to meet the ECCS acceptance criteria. Did I explain that well enough?

MEMBER CORRADINI: For breaks greater than TBS.

MR. DINSMORE: For breaks greater than TBS, right.

MEMBER BANERJEE: That was a public comment?

MR. DINSMORE: Well, okay, the proposed rule prohibited operation of this configuration, said you couldn't do it. If you take -- if you need both LPCI pumps, if you need both LPCI pumps, you take one out for maintenance, you either have to put other equipment that can deal with it or you could reduce your power.

VICE CHAIR WALLIS: But generally, you have to operate at the lower power.

MR. DINSMORE: You'd have to operate, so that was the proposed rule.

VICE CHAIR WALLIS: You mean, you have to shut down or you have to operate at lower power?

MR. DINSMORE: Lower power.

VICE CHAIR WALLIS: You go back to your per-power uprate.

MR. DINSMORE: You'd have to go back to you could demonstrate that you could mitigate them.

VICE CHAIR WALLIS: Okay.

MR. DINSMORE: So the public comments, restriction was not commensurate with safety significance of the configuration and could increase risk by reducing permitted on-line maintenance.

MEMBER BANERJEE: Where did this comment come from?

MR. DINSMORE: Pretty much everybody. This was one of the show stopper comments, one of the three.

VICE CHAIR WALLIS: So how bad can this configuration be? Can you take out both pumps?

MR. DINSMORE: Well, you couldn't take out both pumps because you would violate your less than TBS tech specs and you couldn't take one out -- one pump out indefinitely because you would violate your -- but you could definitely get into this situation.

Now the final rule at this point in time is different than from the one which is on the web. The one on the web says, operation of this configuration not to exceed seven days. The one that we got this week or that we developed recently is operation in this configuration not to exceed 14 days per year. Now we chose 14 days because it's consistent with related guidelines on initiating event frequencies. It's sufficiently long to allow most

maintenance activities at a longer period of time would not be consistent with maintaining the capability to successfully mitigate the full spectrum of LOCAs.

And on the next slide is the guidelines that are similar but no perfect. No guidance directly addressing the system exists but some related does exist. Reg Guide 1.177 approach -- which we use essentially to develop risk informed allowed outage times.

MEMBER APOSTOLAKIS: Water?

MR. DINSMORE: I've got some, thank you. This reg guide has an acceptance criteria for integrated conditional core damage probability less than five times E^{-7}. If you had a $1E^{-5}$ per year frequency, for a LOCA that has no mitigation, you can meet that ICCDP if you had an AOT of 18 days. The SRP Chapter 221 and 222 identify design basis events that need to be mitigated as those events with a frequency greater than 10^{-7} per year. Now if you had a one time 10^{-5} per year frequency event that could exist for four days during the one-year period before exceeding an annual frequency of $1E^{-7}$.

Now, again these guidelines do not directly address our situation. During the allowed

outage time developed under Reg Guide 1.177, all design basis events can still be mitigated unless other independent failures occur. During operation I this configuration, however, mitigation is lost without any additional failures.

The 10^{-7} per year guideline in the SRP was developed to identify external events to the plant that need not be included in the design basis. So after a fair amount of discussion, we selected the time interval consistent with the AOT interval that's 14 days, which is consistent with 18, because configuration is temporary as it is during AOTs, but included the SRPs per year constraint because there is not available mitigative capability which is not permitted by the AOT extension but which is permitted by the SRP.

MEMBER MAYNARD: Can I understand the 14 days per year, that's cumulative 14 days per year?

MR. DINSMORE: Yes, sir.

MEMBER MAYNARD: Okay, what happens if you exceed that? Do you shut down for the rest of the year or how do you reset that?

MR. DINSMORE: No, you'd have to either avoid further maintenance that might put you in that situation or reduce power to where you can demonstrate

or there would be several options.

MEMBER APOSTOLAKIS: If I do nothing, if I don't request any change to my plant and this rule now goes into the books, would there be any configurations that violate the ECCS acceptance criteria?

MR. DINSMORE: Probably not because you'd be able to meet them unless you make changes to --

MEMBER APOSTOLAKIS: The whole idea of the current rule is that it's a bounding rule, either there are no configurations or --

MR. DINSMORE: Well, this only kicks in if you're in a position, an unanalyzed condition where you --

MEMBER APOSTOLAKIS: Or if you request a change that leads to some sequences violating the criteria but they're of low frequency. You still don't want to be in those configurations? Let's say I request something. Can I still request a removal of equipment? I remember that was prohibited in the earlier version.

MR. DINSMORE: It's not prohibited by the rule.

MEMBER APOSTOLAKIS: It's not prohibited now. So let's say I remove something and my risk

criteria are met, acceptance guidelines are met, everything is met. But now there are some configuration -- some sequences, some configurations where I violate the deterministic criteria. Then I could be in one of those for up to 14 days; is that what it is? Intentionally, because some of these are also unintentional. They involve random failure, right? I can't do much about them.

MR. DINSMORE: Yes, intentionally --

MEMBER APOSTOLAKIS: So intentionally, I can be in one of those for up to 14 days.

MR. DINSMORE: Those being that you took something else so you can't --

MEMBER APOSTOLAKIS: Yeah.

MR. DINSMORE: Yes.

MR. TSCHILTZ: Let me just clarify that and that is, say for example, you uprated power so for a large break LOCA you need both LPCI trains to mitigate and your existing tech specs are less than the TBS allowed you to take one pump out for three days, that would govern your outage of the LPCI pump. You would allow -- you'd be allowed to keep that pump out of service for three days and by existing tech specs you would then have to shut down after that.

So in many cases, I think existing tech

specs will govern. For equipment that's not safety-related equipment and equipment that's not in the tech specs this will govern over that equipment and we received a lot of public comment about well, if we're going to credit -- licensees are going to take credit for non-safety related equipment, they don't want to have to put it in the tech specs.

So this was a way to provide an accounting for the availability of that type of equipment that was being credited to mitigate the greater than TBS but not necessarily in tech specs. So it covers both that equipment not in tech specs and tech specs.

MEMBER APOSTOLAKIS: If I -- I mean, it's interesting that now we don't require -- now we allow the removal of equipment at least in principle.

MR. DINSMORE: There might be a caveat in there about the security.

MEMBER APOSTOLAKIS: Right, but if I were to remove something would the requirement of maintaining the defense in depth philosophy say no, don't do that?

MR. DINSMORE: It might if you could --

MEMBER APOSTOLAKIS: But it's not clear that it would always do.

MR. TSCHILTZ: Well, this -- I think this

situation, the Commission told us to, I think, balance the unavailability of this equipment with its safety significance, so this was our attempt to do this, to realize that this was a fairly low frequency event and that there needed to be some balancing to allow for other activities at the plant that would put them in a configuration where they may not be able to mitigate for short periods of time this very unlikely event.

So if you were to strictly follow defense in-depth principle, during that short period of time there is not defense in-depth.

MR. RUBEN: The one thing -- Mark Ruben again, the one point I would add is that it's not necessarily the result of any break into the TBS zone that you would not mitigate. Say your TBS is 11 inches, 12 inches, with the power uprate and assuming a double edge guillotine break, the success criteria may be two LPCI pumps. That's an offset break. If you look at a 14 or 15-inch break or equivalent break area, you could very well still have mitigation success but we're only calculating it at the TBS and at the bounding limit. So somewhere you cross the line, we don't know where.

VICE CHAIR WALLIS: How about maintenance? You have two accumulators. You need them for the very

big breaks, don't you, the accumulator is a large break LOCA. Suppose that the valves and things deteriorate so that they don't function so well. Is there any obligation to fix them up if you're still sort of probabilistically are doing well enough on the large breaks with them in their bad state?

MR. DINSMORE: Well, you have to be able to mitigate up to the double ended guillotine with everything working.

VICE CHAIR WALLIS: Mitigate though but less stringently with less probability, right?

MR. DINSMORE: Well, if you needed both of them and one of them keeps failing, you'd run into this 14 days after awhile.

VICE CHAIR WALLIS: But you see what I'm getting at. I mean, they could deteriorate to the point where you meet the new criteria but you don't meet the old ones.

MR. TSCHILTZ: The criteria you're referring to is that you --

VICE CHAIR WALLIS: The new ones that are going to be in the reg guide.

MR. TSCHILTZ: The reg analysis and the not having to withstand single failure --

VICE CHAIR WALLIS: Right, all that sort

of thing, right.

MR. DINSMORE: -- and crediting safety, from that perspective yes.

VICE CHAIR WALLIS: All right, and you don't need them. Maybe you only need one accumulator. I don't know but -- so you could just let one deteriorate to the point where it doesn't work.

MR. DINSMORE: Or take it out of tech specs or -- Ralph, I think has done some analysis to look at this.

MEMBER CORRADINI: I mean, that's what I read it to be the case. I guess that's the way -- unless I misunderstood your whole discussion, there could be a whole raft of things that just kind of are unnecessary. They just start appendages that start frittering away.

MR. DINSMORE: As long as it satisfies the criteria in the rule, they can do it.

MR. TSCHILTZ: Just realistically, from the standpoint of the fact that this is an issue that's going to be periodically reviewed by the staff and the back-fit rule doesn't apply and if there's information that would change the determination of the TBS, I think there's an incentive for licensees not to rip out equipment. There may be incentives to take it

out of tech specs but not to take it out of a facility, not have as stringent of surveillance requirements on it. At least that -- from the discussions that we've had with the industry on it, that would be the type of things that they are looking for is not have such stringent surveillance tests, maybe not have it specifically in tech specs but the equipment would still be left at the facility.

MEMBER APOSTOLAKIS: So one would then -- one could use 50.69 to do this, use some -- let's say I have now a piece of equipment that is safety related and has all the special treatment requirements imposed on it, then I can come to you and request that these be moved to risk category 3 in the 50.69 thing using importance measures and all that because this rule allows me to do that?

MR. DINSMORE: I don't think there's much of a connection. I mean, this rule would allow you --

MEMBER APOSTOLAKIS: Why not? I'm going to change the status form safety related --

MR. DINSMORE: Well this wouldn't -- okay.

MEMBER APOSTOLAKIS: Then I'm invoking the other rule now.

CHAIR SHACK: I mean, this would be safety related but not safety significant if it was

only needed for a large break LOCA.

VICE CHAIR WALLIS: Right, right.

MEMBER APOSTOLAKIS: This rule allows me to do that in principle but now how to do it, I'll have to go to 50.69 and I take the importance measures and show that it's not risk significant even though it is now safety related so it goes from Risk 1 to Risk 3. And I remove some of the special treatment requirements. Is that a conceivable --

MR. DINSMORE: If you could make something non-safety related because of this rule, then it would be --

MEMBER APOSTOLAKIS: This rule just allows me to do it. It doesn't say how to do it.

MR. DINSMORE: Yeah.

MEMBER APOSTOLAKIS: So then I would go to another rule that tells me how to do it.

MR. DINSMORE: Right, we haven't considered avalanching.

MEMBER APOSTOLAKIS: You haven't what?

MR. DINSMORE: We've considered tentacles but not that avalanching effect.

MEMBER BANERJEE: Will this rule you're proposing to apply to the advanced reactors that are coming in as well?

MEMBER APOSTOLAKIS: That's coming up.

CHAIR SHACK: Yeah, we're going to have to move on. We're running out of our margin here.

VICE CHAIR WALLIS: Will it allow you to have less water --

MEMBER APOSTOLAKIS: Will we have any redundancy left?

VICE CHAIR WALLIS: Will it allow you to have less water available for cooling the core because you don't need to pour it in. It goes out the large break. Will it enable you to have a smaller IRWST tank and things like that? You don't need them any more because you're so big. Would it enable you to do that, have less water available?

MEMBER BANERJEE: Yeah, it has also implications for AP 1000 and --

MR. TSCHILTZ: You still need to be able to mitigate the large break LOCA.

VICE CHAIR WALLIS: Only with a lower probability and without all these other things going wrong.

MR. TSCHILTZ: From a practical sense, I don't know why anybody would change the size of the tank. They'd have to replace it with another tank that would have to supply water to a large break LOCA.

VICE CHAIR WALLIS: Well, I'm just sort of saying you might put -- keep less water in there.

MEMBER BANERJEE: It was sort of on the border for the large break LOCA the IRWST system for the AP1000.

CHAIR SHACK: We'll take a break now for 10 minutes since we're running kind of tight here.

(Whereupon, a recess was taken at 11:03 a.m.)

CHAIR SHACK: We're back into session. We're running low on time here.

MR. DUDLEY: Okay, again, I'm Richard Dudley. I work in the Division of Policy and Rulemaking. Briefly I'd like to discuss the applicability of 50.46A to future reactors. The proposed rule and as -- which the Committee saw, did not apply, did not allow 50.46A to be applied to future reactors. It was limited to existing BWRs and PWRs because these were the reactors from which the expert elicitation curves were developed and these were the reactors that we fully understood how 50.46A would impact them.

The Commission, however, gave us direction to solicit public comments on whether this proposed rule should be applicable to future reactors and we

did that. We put that in the Federal Register as one of the specific questions on which we were soliciting public feedback. And as you might -- well, as you know now, industry commentators came back unanimously in favor of applying 50.46A to future light water reactors that are similar to current light water reactors.

In reviewing the industry comment, we looked at some future designs, AP100, USEPR, ESBWR and we looked at them and thought, well, they might potentially be similar and there might be ways that you could apply 50.46A to these future designs in a manner that's consistent to how it would be or will be applied to existing BWRs and PWRs.

MEMBER ARMIJO: Just a question. You didn't mention ABWRs. Are they included as future?

MR. DUDLEY: I really couldn't answer that. Are they certified? ABWRs are certified?

MEMBER ARMIJO: Yes, it's a certified.

MR. DUDLEY: The problem with a certified design is that you can't change it and if an ABWR wanted to come back in and change for recertification or something like that, I would think they would certainly have the same flexibility as these other facilities. AP 1000 also, I believe, is certified.

MEMBER CORRADINI: Certified meaning by a current rule? I don't understand what the certification change is into all of this.

MR. DUDLEY: Design certification has been issued and it was done as a rulemaking so that design is approved but frozen as a basis of that rulemaking. So they can't really change those designs without going back into a rulemaking or a licensing process.

VICE CHAIR WALLIS: Can we get back to the question of water. It appears that if you relax these requirements for large breaks you might not need so much water. Now, AP 1000 is vulnerable to some seismic considerations because of the huge water tank that it has on its roof. And if they don't need so much water, they don't need so much water up there. They can change a lot of things about the whole design which would make it more attractive or more -- withstand seismic better. It has those sorts of effects, doesn't it?

MR. DUDLEY: There are significant effects. The tentacles of this sort of a decision are widespread. We're not here today to tell you that it -- that AP 1000, USEPR, ESBWR are similar. All we're saying is that they are potentially similar and --

VICE CHAIR WALLIS: And you're going to

let them use a TBS.

MR. DUDLEY: No.

VICE CHAIR WALLIS: You're not?

MR. DUDLEY: No, what we're going to do is we're going to allow in the final rule licensees who believe they are similar to come in with an application and explain to us in great detail why they're similar, what aspects are similar and on what basis they think they are similar. And we're also going to allow those licensees in the final rule to propose a TBS for their design that would result in a similar effect as the current design specific TBS' that have been specified in 50.46A for PWRs and BWRs which are different. So we're going to allow licensees to make their case and propose their TBS.

The rule does not say that that means they can apply it. It means that if the NRC agrees that they are similar after completing a design specific review, of their basis for why they're similar and if the staff agrees with their proposed TBS --

VICE CHAIR WALLIS: Well, you don't know the criteria for a status in the TBS already. How can you apply it to something else. I mean, the whole sort of -- they're only similar on the basis of the expert elicitation? Is that the basis? What else is

there to justify it?

MR. DUDLEY: We -- again, licensees come in, they make their case. The staff has to approve number one, that the concept is indeed similar, and number two that the TBS that they propose is --

VICE CHAIR WALLIS: Yeah, it's obviously similar.

MR. DUDLEY: We have developed --

VICE CHAIR WALLIS: I mean, if they have expert elicitation, it looks like the same kind of piping, they're probably going to get approval.

MR. DUDLEY: Right. Well, we've developed some general similarity characteristics. And these are the ones that we've looked at. We're going to have to -- licensees will have to make a case why -- that LOCA frequency versus pipe size for their facility is similar to or bounded by the curves in the export elicitation. Licensees should probably give us -- similarity would depend on the overall piping configuration. Maybe some piping configurations are such with maybe say a manifold and a lot of small pipes, maybe a single pipe rupture is not -- would not be a similar application.

Maybe you need to look at the rupture of the manifold and maybe you get no credit because since

the manifold could rupture, that's your double ended guillotine break. We could conclude on the basis of piping configuration that the facility design, a new reactor design was not similar.

We also need to look at core --

VICE CHAIR WALLIS: Let's go back to this -- I'm sorry, but this LOCA frequency is based on piping configuration, isn't it? If the pipe is longer, it has a higher frequency of failure; is that right?

MR. DUDLEY: Well, I believe Rob Tragoning has looked at those things. I believe that length of the pipe is not so important. It has to do more with numbers of elbows and numbers of welds.

VICE CHAIR WALLIS: Oh, places where it's more likely to break?

MR. DUDLEY: Yeah, so, you know, those will all be issues that are looked at. And it won't be a decision made by any single individual. There will be a multi-disciplinary review team put together with systems folks and engineering folks and chemistry and --

VICE CHAIR WALLIS: Now, the third bullet is very interesting because I haven't really seen that applied to the present rule at all.

MR. DUDLEY: Well, what we're --

VICE CHAIR WALLIS: Why should you apply it to new reactors?

MR. DUDLEY: What we're worried about is that a licensee could come in with a new design and design their facility with a containment that's not large, robust and substantial as the containments that we're comfortable with now. And those large, robust containments give us significant margins for protection against severe accident and we would look very -- with great concern over a new facility design that came in with an insubstantial containment that would not give good protection and margins against severe accidents.

And we might not -- again, that might be another criterion we would use to determine that they were dissimilar or not similar and wouldn't be allowed to use 50.46A.

CHAIR SHACK: You need to move on.

MEMBER CORRADINI: Bill, one more question.

CHAIR SHACK: Okay.

MEMBER CORRADINI: I guess I'm confused because the containments are not -- unless I might be wrong about this, so you correct me, but containments

are not designed off of for severe accidents. They may have been invented for that but all their criteria for performability are essentially LOCA based.

MR. DUDLEY: LOCA, steam line break, other design basis accidents.

MEMBER CORRADINI: Okay, and what I guess I'm trying to unravel here is that so you're going to look at things beyond the design base to determine if these geometries are -- or these new plants are such that you can consider them similar?

MR. DUDLEY: These are the factors that we've been able to develop in a short period of time. It may be when we're doing this multi-disciplinary design specific review we uncover a new factor that is also important and has a bearing on the decision. We would not be constrained by the rule to applying any group of factors. We can use whatever factors, significant criteria we think we need to make this determination.

MEMBER CORRADINI: Can I just follow up with one other thing?

MR. DUDLEY: Yes.

MEMBER CORRADINI: The reason I asked it back to the ECCS is because I'm just thinking out loud and I could be wrong about this; if I had a power

uprate and it had more -- no, never mind, I've answered my own question. Thank you.

MR. DUDLEY: Okay, and as we -- as we gain experience with this sort of thing, we'll have better guidance and as soon as we get -- we will include guidance to the extent that we can in the regulatory guide, but we have to recognize that for reactors that you haven't seen, you can't -- there is a real limit to the accuracy of the criteria that we can develop now and that we may have to very much rely on criteria that we determine as a result of looking at the new design.

MEMBER BANERJEE: I guess the most useful thing about this rule would be -- one useful thing certainly that they could -- if they knew it would apply, design to meet the rule and get a lot of margin out of it, credit out of it, you can see how this could be applied to the new designs, if they knew it would be applied.

MR. DUDLEY: A vendor or a licensee starting with a clean sheet of paper has the maximum flexibility. They can make the maximum amount of changes from adopting 50.46A. Yet the staff's basis for approving the existing 50.46A is that some of the changes that licensees can make are limited by other

factors. So we would not think that a new licensee could come in with a blank sheet of paper and just run wild with this thing and make tremendously different changes. The --

MEMBER BANERJEE: But the major benefits of this could come with the new generators of reactors.

MEMBER APOSTOLAKIS: I mean, the whole thing here rests on 1.174 and I don't see how that could be applied to a new reactor. They would really have to do something else, because all the changes, I mean, you're asking them to keep track of the changes and compare them to guidelines that --

VICE CHAIR WALLIS: No, George, they would apply to the design of the ECCS itself.

CHAIR SHACK: Risk informed changes.

MR. DUDLEY: The risk informed acceptance criteria.

MEMBER BANERJEE: For example, for the AP 1000, it could significantly impact the IRWST system, how it's set up.

MEMBER CORRADINI: But I think what George is saying though is true. Now, they've invented a third category of accidents that's not a design base. It's not a severe accident. And it's essentially

controlled by both a design basis-like set of calculations and a risk calculation that's differential. And you have nothing to differentiate against.

MEMBER APOSTOLAKIS: That's right, for the new design, you don't have a base line.

MEMBER MAYNARD: But you do have a baseline for certified design. Don't you have a baseline for the certified designs? They may not be the --

MEMBER APOSTOLAKIS: The ones that have already been certified, you do but even that is not a complete PRA because a lot of things are missing.

MEMBER MAYNARD: Okay, but it is a complete sheet of paper.

MEMBER SIEBER: There's a lot of things you don't know yet.

MEMBER APOSTOLAKIS: Yeah, exactly. That's why they're missing, yeah, until you go to the COL stage and so on. So I think it will take a little more thinking how to apply this to a new design because the rule right now refers to existing LWRs that have been licensed. We have estimates of the CDF and we are changing things and compare it with acceptability limits and so on. But for a new design,

you don't have any of that.

MR. DUDLEY: You make a good comment in that the risk acceptance criteria in the existing rule based on current reactors and if new reactors are much safer, we would probably need different risk acceptance criteria, would we not?

MEMBER APOSTOLAKIS: Also -- I'm sorry.

CHAIR SHACK: Let's move on.

MR. DUDLEY: It seems to me that we might -- that's a good comment. Okay.

MEMBER APOSTOLAKIS: Finally, you got a good comment.

MR. DUDLEY: Gary Hammer is going to talk about the BWR transition break sense.

MEMBER APOSTOLAKIS: So this is the part of the agenda that was supposed to be done an hour ago.

CHAIR SHACK: Yes, yes.

MR. HAMMER: Good morning, I'm Gary Hammer. We've been working on the TBS selection over the last couple of years and we developed several criteria that we wanted to use in order to make a conservative selection. There was some discussion earlier about the TBS becoming a design basis limit and that's an important consideration because if

you're doing that, then you do want this to be a conservative limit because everything below that is within the design basis and like setting all other design basis limits, you want to consider uncertainties and things like that.

But we started with the expert elicitation estimates as a starting point at the 10^{-5} per reactor year frequency and I think we made adjustments to account for uncertainties and sensitivities within the elicitation itself. There were uncertainties that the elicitation panel estimated for their own estimates and then there were sensitivities in how you aggregate that data and we've had discussion with you fellows before on some of those things.

VICE CHAIR WALLIS: This 10^{-5} came from the Commission, didn't it?

MR. HAMMER: Yes.

VICE CHAIR WALLIS: Thank you.

MR. HAMMER: That was guidance from the Commission. And then we --

MEMBER APOSTOLAKIS: Actually did the Commission ever say whether this was intended to be a mean value or they just gave you a value?

MR. HAMMER: I can't exactly remember.

MEMBER KRESS: It was a mean value.

MR. HAMMER: I think we did start with a mean value and then we looked at -- because we had estimates for means and we have estimates for 95th and all of those numbers.

MEMBER APOSTOLAKIS: But the ranges that you called later really come from the fact that you look at the mean and the 95th percentile and say this is a range.

MR. HAMMER: Right.

MEMBER APOSTOLAKIS: I'm not sure that the Commission intended this to be 95th percentile, but I don't remember what it was.

MR. HAMMER: Like I said, the TBS becomes a design basis limit. So that's the way we looked at it was that we would consider significant uncertainties and other things. On the third bullet, there were other things that we also wanted to consider, failure of mechanisms that the elicitation did not or could not specifically consider such as seismic loads, heavy load drops, other things that tended to be plant specific, even things like active LOCAs like stuck-open valves and things like that where you could get significant types of LOCAs.

Then we wanted to look at what are the actual configurations in the plants. You know you

have these pipes that are very big pipes in the main coolant LOOP and then you have smaller pipes attached to those. Is there some logical demarcation that we should consider with regard to that? Thinking about the possibility what if you completely fail a pipe, what does that represent and what does that look like?

Then we wanted to ultimately come up with something that we felt like had regulatory stability because the rule as it's proposed has in it a built in mechanism where the NRC could change the TBS after being reevaluated and we could impose that without going through the backfit process in order to make licensees adjust to the new TBS. So rather than go through that process and have some iterative thing where, no, we set it too high, no, we set it too low, and so to speak make an unstable choice, we would rather make something that was more conservative to add some stability.

Okay. This is specifically about the elicitation, a little more information about that. When you consider the 95th percentile which we wanted to do to address some uncertainty in the estimates and then look at the different sensitivities in the way the data is aggregated, for BWRs you come up with approximately a range of numbers from 13 inches to 20

inches in diameter. That would be a circular opening equivalent and that considers like I said the 95th percentile and then we looked at the geometric and arithmetic --

VICE CHAIR WALLIS: Can I ask you about that? I mean it may be reasonable that the attached pipe will break but it's probably unreasonable on the same basis to assume a 20 inch break in a main pipe. It would be a different phenomenon, isn't it?

MR. HAMMER: But the estimates, Graham, were a composite of all of these things.

VICE CHAIR WALLIS: Right.

MR. HAMMER: And so without further parsing it --

VICE CHAIR WALLIS: They still have to consider this partial break of the main pipe?

MR. HAMMER: Yes.

VICE CHAIR WALLIS: Because you might go further and say the main pipe doesn't break at all but you have to consider these attached pipes breaking.

MR. HAMMER: Right. Yes, we -- Your point is well taken. Wells are typically circumferentially oriented. So in order to get a break of this size --

VICE CHAIR WALLIS: You break a whole pipe.

MR. HAMMER: You would most likely break it all the way around circumferentially and get that kind of a break. So that was the reason why we wanted to focus on the attached pipes. But the elicitation estimates were also inclusive of these partial breaks that you're talking about. So all that's mixed in and it's kind of hard to separate.

MEMBER ARMIJO: In this elicitation, what was a dominant mechanism that would cause these failures? What did they use as the mechanism that would trigger these failures?

MR. HAMMER: I see Rob has stepped to the microphone. He's the expert.

MR. TRAGONING: Yes. Rob Tragoning from Office of Research. A couple of pieces of clarification.

MEMBER APOSTOLAKIS: We can't see you, Rob. Can you move a little bit?

MR. TRAGONING: That's a function of the microphone. I could have sat there, but I figured it was safer behind everyone.

(Laughter.)

MR. TRAGONING: To clarify Professor Wallis' comment about the partial breaks, again when we did the elicitation it was primarily based on flow

rate. You could have a full circumferential break of a large reactor pipe and give you the equivalent flow rate of a 20 inch double ended guillotine type break. It would depend on how the pipes would separate and the configuration and things like that. So when we say partial it's good to keep in mind that we're really saying partial with respect to being a double ended guillotine break which is the worst possible scenario for any given size piping.

And the second question to pick up over here --

CHAIR SHACK: Didn't the elicitation also conclude that, say, a six inch diameter break was more likely to come from the failure of a six inch pipe than is a six inch partial break in a 20 inch pipe?

MR. TRAGONING: In general, except for BWRs where there was concern with BWRs with a lot of the main LOOP piping where that piping had not been replaced and even though there had been mitigation measures that had been applied that the panel universally recognized as being generally effective, they still believed that even though they were effective one of the major risk drivers for the BWR frequency estimates were partial failures of the main recirculation LOOP piping. However for PWRs and then

smaller BWR breaks, that general rule of thumb or it's more likely to have a complete break of a smaller line than a partial break of a bigger line held true and that that was usually the biggest risk contributor.

MEMBER ARMIJO: That doesn't answer my question. My question --

MR. TRAGONING: I know. That was meant to address Professor Wallis' question. So let me try to address your question next in terms of what failure mechanisms we looked at. We really -- I would argue we looked at a whole suite of failure mechanisms in that when we identified what we would be looking at we identified through the various experts what were all possible degradation mechanisms. Now these were mechanisms that had been explicitly seen in operating experience and some which had not been seen in the operating experience but some of the experts felt based on the materials, the conditions, the operating parameters, that they were at least possible. So some of the mechanisms just to list a few and we looked certainty at intergranular stress corrosion cracking, thermal fatigue, flow accelerator corrosion, PWSCC, regular vibratory fatigue, typical overload mechanisms which is a standard failure just due to again a water hammer type of event and fabrication defects, weld

repair defects, all those types of things that can induce and that we have seen in the past have led at least to failure precursors if not actual failures in the past.

MEMBER ARMIJO: My question was what was the dominant mechanism. Was there a dominant mechanism?

MR. TRAGONING: For Bs or for Ps?

MEMBER ARMIJO: We're talking about Bs.

MR. TRAGONING: For Bs, the two dominant mechanism were that largely came up were again concerns related to IG SEC and general thermal fatigue, that they were still the big risk drivers even though again and I think the BWR Owners Group pointed out in some of their comments that there has been mitigation mechanisms that have been put in place over the years to deal with both of those issues and the experts certainly recognize that and accounted for that. But they said even with those mitigated mechanisms that they still were the dominant risk drivers even though the frequencies were somewhat reduced compared to historical 57.50 estimates.

MEMBER ARMIJO: My issue is that the amount of credit provided for a lot of mitigation and I haven't read the elicitation report. I'm going to

do that, but it seems to me that there should have been a huge benefit from the changes in the various mitigation steps that were taken particularly the water chemistry and I wanted to know how big a credit was given for hydrogen water chemistry as well as the other mitigation. Was it trivial? Was it significant? It sounds like it was trivial credit.

MR. TRAGONING: No, not at all. It wasn't trivial credit at all. There's a number of mitigation measures that have been put in place for IG SEC and including hydrogenated water chemistry, mechanical stress improvement, BWR Owners Group though I'm sure in lightness on can go into much more detail into all of these.

But we discussed all of the mitigation measures and I think 57.50 used a factor in that study of a factor of 20 accounting for mitigation mechanisms. If you compare the BWR LOCA frequency estimates at the largest break size which is greater than four inches, these frequencies are a factor of three lower than the 57.50 estimates given a somewhat similar operating experience base. So I would argue that that factor of three is largely attributed to additional credit from mitigation mechanisms that have been put in place and we did actual probabilistic

fraction mechanic studies to help anchor the elicitation results which looked at the effect of -- We didn't look at the mitigation mechanisms, but we looked at a few. For instance, we ran explicit cases. Even though we used normal water chemistry, we ran them with and without weld overlays to look at the effect of that particular mechanism.

We had operating experience. We looked at pre 1983 operating experience which certainly had a prevalence of indications with respect to IG SEC and then we looked at post 1985 operations experience which also factors in the effect of mitigation and when we gave the experts that service data, we made sure that everyone was aware of all the differences, all the things that had happened post 1985 and I can tell you that all the experts that used that information essentially based their estimations on the post 1985 service data which again also implicitly account for mitigating factors that have been put in place since then.

MEMBER ARMIJO: Okay. I don't want to belabor it but the most powerful that I think the BWR has is the hydrogen water chemistry and that wasn't introduced -- that was introduced after 1985. So I'd like to -- I'll find out more how much operating

experience you have since that time because the mechanism basically of IG SEC gets turned off with the right water chemistry. It's not a slight improvement. It's a yes/no. It no longer can occur. So I want to find out more about whether the experts had any information to assess the mitigation by hydrogen water chemistry.

MR. TRAGONING: Again, we printed out precursor events as a function of time post 1985. So that trending analysis was certainly available.

MEMBER ARMIJO: Okay.

MEMBER BANERJEE: I just have a question about was such a study ever done a decade ago or two decades ago. Are there any documented studies of this nature done earlier than this last study?

MEMBER APOSTOLAKIS: You mean the frequency of --

MEMBER BANERJEE: Yes.

MR. HAMMER: Frequency of occurrence of breaks. Yes, there was WASH-1400 back as far as 1976 that estimated break frequencies.

MEMBER BANERJEE: And was there one which did something similar like this expert elicitation and things?

MR. HAMMER: Yes. Help me, Rob. I think

expert elicitation was used in some seismic studies at one point.

MR. TRAGONING: Yes. LOCA frequencies have never been calculated for use by the agency using this method. There were two prior studies that Gary mentioned, WASH-1400 and the NUREG CR 57.50. But both of them based their estimates on the available operating experience data at the time and then 57.50 made various adjustments especially with respect to BWRs to account for the fact that they wanted to account for the effectiveness of the mitigation measures that had been put in place again starting in post 1985.

MEMBER BANERJEE: So if you compared these studies, what were the most significant differences between, say, the most recent one and this one that we are talking about?

MR. TRAGONING: In terms of what? Quantitative or qualitative?

MEMBER BANERJEE: In terms of probability of failure for different sizes and things like that. I'm talking a broad brush. I'm trying to understand what has caused these differences. I mean it's somehow related to Sam's question as well.

MR. TRAGONING: Essentially -- Let me use

57.50 because that's the latest prior study to this one. Essentially the elicitation, the medium break mean frequencies were higher for the expert elicitation than they were in 57.50 by a factor of two or so.

MEMBER BANERJEE: The most recent study is higher.

MR. TRAGONING: Just for medium breaks. Things less than -- Partial breaks or breaks less than three inches in effective diameter. For the large break greater than four inches and higher, they are about a factor of three or more lower than 57.50. And 57.50 did not discretize (sic) and go beyond six inches. We explicitly looked at frequencies all the way to effectively a double ended guillotine break. So it's not really fair to make direct comparisons with 57.50 because their biggest break size was essentially greater than a four to a six inch break. If I compare just the break size, it's a factor of three lower.

MEMBER BANERJEE: This 57.50 now, all these experts, would they have predicted Alloy 600 cracking?

MR. TRAGONING: We --

MEMBER BANERJEE: In that last expert

elicitation?

MR. TRAGONING: You mean 57.50?

MEMBER BANERJEE: Right.

MR. TRAGONING: 57.50 was not an expert elicitation.

MEMBER BANERJEE: It wasn't? Well, take one. Would they have predicted Alloy 600 cracking?

MR. TRAGONING: 57.50 was based on precursor operating experience information that was available up to 1995 essentially when that study was done.

MEMBER BANERJEE: But these studies, the expert elicitation is there because in some way they're supposed to have some predictive capability. Right?

MR. TRAGONING: Yes.

MEMBER BANERJEE: Otherwise, it's not science. We have to predict things. Did anybody predict Alloy 600 cracking before?

MR. TRAGONING: You're asking me to go back to the 1995. I mean Alloy 600 cracking is --

MEMBER BANERJEE: Whatever.

MR. TRAGONING: When the elicitation was done, I mean it was certainly known at the time.

MEMBER BANERJEE: Yes, but before it was

known. Was it predicted?

MR. TRAGONING: I could have been.

MEMBER BANERJEE: It could have been.

MR. TRAGONING: I think a materials person would have expected Alloy 600 to crack based on its experience in steam generator tubing.

MEMBER BANERJEE: It could have gone into the prediction of the frequency of the break.

MR. TRAGONING: And 57.50 was a statistics based one with an extrapolation on diameter, an empirical correlation to let you extrapolate on diameter which is a backdoor expert elicitation for the effective diameter. But it really wouldn't have included Alloy 600 very much. But I think we're going to have to move on a little bit here.

MR. HAMMER: Yes. I may point out that, Rob, you're going to come back and make a presentation specifically on the elicitation in a couple of weeks.

MR. TRAGONING: Yes.

MEMBER BANERJEE: Oh really. Where at? To us?

MEMBER APOSTOLAKIS: Haven't we heard about it already?

MEMBER SIEBER: No.

MR. TRAGONING: We've talked about it a

lot, but I think the thing we haven't discussed, the thing that we need to come back to discuss, is we've gotten public comments. So we haven't been back to the committee to discuss the public comments and the resolution of those comments.

MEMBER APOSTOLAKIS: That would be a subcommittee meeting again.

MR. TRAGONING: That would be -- I think it's -- I believe it's planned as a subcommittee meeting.

MR. THORNSBERRY: It's been floating along with the regulatory guide. When the regulatory guide comes, we're planning on looking at the expert elicitation all at the same time which was going to be last we've heard was in the spring.

MEMBER APOSTOLAKIS: Wow.

MEMBER ARMIJO: Is that going to be this subcommittee or is it going to yours?

MEMBER APOSTOLAKIS: Your subcommittee or mine?

MR. THORNSBERRY: It will be a combined one probably between the PRA subcommittee and this one.

MR. TRAGONING: That's what we've done in the past.

MEMBER BANERJEE: Can we have the report well in advance at least?

CHAIR SHACK: You have the NUREG -- or at least a draft.

MEMBER APOSTOLAKIS: The main report we have. Right?

MR. THORNSBERRY: Yes, it's available. If you don't have one, I'll get you one.

VICE CHAIR WALLIS: What does the public have to say about an expert elicitation? An expert elicitation is a product of the experts and the public has nothing to do with it.

MEMBER APOSTOLAKIS: Wait a minute. I think there is a misunderstanding here. When you assemble a group of experts, basically what you want to know is what is the current state of the art. I don't think you should be using what is predictive. They're coming in there. They're looking at all the available evidence and they're saying this is what we know now. Now whether we're surprised three months later, these are the guys who take care of it. That's why they take the mean, the 95th percentile, and they add margin.

MEMBER BANERJEE: They should triple it then. Right?

MEMBER APOSTOLAKIS: Whatever. Triple. Quadruple. It's up to them. But the experts are telling you this is what the state of the art is now and if you disagree with us, tell us where you disagree and they go through PR reviews. They go through all. So in that context, it seems to me that it's a very reasonable thing to do. Otherwise, you don't really know the state of the art.

I mean they had a guy there who had participated very actively in the Swedish collection of data. All that was there in the expert elicitation. They had people who used probabilistic fraction mechanics. Other people used operating experience. It was really an amalgamation of everything that's available.

MEMBER BANERJEE: Yes, the problem taking rare events.

CHAIR SHACK: We have to move on.

MEMBER APOSTOLAKIS: That's the problem and that's why NRR adds margin.

MEMBER BANERJEE: And unfortunately these rare events --

MEMBER APOSTOLAKIS: But it's not the fault of the experts or anything. I mean this is what we know now.

VICE CHAIR WALLIS: Or we think we know.

MEMBER APOSTOLAKIS: In that context, it makes sense. When are we going to hear from the owners group?

CHAIR SHACK: If we let these guys finish.

MR. HAMMER: I'll try to do that.

CHAIR SHACK: During lunch.

MEMBER APOSTOLAKIS: We know what they're going to say.

MR. HAMMER: So at any rate, those were the frequency ranges, the sizes, the size range, 13 to 20 inches. And we looked at the piping in BWRs, typical BWRs and those sizes are approximately the sizes of the largest attached feedwater and residual heat removal lines inside of containment which connect with the reactor coolant system. They're Class 1 piping and they're typically 18 to 24 inches and then if you look at the ID which we're really using since the rule is based on the inside diameter dimension for the TBS, you get something that's even closer, 16 to 21.5 inches in inside diameter.

And then if you look at breaks that would be much larger than that or let's just say larger than these, you would have to break a significantly larger pipe, that being the large recirculation piping which

has a significantly lower frequency of occurrence. So it looked like that was a reasonable demarcation to us.

And we, like I said, looked at the pipes and there you see a survey that we did of the various pipe sizes with the databases that we had available to us and you can see there the feedwater and the RHR are similar in size. One may be a little bigger than the other, but they all come up in that size range.

We did receive some public comments on the BWR TBS. We received a comment from Dr. Hochreiter at Pennsylvania State University who did his own study of the -- quite a large report that he submitted to us which indicated in his view point that the break frequencies appeared to be larger than the expert elicitation estimates and he also premised some of his estimates on what he thought was reasonable which was that leaks really should be treated as breaks because a leak is going to lead to a break eventually.

We looked at his study. We didn't think that the break frequency did look like it was significantly greater than the expert elicitation. So we couldn't go along with that and regarding whether or not leaks should be treated as breaks, we've held a position for some time that you have to have

significant additional degradation before a leak actually becomes a break.

MEMBER BANERJEE: So a leak is not considered a break and is not put into your frequency?

MR. HAMMER: Ask that again. What?

MEMBER APOSTOLAKIS: A leak is not a break, is it?

MEMBER BANERJEE: You don't consider in your database where you derive the frequencies for different break sizes. Leaks are taken out of that database? Somebody told me it was statistical what you did. Right?

MR. HAMMER: Right.

MEMBER BANERJEE: So leaks are not breaks then.

MR. HAMMER: That's true.

MEMBER BANERJEE: How do you distinguish between a leak and a break?

MR. HAMMER: I think there's a cutoff. Can you help me with that a little bit?

MR. TRAGONING: Yes. We did consider leaks because leaks are precursors to failures. So they were -- In fact, that's a very important thing.

MEMBER BANERJEE: Oh, they are. I'm confused by what he's saying.

MR. TRAGONING: But the threshold for the elicitation was we only considered failures that would result in a flow rate loss of primary coolant of greater than 100 GPMs which has been typical small break LOCA thresholds that we've used historically here in the agency. So breaks that would be less than that, either a smaller diameter line or a partial failure of a bigger line that will give you less flow rate were not considered to be LOCAs in this exercise.

MEMBER BANERJEE: Were not put into the statistical analysis.

MR. TRAGONING: The database again --

MEMBER BANERJEE: The database contained it but it did not enter the statistical analysis that you did.

MR. TRAGONING: They were treated as precursors but they're not treated as LOCAs.

MEMBER BANERJEE: Just to give me an idea, what was the frequency of these precursors compared to the smallest break that you considered?

MR. TRAGONING: You would have to look at the degradation mechanism, but the frequency of precursor might be, and this is off the top of my head, a couple orders of magnitude higher.

MEMBER BANERJEE: We would be very

interested to see this report and maybe Hockreiter's comments as well.

MEMBER CORRADINI: I don't understand the comment as you summarize it, I guess.

MEMBER APOSTOLAKIS: Yes. This doesn't make sense to me either. Break frequencies appear to be larger than expert elicitation estimates. Which frequencies are these?

MR. HAMMER: He developed a relationship similar to the expert elicitation curve that his curve was above ours. In other words, he picked --

MEMBER APOSTOLAKIS: So his estimates?

MR. HAMMER: Right. He came up with his own estimates of what those datapoints are.

MEMBER BANERJEE: And I guess he considered leaks as breaks and if their frequencies were two orders of magnitude higher it made a significant difference.

MR. HAMMER: It makes a significant difference in how --

MEMBER BANERJEE: Yes. It depends on where you put the cutoff in some way as well. All right. It will be interesting to look at the whole thing.

MEMBER SIEBER: We have Hochreiter's

report. Right?

MR. HAMMER: Yes. We have the PSU study if you'd like to --

MEMBER SIEBER: Yes, I think we reviewed this a couple of years ago.

MEMBER BANERJEE: I think we should get everything.

MEMBER APOSTOLAKIS: They considered in the expert -- As I remember, they showed us a table what they had as a continuum of flow rates.

MR. HAMMER: Right.

MEMBER APOSTOLAKIS: And then they discritized (phonetic) those to define small, medium and large and so on.

MR. TRAGONING: Including below the threshold. Dr. Banerjee, that information is in the report.

MEMBER BANERJEE: Yes.

MR. TRAGONING: And I would suggest -- When we come back and discuss --

MEMBER BANERJEE: Have the precursor frequencies and everything.

MR. TRAGONING: And I think what might be effective because there is a number of new members when we plan for this meeting or this next

subcommittee meeting, we'll meet with Dr. Shack and Dr. Apostolakis and figure out the right level of background material that we need to revisit to make sure everyone's brought up sufficiently up to speed.

MEMBER BANERJEE: Right, and in particular we'd like to see the reports in advance. Maybe --

MEMBER APOSTOLAKIS: The report is available.

MEMBER BANERJEE: Well in advance.

MR. TRAGONING: The report has been available for a year.

MEMBER APOSTOLAKIS: Has been available for a long time. So maybe, Eric, you can provide that.

MEMBER BANERJEE: And the names of the experts and everything.

MEMBER APOSTOLAKIS: Yes.

MR. TRAGONING: On the report. It's on the report.

MEMBER APOSTOLAKIS: What they ate for lunch, Sanjoy, is there.

MEMBER BANERJEE: You have know this is a very serious matter.

MR. TRAGONING: It's a fairly detailed report. So after perusing that if there are questions

we can --

MEMBER APOSTOLAKIS: I do believe though, Rob, that calling it expert opinion elicitation is a misnomer and I saw that in the quadripartite meeting with the foreign advisory committees. Some other name would probably be more appropriate like an assessment of the state of the art or something like that.

MR. TRAGONING: Okay.

MEMBER APOSTOLAKIS: Because people think when you say the experts, hey, Mike what do you think? 10^{-4} . Good. And I put it on. That's not what happened. That was a very detailed evaluation. People did analyses. It was not just a I think it's this and I think calling it expert opinion elicitation does not do justice to it.

VICE CHAIR WALLIS: Expert evaluation then.

MEMBER APOSTOLAKIS: Evaluation of the expert of the state of the art.

(Off the record discussion.)

CHAIR SHACK: Can we move on?

MEMBER APOSTOLAKIS: No, but that has been a problem, a continuing problem.

CHAIR SHACK: That's a problem. I agree.

VICE CHAIR WALLIS: Let's move on though.

It's been accepted. So let's move on.

MEMBER KRESS: Get the report and read it and we'll feel better.

MEMBER BANERJEE: And it's never gone to the National Academy or the NRC or anything.

MEMBER APOSTOLAKIS: There was a PR review that was done.

MEMBER BANERJEE: Oh, they did that?

MEMBER APOSTOLAKIS: Yes.

MEMBER SIEBER: Yes. That was the first class job.

MEMBER APOSTOLAKIS: It was a pretty expensive proposition.

MR. HAMMER: And we have some comments from the BWR Owners Group who's with us here today who will come on a little later.

So I'm going to summarize what we --

PARTICIPANT: They may not get a chance.

MR. HAMMER: They felt like, if I understood the comment correctly and they can explain further, that we shouldn't consider it a feedwater piping and that the size should be based on a 16 inch diameter circumferential opening in the residual heat removal line and they wanted to apply that uniformly to all BWRs which was a little different way than what

we had done because we had felt like we wanted to consider all of the attached pipes because we felt like a likely way for the break to occur is with a complete break of that size pipe. So we gave consideration to all the pipes in that frequency range which appeared to be these two pipes, feedwater and RHR, without regard to which one may be more limiting in the LOCA analysis.

We should note that we were also, in selecting the largest feedwater and RHR pipes, that 18 to 24 inch range that you get when you select those two, you will bound the complete break of a smaller 12 inch recirculation pipe and the 12 inches is of course smaller, having a larger frequency of occurrence than either of these. So we wanted to bound that and if you break that 12 inch pipe you get a double ended discharge. So if you do the math, 1.4 times 12, you get something like 18.

Another comment from the BWR Owners Group was that we didn't give proper credit for the mitigation programs. We had significant discussion about that a little earlier. I'm just going to skip over that. And that's it.

MEMBER APOSTOLAKIS: Wow. You managed to take us to the end.

(Off the record comments.)

MR. BUNT: Thank you all. I want to thank you all for letting us come. I'm Randy Bunt, the current BWR Owners Group Chairman and we have two other experts here that will be talking for most of the rule, Tony Browning who is our Committee Chairman for the Option 3 which is the other proposed rule that we have that's been mentioned several times this morning and Fran Bolger from GE who does our thermal hydraulic issues.

I'm going to briefly go over the introduction and then turn it over to these gentlemen to talk in detail. One is that we are pleased that the rulemaking has gone as far as it has and that we are getting toward the end or conclusion. However, we also want to bring about that the way it's currently written there will be very little BWRs that will take advantage and use this rule. So we think that the effectiveness will not be as expected from the rule. We do feel some very minor changes could applied and it would be effective and be implemented by most of the BWRs. Tony.

MR. BROWNING: This is Tony Browning. Again, I'm representing the BWR Owners Group Option 3 Committee as Chairman. That's the group that put

together the topical report that was referred to earlier by Dr. Shack on separation of LOOP and large break LOCA where we've done extensive work already in both risk and thermal hydraulic space to demonstrate the benefits of that program.

Today we're going to talk primarily about the thermal hydraulic analysis. It's good to hear that we're going to have an opportunity maybe perhaps to come back in the near future and discuss the materials issues in more depth. Because of the brevity of what we're going to talk about today, we're going to cut out that part of the presentation and defer it to another day and give most of the time to Fran to talk about the thermal hydraulic work that we've done which is new work that the staff has not seen yet.

Again, we're recommending to make this a useable rule for the BWR so that we do need to lower the TBS and what I want to say here is that we're not very far apart. I mean we're not miles apart between what the staff has recommended and what the owners are looking at. We're incrementally getting closer to each other and we just need to nudge a little more closer and one of the things we want to consider --

VICE CHAIR WALLIS: What are we reviewing?

Are we reviewing the staff TBS or your TBS or you have a choice on TBS?

MR. BROWNING: We are proposing -- The staff's TBS is on record. We have commented on that rule. We've provided alternative language that's been reviewed earlier.

VICE CHAIR WALLIS: Are you going to propose a number?

MR. BROWNING: Yes, we do. All right. We believe that that definition does several things. One, it removes what we consider to be unnecessary conservatism that's been applied to the elicitation, some of the things that Dr. Armijo was referring to earlier about proper credit for hydrogen water chemistry, thermal fatigue, etc., and again we'll talk about those on another day.

Demonstration of safety benefits, one of the things that we've taken to heart is some of the guidance that the ACRS made earlier back to the staff and to the Commission that says look carefully at the TBS and make a proper balance between what you decide in this rule and that you can get true safety benefit out of it. We've taken that to heart. We've tried to look at carefully and say in order to derive what we consider to be enough safety benefit to make this

implementable for boilers on a cost/benefit basis, we need to drive this TBS a little bit lower and we'll show that result in a second.

And also to be frank, the plain language standard comes into play here. We've struggled in the owners group trying to understand this definition of TBS, how it would be applied not having seen the reg guide yet. There are a number of things that come into play here. The "or" between the feedwater or RHR piping, one of the things that we'll talk about shortly is there's a presumption apparently on the staff's part that RHR piping in a plant is all one size. That's not the case which introduces one level of confusion.

When you talk to analysts such as Fran trying to compare a feedwater pipe break to an RHR pipe break, you get radically different results. So there we're trying to balance out again what are you trying to optimize here. Are you looking at it from a fraction mechanic's perspective or because this is 50.46 in the LOCA rule, are you really trying to skew it to the thermal hydraulic side and try and get a conservative result?

VICE CHAIR WALLIS: Do you have a measure of these safety benefits?

MR. BROWNING: Yes, we do.

VICE CHAIR WALLIS: Is it in terms of CDF?

MR. BROWNING: No, it's in terms of delta PCT.

VICE CHAIR WALLIS: How is that related to safety?

MR. BROWNING: Because we're going to maintain the existing margins and we'll talk about that.

VICE CHAIR WALLIS: Oh, you haven't gotten any benefit. You just haven't gotten any loss.

MR. BROWNING: The topical report that's on the docket covers a number of these same changes and while we could debate the incremental improvement in safety that may be derived there under the PRA analysis that was done, there are some other factors that go into that that make those numbers look rather small that need to be considered.

VICE CHAIR WALLIS: Safety benefit to me means something better than you had before.

MR. BROWNING: Correct. An improvement in overall ability of diesel generators is the first thing that comes to mind.

VICE CHAIR WALLIS: But that -- Yeah, okay. That's not a safety measure. That's just

something which might influence safety. Is it 10^{-8} or something on CDF? Did I hear that from my chairman here?

MR. BROWNING: Yes. But there are some other things about that evaluation that need to be taken into consideration one of which was that we made an assumption in that PRA that all large break LOCA LOOPS went straight to core damage with a factor of one and then we worked backwards from that point. So when you see 10^{-8} it's really -- the improvement in safety is a bigger number than that if you took it on its own merit and said while there is a probably that some large break LOCA LOOPS would still continue to be mitigated, that that was a conservatism that we did in that calculation.

VICE CHAIR WALLIS: But if it were a safety benefit 10^{-4} , 10^{-5} or something, we might jump up and cheer. But if it's 10^{-8} I have a little difficulty knowing what to do.

MR. BROWNING: Risk neutral. How about that?

VICE CHAIR WALLIS: Well, that's very different from benefit.

MR. BROWNING: Well, safety benefit can be manifested in a number of ways other than CDF.

MEMBER APOSTOLAKIS: But, it's also true, Graham, that not -- that all the risk informed changes that have been approved in the past were not done because it was a safety benefit. We just said that the penalty you pay on the safety side is so small that it's worth granting them the flexibility or --

VICE CHAIR WALLIS: Okay, but I keep hearing about safety benefits. If there's going to be an argument, there needs to be an argument.

MEMBER APOSTOLAKIS: You're right, you're right but it doesn't have to be a clear safety benefit to grant this. You're just eliminating unnecessary burden is another way of putting it. That's not true?

MR. BROWNING: Yes.

MEMBER APOSTOLAKIS: Oh, I thought you said it's not true.

MR. BROWNING: No, no, it's perspective. Again, as we've talked about before, both the NUREG and the proposal were published for comment. The owner's group has commented both times and again, that's why we're here again today is to continue that dialogue. One of the things that bothered us about the elicitation result was that this apparent lack of credit, our opinion, of mitigation of these failure mechanisms that were brought out in the elicitation of

IGSCC, FAC and thermal fatigue.

One of the things that's not recognized, of course, is that we've formed the BWR vessel internals program in 1994 which is in great measure been to deal with these material issues and has successfully done so and the operating experience today has proven that. We have over 20 years of operating experience with a lot of these mitigation features in place with no further evidence of further degradation. We're not here to challenge the elicitation on its own right but we do want to point out our opinion there's excess conservatism been applied and we'll show you that in a second.

MEMBER APOSTOLAKIS: Is it really lack of credit or lack of sufficient credit because Rob just told us that they did take into account.

MR. BROWNING: Sufficient credit. One of the things that we've noticed as we've gone through this process is what we refer to as the evolution of the TBS. First, you started out with the elicitation of the mean values of trying to find a break size that was equivalent to roughly $1E^{-5}$ which is what the Commission proposed and you get a range of break sizes out of the elicitation of roughly six to 14 inches. You apply the 95^{th} percentile to that and it raises it

obviously the numbers up to the 13 to 20-inch ranges which we've been discussing, but then the staff came along and said, "Okay, now we're going to apply these uncertainties to these failure mechanisms that weren't considered such as seismic, heavy loads, those other things and then they skewed it to the upper end of the 20 inches."

Now, this is where we start to deviate from the staff's opinion a little bit. So then they went on and said, "Okay, now we're going to modify the rule language and say it's going to be the larger of feedwater or RHR piping inside containment." Well, when we look at it, the typical BWR 4 which comprises most of the fleet of operating BWRs in this country, the TBS for those plants will be 24 inches which is outside the range of what's been proposed. We're saying, "You gone too far, you've pushed it too far. We need to come back closer to where the elicitation drove us including proper consideration for these uncertainties".

Again, when we commented on the rule, we proposed alternative language. We just didn't criticize. We said, "Here's what works for us and we're prepared to come in and demonstrate why we believe this is an effective rule". And what we asked

for was an equivalent size to the internal diameter of a 16-inch Schedule 80 pipe which, as we were all trying to get to, is what was the break flow and a break size of 1.177 square feet and we proposed it to be in the residual heat removal system on the shutdown cooling suction pipe which is from our experience doing LOCA analysis is the worst location in the research system and where to put it is on the suction side of the pump.

CHAIR SHACK: That's roughly, what, like a 13-1/2 inch break?

MR. BOLGER: About 14, I would say.

CHAIR SHACK: Fourteen one inch on a Schedule 80.16. Yes, that's about right.

MR. BOLGER: Right. 1.77 square feet.

MR. BROWNING: Our considerations were a fixed size and a fixed location, something that was clear and understandable to everybody, no interpretation. It was the benefits, again we considered --

MEMBER BANERJEE: Excuse me. I just wanted to ask you if it was a feedwater line break is it a more difficult accident to cope with.

MR. BROWNING: Actually just the opposite. It's one of the easier ones.

MEMBER BANERJEE: So you could have either. Right?

MR. BROWNING: As long as --

MEMBER BANERJEE: What would be the difference?

MR. BOLGER: This is Fran Bolger from GE. The way the rule is written in the interpretation is that let's say the largest pipe is 24 inches and happens to be a feedwater pipe, that that 24 inch would then be applied to the recirc line as the size of the break on the recirc pipe.

MEMBER BANERJEE: Oh, I see.

MR. BROWNING: It's not the actual break of the feedwater pipe.

VICE CHAIR WALLIS: The amount of debris that it makes depends on where it is, not how big it is, particularly for PWR, but you also have debris from insulation and stuff.

MEMBER BANERJEE: But BWRs are not particularly challenged by the --

VICE CHAIR WALLIS: But they are. They're the only ones that had problems --

MEMBER BANERJEE: The debris is a separate issue but I'm saying with regard to the break itself.

MR. BOLGER: We'll discuss what's the

limiting breaks in the BWRs in the next few slides.

MEMBER BANERJEE: All right.

MEMBER APOSTOLAKIS: So essentially what you're saying then is that if you use the 10^{-5} guidance from the Commission as a mean value, you get the range of six to 14 inches and you are adding two inches for things that they haven't thought of.

CHAIR SHACK: No. It's 14 because the six to 14 is break size as whole size. So these internal diameters is 14.

MEMBER APOSTOLAKIS: Right. And he's making it 16.

CHAIR SHACK: No. A 16 inch diameter pipe with a 14 inch hole.

VICE CHAIR WALLIS: Sixteen inch is the outside diameter or the nominal diameter.

(Several speaking at once.)

VICE CHAIR WALLIS: It's not even exactly 16 inches.

MEMBER APOSTOLAKIS: Wait a minute. It says equivalent in size to internal diameter of a 16 inch Schedule AD pipe.

MEMBER CORRADINI: A schedule AD pipe is not 16 inches inside though, George.

MEMBER APOSTOLAKIS: Oh.

MEMBER CORRADINI: It's a thick pipe.

CHAIR SHACK: It's a thick pipe.

PARTICIPANT: It's the opening that counts.

MEMBER CORRADINI: It's 1.177 square feet.

CHAIR SHACK: But it's close to the upper end.

MEMBER CORRADINI: Right.

MR. BROWNING: And what we were trying to get to was really, Dr. Apostolakis, the mid range of the 95th percentile is really what was driving our --

MEMBER BANERJEE: I guess the implications of this will become clear when you talk about the thermal hydraulic analysis because I don't understand the implications at the moment.

MR. BROWNING: Right and that's why we're here to talk about that and again we'll belabor the term "safety benefit" but as shown by the current Appendix K methods, we didn't go off and use best estimate. We used current Appendix K modeling and the metric that we were using was no significant increase in current peak clad temperature from the DBA or we were not going to cut into that model. And what we're going to show is that with the properly sized TBS we can delay ECCS injection which is a cumulation of both

slowing down the diesel generator and you could also use it for valve stroke time on ejection valves and also to look at reduced requirement for the hardening of certain ECCS loads which is also a benefit to the diesel generator. We're not proposing that we remove any ECCS pumps. We make them manually initiated.

VICE CHAIR WALLIS: This is no considerable increase in current PCT for pipes with a size below a certain amount?

MR. BROWNING: Right. Where we started --

VICE CHAIR WALLIS: This last one describes only for pipes below the pipe size you've selected, is that right?

MR. BROWNING: We will show you shortly.

MR. BOLGER: That's correct.

MR. BROWNING: We're going to cut right into the chase here and let Fran take over on how we can start to this analysis and then you can see how we went through the process.

VICE CHAIR WALLIS: Or you could go back to the pipe size you want by saying what the pipe size has to be in order not to get above the ECC criteria.

MR. BROWNING: Correct.

VICE CHAIR WALLIS: Then you could justify that.

MR. BROWNING: Right, and you'll see that shortly.

MEMBER BANERJEE: That's more or less what you're doing. Let's see.

MR. BOLGER: Just a brief introduction on the GE safer process or methodology, we employ kind of a dual methodology where we use Appendix K assumptions as a bounding analysis and then we also do an upper bound analysis. Most plants are limited by the DBA large break. There are some plants that are limited by small breaks and generally they are less than 0.1 square foot. Just to note that for breaks on the discharge size, the break area is limited by the nozzles on the jet pump as well as on the I of the pump.

As far as intermediate breaks, I just wanted to note that the benchmarking of the safer process has been oriented toward DBA type large breaks, guillotine size and we feel we would need to do benchmarking over our code against track which is part of our standard track methodology. When we develop our upper bound outers, we compare safer against track.

MEMBER BANERJEE: Track G, right?

MR. BOLGER: Track G. That's correct.

All right. With respect to what is the limiting break, the main steamline and the feedwater line breaks are not limiting for BWRs. In these type of breaks, the break location is above the core. The core is only covered briefly. We quickly restore the level and the resulting PCTs are less than what we see for the small breaks which are these less than 0.1 square foot type breaks. So they would not be limiting with any definition of the TBS.

VICE CHAIR WALLIS: With the present assumptions or with the relaxation of the assumptions?

MR. BOLGER: Even with relaxation of ECCS systems or changing of diesel start times, these breaks would not become limiting.

The first thing we'll talk about is ECCS injection delay and later we're going to talk about system relaxation or basically reoriented some ECCS systems. With respect to when are the systems needed to inject, if the break is a small type break, it takes longer for the plant to depressurize. Before the low pressure system to come into play, the pressure has to be low enough for the pressure for misses of valves or for the pumps to be able to perform and so if you have small breaks and even some of these "intermediate size" breaks it takes awhile

for the plant to depressurize. So these delay times become somewhat irrelevant when you're getting great than two minutes.

Large breaks inject in less than one minute. PCT as you would expect will decrease as the TBS size is reduced and the figure of merit here is how much can we relax the ECCS start times. So what we're saying is if what time of start times do we need to improve the reliability of the diesel and if we can get things in the order of one to two minutes for the start times that will improve the reliability of the system. So that's going to be our basis of quantifying an optimal transition break size is.

On this next slide, it looks pretty busy and it's a number of different plants. These are all BWR 4 type plants. These plants have a 28 inch recirc pipe size which is roughly 26 inch inside diameter. Their attached RHR piping is approximately 24 inches and there are a number of plants, even large or smaller sized plants that have these type of dimensions.

Now what we're showing here is an estimate of what injection delay would correspond to a reduction in the break size. Now you see that line on the chart, the heavy green line, is what would be the

transition break size with a 24 inch RHR pipe and you see from that if you're looking for an increase in your injection delay of in the order of, say, going from 20 to 60 seconds, the majority of the plants are about in line there. But if you really like to increase the delay time up to, that's in the order of almost two minutes the break size as defined, the 24 inch break size, won't even do it.

VICE CHAIR WALLIS: This delay time simply means the diesels are now more reliable if you have more time to start them. It doesn't mean that they won't start.

MR. BOLGER: Maybe somebody else wants to comment on this, but the diesels if you give them more time to warm up --

VICE CHAIR WALLIS: They're more reliable.

MR. BOLGER: They're more reliable.

VICE CHAIR WALLIS: But they're pretty darn reliable now, with the fast start, so it isn't that much of an incentive to make them --

MR. BROWNING: Well, there's an incentive on maintenance.

VICE CHAIR WALLIS: Yeah, but it's not that big a deal.

MR. BROWNING: Well, maybe to you. Yeah,

talk to my mechanics out in the field that have to maintain them to this pristine level --

VICE CHAIR WALLIS: Yeah, but it's not hundreds of millions of year or something like that.

MR. BROWNING: But still it's significant, they're finicky machines. They're -- you know, to maintain them to this peak performance, I mean, we're truly talking about peak performance.

VICE CHAIR WALLIS: But, I mean, their average performance is damn good too, so you don't really have to rely on that peak --

MR. BROWNING: Well, but we're not allowed to degrade to that point.

VICE CHAIR WALLIS: Well, yeah.

MEMBER SIEBER: The time is so short that the opportunity to miss the time is real.

VICE CHAIR WALLIS: But the thing is, if you're allowed in your calculations to give them the 60-second or two-minute delay, if you did get a DBA, you would start them quicker, wouldn't you, and they would probably start quicker. It's not as if they wouldn't function.

MR. BROWNING: No, you're right, but what we're talking about here --

VICE CHAIR WALLIS: What are you buying

really. I don't quite see --

MR. BROWNING: -- in physical reality is we're going to go change the way these machines run. They will always run to this standard. They will take 30 seconds to ramp up.

VICE CHAIR WALLIS: So you won't start them fast then even if you want to?

MR. BROWNING: We wouldn't want to.

VICE CHAIR WALLIS: Why not if you need them?

MR. BROWNING: Not to that standard and that's what we're trying to demonstrate here is you don't --

MEMBER BANERJEE: No, but suppose you really had a doubled ended guillotine break, forbid, yeah --

MEMBER SIEBER: Then you would want to start that.

MEMBER BANERJEE: Then wouldn't they just come on? They wouldn't. So this is not just to deal with reducing testing, maintenance, whatever and still having them there to come on as quickly.

MR. BROWNING: They will come onto this standard. They will come up to speed in 30 seconds idle and then you'll start loading pumps on.

MEMBER SIEBER: You're going to change the sequence or settings.

MR. BROWNING: Exactly.

MEMBER BANERJEE: So you're actually going to change that.

MEMBER SIEBER: Yeah, it won't happen any faster than what that sequence is set at.

MR. BROWNING: And the difference is, is because above the transition break size, I don't have to postulate the loss of offsite power, so I'm not relying on the diesel generator for the double ended guillotine break any longer.

VICE CHAIR WALLIS: That's the thing, we should do away with this LOOP and then you wouldn't have this problem.

MR. BROWNING: I'm sorry?

VICE CHAIR WALLIS: If we did away with this LOOP requirement, you wouldn't have this problem.

MR. BROWNING: That's one aspect, yeah, that's --

MEMBER BANERJEE: But you can imagine that there's some terrible situation where there's a seismic event knocks out the power and makes a big break or whatever and at that point these diesels wouldn't come on then, really. What you're saying is,

you've sequence it differently.

MR. BROWNING: Right.

MEMBER BANERJEE: So it wouldn't -- it's not just a question of maintenance.

MR. BROWNING: Right, so the metrics that we use to demonstrate mitigation capability are different. For example, I won't use Appendix K methods to demonstrate that mitigated capability. I'll go straight to Track G and take advantages of the more realistic correlations that are built into Track G of the --

MEMBER BANERJEE: We should to that anyway by never mind.

MR. BROWNING: That is a potential opportunity but Track G is currently not licensed by the Commission to do these calculations. So that, to me as a licensee, that option is a future thing that's potential but it doesn't exist today. And I'm commenting on a rule making that's about to go into the books soon.

VICE CHAIR WALLIS: Well, what is the advantage in reliability in terms of numbers in going from quick start to slow start? Is it going from 98 percent to 95 or 95 to 98 or 98 to 99 or what?

MR. BROWNING: That's one of the things

that Dr. Shack referred to earlier in the topical that we have on the docket already and we pretty much polled -- I won't use the word, "expert elicitation" but polled our diesel generator experts and we arrived at a figure of roughly 10 percent improvement over current reliability.

VICE CHAIR WALLIS: But they're going from what efficiency to what efficiency?

MR. BROWNING: It was pretty much -- do you remember the numbers?

MR. BUNT: It was one failure in three and a half years to one failure in five years.

VICE CHAIR WALLIS: Of how many starts? One failure and how many starts?

MR. BROWNING: I don't remember. It was in the upper 90 percentile.

VICE CHAIR WALLIS: So you're already in the 90s. I don't think it's a big deal.

MR. BROWNING: Ninety-fifth to 98th percentile.

VICE CHAIR WALLIS: That's not a big deal. That's no big deal going from 95 to 98.

MEMBER BANERJEE: Was this the only advantage you get or are there also some other things?

MR. BROWNING: Once we're allowed to do

some of these things -- Sorry. One of the things that we've also looked at that's not on the table here that's in the LOOP/LOCA topical is the dedication of RHR pumps to suppression of the coolant because we all know from PRA studies that BWRs are more vulnerable to decay heat removal scenarios than they are to LOCA injection scenarios.

MEMBER SIEBER: Right.

MR. BROWNING: We have a plethora of pumps that can inject water into a vessel and boilers. We have more water than we need for almost every conceivable scenario. We would like to optimize that and that's one of the things we talk about in the other topical is let us move some of the RHR pumps away from this primary mission of LPCI injection over to decay heat removal where they're more useful to us. And that's one of the things that we would derive as a benefit out of this rulemaking mainly because of the fact that we get rid of the single failure criteria.

MEMBER BANERJEE: Does this also impact your sump screen blockage situation?

VICE CHAIR WALLIS: They don't have sump.

MR. BROWNING: It's already been dealt with.

MEMBER BANERJEE: No, I'm saying that in

a real way if you have a smaller break you must generate less debris. Right?

CHAIR SHACK: Well, no. You're going to have three pipe sizes as I understand the real world here. You're going to have a break size for dynamic loads, a break size for debris generation and a break size for ECCS.

MR. BROWNING: That's pretty close to the rule where we have it now which we've talked about that too and a different break size for containment analysis.

MEMBER BANERJEE: So you don't get --

VICE CHAIR WALLIS: It would be nice if these rules got simpler.

MEMBER BANERJEE: -- from your debris generation you're saying.

MR. BROWNING: We've not looked at debris generation for this rule.

CHAIR SHACK: Let me just understand this calculation.

MR. BROWNING: We're not going to go back and take out our old strainers.

CHAIR SHACK: You take a TBS and above this size you assume no LOOP and that's how you do this calculation. Is that the way it's done?

MR. BOLGER: Not the calculation on the screen but the calculation that will be done when this rule is implemented. Is that the question?

CHAIR SHACK: How is this calculation -- Exactly what am I calculating here?

MR. BOLGER: This calculation here is based on what the current analysis meth process is which is the DDA break, double-ended guillotine break. As you reduce the break size --

CHAIR SHACK: So you're even taking the LOOP here then?

MR. BOLGER: Yes, we're taking the LOOP.

CHAIR SHACK: Suppose I got rid of the LOOP and I left the break at 20 inches. Where would you end up?

VICE CHAIR WALLIS: You wouldn't need the diesels.

MEMBER CORRADINI: Start time issue --

CHAIR SHACK: Just goes away. You need the diesel for the break below the 20 inches and that's what I want to know.

MEMBER BANERJEE: You'd need the same as the lefthand side.

MR. BOLGER: The amount of time you save with not requiring the diesel, what do you think?

Maybe ten seconds?

MR. BROWNING: I think if you showed the --

MR. BOLGER: You might have more systems available.

CHAIR SHACK: -- graph I'd find out that I had about 50 seconds by just getting rid of the LOOP. Is that what you're telling me? If I get rid of the LOOP above 20 inches, I would get the 50 seconds.

VICE CHAIR WALLIS: Why do you need the diesels if you don't have a LOOP?

CHAIR SHACK: Because I need them for everything 20 inches and below.

VICE CHAIR WALLIS: Why?

MEMBER MAYNARD: You still have to be able to cope with loss of offsite power.

CHAIR SHACK: The LOOP is going to have -- I'm going to only get rid of the LOOP above the TBS.

MEMBER MAYNARD: Right.

VICE CHAIR WALLIS: But you can get rid of -- Oh, I see.

CHAIR SHACK: I'm just wondering once you get rid of the LOOP do we really have a fight between 16 and 20 inches?

VICE CHAIR WALLIS: I thought you were talking about getting rid of the whole idea of simultaneous LOOP and break. If you did that, you wouldn't need the diesels at all, would you?

CHAIR SHACK: No. I still have a big difference between 16 and 20, LOOP or no LOOP here. I go from 50 seconds to 80 seconds.

MR. BROWNING: If I may, one of the things that you don't see on this graph is this is only looking at ECCS delay. It doesn't factor in us removing an RHR pump to dedicate it to decay heat removal. When you do that, then you effectively take that green line and shove it to the left. But when you start removing ECCS pumps off the equation, the mitigative capability below the TBS starts to get compounded and because we consider that to be a benefit of the rulemaking, that's another consideration. So to get both the injection delay and the ability to not auto-start ECCS pumps, RHR pumps in ECCS mode, but to dedicate them to decay heat removal, you have to get the transition break size to the left.

VICE CHAIR WALLIS: So how would you explain --

MR. BOLGER: And we're going to show some data on that system changes as well.

MEMBER ARMIJO: Are those the two big benefits that you're looking for?

MR. BROWNING: Yes.

MEMBER ARMIJO: Those are the two big benefits that you're looking for and your goal is to get that by moving that green line down to around 16 inches?

MR. BROWNING: And I think we're all in agreement at least from the thermal hydraulic side that we all understand that the boilers behave in PCT space in a bathtub and what we're talking about was we're trying to finagle down to the trough. We just want to make sure that we're down on the trough and the 24 inches that's the current rule is not in the trough. It's up on the high side towards the double ended guillotine break and we don't see these kind of benefits at a 24 inch break.

VICE CHAIR WALLIS: How do you explain to the public? I mean I understand this of 95, 98 percent more reliable diesels, but what does this effect have on nuclear safety?

MR. BROWNING: I would say the right way to couch is we've tried to construct the benefits that we want to derive in the industry without significantly eating into the current margins.

VICE CHAIR WALLIS: Well, does it change public risk in some way by doing this? I mean, is there any benefit to the public risk by changing this diesel start time and --

MR. BROWNING: Diesel generator reliability is one aspect. I think, Dr. Wallace, if when we look at it in risk perspective, the benefit to the public is an enhancement in BWR decay heat removal over the current capability.

MEMBER ARMIJO: Have you quantified that in any way or can you --

MR. BROWNING: We did it in the PRA study for the LOOP/LOCA topical.

VICE CHAIR WALLIS: And what do you gain?

MR. BROWNING: As we've heard earlier, it's not huge.

VICE CHAIR WALLIS: It's not huge at all, is it?

MR. BROWNING: Well, and again, that's an artifact of how that analysis was constructed because we took a substantial penalty for all large break LOCA LOOPS going straight to core damage with a frequency of one. And then we worked backwards incrementally from that. So that's why you see such a small number for that improvement in core damage frequency from

that aspect is because we took such a heavy penalty at the front end and it was just the artifact of how the analysis --

VICE CHAIR WALLIS: Have you tried to explain this in a public meeting to members of the public about what you're gaining by doing all this in their benefit?

MR. BROWNING: I would say, again, their benefit is, you know --

VICE CHAIR WALLIS: Have you tried to do that, though? I mean, all this talk seems to be with industry, all this negotiation is with industry. Have you tried to sit down with some representative members of the public and explain to them why this is helping them in some way?

MR. BROWNING: I would say through a number of public forums, yes. I would say that probably the most vocal member of the public that we've encountered so far has been Professor Hochreiter from Penn State but we've had entertained dialogue with him.

MEMBER CORRADINI: But he seems to be in the other direction, unless I'm off base. Unless I misunderstood his comments, he thinks that the break frequency is higher and he includes leaks as if they

behaved as breaks. Am I misunderstanding his comment, though?

MR. BROWNING: On those aspects I can't comment but in past forums he's been a very strong advocate for more going to the existing rule and using best estimate LOCA methods without certainty.

VICE CHAIR WALLIS: But you know something that --

MEMBER APOSTOLAKIS: Again, I'm a little confused here.

VICE CHAIR WALLIS: -- you know some of the public critics.

MR. BROWNING: Right.

MEMBER APOSTOLAKIS: What are you trying -- I mean --

VICE CHAIR WALLIS: You didn't get any input from them?

MR. BROWNING: As you've heard earlier from the staff, the public comment on the rule to date is --

VICE CHAIR WALLIS: Well, I think their silence is significant. I think that you really ought to solicit some opinion from someone who's not just from industry about this stuff.

MEMBER APOSTOLAKIS: We are changing the

rules of the game again. The whole idea of risk informing the regulations was to remove unnecessary regulatory burden, even at the expense of increasing a little bit the CDF and LERF. And now we're asking these people to demonstrate the safety benefit from the change. That's a very big plan.

VICE CHAIR WALLIS: That's because that's what they claim. That's because that's what the claim.

MEMBER APOSTOLAKIS: Well, maybe they will quit claiming it. I think their main argument, their main argument is that the margin, the margin is not effected significantly. I think that's the main argument.

CHAIR SHACK: Well, I also want to get that, so that the main benefit you get out of this is reduced maintenance cost on your diesels.

MEMBER APOSTOLAKIS: But that's their problem. It's not ours.

CHAIR SHACK: Well, no, I want to know -- you know, I want to know the cost and the benefit.

MEMBER APOSTOLAKIS: We are not making a decision here based on what their benefit is.

VICE CHAIR WALLIS: Whose benefit?

MEMBER APOSTOLAKIS: Our -- the owner's

group. Our decision will be is there still sufficient margin.

MR. BROWNING: Well, no, I don't take any increases in risk without some benefit, George. If they can --

MEMBER APOSTOLAKIS: Well, we are removing unnecessary burdens.

MR. BROWNING: But they're reducing costs or benefits, that's fine with me. That's a benefit. I have no problem with that. I just want to know what the benefit is.

MEMBER APOSTOLAKIS: If you just want to know, that's fine. But your decision cannot be based on whether they have any benefit. It's their business. We worry only about undue risk to the pubic that --

VICE CHAIR WALLIS: The decision is based on the arguments offered and the arguments offered were safety benefit. Okay.

MEMBER APOSTOLAKIS: That's an extra thing.

CHAIR SHACK: We've got 10 minutes to go because at 12:45 we're pulling the plug.

MEMBER MAYNARD: I agree with George's comments there.

MEMBER APOSTOLAKIS: Thank you. Common sense, I knew would prevail.

MR. BOLGER: We did, we talked a little bit about changing the ECC configuration, allocating ECC systems for other duties such as RHR and on the next slide I have some additional analysis which shows you know, what is the impact on the PCT relative to changing the number of system combinations and putting that together with relaxing ECC start times.

So the first line here, this is a summary of a number of different calculations that we did. The first one is the standard DBA with -- you know, it has one available low pressure core spray and two available LPCI. Now if we then -- if we then go to a 21-inch break size and we also at the same time reduce from two LPCI to one LPCI, we do get a reduction in the PCT. Well, we can push that a little bit further. Let's say we do the same thing which is reduce from two to one LPCI and that one LPCI could be considered available for RHR. Then with that we can also get a 50-second increase in the ECC delay and that's a good net positive benefit.

Now, we could go even further with that where we go from two LPCIs to none and we only have one -- only one LPCS. Well, in that case, with a 50

percent 50-second ECC delay, we get a large increase in PCT, so we would not want to be there.

MEMBER ARMIJO: Is that increase 200 from a 1600 basis or from the --

MR. BOLGER: From let's say approximately 1600 base.

MEMBER ARMIJO: You go up to 1800, well below the 2200.

MR. BOLGER: That's right. I mean there is still margin in a lot of these plants from the current PCT to 2200.

If we continue, then we go to 18 inch break. Go back to the baseline. We get a large improvement in our PCT. Then we step it up a notch where we go with only one low pressure core spray but 50 second ECCS delay, we get a reduction of PCT. So we're better off if we have a TBS at 18 inch and we have a 50 second ECCS delay. We can mitigate that plant with one low pressure core spray.

If we can continue to 80 second, then we get in a situation where our PCT increases. We're considering that not a desirable. We're looking to maintain the PCT even though there may be margin at 2200, we're looking at an equivalent PCT to what it was prior to implementing the rule.

Looking at a different scenario, one lump LOOP pressure core spray and one LPCI, at 80 second ECCS delay, things stay about the same and if we go to 16 inch with the 80 second ECCS delay and one low pressure core spray, we stay about the same. That's so you kind of get an idea of combinations of delay and ECCS system availability.

MEMBER CORRADINI: Can I ask you a question here because this is helpful to me at least to see the various combinations? So to go -- Let me just push my point or push a point. To go from 16 to 21 the benefit was you already had margin. So if you already had margin, I guess it's line three, three down and then all the way at the bottom, you already have margin. You increase the PCT. The only benefit I see is 30 more seconds of ability to operate. But everything else remains the same. Am I missing something?

MR. BOLGER: We went down one more system though. We went from one LPCI to zero LPCI.

MEMBER CORRADINI: Okay. Right. And that was my next question. So you took away a system. You gained 30 seconds. What are you going to do with that system?

MR. BROWNING: That's the one that we're

talking about dedicating --

MEMBER CORRADINI: I missed that. I apologize.

MR. BROWNING: That's the one that we're talking about dedicating to decay heat removal because it's no longer required for LPCI injection.

MEMBER CORRADINI: And that will buy you additional redundancy on decay heat removal?

MR. BROWNING: Correct.

MEMBER BANERJEE: But you still get that with the 21 inch, don't you? You get only one LPCI -- necessary.

MEMBER CORRADINI: That was going to be my point. The only difference between line three and the bottom 16 is 30 seconds.

MR. BROWNING: Right.

MEMBER CORRADINI: And it still falls within your margin.

MEMBER BANERJEE: You probably don't want to take out both LPCIs. Right? If you take out one, that's sufficient for you. All right. So you can get that with the 21.

VICE CHAIR WALLIS: Line three gives a large increase in PCT.

MR. BROWNING: But they're still within

margin as well.

MEMBER BANERJEE: That's well within margin.

MR. BOLGER: I thought they explained to us. So I'm just trying to --

MEMBER BANERJEE: But you don't want line three anyway. Don't you want to keep one LPCI just for safety? You'd think this good engineering job would keep one.

MR. BOLGER: I would think so. You would want to have one LPCI.

MEMBER BANERJEE: And forget all this stuff. Right. But I wouldn't get rid of both.

MEMBER ARMIJO: Did you do the case of a 16 inch break including the LPCS and the LPCI? What was the time?

MR. BOLGER: No, we didn't run that case.

MEMBER ARMIJO: But it would be closer to the 120 that you were talking about earlier?

MR. BOLGER: That would be some kind of a reduction, PCT reduction.

MEMBER ARMIJO: Yes, your PCT would be reduced and you'd have --

CHAIR SHACK: Or you could up your ECCS delay.

MEMBER ARMIJO: Yes. Right.

MR. BOLGER: You know, note this is one plant. Different plants are going to have different TBSs. If you looked that table in the slide that was presented by staff for a BWR 5 with a 24 inch recirc pipe also has a 24 inch feedwater pipe. The TBS size and the DBA size are the same size. Even though you would go from a guillotine break in one case to a single-sided break on the other, in that sort of situation, you would get hardly any improvement because of the TBS.

MEMBER ARMIJO: Now twos and threes are just out of the question as far as any benefit?

MR. BOLGER: BWR 3s have substantial benefit. You know actually those plants are riding much closer to 2200 than the BWR 4 type plants.

MEMBER ARMIJO: Okay.

MR. BOLGER: If we go from the guillotine break to an 18 inch break for those plant types even if we go from two low pressure core spray to one low pressure core spray, we still get a large reduction of PCT. So there is a substantial amount of benefit for those plant types. But with the current rule as defined, it would provide that.

VICE CHAIR WALLIS: Why would you want to

go to --

MEMBER BANERJEE: What is not clear is why? Other than the effect on the diesels, it seems that with the current NRC proposal of the 24 inch whatever, you would still remove one of the LPCIs for your long-term link? You know you don't seem to be limited by that right now.

MR. BOLGER: Yes, in some situations, you know, with the proposed rule, you would provide the benefit. In not all plants, you may. Tony.

MR. BROWNING: One of the things that you have to consider here is that as Dr. Shack said earlier that this is at the TBS. So we have to comply with offsite power and single failure. So when I start taking, you know, saying I'm going to dedicate the A side of RHR to decay heat removal, I've taken them off the books. They're not available for ECCS and they're effectively gone. So when I start worrying about single failure criterion if I lose the LPCI inject valve, that effectively gets me down to the single core spray tanks.

MEMBER BANERJEE: But we are still within the --

MR. BOLGER: You're getting lost here on the --

MEMBER BANERJEE: But you're still within your PCT criteria.

MR. BROWNING: Right. So that's why we're trying to get down to the single core spray case and see how far out we can get the diesel generator benefit because we still have to consider single failure criterion and not have large increases in PCT over current.

MEMBER SIEBER: But is the LOOP in the single failure that drives the plant configuration?

MR. BROWNING: Correct, and when you're talking about the double ended guillotine break in today's rule that really drives all the stuff.

MEMBER SIEBER: That's right.

MR. BROWNING: So it's maximum performance capability because that's what it was ultimately designed to be able to do.

MEMBER SIEBER: So right now, you don't have the flexibility to optimize your systems.

MR. BROWNING: That is correct.

CHAIR SHACK: Okay. I think we're going to have to finish here unless you want to give us some final words.

MEMBER APOSTOLAKIS: So all these slides are materials when -- Some other time?

CHAIR SHACK: Do you want to take five minutes and go over the material slides?

MR. BROWNING: I think we understand that there's an opportunity to come back and talk about that another day. I think it's probably best that we do so. We can have some more of our technical experts here. We also understand that you disagree.

CHAIR SHACK: Yes.

MR. BROWNING: But really --

MEMBER SIEBER: In the injection work.

MR. BROWNING: But I would argue that when you get experts together to discuss rare events differing between 16 and 20 inches is exact science.

VICE CHAIR WALLIS: But your point as I get from the bottom line is if we don't go with you, then BWRs won't get any benefit from the rule change.

MR. BROWNING: Right.

VICE CHAIR WALLIS: That was your starting point.

MR. BROWNING: Yes.

VICE CHAIR WALLIS: It seems to be a major point.

MR. BROWNING: Right. As currently constructed the language in the rule would force most BWRs to consider a transition break size of 24 inches.

VICE CHAIR WALLIS: Which would have no benefit?

MR. BROWNING: Which would have not enough benefit to be cost justifiable.

VICE CHAIR WALLIS: That seems to be a significant point.

MR. BROWNING: And we've made that on a number of occasions.

MR. TSCHILTZ: Yes, this is Mike Tschiltz again. I would just like to offer that I think it's particularly important for the ACRS to understand the BWR Owners Group's issues at this point in time and not put it off to a potential meeting in the future just based upon where we are potentially with the schedule for the rulemaking.

MEMBER ARMIJO: You know that's why I'm a little bit concerned about the materials issue because if you really believe are susceptible let's say to IG SEC or thermal fatigue in the feedwater, then we really have to talk about it near term. I happen to believe they have a lot more margin than they were given credit for particularly with modern water chemistry and that's the base from which you start developing these failure frequencies. So I don't know when we're going to get to it unless we discuss

materials issue sometimes in the near future, we're --

CHAIR SHACK: Let's take 15 more minutes.

MEMBER ARMIJO: Yes, I would like to hear --

MR. BROWNING: I'll do the best I can in 15 minutes and please bear with me. I'm not a technical expert in this area at all.

MEMBER BANERJEE: Have the experts here.

CHAIR SHACK: That's why I --

MR. BROWNING: -- present new information on the thermal hydraulics to the committee and to the staff.

MEMBER SIEBER: Before you start, I would point out that those of you who are going to the Fire Protection meeting, the latest we can start that is 2:00 p.m. It will be in this room.

VICE CHAIR WALLIS: We'll start at 2:00 then.

MEMBER SIEBER: At 2:00 p.m.

MR. BROWNING: You know one of the things that we've been talking about in the materials area of course is intergranular stress corrosion cracking and the thing that we're debating here is what's proper credit for water chemistry improvement, use of better materials and also repair measures for overlays and

then stress improvements.

VICE CHAIR WALLIS: Are you thinking that the experts didn't take this into account?

MR. BROWNING: We didn't say they didn't take it into account. We're saying did they give us proper credit.

MEMBER APOSTOLAKIS: It's the degree to which.

MEMBER BANERJEE: I think we need another meeting.

MR. BROWNING: And one of the things that we would like to bring up is the factor improvement for hydrogen water chemistry. The elicitation and NUREG CR 57.50 talk about numbers unlike the order of a factor of improvement of 20 is as Sanjoy talked about earlier.

We've done our own analysis of it and we think the number looks more like 33, for example, which is a substantial improvement in the factor of improvement for hydrogen water chemistry and when you start taking those things into account, you start to see what we consider to be extra conservatism that was applied to the elicitation mean result and if you want to add on a bias at the end for uncertainties about what we don't know about materials, the next AP 600,

the next PWSCC, whatever it might be, that's fine. But let's make sure that we're not piling conservatism onto conservatism onto conservatism because this is supposed to be a risk informed rule, again, feedwater nozzles, thermal fatigue.

So the boiler perspective, these issues have been dealt with quite some time ago and we have lots of operating experience to demonstrate that capability. We're not talking one or two years. We're talking 15, 20 plus years of operating experience that says we've successfully mitigated these materials issues.

Again FAC again. Programs are in place. They're robust. We have the mitigation capability to prove it. Some of the things we're talking about here, feedwater piping inside containment for example, not overly susceptible to FAC. The temperature is too high. We inject oxygen back into the feedwater to compensate for hydrogen water chemistry to make sure that we're above the FAC threshold of 30 ppb.

We deal with these issues and we believe on our side of the industry that we've dealt with them successfully and when you consider all this additional information, then you might come to the conclusion that there is access conservatism that's been applied

to the base elicitation result and when you remove it, we're not that far apart with the staff on where a proper TBS is. Then when you couch it in terms of thermal hydraulics and where do you start to really see and derive benefit be it safety, be it economic, then you start to get closer down to the TBS that we've proposed.

MEMBER BANERJEE: Just a point I want to ask you. The Forsnach plant is an ABB plant. Right?

MR. BROWNING: Yes. Correct.

MEMBER BANERJEE: And was there cracking in the feedwater nozzles even after they did hydrogen chemistry?

MR. BROWNING: Hydrogen water chemistry really wasn't intended to mitigate feedwater nozzle crack.

PARTICIPANT: Thermal fatigue.

MR. BROWNING: Yes. That's -- 619 kinds of issues of removing crevices, crevice geometry, looking at thermal fatigue.

MEMBER BANERJEE: So this was thoroughly unrelated.

MR. BROWNING: Right. It's a different phenomenon. It's not IG SEC.

(Off the record comments.)

MR. BROWNING: Thank you for your time.

CHAIR SHACK: Okay. I appreciate that. At least we heard it.

VICE CHAIR WALLIS: We've gained some time.

CHAIR SHACK: We gained some time.

MEMBER CORRADINI: Are we done?

VICE CHAIR WALLIS: Now it says to be announced or something.

CHAIR SHACK: To be determined.

(Off the record comments.)

CHAIR SHACK: The question is do we want to discuss where we want to go in 50.46 now or should we wait until later?

MEMBER BANERJEE: I'm just puzzled. I would like to see this thing rationalized.

MEMBER APOSTOLAKIS: We have a whole session tomorrow afternoon. Right?

MEMBER BANERJEE: Bill Shack can explain everything.

(Off the record comments.)

CHAIR SHACK: We're finished. We're adjourned. Off the record.

(Whereupon, at 12:54 p.m., the above-entitled matter was concluded.)

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 Plant Operations & Fire Protection Subcommittee

Docket Number: (Not provided)

Location: Rockville, Maryland

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

Charles Morrison
Official Reporter
Neal R. Gross & Co., Inc.

BWROG Perspectives on the 10 CFR 50.46a Rulemaking

Randy Bunt, BWROG Chair
Tony Browning, BWROG Option 3 Committee Chair
Francis Bolger, GE
October 31, 2006

1

Introduction

- BWROG pleased that this initiative has proceeded to a draft rule
- Rule as written would not be used by a significant number of BWRs
  - Little benefit to offset cost of implementation
- Minor changes would significantly improve this

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Outline

- Purpose
- Background
- Technical discussion of BWROG T/H analysis
- Technical discussion of BWR materials issues

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Purpose

- Provide recommendations for achieving a rule that is useful to BWRs
  - Present technical information supporting a revision to the BWR TBS definition in the proposed rule
    - Remove unnecessary conservatism
    - Demonstration of safety benefits
    - Conform to "plain language" standard

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Background

- NUREG-1829, Estimating LOCA Frequencies Through the Elicitation Process
  - Published for comment in June 2005
    - BWROG comments provided January 12, 2006
- Proposed 10 CFR 50.46a
  - Noticed November 7, 2005
    - BWROG comments submitted March 8, 2006

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BWROG Comment Summary

- Principal BWROG comment on NUREG-1829
  - Apparent lack of credit for mitigation of failure mechanisms (IGSCC, FAC, and Thermal Fatigue) attributed to the BWR piping designs
    - BWR Vessel Internals Program (BWRVIP) created in 1994 to deal with such material issues
    - Operating experience indicates mitigation efforts have been successful

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Evolution of NRC TBS

TBS Determination Steps	BWR TBS
Starting Point - NUREG-1829: Break Sizes with mean frequency of 1 E-5	6-14 inches
Next: Apply uncertainty to mean Break Sizes - 95th percentile	13-20 inches
Next: Apply biases for failure mechanisms not considered in NUREG-1829 elicitation	20 inches
Last: Modify definition based upon initial comments on rule package	Larger of FW or RHR piping inside containment: (Typical BWR/4 TBS = 24 inches)

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Principal BWROG comment on Draft 10 CFR 50.46a Rule Package

- Proposed Alternative BWR TBS definition:

  TBS = Equivalent in size to internal diameter of a 16 inch Schedule 80 pipe (1.177 ft^2), in the Residual Heat Removal System (RHR) shutdown cooling suction piping

- BWROG considerations
  - Fixed size
  - Fixed location

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10 CFR 50.46 Rulemaking

- Merits of the BWROG alternative:
  - Fidelity to NUREG-1829 results (w/o application of unnecessary conservatisms)
  - Uniformity of TBS across BWR Fleet (FW and RHR pipe sizes vary)
  - Safety benefit as shown by SAFER/GESTR-LOCA analysis
    - No significant increase in current PCT (DBA) with:
      - Delayed ECCS injection (relaxed DG starts, valve stroke times)
      - Reduced requirement for auto-start of ECCS trains (reduced DG loading)

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Technical Discussion

- Demonstration of Safety Benefits (T/H analysis)
- Successful mitigation of identified BWR material issues

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Impact of TBS Size for BWRs SAFER/GESTR methodology

- SAFER/GESTR methodology is the current NRC approved GE LOCA methodology for BWRs
  - Consists of dual Appendix K bounding analysis and nominal upper bound analysis (licensing PCTs typically about 1600°F but can be near 2200°F for BWR 2/3)
  - Generally limiting for DBA large breaks, but some plants limiting for small breaks (< 0.1 ft^2)
    - Recirc discharge break area set by jet pump nozzles and recirc pump eye (can be smaller equivalent break area than largest attached pipe)
  - Intermediate breaks less limiting but methodology would need to be reviewed with implementation of TBS

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Impact of TBS Size for BWRs Non-limiting Breaks

- Main Steam Line and Feedwater Line Breaks are not limiting for BWRs
  - Break location above core
  - Core uncovered briefly with little heatup
  - Level quickly restored following initiation of ECC systems
  - Will not become limiting with any TBS since bounded by recirc line small breaks

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Impact of TBS Size for BWRs
ECC Injection Delay

- Small breaks not impacted by ECC injection delays > 2 minutes since high pressure system is typically a limiting failure and injection waiting for depressurization
- Large breaks typically begin injecting in < 1 min and PCT increases as delay increases
- DBA limited plants see PCT reductions as TBS size is reduced
- Most plants will not be able to maintain their PCT with a 120 sec ECC injection delay if the TBS set to the RHR size

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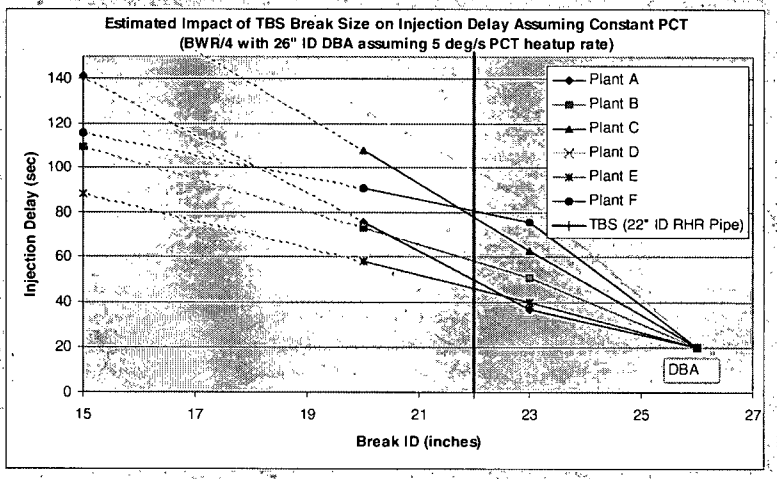
Impact of TBS Size for BWRs
ECC Delay (BWR/4 impact of TBS)



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Impact of TBS Size for BWRs
System Relaxation

- Small breaks less impacted by ECC system relaxation since level recovers very quickly
- DBA limited plants show a greater ability to relax ECC systems as TBS size is reduced

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Impact of TBS Size for BWRs
SAFER Analysis for System Relaxation

- SAFER/GESTR analysis was performed for a BWR/4 and a BWR/3 to assess the impact of analyzing at TBS, increasing the ECC injection delay time, and relaxing ECC systems
  - Plants analyzed: BWR/4 and BWR/3
  - Analysis performed for limiting failure and varying break sizes

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Impact of TBS Size for BWRs
SAFER PCT Impact

Case Description - Break Size (ID) / Location	ECC Delay	Available Systems	PCT Impact
BWR/4			
DBA Recirculation Suction Break, 25" guillotine	Base	1 LPCS + 2 LPCI	N/A
21" Discharge Break (single sided)	Base	1 LPCS + 1 LPCI	Reduction
21" Discharge Break (single sided)	+50 sec	1 LPCS + 1 LPCI	Same (< ± 50 deg F)
21" Discharge Break (single sided)	+50 sec	1 LPCS	Large Increase (>200)
18" Suction Break (single sided)	Base	1 LPCS + 2 LPCI	Large Reduction (>200)
18" Suction Break (single sided)	+50 sec	1 LPCS	Reduction
18" Suction Break (single sided)	+80 sec	1 LPCS	Increase
18" Suction Break (single sided)	+80 sec	1 LPCS + 1 LPCI	Same
16" Suction Break (single sided)	+80 sec	1 LPCS	Same
BWR/3			
DBA Recirculation Suction Break, 25" guillotine	Base	2 LPCS	N/A
18" Suction Break (single sided)	Base	2 LPCS	Large Reduction (>200)
18" Suction Break (single sided)	+40 sec	2 LPCS	Large Reduction (>200)
18" Suction Break (single sided)	+40 sec	1 LPCS	Large Reduction (>200)

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BWR Materials Issues

- Overview
  - The BWROG requests appropriate consideration of acknowledged IGSCC, thermal fatigue, and FAC mitigation in BWRs in removing unnecessary conservatism applied to TBS definition in the proposed rule
  - The BWROG is not recommending revision of NUREG-1829

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BWR Materials Issues

- IGSCC Concerns
  - NUREG-1829 page xvii states, in part:
    - "…the biggest frequency contributors for each LOCA size tend to be systems having the smallest pipes, or component, which can lead to that size LOCA. The exception to this general rule is the BWR recirculation system, which is important at all LOCA sizes due to lingering IGSCC concerns." {emphasis added}

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Materials Discussion

- BWR mitigation measures for IGSCC in piping
  - Water chemistry
  - Better material and/or repair measures
  - Stress improvement

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Materials Discussion

- References supporting IGSCC mitigation in piping
  - ***BWRVIP-75-A: BWR Vessel and Internals Project, Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules***
    - An industry survey was conducted by the ASME Task Group on ISI Optimization (1995)
      - Approximately 10,000 Class 1 welds under the current ASME Section XI sampling requirement, in 50 responding plants,
      - Only a small number (5) innocuous indications.
      - The only significant service-induced flaws that have been observed in Class 1 piping have been due to unmitigated occurrences of IGSCC.
  - ***GE-NE-A41-00110-00-1, Rev. 0, A Review Of NUREG/CR-5750 IGSCC Improvement Factor and Probability of Rupture Given a Through-Wall Crack***
    - Provided to NRC by BWROG letter on April 25, 2002
    - Address Staff concerns with Factor of Improvement (FOI) for HWC

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BWR Materials Issues

- Thermal fatigue in BWR Feedwater Nozzles
  - Design Modifications and rigorous inspection program per NUREG-0619 have been in place since 1981
  - **GENE-523-A71-0594, *Alternate BWR Feedwater Nozzle Inspection Requirements*,** May 2000.
    - ***It should be emphasized no new cracking has been identified in the last fifteen years.***
  - NRC has approved a relaxed inspection schedule for FW Nozzles based upon GENE-523-A71-0594:
    - *The staff has completed its review and determined that the proposed inspection program and schedule in GE-NE-523-A71-0594, Revision 1 is justified and provides an acceptable level of quality and safety. Therefore, GE-NE-523-A71-0594, Revision 1, is an acceptable alternative to the inspection guidelines in NUREG-0619.*

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BWR Materials Issues

- Flow-Assisted Corrosion (FAC)
  - NUREG-1829 - Tables 3.7 and B.1.9 mention flow-assisted corrosion (FAC) as a long-term aging mechanism
    - Main Recirculation System is Stainless Steel – not susceptible
    - FW Piping Inside Containment (TBS) not overly susceptible to FAC
      - Temperature is high (> 200°C/400°F)
      - HWC plants inject O_2 into FW to increase concentration above FAC range (> 30 ppb)
    - RHR Piping Inside Containment (TBS) not susceptible to FAC
      - Material is Stainless Steel at connection to Recirculation System piping (carbon steel outboard of isolation valves)
      - Minimum flow duty (standby system)

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BWR Materials Issues

- Summary
  - Credit for mitigation of IGSCC, thermal fatigue, and FAC should be considered in removing the excess conservatism added by NRC Staff to the TBS results from the Expert Elicitation
    - BWROG Proposal (16" pipe break) represents mid-range of 95th percentile values from Expert Elicitation

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10 CFR 50.46 Rulemaking

- Summary:
  - For the proposed rule to be useful to BWRs, a reduced TBS should be allowed based on
    - T/H analysis results demonstrating Safety Benefits from a reduced TBS
    - Significant Operating Experience with successful mitigation of IGSCC, Thermal Fatigue, and FAC

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10 CFR 50.46a Rulemaking Risk-Informed ECCS Requirements

Advisory Committee on Reactor Safeguards

October 31, 2006

Richard Dudley
Rulemaking Project Manager
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

10 CFR 50.46a Rulemaking

Background and Status

- ACRS letter on proposed rule March 14, 2005
- SECY-05-0052; March 29, 2005
- Commission approval July 29, 2005
- Proposed rule published November 7, 2005
- Comment period ended March 8, 2006

10 CFR 50.46a Rulemaking

Background and Status (Cont.)

- Public meetings (February, June, August 2006)
- Draft final rule language posted October 3, 2006
- Draft *Federal Register* notice October 16, 2006
- Final rule to Commission by February 2007
- Staff to meet with ACRS in spring 2007 on Regulatory Guide

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10 CFR 50.46a Rulemaking

Request for ACRS Letter on Final Rule

- Potential impact of pipe crack indications at Wolf Creek plant has caused staff to review its position on seismic analysis supporting the PWR TBS
- Staff seeks ACRS review of all other technical issues related to the §50.46a final rule
- Staff will meet again with ACRS to discuss PWR TBS

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10 CFR 50.46a Rulemaking

Agenda

- Discuss comments on thermal-hydraulic analysis (R. Landry)
- Discuss comments related to risk analysis and operational requirements (S. Dinsmore)
- Discuss comments on applicability to future reactors (R. Dudley)
- Discuss method for selecting BWR TBS (G. Hammer)
- Discuss comments on the BWR TBS (G. Hammer)

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10 CFR 50.46a Rulemaking

Public Comments

- Six licensees, two reactor vendors
- Four industry groups (NEI, BWROG, WOG, STARS), NRC employee
- Comments on expert elicitation (NUREG-1829)

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10 CFR 50.46a Rulemaking Thermal-Hydraulic Req'ts

At and below the TBS requirements are the same as current

- Analysis with uncertainty evaluation
- Analysis that complies with 10 CFR 50, Appendix K

Above the TBS, analysis methods can be as current or another approach. The Regulatory Guide will identify items the staff believes to be important to consider in the analysis.

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10 CFR 50.46a Rulemaking T/H Acceptance Criteria

At or below the TBS the acceptance criteria are the same as in 10 CFR 50.46

- PCT ≤ 2200 °F
- MLO ≤ 17%
- CWO ≤ 10%
- Coolable core geometry
- Must provide long-term cooling

Above the TBS the acceptance criteria are:

- Coolable core geometry
- Must provide long-term cooling

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10 CFR 50.46a Rulemaking Major Public Comments

Advisory Committee on Reactor Safeguards

October 31, 2006

Stephen Dinsmore
Senior Reliability and Risk Analyst
Office of Nuclear Reactor Regulation

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10 CFR 50.46a Rulemaking Major Public Comments

Summary of Major Public Comments on Risk informed Change process

- Scope of facility changes requiring a risk evaluation
- Identification of changes that require prior staff review and approval
- Tracking risk increases
- Periodic PRA update and reporting
- Acceptance criteria on amount by which risk increases
- Operational restrictions / maintaining mitigation

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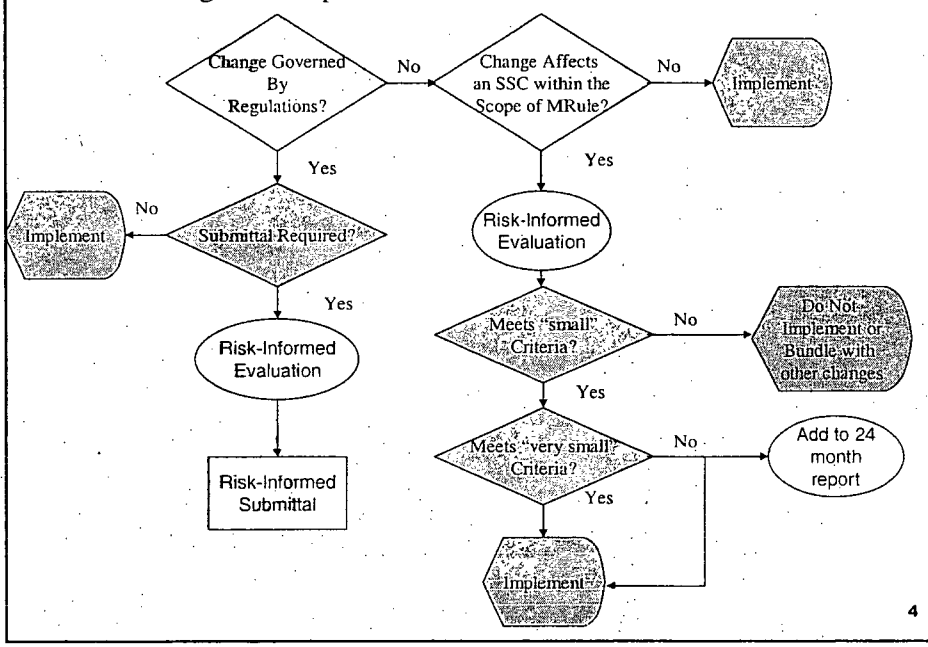
10 CFR 50.46a Rulemaking Major Public Comments

Issue: Scope of facility changes requiring a risk evaluation

- Proposed rule: A risk evaluation of all changes is required prior to implementing the change
- Comment: Does not credit current change control processes and is unnecessarily burdensome
- Final Rule: A risk evaluation is required prior to implementing potentially risk-significant changes. A periodic risk evaluation is required to assess the cumulative effect of all changes

3

50.46a Change Control process



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10 CFR 50.46a Rulemaking Major Public Comments

Issue: Identification of changes that require prior staff review and approval

- Proposed rule: Current regulatory requirements and any change that increases risk by more than a "very small" amount govern what must be submitted for prior staff review and approval.
- Comment: Does not credit current change control processes and is unnecessarily burdensome.
- Final Rule: Current regulatory requirements govern which changes must be submitted for prior staff review and approval.

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10 CFR 50.46a Rulemaking Major Public Comments

Issue: Tracking risk increases

- Proposed rule: The amount by which CDF and LERF increase over time must be estimated and tracked.
- Comment: It should be sufficient to estimate and track the overall CDF and LERF over time.
- Final Rule: Unchanged

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10 CFR 50.46a Rulemaking Major Public Comments

Issue: Acceptance criteria on amount by which risk increases

- Proposed rule: The amount by which CDF and LERF increase is compared to the acceptance criteria that the "total increases in CDF and LERF are small and the overall risk remains small." Small is defined using RG 1.174 guidelines.
- Comment: Do not put acceptance criteria in the rule and rely on RG 1.174 guidelines for controlling risk increases over time.
- Final Rule: Unchanged

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10 CFR 50.46a Rulemaking Major Public Comments

Issue: Periodic PRA update and reporting

- Proposed rule: PRA update every two refueling outages and reporting of
  - Changes that result in a "significant reduction in the capability to meet the acceptance criteria" and
  - Short description of all changes involving minimal increases in risk
- Comment: Industry proposed PRA update every two refueling outages to assess the cumulative effect of changes and reporting of the results (i.e., overall CDF and LERF) of this assessment to the NRC.
- Final Rule: PRA update every two refueling outages and reporting of
  - Steps and a schedule to bring the facility back into compliance if the acceptance criteria have been exceeded and
  - Potentially risk-significant changes implemented without NRC review that increased risk greater than very small

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10 CFR 50.46a Rulemaking Major Public Comments

- Issue: Operating restriction when in a configuration not demonstrated to meet the ECCS acceptance criteria for breaks>TBS
  - Proposed rule: Prohibited operation in this configuration.
  - Public Comment: Restriction not commensurate with safety significance of configuration and could increase risk by reducing permitted on-line maintenance.
  - Final Rule: Operation in this configuration not to exceed 14 days per year. Fourteen days was chosen as
    - Consistent with related guidelines on initiating event mitigation
    - Sufficiently long to allow most maintenance activities
    - A longer period of time would not be consistent with maintaining the capability to successfully mitigate the full spectrum of LOCAs

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10 CFR 50.46a Rulemaking Major Public Comments

Issue: Operational Restrictions (Cont.)

- No guidance directly addressing this issue exists but some related guidance does exists
- RG 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications "
  - Acceptance guideline for integrated conditional core damage probability <= 5E-7
  - 1E-5/year frequency with no LOCA mitigation yields an allowed AOT of 18 days
- SRP Chapter 2.2.1 and 2.2.2 identifying design basis events (that need to be mitigated) as those with a frequency >1E-7/year
  - 1E-5/year frequency could exist for 3.6 days in a one year period before exceeding an annual frequency of 1E-7

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10 CFR 50.46a Rulemaking Major Public Comments

Miscellaneous

Risk-Informed change process description should not be required with submittal to adopt 50.46a

The acceptability of many changes, including some without prior staff review and approval, will be based, in part, on the results of the risk-informed evaluation. Without opportunity to review a description of the proposed process, the staff would have no basis for concluding the process is capable of demonstrating the acceptance criteria are satisfied

Deletion of requirement for LOOP and single failure for > TBS could result in all EDGs being required to mitigate a LBLOCA/LOOP.

The risk increases arising from such changes must be evaluated and, if acceptance criteria are exceeded, the change would not be permitted or must be otherwise compensated.

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10 CFR 50.46a Rulemaking

Applicability to Future Reactors

- Proposed rule only applicable to current LWRs
- Industry commenters recommended applicability to future LWRs similar to current LWRs
- Staff considers AP 1000, US EPR, ESBWR as potentially similar re: §50.46a
- Final rule allows future LWR applicant to justify why design is similar; propose TBS
- NRC staff design-specific review
- NRC must approve both applicability and TBS
- General similarity characteristics developed

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10 CFR 50.46a Rulemaking

General similarity characteristics

- LOCA frequency vs. pipe size
- Overall piping configuration
- Core/containment capabilities and severe accident margins
- Guidance will be included in Regulatory Guide

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BWR TBS Selection

- BWR TBS in the proposed rule uses expert elicitation estimates of LOCAs at 1E-5/R-Y frequency as a starting point.
- Adjustments made to account for uncertainties and sensitivities with respect to elicitation.
- Other considerations to accommodate failure mechanisms not explicitly considered in elicitation such as seismic loads.
- Consideration of actual pipe sizes.
- Consideration of regulatory stability.

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BWR TBS Selection

- From the expert elicitation estimates, also considering uncertainties and sensitivities, BWR break sizes at a 1E-5 frequency are approximately 13 inches to 20 inches in diameter.
  - Considers 95th percentile estimates.
  - Considers geometric and arithmetic mean aggregations of estimates.

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BWR TBS Selection

- These sizes are approximately the sizes of the largest attached feedwater and residual heat removal lines inside containment, typically 18 to 24 inches nominal diameter (or 16.12 to 21.56 inches ID).
- Breaks larger than these in size would require complete failure of large recirculation piping, which has a significantly lower frequency of occurrence.

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BWR TBS Selection

Survey of BWR Pipe Sizes

		Nominal Diameter, inches			
GE	Plant	Feedwater	RHR	MS	Recirc
BWR-2	Nine Mile Pt 1	18	14	24	28
	Oyster Creek	18	14	24	26
BWR-3	Dresden 2/3	16	16	20	28
	Monticello	14	18	18	28
	Pilgrim	18	18	20	28
BWR-4	Browns Ferry 1/2/3	24	24	24	28
	Cooper	16	24	24	
	Duane Arnold	16	18	20	22
	Fermi 2	20	24	26	28
	FitzPatrick	18	24	24	28
	Hatch 1/2	18	20	24	28
	Vermont Yankee	16	24	18	28
BWR-5	Columbia	24	20	26	
	LaSalle 1/2	24	20	26	24
	Nine Mile Pt 2	24	20	26	24
BWR-6	Grand Gulf	24	20	28	24
	Perry	20	20	26	
	River Bend	20	18	24	

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BWR TBS comments

- Staff received public comments on proposed BWR TBS:
  - PSU comment: Break frequencies appear to be larger than expert elicitation estimates, and leaks should be assumed to be breaks.
  - Staff response: Staff review of break data does not indicate break frequency is significantly greater. Significant additional degradation is required before a leak becomes a much larger break.

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BWR TBS comments

- BWROG comment: TBS should not be based on the size of any feedwater (FW) piping, and should be a 16 inch break in the residual heat removal (RHR) line for all BWRs.
- Staff response: A likely way for a break as large as the TBS to occur is with a complete break of that size pipe. Consideration was given to all attached pipes inside containment having diameters corresponding to the 1E-5 break frequency, which are typically the FW or RHR pipes. Also, this would bound a complete break of a smaller 12 inch recirculation pipe, which would result in a double-ended discharge.

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BWR TBS comments

- BWROG comment: Proper credit was not given by the expert elicitation for mitigation programs for various degradation mechanisms (i.e., thermal fatigue and IGSCC).
- Staff response: Mitigation programs were considered in the estimates in the expert elicitation. These measures are generally effective in lowering break frequencies from what they were prior to mitigation.

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